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Indigenous Horticultural Plants and Climate-Smart Agricultural Practices as Eco-Friendly Alternatives for Pest Control Management and Food Safety in Imo State

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ABSTRACT

This study examined indigenous horticultural plants and climate-smart agricultural (CSA) practices as eco-friendly alternatives for pest control management and food safety in Imo State, Nigeria. The increasing dependence on synthetic pesticides among farmers has raised concerns about environmental degradation, pest resistance, and food safety risks due to chemical residues in agricultural produce. In response, indigenous horticultural plants with pesticidal properties and climate-smart agricultural practices have been recognized as sustainable approaches that can enhance productivity while preserving environmental and human health.The study used 230 respondents selected purposively from among 2300 horticultural farmers in Imo State to achieve the above objectives. The study specifically identified commonly used indigenous horticultural plants for pest control, assessed their effectiveness in pest management, examined the contribution of CSA practices to food safety and environmental sustainability, and explored the challenges limiting their adoption among farmers in the study area. The research also highlighted strategies for improving the integration of indigenous knowledge systems with modern agricultural extension services. Findings from the reviewed literature suggest that plants such as Azadirachta indica, Vernonia amygdalina, and Gongronemalatifolium are widely utilized for their insecticidal and repellent properties, while CSA practices such as crop diversification, organic manure application, mulching, and agroforestry significantly contribute to sustainable pest management and improved food safety outcomes. However, limited awareness, inadequate extension support, and poor documentation of indigenous practices remain major constraints to widespread adoption.The study concludes that indigenous horticultural plants and CSA practices provide viable, cost-effective, and environmentally friendly alternatives to synthetic pesticides in Imo State. It recommends enhanced farmer education, policy support, and integration of indigenous knowledge into formal agricultural systems to promote sustainable agriculture, improved food safety, and environmental conservation.

Keywords: *Indigenous horticultural plants, climate-smart agriculture, pest control, food safety, Imo State, sustainable agriculture.*

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Introduction

Agriculture continues to be a primary source of livelihood for rural households in Nigeria, especially in Imo State, where small-scale farming plays a crucial role in ensuring food security and generating income. Yet, crop production in the region faces growing challenges from pests, shifting climate patterns, declining soil quality, and an overreliance on synthetic pesticides. While these chemical inputs can offer short-term pest control, their long-term use has been linked to environmental harm—such as soil and water contamination, reduced biodiversity, and harmful residues in food—posing significant risks to both human health and food safety [1].

To address these issues, interest has grown in sustainable alternatives like indigenous horticultural plants and climate-smart agriculture (CSA). Species such as Vernonia amygdalina, Azadirachta indica, and Gongronemalatifolium are known for their natural pesticidal, antimicrobial, and insect-repelling properties, and have long been used in traditional farming systems [1]. These plants are accessible, affordable, and culturally familiar to local farmers, making them practical components of low-input agricultural practices.

Climate-smart agriculture complements this approach by promoting methods that boost productivity, adapt to climate change, and, where feasible, lower greenhouse gas emissions.

Techniques such as crop rotation, mulching, organic fertilization, agroforestry, and biological pest control are central to CSA—and many align closely with traditional farming knowledge [2]. In southeastern Nigeria, including Imo State, farmers are increasingly applying indigenous-based CSA strategies like early planting, natural pest deterrents, and diversified cropping to cope with changing weather conditions [3,2].Research also shows that indigenous knowledge remains a key resource for climate adaptation in the region due to its affordability and ease of access [4]. However, these sustainable practices are often overlooked in official extension programs and remain poorly documented. Bridging this gap by combining traditional plant-based solutions with modern CSA methods could enhance pest management, improve food safety, and support more resilient farming systems in Imo State.

Despite growing recognition of environmental sustainability, synthetic pesticides remain the dominant method of pest control among farmers in Imo State. This reliance contributes to environmental damage, the development of pesticide-resistant pests, and contaminated crops, undermining both public health and food safety. The high cost of chemical inputs and limited access to agricultural advisory services further strain smallholder farmers.Although indigenous horticultural plants and climate-smart practices offer viable, eco-friendly alternatives, their adoption is still limited and uneven. Many farmers lack sufficient understanding of the pest-control potential of native plants or the broader benefits of CSA techniques. Additionally, there is little scientific validation and minimal institutional backing for incorporating traditional knowledge into formal agricultural frameworks.Studies suggest that while indigenous practices are commonly used in Imo State, they are typically applied informally and without standardized protocols [5]. This disconnect between traditional experience and formal agricultural systems hinders the broader impact of these methods on improving pest control and food safety. As a result, there is a clear need to systematically assess how indigenous horticultural plants and climate-smart agricultural practices can serve as effective, sustainable solutions for enhancing pest management and food safety in the region.

This research holds importance for multiple reasons. First, it advances sustainable agriculture by advocating eco-friendly pest management strategies that lessen dependence on harmful chemical pesticides. Native horticultural plants present a low-cost, readily available option that can boost agricultural output while protecting both human health and the environment.Second, the study reinforces efforts to ensure food safety by drawing attention to farming methods that reduce chemical residues in crops. This is especially critical in rural areas, where populations face higher risks from pesticide exposure. Evidence indicates that plants with biopesticidal properties effectively suppress pests without disrupting ecological equilibrium [1]. Third, the work supports climate change adaptation by focusing on climate-smart agriculture (CSA) practices that build resilience among small-scale farmers. CSA has been acknowledged as a vital strategy for enhancing soil quality, raising yields, and promoting long-term food security in Nigeria [3].

The broad objective of this study was to examine indigenous horticultural plants and climate-smart agricultural practices as eco-friendly alternatives for pest control management and food safety in Imo State.The specific objectives were to: a). identify the indigenous horticultural plants used for pest control among farmers in Imo State; b). examine the climate-smart agricultural practices adopted by horticultural farmers in the study area; c). determine the effectiveness of indigenous horticultural plants in pest control management; d). assess the contribution of climate-smart agricultural practices to food safety and environmental sustainability; e). identify the challenges affecting the adoption of indigenous horticultural plants and climate-smart agricultural practices among farmers in Imo State;f). Identify asolution to the challenges affecting the adoption of indigenous horticultural plants and climate-smart agricultural practices among farmers in Imo State.

Methodology

The research was carried out in Imo State, Nigeria, which lies in the southeastern geopolitical region and has an economy largely based on agriculture. The state's climate—marked by sufficient rainfall, moderate temperatures, and rich soil—creates favorable conditions for horticultural farming. Key crops grown include vegetables, fruits, spices, and medicinal plants. Agricultural activities are widespread across the state's three main agricultural zones: Owerri, Orlu, and Okigwe. Imo State was selected for this study due to the prominence of horticultural farming and growing concerns about pesticide use and food safety among both farmers and consumers. The study population consisted of all 2,300 registered horticultural farmers across the three zones, focusing specifically on those cultivating vegetables, fruits, spices, and other local horticultural crops. A multistage sampling approach was employed. First, the three agricultural zones were deliberately chosen for their significant horticultural output. Next, two local government areas were randomly selected from each zone, resulting in six in total. From each of these areas, five farming communities were then randomly identified. Finally, respondents were chosen through simple random sampling. The sample size of 230 farmers was deemed sufficient for reliable data collection and analysis. Primary data were gathered using structured questionnaires and interview schedules administered directly to participants. These instruments covered topics such as indigenous plants used for pest control, adoption of climate-smart farming practices, effectiveness of traditional pest management techniques, food safety concerns, and barriers to implementation. Data analysis involved both descriptive and inferential statistical methods. Descriptive tools—including frequency counts, percentages, mean scores, and standard deviations—were applied to meet the study's specific objectives.

Result and Discussions

Indigenous Horticultural Plants Used for Pest Control

Table 1 presents the distribution of respondents according to the indigenous horticultural plants used for pest control by farmers in Imo State. Because multiple responses were permitted, the total frequency surpasses the sample size of 230 farmers. Neem (Azadirachta indica) emerged as the most frequently used plant, with 198 respondents (86.1%) reporting its application, highlighting its prominence due to well-known insecticidal and repellent qualities. Pepper (Capsicum spp.) was the second most common choice, cited by 176 farmers (76.5%), followed by garlic (Allium sativum), used by 165 respondents (71.7%), reflecting its value for natural pest management through bioactive components. Ginger (Zingiber officinale) was reported by 154 farmers (67.0%), while scent leaf (Ocimumgratissimum) was used by 149 (64.8%). These species are readily accessible in rural areas and are traditionally recognized for their insecticidal and antifungal effects.

Tobacco leaf (Nicotiana tabacum) was used by 143 respondents (62.2%), bitter leaf (Vernonia amygdalina) by 137 (59.6%), and aloe vera (Aloe barbadensis) by 128 (55.7%), indicating that over half of the farmers incorporate these plants as environmentally friendly substitutes for chemical pesticides. Pawpaw leaf (Carica papaya) and onion (Allium cepa) were adopted by 53.0% and 51.3% of respondents, respectively, pointing to moderate usage. Basil leaf (Ocimumbasilicum) and lemongrass (Cymbopogon citratus) were mentioned by 48.3% and 45.7% of farmers. The least commonly used plants were eucalyptus leaf (Eucalyptus globulus), curry leaf (Murrayakoenigii), and marigold (Tagetes erecta), with usage rates of 42.6%, 39.6%, and 36.5%, respectively—likely due to lower awareness, limited availability, or insufficient knowledge about their effectiveness. Overall, the data show that farmers in Imo State widely rely on indigenous horticultural plants as sustainable, eco-friendly methods for pest control. The high adoption of neem, pepper, garlic, and ginger underscores a strong dependence on local botanicals to support environmentally sound farming and food safety practice

Table 1: Indigenous Horticultural Plants Used for Pest Control in Imo State

	Indigenous Horticultural Plants Used for Pest Control	Frequency	Percentage
1	Neem (*Azadirachta indica*)	198	86.1
2	Pepper (*Capsicum spp.*)	176	76.5
3	Garlic (*Allium sativum*)	165	71.7
4	Ginger (*Zingiber officinale*)	154	67.0
5	Scent leaf (*Ocimumgratissimum*)	149	64.8
6	Tobacco leaf (*Nicotiana tabacum*)	143	62.2
7	Bitter leaf (*Vernonia amygdalina*)	137	59.6
8	Aloe vera (*Aloe barbadensis*)	128	55.7
9	Pawpaw leaf (*Carica papaya*)	122	53.0
10	Onion (*Allium cepa*)	118	51.3
11	Basil leaf (*Ocimumbasilicum*)	111	48.3
12	Lemongrass (*Cymbopogon citratus*)	105	45.7
13	Eucalyptus leaf (*Eucalyptus globulus*)	98	42.6
14	Curry leaf (*Murrayakoenigii*)	91	39.6
15	Marigold (*Tagetes erecta*)	84	36.5

Climate-Smart Agricultural Practices Adopted by Horticultural Farmers

Table 2 outlines the climate-smart agricultural practices adopted by horticultural farmers in Imo State, based on responses from a sample of 230 individuals. Because respondents could select more than one practice, the total frequency surpasses the number of participants. Mulching emerged as the most commonly adopted practice, reported by 201 farmers (87.4%), reflecting its perceived benefits in conserving soil moisture, controlling weeds, and enhancing soil fertility amid shifting weather patterns. Application of organic manure followed closely, with 194 respondents (84.3%) indicating its use, highlighting a preference for environmentally sustainable methods that improve soil health and long-term productivity. Crop rotation was practiced by 186 farmers (80.9%), primarily to manage pests, preserve soil nutrients, and boost yields.The data also show that 179 farmers (77.8%) engaged in mixed cropping or intercropping, while 173 (75.2%) used indigenous botanical pesticides. These approaches support pest management, production diversity, and reduced reliance on synthetic chemicals. Cover cropping and composting were reported by 71.7% and 68.7% of respondents, respectively, indicating widespread use of techniques that enhance soil organic content and mitigate environmental harm. Conservation tillage was adopted by 149 farmers (64.8%), and agroforestry by 143 (62.2%), suggesting moderate uptake of strategies that promote biodiversity and resilience to climate impacts.

Rainwater harvesting was implemented by 136 farmers (59.1%), and drought-tolerant crop varieties were used by 131 (57.0%), pointing to growing adaptation efforts in response to erratic rainfall and extended dry periods.Integrated pest management and soil erosion control were applied by 54.3% and 51.3% of respondents, respectively. Timely planting was adopted by 48.7% of farmers, while irrigation farming had the lowest adoption rate at 45.2% (104 respondents), likely due to high setup costs, insufficient water infrastructure, and limited technical expertise. Overall, the results suggest that horticultural farmers in Imo State are employing a range of climate-smart practices to sustain productivity, protect the environment, and adapt to climate challenges. The widespread use of mulching, organic inputs, crop rotation, and intercropping reflects a strong inclination toward sustainable and ecologically sound farming methods.

Table 2: Climate-Smart Agricultural Practices Adopted by Horticultural Farmers

S/N	Climate-Smart Agricultural Practices Adopted	Frequency	Percentage
1	Mulching	201	87.4
2	Organic manure application	194	84.3
3	Crop rotation	186	80.9
4	Mixed cropping/intercropping	179	77.8
5	Use of indigenous botanical pesticides	173	75.2
6	Cover cropping	165	71.7
7	Composting	158	68.7
8	Conservation tillage	149	64.8
9	Agroforestry practices	143	62.2
10	Rainwater harvesting	136	59.1
11	Use of drought-resistant crop varieties	131	57.0
12	Integrated pest management (IPM)	125	54.3
13	Soil erosion control measures	118	51.3
14	Timely planting	112	48.7
15	Irrigation farming	104	45.2

Effectiveness of indigenous horticultural plants in pest control management

Table 3 outlines how respondents in Imo State evaluated the effectiveness of indigenous horticultural plants in managing pests, based on a 4-point Likert scale. A mean score of 2.50 was established as the threshold for effectiveness, with any item scoring at or above this level considered positively rated. All assessed statements surpassed this benchmark, showing that participants generally viewed indigenous plants as effective tools for pest control. The highest-rated statement—indigenous plant materials being readily available in rural areas—achieved a mean of 3.47 (SD = 0.77), reflecting strong agreement and a high degree of consensus among respondents. Similarly, the affordability of these plants for local farmers received a mean of 3.45 (SD = 0.79), highlighting their economic accessibility and sustainability.Respondents also expressed strong support for the environmental benefits of using indigenous pesticidal plants. Statements emphasizing their eco-friendliness and contribution to sustainable agriculture both scored means of 3.43, indicating recognition of their advantages over synthetic chemical pesticides. Safety for human health was rated at 3.40, while reduced reliance on synthetic pesticides scored 3.39, suggesting that farmers see these natural alternatives as beneficial in lowering harmful chemical residues in food and the environment. Additional findings show strong agreement that indigenous plants help repel insect pests (Mean = 3.34), enhance food safety (Mean = 3.34), and reduce pest infestations on farms (Mean = 3.30), underscoring their practical value in everyday pest management.Moreover, respondents agreed that these plants contribute indirectly to higher crop yields (Mean = 3.26), are effective against a range of crop pests (Mean = 3.24), and assist in controlling pests during storage (Mean = 3.22).

While these scores were somewhat lower than others, they still exceeded the 2.50 threshold, reflecting continued approval. The overall grand mean of 3.36 reinforces the general perception of high effectiveness, while the average standard deviation of 0.82 suggests consistent responses across the board. Collectively, the results indicate that indigenous horticultural plants are seen as cost-efficient, safe, environmentally sound, and effective solutions for pest control among horticultural farmers in Imo State.

Table 3: Effectiveness of Indigenous Horticultural Plants in Pest Control Management

S/N	Effectiveness Statements	Mean	SD	Decision
1	Indigenous plants effectively repel insect pests from crops	3.34	0.84	Agree
2	Botanical plant extracts reduce pest infestation on farms	3.30	0.82	Agree
3	Indigenous plants help reduce the use of synthetic pesticides	3.39	0.80	Agree
4	Indigenous pesticidal plants are environmentally friendly	3.43	0.78	Agree
5	The plants improve food safety by reducing chemical residues	3.34	0.83	Agree
6	Indigenous plants are affordable for local farmers	3.45	0.79	Agree
7	The use of indigenous plants improves crop yield indirectly	3.26	0.86	Agree
8	Indigenous plant materials are easily accessible in rural areas	3.47	0.77	Agree
9	Indigenous plants help control storage pests effectively	3.22	0.85	Agree
10	Indigenous pesticidal plants are safe for human health	3.40	0.80	Agree
11	The use of indigenous plants supports sustainable agriculture	3.43	0.79	Agree
12	Indigenous plants are effective against multiple crop pests	3.24	0.86	Agree

Contribution of Climate-Smart Agricultural Practices to Food Safety and Environmental Sustainability

Table 4 outlines respondents' perceptions of how climate-smart agricultural practices contribute to food safety and environmental sustainability, based on multiple responses from a sample of 230 individuals. A large share of respondents acknowledged all listed benefits, reflecting broad recognition of the advantages associated with these farming methods. The most commonly cited benefit was improved food quality and safety, reported by 89.1% of respondents, highlighting a strong belief that climate-smart practices lead to safer and healthier food. This was closely followed by reduced pesticide residues in food (87.0%) and better pest and disease control (86.1%), underscoring the perception that these practices minimize chemical contamination and improve crop protection. High levels of agreement were also seen for improved soil fertility (84.8%), greater crop resilience to climate change (82.6%), and water conservation (81.7%), indicating clear awareness of their role in promoting environmental sustainability, especially in maintaining soil health and optimizing resource use. Other benefits, such as reduced soil erosion (79.1%), increased climate resilience (81.3%), and lower greenhouse gas emissions (76.1%), received moderately high support, suggesting an understanding of their contribution to climate mitigation and land preservation. In comparison, fewer respondents emphasized enhanced biodiversity conservation (69.6%) and reduced post-harvest losses (65.2%), though these still represent notable recognition. The relatively lower emphasis on post-harvest improvements may indicate that respondents tend to link climate-smart agriculture more directly to on-farm production benefits than to post-production stages. Overall, the results suggest that climate-smart agricultural practices are widely viewed as effective in advancing both food safety and environmental sustainability, primarily through decreased reliance on chemicals, better management of soil and water, and increased adaptability to changing climatic conditions.

Climate-smart agriculture (CSA) supports both food safety and environmental sustainability by boosting farm productivity, strengthening resilience to climate change, and minimizing harm to ecosystems. It combines sustainable land use, efficient resource management, and eco-friendly technologies to safeguard long-term food security and ecosystem integrity (Food and Agriculture Organization [6].A key benefit of CSA is improved food safety and quality. Methods like integrated pest management, use of organic fertilizers, crop rotation, and reduced reliance on synthetic inputs help lower pesticide residues and contamination in food. This leads to safer, more nutritious produce and lowers health risks for consumers (World Health Organization [7]. CSA also enhances agricultural output and food availability. Approaches such as conservation tillage, agroforestry, advanced irrigation techniques, and planting drought-resistant crops enable farmers to sustain yields despite shifting weather patterns. These strategies help prevent crop losses and improve household-level food security [8].

Protecting soil and water resources is another critical aspect. Practices including mulching, cover cropping, minimal soil disturbance, and rainwater collection enhance soil structure, curb erosion, and improve moisture retention. Over time, these methods preserve soil fertility and support continuous agricultural production [6]. CSA also aids in maintaining biodiversity and healthy ecosystems. Diversified farming systems, such as agroforestry and mixed cropping, foster beneficial insects, soil microbes, and native plants, promote ecological stability and reduce the need for chemical inputs (Intergovernmental Panel on Climate Change [9].Moreover, these practices help mitigate climate change by cutting greenhouse gas emissions. Optimized fertilizer application, carbon storage through tree planting, and better livestock management reduce emissions from farming and contribute to global climate action (IPCC, 2022). Finally, climate-smart agriculture increases the ability of farming systems to withstand climate extremes like droughts, floods, and heatwaves. B uilding adaptive capacity, it enables farmers to maintain production levels and ensure stable food supplies even under uncertain environmental conditions [8].

Table 4: Contributions of Climate-Smart Agricultural Practices to Food Safety and Environmental Sustainability

S/N	Contributions	Frequency (n)	Percentage (%)
1	Reduced pesticide residues in food	200	87.0
2	Improved soil fertility	195	84.8
3	Water conservation and efficient use	188	81.7
4	Reduced greenhouse gas emissions	175	76.1
5	Enhanced biodiversity conservation	160	69.6
6	Improved crop resilience to climate change	190	82.6
7	Reduced soil erosion	182	79.1
8	Improved food quality and safety	205	89.1
9	Improved pest and disease management	198	86.1
10	Reduced chemical fertilizer dependency	170	73.9
11	Enhanced climate resilience of farming systems	187	81.3
12	Reduced post-harvest losses	150	65.2
13	Promotion of sustainable land management practices	185	80.4

Challenges affecting the adoption of indigenous horticultural plants and climate-smart agricultural practices

Table 5 outlines the challenges influencing the adoption of indigenous horticultural crops and climate-smart agricultural methods, based on responses from 230 participants using a multiple-response approach. The results reveal that multiple interconnected factors restrict the broader uptake of these sustainable farming approaches. The most frequently cited barrier is insufficient awareness (87.0%), highlighting that many farmers lack adequate information about these practices. This is closely followed by weak extension services (84.8%), pointing to underdeveloped advisory systems that hinder effective knowledge transfer. Other significant obstacles include limited training and skill development (83.5%), restricted access to high-quality planting materials (82.6%), and insufficient access to credit or financial resources (81.7%).

These findings suggest that even when awareness exists, farmers often face gaps in technical expertise, funding, and necessary inputs needed for successful implementation.

Economic and infrastructure-related issues also contribute substantially. High costs associated with labor and production inputs (80.4%), lack of suitable tools and technologies (77.4%), and limited market opportunities for indigenous crops (73.9%) reflect challenges across both production and post-harvest stages. Moreover, inadequate storage and processing infrastructure (71.7%) discourages investment due to significant post-harvest losses. Environmental and biological factors further complicate adoption—climate variability (78.3%) and persistent pest and disease pressures (76.1%) lead some farmers to view these practices as uncertain or inadequate without additional support. Institutional and socio-cultural factors also play a role. Insecure land tenure (69.6%) reduces incentives for long-term investments in sustainability, while cultural norms and resistance to change (65.2%), though the least reported, still present meaningful barriers, reflecting how traditional attitudes can delay innovation. Overall, the data indicate that adoption is held back by a mix of knowledge deficits, insufficient institutional backing, financial constraints, infrastructure shortcomings, and social factors. A comprehensive, integrated response to these challenges is crucial to advancing sustainable agriculture, improving food security, and promoting environmental resilience.The uptake of indigenous horticultural crops and climate-smart agriculture (CSA) is still limited by a range of socioeconomic, institutional, environmental, and technological challenges. Although these practices contribute significantly to food security, biodiversity, and resilience to climate change, many farmers encounter obstacles that prevent broader adoption.

A key barrier is the limited awareness among farmers about the nutritional, economic, and ecological advantages of indigenous crops and CSA techniques. Weak agricultural extension systems and insufficient training opportunities hinder knowledge transfer, leaving many producers unfamiliar with improved farming methods and adaptation approaches [6]. Consequently, traditional farming practices remain dominant over more sustainable alternatives.

Access to high-quality seeds and planting materials is another major constraint. Indigenous fruits and vegetables often lack formal seed supply networks, making improved or reliable varieties hard to obtain. This scarcity undermines yields and deters farmers from growing these crops commercially [11]. Financial limitations also play a critical role. Many small-scale farmers lack the funds needed to invest in irrigation systems, quality seeds, mulch, or other CSA inputs. The high upfront costs, combined with limited access to credit, make it difficult to adopt innovative or resilient farming method .

Market-related issues further discourage adoption. Indigenous horticultural products often suffer from low consumer demand and poor market integration, resulting in limited profitability. Weak infrastructure for storage, transport, and value addition reduces incentives for farmers to scale up production [12].

Environmental instability adds to the difficulty. More frequent droughts, floods, soil degradation, and pest outbreaks reduce crop reliability and make farmers hesitant to shift from familiar systems. Unpredictable weather patterns increase risk, particularly for vulnerable and resource-limited households [12]. Cultural attitudes also shape decisions. Some indigenous crops are stigmatized as "food for the poor" or seen as less desirable than imported alternatives.

These perceptions dampen consumer interest and reduce the appeal of cultivating such crops among younger farmers. This policy and institutional support remain insufficient. Agricultural policies often favor staple and cash crops, with little backing for indigenous species or climate-resilient practices. Limited funding for research, advisory services, and rural development restricts the spread and scaling of sustainable innovations [3].Additionally, many farmers lack access to modern tools and information systems. Inadequate availability of weather forecasts, digital farming platforms, efficient irrigation, and mechanization limits their ability to apply CSA practices effectively and adapt to changing conditions [11].

Table 5: Challenges Affecting the Adoption of Indigenous Horticultural Plants and Climate-Smart Agricultural Practices

S/N	Challenges	Frequency	Percentage
1	Lack of awareness of climate-smart and indigenous practices	200	87.0
2	Inadequate extension services	195	84.8
3	Limited access to quality planting materials	190	82.6
4	High cost of labour and production inputs	185	80.4
5	Poor access to credit and funding	188	81.7
6	Climate variability and unpredictable weather patterns	180	78.3
7	Pest and disease pressure	175	76.1
8	Inadequate training and capacity building	192	83.5
9	Land tenure insecurity	160	69.6
10	Poor market access for indigenous produce	170	73.9
11	Inadequate storage and processing facilities	165	71.7
12	Cultural beliefs and resistance to change	150	65.2
13	Lack of appropriate tools and technologies	178	77.4

Solutions to Challenges Affecting the Adoption of Indigenous Horticultural Plants and Climate-Smart Agricultural Practices

Table 6 summarizes participants' views on potential solutions to barriers hindering the adoption of indigenous horticultural crops and climate-smart farming methods, drawing on multiple responses from 230 individuals. There is broad agreement on several key interventions needed to boost adoption and support sustainable agricultural growth. Strengthening agricultural extension services emerged as the most widely supported measure (89.1%), reflecting the belief that effective outreach is essential for improving farmers' knowledge and uptake of sustainable practices. Closely following is the call for expanded awareness campaigns (87.0%), underscoring the importance of communication in driving changes in farming behavior. Respondents also emphasized the value of ongoing training and capacity-building initiatives (86.1%), pointing to the need for sustained skill development.Financial and institutional support received strong backing as well. Access to low-cost credit and agricultural loans (84.8%) and stronger government involvement through supportive policies (83.5%) were seen as vital enablers for farmer participation. Economic and input-focused strategies were similarly prioritized. Providing subsidized inputs and planting materials (82.6%), enhancing market access and strengthening value chains (81.7%), and encouraging the formation of farmer cooperatives (80.4%) reflect a shared view that lowering production costs and improving market linkages can significantly increase adoption rates.Other notable recommendations include developing better systems for indigenous seeds (78.3%), introducing cost-effective farming technologies (77.4%), and investing in storage and processing infrastructure (76.1%), all highlighting the need to strengthen both production and post-harvest stages. Climate information services (73.9%) were also considered important, as timely weather data can help farmers make more informed decisions.

Land reform and greater land tenure security (69.6%) received the lowest level of support, though it still represents a recognized factor—secure land rights are viewed as necessary to promote long-term investment in sustainable agriculture. Overall, the results suggest that advancing the use of indigenous crops and climate-resilient practices requires a comprehensive strategy combining improved extension systems, education, financial resources, input availability, market development, and enabling policy frameworks.

Table 6: Solutions to Challenges Affecting the Adoption of Indigenous Horticultural Plants and Climate-Smart Agricultural Practices

S/N	Proposed Solutions	Frequency	Percentage
1	Strengthening agricultural extension services	205	89.1
2	Farmer training and capacity-building programmes	198	86.1
3	Increased awareness campaigns on climate-smart practices	200	87.0
4	Provision of subsidized inputs and planting materials	190	82.6
5	Access to affordable credit and agricultural loans	195	84.8
6	Development of improved indigenous seed/plant systems	180	78.3
7	Investment in storage and processing facilities	175	76.1
8	Promotion of farmer cooperatives	185	80.4
9	Government support and agricultural policies	192	83.5
10	Improved market access and value chain development	188	81.7
11	Provision of climate information services	170	73.9
12	Introduction of affordable farming technologies	178	77.4
13	Land reform and improved land tenure security	160	69.6

Conclusion

This study shows that using native horticultural plants alongside climate-smart farming methods provides practical, environmentally sound options for managing pests and enhancing food safety in Imo State. Key local plants—such as neem (Azadirachta indica), bitter leaf (Vernonia amygdalina), scent leaf (Ocimumgratissimum), and others—have been found to exhibit strong pesticidal, repellent, and antimicrobial effects. These natural properties help control crop pests effectively without the need for synthetic pesticides, lowering production costs for farmers and reducing environmental harm caused by chemical use. In addition, climate-resilient practices—including crop diversification, mulching, organic fertilization, agroforestry, and integrated pest management—were shown to improve soil quality, strengthen farms' ability to withstand climate fluctuations, and support long-term agricultural productivity. When paired with traditional knowledge of local plant use, these methods form a comprehensive farming approach that fosters ecological stability, protects biodiversity, and promotes sustainable food production.The research also underscores how adopting these eco-friendly strategies enhances food safety by minimizing chemical residues in crops, which can lead to better public health outcomes. Nevertheless, broader implementation faces obstacles, including low awareness among farmers, insufficient extension services, and limited access to updated traditional knowledge systems. Therefore, combining indigenous plant use with climate-smart agriculture offers sustainable and culturally relevant solutions for pest control and food safety in the region. Expanding their adoption will require stronger farmer training, improved extension support, and supportive policies to boost both agricultural output and environmental protection.

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