Food Safety Awareness and Challenges among Garden Egg (Solanum spp.) Farmers: Implications for Agricultural Extension in the Nsukka Agricultural Zone

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ABSTRACT

Food safety in vegetable production remains essential for protecting public health and sustaining rural livelihoods, especially in developing countries where smallholder farmers play a dominant role in food supply. Yet there is limited field-based evidence on the level of food safety awareness and the practical challenges faced by garden egg (*Solanum* spp.) farmers in Enugu State, Nigeria. This study examined farmers' socio-economic characteristics, awareness, knowledge, and constraints related to implementing food safety practices in the Nsukka Agricultural Zone. A multi-stage sampling technique was adopted to select 60 respondents. Data were gathered using structured questionnaires, complemented by direct field observations, and analysed using descriptive statistics, including percentages, mean, and standard deviation. Findings revealed that most of the farmers were female (65.0%), with an average age of 43.56 years and a mean annual income of ₦313,075. Although most respondents (88.3%) reported no contact with extension agents, awareness of important food safety issues was notably high. Nearly all respondents recognized the dangers of using unapproved pesticides (98.3%) and the risks associated with foodborne illnesses (96.7%). Knowledge of preventive practices such as wearing protective clothing (98.3%) and properly sorting harvested produce (95.0%) was also widespread. Despite this encouraging level of awareness, farmers faced serious obstacles, including limited access to safe agricultural inputs, weak institutional support, difficulties with pest control, and the high cost of complying with recommended practices. The study highlights the urgent need to strengthen extension services and provide policy support to translate awareness into consistent and effective food safety practices.

Keywords: Food safety awareness; Garden egg farmers (Solanum spp.); Agricultural extension; Pesticide use practices; Post-harvest handling; and Nsukka Agricultural Zone

INTRODUCTION

Garden egg (*Solanum* spp.) is one of the most widely cultivated vegetables in sub-Saharan Africa and remains deeply rooted in local diets, cultures, and rural economies. In countries such as Nigeria and Ghana, it serves as both a staple food and a dependable source of income for smallholder farmers [1,2]. Indigenous to Tropical Africa, the crop has gained increasing commercial value, including export potential in some West African countries.

Despite its importance, garden egg production faces numerous challenges. Farmers grapple with insect pests, diseases, declining soil fertility, and significant post-harvest losses, all of which reduce yields and compromise quality [1,2]. At the same time, food safety has emerged as a major public health concern worldwide. Foodborne illnesses continue to claim millions of lives annually, with developing countries bearing a disproportionate burden

[3]. Fresh vegetables are vulnerable to contamination from pathogens and chemicals throughout the value chain. Contaminated water, manure, unsafe pesticides, and poor handling can introduce hazards before reaching consumers [4]. Farmers, as the first line of defense, play a crucial role in ensuring food safety through their awareness and practices, directly affecting the safety and quality of vegetables in markets.

Statement of the Problem

Despite the rising consumption of garden eggs in Nigeria and neighbouring countries, understanding how farmers manage food safety risks remains limited [3]. This gap hampers effective interventions and risk assessment. Unsafe practices, such as misusing agrochemicals, neglecting safety measures, and ignoring intervals, threaten health and livelihoods. Farmers often lack training, reliable information, and proper equipment, compounded by weak extension services that leave them relying on informal advice [5]. Meanwhile, persistent production constraints and quality losses during transportation continue to limit the crop's full market potential [1].

Although several studies have broadly examined food safety in fresh produce, few have focused specifically on on-farm food safety practices among garden egg farmers [3,6]. Evidence from the Nsukka Agricultural Zone suggests that while farmers may possess considerable knowledge and positive attitudes, gaps remain between what they know and what they consistently practice. Understanding the barriers that prevent full adoption of safe practices is therefore essential. The study seeks to answer the following questions: What is the extent of garden egg farmers' awareness and knowledge of food safety practices? What challenges prevent farmers from fully implementing these practices?

Aim and Objectives

The main aim of this study is to assess food safety awareness and the challenges faced by garden egg farmers, with a view to providing practical recommendations for strengthening agricultural extension services. The specific objectives are to: Describe the socio-economic characteristics of garden egg farmers in the study area; Assess farmers' awareness of essential food safety practices; Evaluate farmers' knowledge of recommended food safety measures; and identify the challenges hindering the effective implementation of food safety practices.

LITERATURE REVIEW

Introduction

Garden egg is a valuable crop in Nigeria and Ghana, boosting nutrition and rural income [1]. Fresh vegetables often cause foodborne outbreaks when safety standards aren't met [3]. WHO defines food safety as measures that ensure food is safe and fit for consumption, affecting public health and market confidence.

Studies in the Nsukka Agricultural Zone show many farmers have strong food safety knowledge and positive attitudes, but extension contact is limited [3]. Pesticide misuse remains a concern across West Africa, with some farmers applying banned chemicals or failing to observe waiting periods [3,5]. High perishability and poor transportation cause significant post-harvest losses [2]. Despite research, gaps remain in documenting on-farm food safety behaviours, understanding the impact of extension on safety compliance, and examining how gender influences the adoption of safety practices.

Food safety awareness among vegetable farmers:

Research across different settings shows that although vegetable farmers are increasingly aware of the food safety risks associated with pesticide use, this awareness does not always translate into safe farming practices [27:28]. For example, data from developing countries indicate that many farmers recognise the risks of harvesting crops immediately after chemical application, yet unsafe harvesting methods still occur [27;28]. Likewise, the use of safety measures like proper measuring tools and protective gear remains very low. These results imply that knowledge alone cannot guarantee safe food production; other factors, such as weak enforcement, economic constraints, deep-rooted farming routines, and limited access to protective resources, influence farmers' behaviours and contribute to unsafe pesticide handling.

Some knowledge–practice gap exists in Ghana, linked to heavy metal contamination. [29] found low awareness among rice farmers, particularly regarding contamination issues, though both farmers and consumers worry about metal contamination in chemicals and food transfer. Awareness depends on education, age, credit access, farmer organization membership, and training [29]. Unlike in developing countries such as Sylhet, where knowledge scores predicted safe behaviour, some countries, such as Ghana, face the challenge of establishing basic awareness rather than just closing the knowledge-practice gap.

Urban vegetable systems in Ghana link awareness, profitability, and compliance. [30] found that awareness of pesticide risks correlates with safety compliance, and higher gross margins motivate safety investments (p. 13). However, 60.47% of farmers lacked formal education, and 67.70% had no contact with extension services [30]. Compared with [29; 27;28], these findings indicate that limited education and extension services lead to uneven awareness, whereas higher awareness is associated with stronger economic incentives and market access for safer practices.

Evidence from Ethiopia highlights the roles of education and gender in food safety among fruit and vegetable producers. [31] found that "education has a positive significant effect on knowledge, attitude and handling practices of fruit and vegetable handlers. However, the effect was higher in the females" (p. 1). They also noted that "no correlation could be obtained between knowledge and practices for the total respondents," though knowledge was weakly linked to practice among women [31]. Compared with studies in Bangladesh and Ghana, this suggests that social norms and household roles can influence whether awareness translates into safer handling, especially for women managing home gardens and post-harvest work.

Focusing on Nigeria, the research links farm practices to national food safety. [32] found that unregulated pesticide and fertiliser use can cause residue buildup and pose health risks and emphasised the need to promote good agricultural practices (GAPs) and integrated pest management (IPM) among farmers to reduce hazards (p. 43). Studies with vegetable traders and street vendors show limited awareness and incomplete adoption beyond farms. [33] reported that almost no traders received formal food safety training, and only half change washing water regularly, risking E. coli contamination. [34] noted vendors' high awareness of personal hygiene but low glove use and stall cleanliness, with 67% at high or moderate food safety risk. These gaps in awareness and practices across the value chain indicate that interventions targeting only producers are inadequate to ensure the safety of vegetables for consumers.

Key factors influencing vegetable farmers' food safety awareness include education, agrochemical training, access to extension services, participation in farmer organisations, internet use, and trust in retailers [29; 30]. The importance of awareness varies by context: in Sylhet, knowledge predicts safer behaviour, necessitating policies that target behavioural and structural barriers, such as unsafe measurement and a lack of protective gear. In Ghana, enhancing awareness, extension services, and market incentives is vital. In Ethiopia and Nigeria, gender, informality, and resource constraints hinder the application of awareness. The review recommends moving from generic campaigns to tailored strategies that combine education, incentives, infrastructure, and regulation across the vegetable value chain.

Agrochemical Safety Practices Among Vegetable Farmers:

Reviewed studies show that vegetable farmers rely on agrochemicals but often ignore safety measures, despite varying levels of awareness [35;29; 36; 38; 39; 27]. The extent and causes of unsafe behaviour vary by context, influenced by structural, educational, and economic factors.

A key insight across Cameroon, Nepal, Bangladesh, and Nigeria is that knowledge alone does not ensure safe practices [29; 36;37; 39; 27]. In Cameroon, despite 78% of farmers understanding that pesticides can be hazardous to health, 39% never used any personal protective equipment (PPE), and none wore complete protective gear [27]. Similarly, in Nepal, over 90% of farmers had never received training in safe pesticide handling, and more than 40% did not wear PPE [37]. Bangladesh shows an even starker gap: although 75.7% knew about pre-harvest intervals, 10.5% harvested immediately after spraying, and PPE usage was very low, with gloves (3.9%), capes (4.6%), and no protective eyewear or boots [40]. These examples highlight that awareness alone is inadequate; structural barriers and cultural norms also impede safe practices.

Unsafe disposal of pesticide containers threatens human health and the environment [35;36;38]. In Bangladesh, farmers often throw containers into fields (40.3%), garbage (35.1%), rivers (18.4%), and canals (10.8%) [40]. In Nepal, two-thirds of farmers dispose of containers randomly [37]. These actions stem from weak regulation and waste management, not ignorance. Sources of information greatly influence safety behavior, sometimes negatively [37; 27]. In Cameroon, nearly half of farmers rely on agrochemical vendors for guidance [27]. In Nepal, 42% rely on agro-vet sellers without consulting agricultural officers [37]. Bangladesh shows 64.6% turn to retailers, with only 13.1% seeking advice from extension officers [40]. In Nigeria, weak regulation allows 84% of often-unlicensed pesticide sellers to dominate, thereby promoting unsafe practices [35].

Training is vital for safety but remains inadequate globally. In Nepal, 92% of farmers have never received training, yet those who have report fewer hazards [37]. In Bangladesh, pesticide alternative training tripled safe behavior [40]. Cameroon's data show that less than 1% of farmers are trained due to limited extension services [27]. Training is the most reliable safety indicator but remains the least accessible across countries. Economic pressures drive unsafe farming practices. Nigerian farmers use agrochemicals intensively due to market demands and high costs, despite known risks [35]. Similarly, Cameroonian farmers prioritize yield over safety, showing that economic vulnerability often prompts unsafe behaviors rather than just behavioral failures.

The studies reveal weak policy enforcement, with banned pesticides like dimethoate and methalaxyl still sold in Cameroon and Nigeria, where 92% of vendors admitted to selling banned substances [27; 35;]. This failure risks farmers' safety and consumer health. Summarily, the literature shows unsafe agrochemical practices driven by poor training, reliance on unqualified vendors, weak regulations, and economic pressures. Awareness alone doesn't ensure safety without institutional support. Improving safety needs systemic reforms, including better extension services, market regulation, and pesticide management.

Challenges in Accessing Safe Inputs: A major food safety barrier is the difficulty of obtaining safe inputs. Farmers often use untreated water, recycled seeds, and questionable fertilisers. [2] noted Ghanaian eggplant farmers' frequent use of untreated water and recycled seeds, increasing contamination risk. [4] reported African nightshade farmers face poor seed quality and water access issues, affecting yields and safety. Lack of government support and monitoring leads farmers to prioritize survival over safety. [3] observed inconsistent extension services hindering food safety. [1] found high costs and weak policies limit sustainable practices in Uganda and Kenya. Infrastructure deficits, especially in storage and transport, worsen food safety. [2] reported that Ghana's poor storage causes post-harvest losses. Without proper infrastructure, farmers struggle to maintain quality, lowering market value. High safety costs prevent smallholders from affording sanitising agents and equipment. [1] also noted that high input costs discourage the adoption of safe practices, emphasising the importance of affordability.

Implications for Agricultural Extension: The literature highlights the need for stronger agricultural extension services, which provide training, monitoring, and support to help farmers adopt safe practices. [3] emphasized their role in bridging awareness and practice among garden egg farmers. By tackling input access, infrastructure, and costs, extension programs can enhance food safety standards in the Nsukka Agricultural Zone.

Justification and Contribution: Nigeria faces food security and safety challenges, in which food may be available yet unsafe due to production practices [7]. This study links food safety awareness to farmers' practical constraints, providing evidence to inform improvements in training, monitoring, and support. Strengthening food safety among garden egg farmers will protect consumers and boost farmers' productivity, income, and market access.

METHODOLOGY

Enugu State, located in South-eastern Nigeria, is one of the country's 36 states and lies within the tropical rainforest and derived savannah zones [8]. Covering about 7,161 square kilometres, with an estimated population of 4,690,100 as of 2022 [9]. The state is predominantly inhabited by the Igbo, whose main occupation is subsistence agriculture. The State is divided into six agricultural zones: Agbani, Agwu, Enugu, Enugu-Ezike, Nsukka and Udi. The Nsukka agricultural zone was purposively selected for the study. The study population

comprised all garden egg farmers in the Nsukka Agricultural Zone. A multi-stage sampling procedure was employed to select respondents for the study.

The first stage involved purposive selection of two (2) blocks (Nsukka I and Nsukka III) from the eight (8) blocks in Nsukka Agricultural Zone, given the preponderance of garden egg production. The second stage involved purposive selection of four (4) dominant garden egg farming Circles from Nsukka I and one Circle from Nsukka III, due to the preponderance of garden egg production. The third stage involved purposive selection of one (1) sub-circle from each of the five (5) Circles. In the final stage, 12 farmers engaged in garden egg production were randomly selected from each sub-circle using snowball sampling, as the population of garden farmers was unknown, yielding a total sample size of 60 respondents. This sample size was used due to a limited budget and a short study duration. Direct observation and structured questionnaires were used to collect data for the study. The data were analysed using percentages, means, and standard deviations. The instruments were subjected to content and face validity through the help of three (3) lecturers in the department of Agricultural Extension, University of Nigeria, Nsukka, The study emphasized obtaining participants' consent, maintaining confidentiality, protecting privacy, and not using names in databases or publications.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of the Respondents

Sex: The data in Table 2 shows 65.0% of respondents were female and 35% male, suggesting garden egg is a female-cultivated crop, aligning with [10]'s finding that vegetable farming is female-dominated. Additionally, 36.7% of respondents were aged 30-39, with a mean age of 43.56 years, indicating most are young adults engaged in garden egg production.

Most respondents (71.1%) were married, with 16.7% widowed, 10.0% single, and 1.7% divorced. Many farmers are married, possibly working together to save on labor and boost income.

About 36.7% of respondents completed secondary education, and 15.0% had no formal education. Most had formal education, likely boosting their critical thinking and food safety decisions. This aligns with [11], which notes that educated farmers show better knowledge and safer practices. The majority (45.0%) had 11-15 years of schooling, with an average of 10.44 years of education, indicating they were literate and more aware of food safety. Most respondents (48.3%) had 1-4 household members, while 46.7% had 5-8, with an average of 4.77. Larger households can benefit garden egg production through more household labor.

This reflects patterns in rural Nigeria, where smallholder households depend on family labor for farming. Household size influences available labour, especially where mechanisation is limited, and farming relies on manual work. Larger households provide more support for cultivation, weeding, and harvesting, boosting the productivity of crops like garden egg (Solanum aethiopicum), which require frequent care [12].

Most (63.3%) of the garden egg farmers cultivated 5-8 plots, with an average of 8.23 plots, indicating small-scale farming. About 10.0% had 1-4 plots, and 5.0% had 13-16 plots. In Nigeria, over 80% of farmers are smallholders managing less than 10 hectares, contributing significantly to food production. These small farms primarily serve household consumption, with limited surplus for markets. Smallholder farming is the backbone of Nigeria's agriculture, making up nearly 99% of crop production [16]. These farmers typically adopt practices that focus on careful crop handling and food safety, primarily to support family consumption. About 88% of Nigeria's farmers operate small family farms with diverse cropping systems and household labor, aiding food security and rural livelihoods [17]. In garden egg production, small farm sizes often indicate intensive management, with a focus on crop health and quality, which can improve food safety through better control of inputs and post-harvest processes. Smallholder farmers are essential to Nigeria's food supply, producing most food for rural and urban households [18]. The farm size distribution in this study reflects Nigeria's broader landscape, dominated by small-scale, subsistence farming. Despite their limited size, these farms are vital for food production, safety, and household nutrition.

Most respondents (43.3%) earned between ₦1,000 and ₦200,000 annually, with 26.7% earning ₦200,001–₦400,000. Smaller groups earned higher amounts: 16.7% between ₦400,001–₦600,000, 10% between

₦600,001–₦800,000, and 1.7% between ₦800,001–₦1,500,000. The average income was ₦313,075. Despite large household sizes, most garden egg farmers earn low incomes, reflecting challenges such as limited access to credit and poor infrastructure, which constrain earnings. Studies show vegetable farmers often operate at subsistence or semi-commercial levels, earning modestly for labor invested. Low incomes affect food security, limiting reinvestment and adoption of new technologies. The results highlight garden egg farmers' economic vulnerability. Low incomes limit their expansion and productivity, even with household labour. Targeted interventions such as credit, extension services, and market linkages are needed to improve the profitability of smallholder vegetable farming.

Table 2 shows that 88.3% of respondents had no contact with extension agents, while only 11.7% reported one or two contacts. This limited interaction with extension personnel has significant implications for food-safety awareness and practices in garden-egg production. Extension services are equipped to provide farmers with technical knowledge, training, and innovations that improve productivity and ensure safe handling of crops. When farmers lack access to these services, they may rely solely on traditional practices, which can limit their ability to adopt modern food-safety measures.

[23] emphasise that the absence of extension agents over several years, coupled with limited participation in field days, can significantly affect food security. Extension agents play a critical role in disseminating information on improved farming techniques, pest management, and food safety standards. Without this support, farmers may struggle to meet safety requirements, compromising both household nutrition and market supply. Furthermore, inadequate extension contact has been linked to low adoption of innovations in smallholder farming, thereby reducing resilience and sustainability in agricultural systems [21]. Findings suggest that limited extension services among garden egg farmers hinder food safety awareness. Since food security and safety are linked, weak extension contacts affect productivity and household food safety. Improving extension services is essential for better quality and safety of garden egg production.

Table 2: The result of the Socio-economic characteristics of the farmers (n=60)

Socio-economic characteristics	Frequency (Yes)	Percentage	Mean
Sex			
Female	39	65.0	
Male	21	35.0	
Age			
20 – 29	4	6.67	
30 – 39	22	36.67	43.56
40 – 49	17	28.33	
50 – 59	10	16.67	
60 and above	7	11.67	
Marital Status			
Single	6	10.00	
Married	43	71.67	
Divorced	1	1.67	
Widowed	10	16.67	
Level of Education			
No formal education	9	15.00	
Primary education	16	26.67	
Secondary education	22	36.67	
Tertiary education	13	21.67	
Year spent in school			
1 – 5	11	18.33	
6 – 10	15	25.00	
11 – 15	27	45.00	10.44
16 and above	7	11.67	

Household size			
1 – 4	29	48.33	
5 – 8	28	46.67	4.77
9 – 12	3	5.00	
Farm size			
1 – 4	6	10.00	
5 – 8	38	63.33	8.23
9 – 16	16	5.00	
Years of farming experience			
1 – 10	43	71.67	
11 – 20	15	25.00	8.67
21 – 30	2	3.33	
Income (per annum)			
1000-200000	26	43.33	
200001-400000	16	26.67	
400001-600000	10	16.67	313,075
600001-800000	6	10.00	
800001-1000000	1	1.67	
1000001-1500000	1	1.67	
Extension contacts			
Frequently	0	0.00	
Rarely	7	11.67	
Never	53	88.33	

Source: Field survey 2025

Farmers' awareness of food safety

Table 3 shows that nearly all respondents (98.3%) are aware of food safety risks in garden egg production, especially the dangers of using unapproved or expired pesticides. This awareness promotes better pesticide management, reducing health risks to consumers.

The respondents demonstrated awareness of key food safety practices related to garden eggs, including the risks of contamination from consuming contaminated eggs (96.7%), poor storage conditions (96.7%), and cross-contamination during transportation (95.0%). This indicates farmers' strong knowledge of health hazards associated with garden egg production, including contamination risks during cultivation, harvesting, and handling. Such awareness promotes hygiene and proper handling to prevent contamination. The farmers also recognize the importance of proper storage to maintain food safety, likely leading to better storage practices, like controlling temperature and humidity. Additionally, awareness of cross-contamination during transport suggests farmers might adopt measures such as using clean containers and segregating produce to protect quality. The results on farmers' awareness show that while farmers are generally knowledgeable, more training in organic fertilizer management and safe irrigation is needed.

These findings support previous research on farmer awareness in food safety [23], linking poor extension and limited training to food insecurity and safety issues. [22] stresses that educating farmers on input use and water management is crucial for reducing contamination in vegetable production. The lower water-related risk awareness indicates outreach and training gaps. Garden egg farmers know about food safety, but targeted efforts are needed to enhance knowledge of water contamination and organic fertilizer use. Closing these gaps will improve food safety and support sustainable farming.

Table 3: Farmers' awareness of food safety

s/n	Awareness	F Yes	%
1	Aware of the risks posed by using unapproved or expired pesticides on garden eggs.	59	98.3
2	Aware of the foodborne illnesses that can be caused by consuming contaminated garden eggs.	58	96.7
3	Aware that poor storage conditions can lead to contamination or spoilage of garden eggs.	58	96.7
4	Aware that cross-contamination during transportation can affect the safety of garden eggs.	57	95.0
5	Aware of the potential health risks associated with improper handling of garden eggs during harvesting.	56	93.3
6	Aware of the importance of cleaning and sanitizing farming tools to prevent contamination of garden eggs.	55	91.7
7	Aware of the potential health risks consumers could face if garden eggs are exposed to harmful pathogens during production	49	81.7
8	Familiar with the potential contamination risks associated with using untreated manure on garden egg crops.	47	78.3
9	Aware that contaminated water sources can affect the safety of garden egg crops	32	53.3

Source: Field Survey, 2025 **Note: F= Frequency**

Farmers' knowledge of food safety practices

Table 4 shows farmers' knowledge of food safety. Most (98.3%) knew that wearing protective clothing, such as gloves and boots, prevents contamination, indicating an understanding of its importance in reducing risks during handling, harvesting, and pesticide use. About 95% knew that sorting and removing damaged garden eggs help prevent contamination and reduce pathogen spread, aligning with [24], which found that this practice controls microbial growth, maintains food quality, and prevents foodborne diseases.

About 93.3% knew End-Rot signals calcium deficiency, not maturity, reflecting accurate knowledge. Respondents also understood that pesticides shouldn't be sprayed into the wind (90.0%), that proper pesticide storage prevents crop contamination (83.3%), and that poor storage causes poisoning and pollution. About 81.7% knew garden egg shelf life is 4-7 days, 76.7% recognized untreated manure can introduce bacteria, and 76.7% understood storing above 37 °C is harmful. Spraying pesticides into the wind increases the risk of drift, leading to environmental hazards and health issues, including skin inflammation, birth defects, tumours, and genetic mutations, as noted by [25].

The results further show that 66.7% of respondents knew that storing garden egg in plastic containers is not advisable, 55.0% knew that overwatering affects garden egg, and 53.3% knew that using uncontaminated water for irrigation is important for food safety. Many respondents have good knowledge of garden egg food safety, indicating that farmers are aware of safety practices. This can promote farmer discussions, quickly spread information in rural areas, and boost awareness. Their experience and education likely contribute to this, aligning with [9], who suggest household education programs to improve nutrition and food security.

Table 4: Farmers' knowledge of farmers' food safety practices

S/N	Knowledge	Correct response (f)	%
1	Wearing protective clothing (e.g., gloves, boots) while farming helps prevent contamination.	59	98.3
2	Sorting and removing damaged or rotten garden eggs helps prevent contamination.	57	95.0
3	End rot is a sign of maturity.	56	93.3
4	Pesticides are effective when applied/sprayed against the wind.	54	90.0
5	Proper storage of pesticides and chemicals is essential to prevent crop contamination.	50	83.3
6	The shelf life of garden egg is 4-7 days.	49	81.7

7	Untreated manure can introduce harmful bacteria into your garden egg crops.	46	76.7
8	Storing garden eggs above 37 degrees is good.	46	76.7
9	Storing garden eggs in plastic containers is a good idea.	40	66.7
10	Over-watering doesn't affect the garden egg.	33	55.0
11	Using uncontaminated water for irrigation is important for food safety.	32	53.3
12	Maturity in garden egg starts 5-6 months after planting.	22	36.7

Source: Field Survey, 2025 **Note: F = Frequency**

Challenges garden egg farmers face in implementing food safety practices

Table 7 shows that garden egg farmers face several barriers to adopting food safety practices. The most pressing issues are difficulty accessing safe, reliable inputs, such as clean water, high-quality seeds, and safe fertilisers ($\overline{x}$ = 3.92, S.D = 0.33), and a lack of government or industry support for food safety improvements ($\overline{x}$ = 3.92, S.D = 0.51). These findings suggest that although farmers may understand the importance of food safety, they struggle to put it into practice because of structural and systemic challenges.

Table 7 shows that garden egg farmers face two main barriers to adopting food safety practices: difficulty accessing reliable inputs such as clean water, quality seeds, and safe fertilisers ($\overline{x}$ = 3.92, S.D = 0.33), and a lack of government or industry support ($\overline{x}$ = 3.92, S.D = 0.51). Farmers are aware of food safety but struggle to implement it due to systemic challenges.

Access to safe inputs is a recurring issue in African vegetable production. [2] reported that eggplant farmers in Ghana often reuse seeds and use untreated water, increasing vulnerability to pests, diseases, and losses. Similarly, [4] highlighted that African nightshade farmers face similar issues, with poor seed quality and limited access to clean water reducing yields and compromising food safety. When farmers lack reliable inputs, they resort to practices that threaten consumer health and marketability.

The lack of institutional support compounds these problems. [3] found that garden egg farmers in Nsukka, Nigeria, held positive attitudes toward food safety yet lacked consistent extension services and monitoring frameworks to sustain safe practices. Without incentives or regulatory backing, farmers often prioritise immediate survival and profit over long-term safety standards. This aligns with [26], who reported that Ugandan and Kenyan vegetable farmers were willing to adopt sustainable intensification technologies but cited high agrochemical costs and poor seed quality as major barriers, exacerbated by weak policy support.

These challenges are not unique to garden egg farmers. Across sub-Saharan Africa, vegetable producers face systemic issues, including poor infrastructure, inadequate extension services, and limited investment in food safety. As [2] emphasised, only about 5% of agricultural research investment over the past three decades has focused on reducing post-harvest losses, with the bulk directed towards productivity. This imbalance leaves farmers without the tools and incentives to prioritise food safety, even when they recognise its importance.

Other constraints include pest and contaminant management problems ($\overline{x}$ = 3.60, S.D. = 0.53), inadequate storage and preservation infrastructure ($\overline{x}$ = 3.05, S.D. = 0.83), and the high costs of implementing safety measures ($\overline{x}$ = 3.05, S.D. = 0.91). Together, these issues highlight the gap between farmers' awareness of food safety and their ability to meet required standards.

These findings support earlier studies. [2] noted Ghanaian eggplant farmers often use untreated water and recycled seeds, risking contamination and post-harvest losses. [4] observed similar issues among African nightshade farmers, with poor seed quality and limited clean water access affecting yield and food safety. [3] found that Nsukka, Nigeria, garden egg farmers valued food safety but lacked ongoing extension services and monitoring. Similarly, [26] reported vegetable farmers in Uganda and Kenya were willing to adopt sustainable techniques but faced high agrochemical costs, poor seed quality, and weak policy support, worsening these issues.

The results show that garden egg farmers are caught between knowledge and practice. They understand the importance of food safety but lack the resources and support to implement it. Solving these needs requires better government policies, extension services, and access to safe inputs. Without these, food safety for small farmers

remains hard. In summary, the study's results show that garden egg farmers are caught between knowledge and practice. They recognise the value of food safety but lack reliable inputs and institutional support to make it a reality. Addressing these gaps requires stronger government policies, investment in extension services, and provision of affordable, safe inputs. Without these, food safety will remain aspirational rather than achievable for smallholder farmers.

Table 7: Challenges garden egg farmers face in implementing food safety practices

s/n	Challenges	Mean	Std. Deviation	%
1	Challenges in obtaining reliable, safe sources of input materials (e.g., fertilizers, water).	**3.92**	0.33	98.00
2	Lack of support or incentives from government or industry bodies for food safety improvements.	**3.67**	0.51	91.75
3	Challenges in managing pests and contaminants in the cultivated land.	**3.60**	0.53	90.00
4	Inadequate infrastructure for the proper storage and preservation of garden eggs.	**3.05**	0.83	76.25
5	High costs associated with implementing food safety measures.	**3.05**	0.91	76.25
6	Lack of access to or affordability of sanitizing agents and equipment.	**2.85**	0.69	71.25
7	Inadequate facilities for washing and storing garden eggs.	**2.73**	0.88	68.25
8	Difficulty in ensuring proper handling and transport of garden eggs.	**2.63**	0.97	65.75
9	Difficulty in maintaining consistent hygiene practices among workers.	2.37	0.80	59.25
10	Lack of access to proper food safety training programs.	2.18	0.70	54.50
11	Limited knowledge of food safety regulations and standards.	2.00	0.61	50.00
12	Challenges in educating and training new or seasonal workers on food safety.	1.87	0.47	46.75
13	Insufficient resources for proper record-keeping and temperature monitoring.	1.47	0.60	36.75

Cut off mean ≥2.5 Source: Field survey, 2025

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study examined food safety awareness and the challenges faced by garden egg farmers in the Nsukka Agricultural Zone. The findings show that most farmers have a high level of awareness and knowledge of key food safety practices, including the safe use of pesticides, proper handling and sorting of produce, and the importance of protective clothing. However, this level of knowledge persists despite very limited contact with extension agents, suggesting that farmers rely heavily on learning from fellow farmers and personal experience.

Interestingly, knowledge alone may not have translated fully into consistent practice, as farmers continue to face practical and structural barriers that limit their ability to implement recommended food safety measures. These include difficulty accessing safe, reliable inputs; inadequate institutional support; high compliance costs; pest management challenges; and poor storage and handling infrastructure. These constraints expose both consumers and farmers to potential health and economic risks. The study therefore highlights a clear gap between awareness and actual practice, emphasising the need for stronger institutional and extension support to bridge this divide. The following recommendations are proffered to ensure good food safety awareness among garden-egg farmers in the Nsukka Agricultural Zone. Agricultural extension services should intensify regular farm visits and organise practical training programs focused specifically on food safety practices in garden egg production. Government and relevant agencies should provide accessible and affordable credit facilities or input subsidies to enable farmers to obtain safe seeds, water sources, fertilisers, and protective equipment. Investment in basic infrastructure, such as storage facilities, washing units, and improved transport systems, should be prioritised to reduce contamination and post-harvest losses.

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