Journal of Community & Communication Research
ISSN: 2635-3318
Volume 10, Number 2, December 2025
Pp. 259-265

Constraints Affecting Adoption of Pesticides among Vegetable Farmers in Akwa Ibom State, Nigeria

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Abstract
Pest remains a crucial constraint to vegetable production in Akwa Ibom State Nigeria. This study was therefore undertaken to examine constraints to t*he adoption of pesticides among vegetable farmers. A multi-stage sampling technique was adopted with 120 respondents for the study.* Result of socio-economic characteristics of farmers showed that they had a mean age of 41, *a greater number (50%) of the respondents had formal education. A greater proportion (66.7%) respondents earned between ₦21,000 – ₦40,000 per month, with mean monthly income of ₦30,500. The result indicated the prevalence pesticides use in the area. As per factor analysis, Factor 1 show the economic and accessibility challenge which explains 34.37% of the variance, high cost of pesticide" (0.842), "Poor pesticides education" (0.828), and "inadequate fund to buy" (0.811) loaded heavily, emphasizing that economic constraints significantly hinder the use of pesticides. The study concluded that economic, logistical, and knowledge-related factors are the primary barriers preventing the widespread use of pesticides. The study recommended awareness creation by sensitizing farmers through the extension agents.*
Keywords: Constraints; Adoption, Pesticides, Vegetable farmers.

Introduction

Vegetables are most important component of food and are rich in vitamins, minerals and fibre essential for human health. Many vegetables are considered as protective food items which prevent many diseases and ailments. Many patients with permanent diseases are advised to take vegetable diets to cushion the effects of the diseases, vegetable are grown all year round majorly as homestead crops, in garden or backyard for common uses which yield high economic and domestic returns. But regrettably vegetable production is seriously attacked by pests and diseases which resulted to farmer's use of pesticides. Miriam J.T (2022).
Pesticides can prevent large crop losses and protect crops against insects, weeds, fungi and other pests and as such they play a significant role in food protection by also increasing yields but pesticides are potentially toxic to humans and can have both acute and chronic health effects depending on the quantity and way in which a person is exposed. Udousung *et al.,* 2024a;
Furthermore, pesticide is believed to improve competitive advantage in agriculture. There is a widespread acceptance that the use of modern agricultural practices like alternation of planting season, continuous cropping and irrigation methods has sharply increase pesticide use.
The Pesticide Action Network (2022) estimates that globally over 4 million tons of pesticides are sold every year on average, mostly herbicides (50%), followed by insecticides (30%) and fungicides (17%) and other pesticides like rodenticides and nematicides (3%). In Europe alone, the FAO reports an annual use of over

460,000 tons of pesticides since the early 1990s (FAO, 2020). During the same period, the USA applied more than 406,000 tons, while less industrialized countries used on average over 24,000 tons of pesticides per year (FAO, 2020). However, there is a widespread claim that pesticides are harmful to human health and the environment (Ahmad *et al.*, 2024). The environmental and social impact of pesticide use in the USA alone is estimated at USD 10 billion per year (Mahmood *et al*., 2016; Balasha *et al.*, (2023).

The issue of climate change has also contributed to the alteration of planting season in the region leading to the proliferation of varieties of weeds and insect pests which has contributed to low yield. The adoption of improve agricultural techniques in Akwa Ibom State is inevitably for food security and food self-sufficiency policies to be prioritized (Udousung *et al.,* 2019, Udousung *et al.,* 2024a; and Udousung *et al.,* 2024b). The major constraints on improving agriculture in Nigeria is the subsistence production system, the low level of modern technology adoption, land fragmentation, and crop failure, which increases production risk. Poor agricultural information dissemination and lack of the use of damage control inputs. This is because about 20–40% of potential food produced is lost to insects and other pests in Africa (Anang and Amikuzuno, 2015).

Pests like insects and rodents that damage crops, livestock, or human health. They encompass a variety of species including insects, ticks, mites, and other arachnids; nematodes and other parasitic worms; weeds and other unwanted plants; fungi, bacteria, viruses, and other harmful microorganisms, as well as some vertebrates such as certain birds and rodents. Miriam (2022). Large number of insects may be external or temporarily internal pests of man and other animals. Most have alternate hosts which compounds problems of their eradication. Insect parasites generally weaken their hosts and make susceptible to attacks of disease-causing organisms. Others as a result of feeding may cause irritation or sores which may be infected.

The global losses due to various categories of pests vary with the crop, the geographical location and the weather. Despite the plant protection measures adopted to protect the principal crops, 42.1 % of attainable production is lost as a result of attack by pests. However, if no control measures were used to protect crops, the figure would be 69.8% (Miriam, 2022). To minimize the detrimental effects of these pests' farmers are obliged to use different pesticides. Majority of the modern synthetic insecticides have detrimental effects on beneficial insects including natural enemies of crop pests. It is necessary to have some knowledge on the safety of different insecticides to the natural enemy complex occurring in a given ecosystem.

Many insecticides when used in agro ecosystems target insect pests along with beneficial or natural enemies. Insecticides should not only suppress the insect pest population but also be safe to their natural enemies. Application of pesticides to crops that are in bloom can kill honeybees which act as pollinators. Hence, it is imperative to screen the insecticides before incorporating them into the insect pest management programme. Screening is imperative to safeguard the beneficial from the hazardous effects of insecticides (George and Ambrose, 2024). Some beneficial insects have economic value that acts as biological control agents, may be exposed to the insecticides which are indiscriminately used to control the insect pests and consequently their physiological and behavioural functions get affected. Information on the impact of insecticides on the non-targeted beneficial is imperative for the researchers as well as farmers to select the most suitable insecticide with least damage to beneficial George and Ambrose (2024).

In Akwa Ibom State, vegetable farmers rely extensively on pesticides, but their use is constrained by information gaps, inconsistent product quality in retail markets, and weak compliance with safe-use standards. Common challenges include misuse, improper disposal, and failure to observe pre-harvest intervals. These practices not only increase health risks and the chances of pesticide residues in fresh produce but also threaten consumer confidence.

Methodology

Study Area

The study was carried out in Akwa Ibom State, which formed a part of the core States in the production of vegetable of the Niger Delta region of Nigeria. The State is located at latitude $4^{0}33^{1}$ and $5^{0}53^{1}$ North and longitude $7^{0}25^{1}$ and $8^{0}25^{1}$ East and occupies a total land area of 8,421 square kilometres. There are two distinct seasons – rainy and dry seasons, with the rain evenly distributed throughout the year and decreasing from over 3,000mm in the south to about 2,700mm in the North. It has an estimated total population of

3,920,203 people. The predominant occupation of the people in the study area is farming where the major land use pattern is rain fed and food crop production including vegetable of all types and livestock rearing while fishing is conducted in the riverine areas of the State.

Sampling Techniques / Analytical Techniques

A multi-stage sampling procedure was adopted in the study. At the first stage, a simple random sampling technique was used to select three (3) agricultural zones out of the six (6) ADP zones in the State; at the second stage simple random sampling technique was used to select 12 extension blocks from each of the zones, the third stage was a purposive selection of two (2) cells from each of the selected 12 blocks giving a total of 24 cells. Finally, five (5) vegetable farmers were randomly selected from each of the cells, giving a total of 120 vegetable farmers as the respondents which served as the sample size.

Model Specification

Factor Analytic Procedure using factor analysis procedure by principal component approach was adopted for the analysis. The principal components method using an exact mathematical transformation of the original set of variables to a new set, with the later summarizing linear relationships exhibited in the data the model is specified thus;

Fa = aWA + bwB +….kwk - (1)

Where =factor a, being the best linear combination of all the variable A-K

aw-kw = are weight attached to variables

A-k = variable A-k

Other factors can be similarly defined, as explained earlier. When the factors are uncorrelated, they are said to be orthogonal and a variable "a" in the original data can be defined as

$Z_a = W_{a1} F_1 + W_{a2}F_2 +…+W_{a2}F_{2+}……W_{ak}F_k – (2)$

Where Z_a = variable a in standard score format (mean = 0 and variance = 1), W_{a1} to W_{ak} = weights (normally called factor loadings) attached to factors, and F_1-F_k = factors 1-K. formula 2 simply means that in factor analysis employing the principal components methods, a variable is viewed as the sum of weighted factors derived from the data. When the data is initially factored, the concern is more on the possibility of reducing the data to a smaller composite set of factors. At this stage, the factors may not make any meaning until they are rotated to a final solution.

Results and Discussion

Socio - economic characteristics of vegetable farmers in Akwa Ibom State as presented in Table 1. The result for sex distribution shows that the majority (56.7%) were females while (43.3%) were males. This indicates that vegetable production in the area was dominated by females. This corroborates the findings of Ekanem *et al.* (2022) who reported that females made up the bulk of farming population in Akwa Ibom State.

The age mean was 41 years, in line with findings of Udousung *et al.,* (2019) which indicated that young energetic respondents were engaged in farming in the state and they would be able to indulge in more demanding farm activities. With regards to educational attainment 50% of the respondents had acquired a primary/ vocational education while a negligible number 8.3% per cent of the respondents attended tertiary education, this suggested that farming activities in the area was handled by enlightened people. Table 1 also shows that 71.6% of the respondents had acquired more than 10 years of farming experience. This implies that majority of vegetable farmers are experienced farmers who have practiced vegetable farming for a number of years. This study is in line with the findings of Udousung and Umoh (2024) who opined that the years of farming experience is factors that aid in the adoption of new innovations. Also, reported that experienced farmers are better equipped to handled production challenges and make effective use of resources. With regards income majority (66.7%) of the respondents earned between ₦21,000 – ₦40,000 per month. The mean monthly farm income of ₦30,500 indicating that most of the vegetable farmers in the area earned below the national minimum wage. Information sources revealed that majority (52.5%) received information on farming practices from their fellow farmers, while 40.8% of the respondents,

received information from radio/ television. This may be as a result of farmers not having regular contact with agricultural extension services few (4.17%) had contact with extension services, extension agents give farmers access to information on innovations, advice on inputs and their use, and management of vegetable farming technologies (Giginyu and Danladi 2020).

Table 1 Socio-Economic Characteristics of Vegetable Farmers in Akwa Ibom State, Nigeria (n=120)

Variables	Frequency	Percentages
Sex		
Female	65	56.7
Male	55	43.3
Age Distribution (years)		
18 -30	0	0
31-40	61	50.8
41-50	47	39.2
51-60	12	10.0
Mean = 41 years		
Educational Status		
Primary/Vocational	30	50.0
Secondary	20	16.7
Tertiary	10	8.3
None of above	60	25.0
Primary Occupation		
Farming	58	48.33
Farming/Trading	53	44.16
Farming/Civil Service	9	7.51
Farming Experience		
Less than 10 years	86	28.4
More than 10 years	34	71.6
Farm Income		
₦ 1,000 --20,000	30	25.0
₦21,000– ₦40, 000	80	66.7
₦41,000– ₦60, 000	-	-
₦61,000– ₦80, 000	-	-
₦81,000 and above	10	8.3
Sources of information		
Mean = 30,500		
Radio/TV	49	40.8
Newspaper	3	2.5
Extension agents	5	4.17
Fellow farmers	63	52.53

Source: Field Survey, 2024

Types of Pesticides for Vegetable Cultivation Available in Akwa Ibom State

Table 2 presents the types of pesticides available for vegetable production in Akwa Ibom State. Findings have shown that all the pesticides listed were readily available in the study area. But quinones (88.3%), followed by bromethalin (86.7%), Organo chlorines (Aldrin) (82.5%), Organophosphorus compounds (81.7%), Zinc phosphorus (79.7%), and Niclosamide (76.7%) were the most available types of pesticides as identified by respondents in the study area. The reason for this result might be from the fact that Quinones are commonly used in controlling fungal diseases, Organophosphorus compounds commonly

used in targeting various insect pests and Bromethalin commonly used to control rodents that may damage produce or storage. This finding collaborates with Udousung and Umoh, 2024, that farmers prefer use of quinones, Organophosphorus, bromethalin, among others.

Table 2: **Prevalence of Pesticide Use in Akwa Ibom State, Nigeria**

Variables	Yes	No	Don't know
Carbamates	82(68.3)	25(20.8)	13(10.8)
Paraquat	85(70.8)	23(19.2)	12(10.0)
Glyphosate	82(68.3)	27(22.5)	11(9.2)
Oxadiazon	79(65.3)	30(25.0)	11(9.2)
Metolachor	77(64.2)	30(25.0)	13(10.8)
Benomyl	76(63.3)	30(25.0)	11(9.2)
Oxamyl	75(62.5)	75(62.5)	13(10.8)
Triazophos	73(60.8)	34(28.3)	13(10.8)
Carbosulfan	73(60.8)	32(26.7)	15(12.5)
Pentachlorophenol	79(65.3)	34(28.3)	7(5.8)
Quinones	106(88.3)	14(11.7)	-
Bromethalin	104(86.7)	16(13.3)	-
Zinc phosphorus	95(79.7)	19(15.8)	6(5.0)
Niclosamide	92(76.7)	25(20.8)	3(2.5)
Organophosphorus	102(81.7)	18(15.0)	-

Source: Field Survey, 2024

Constraints Affecting Adoption of Pesticide Use in Akwa Ibom State, Nigeria

The factor analysis results for the constraints to the adoption of pesticides reveal four key components, with each addressing different challenges in adopting these methods. The diagnostic statistics indicate that the factor analysis is valid and the data is suitable for this method. The high KMO value, significant Bartlett's test, and good Cronbach's alpha suggest that the factor model is reliable and meaningful. The fact that a substantial percentage of variance is explained by the factors (79.06% in total) further confirms that the model provides a strong explanation of the data's structure.

Factor 1 (Economic and Accessibility Challenges), which explains 34.37% of the variance, focuses on issues related to the high costs of pesticides and the inadequacy of funds to purchase necessary pesticides for treatments. Variables such as "high cost of pesticide" (0.842), "Poor pesticides education" (0.828), and "inadequate fund to buy" (0.811) load heavily on this factor, emphasizing that economic constraints significantly hinder the use of pesticides. These findings are consistent with previous studies of Akinbile *et al.,* (2014) that highlight the financial burden on small-scale farmers as a primary barrier to adopting these methods, leading many to revert to cheaper, traditional alternatives.

Factor 2 (Logistical and Procedural Inefficiencies), explaining 21.22% of the variance, reflects of challenges related to delays and inefficiencies in the application pesticides. The variables that load strongly on this factor include "long procedure before pesticides are administered" (0.865), "prevalence of fake or adulterated pesticides" (0.827), and "registration procedure" (0.811). These variables suggest that bureaucratic processes and the presence of counterfeit products reduce the trust and reliability of orthodox pest control methods. Farmers may perceive these methods as unreliable and time-consuming, which could explain their preference for more immediate and accessible alternatives, as noted in research by Rahman *et al.,* (2018).

Factor 3 (Communication and Service Accessibility), explaining 14.16% of the variance, includes variables like "poor communication facilities" (0.873), "inaccessibility of service providers" (0.849), and "long distance to shops" (0.892). These findings highlight that communication and logistical barriers, such as

inadequate access to pest control services and information, further discourage the use of pesticides. This aligns with existing literature that points to limited extension services and poor infrastructure in rural areas as significant obstacles. Farmers are less likely to adopt new technologies when they have insufficient access to information and expert advice.

Factor 4 (Lack of Expertise and Technical Know-How), explaining 9.31% of the variance, includes variables such as "lack of technical know-how" (0.844) and "lack of extension agent/expert" (0.621), suggesting that the absence of adequate expertise and training further limits the effective use of pesticides. This reinforces findings from previous research, which indicates that a lack of knowledge and skilled personnel in rural areas undermines the adoption and success of such methods.
In summary, the results indicate that economic, logistical, and knowledge-related factors are the primary barriers preventing the widespread use of pesticides. Improving affordability, streamlining procedures, enhancing communication and service access, and providing better training and expertise are essential to overcoming these barriers and encouraging the adoption of pesticides use strategies.

Table 3: Constraints Affecting Adoption of Pesticide Use in Akwa Ibom State, Nigeria

	Component				
	Factors 1	**Factors 2**	**Factors 3**	**Factors 4**	**CEI**
High cost of pesticide	0.842				.656
Poor pesticides education	0.828				.806
Inadequate fund to buy pesticides	0.811				.701
Lack of adequate information, knowledge and awareness of the inherent dangers of pesticides	0.798				.659
Long procedure before pesticides are administered		0.865			.816
Prevalence of fake or adulterated pesticides		0.827			.476
Registration procedure		0.811			.662
Poor communication facilities			0.873		.615
Inaccessibility of service providers			0.849		.831
Long distance to shops				0.892	.719
Fear of losses by vegetable farmers				0.873	.633
Lack of technical know-how				0.844	.689
Adulterated Pesticide				0.810	.720
Lack of extension/ expert	0.621	0.593			.632
KMO	0.798				
Bartlett's test of spherecity	Sig. = 0.000				
Cronbach alpha	0.889				
Initial Eigenvalues	4.812	2.971	1.982	1.304	
% of variance	34.37	21.22	14.16	9.31	
Cumulative %	34.37	55.59	69.75	79.06	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations.

Source: SPSS 22 (2024)

Conclusion

Findings revealed that female farmers with low monthly income dominated vegetable production in the study area. They were aware of all the types of pesticides available in the study area. The result in Table 3

revealed that out of 15 variables used in the analysis six had shown to be highly prevalence which includes (88.3), (86.7), (81.7), (79.7), (76.7) and (70.8). Results of factor analysis shows that economic, logistic and knowledge-related factors are the primary constraint influencing the adoption of pesticides in the study area.

Economic and accessibility challenges explain 34.37% of the variance, focuses on issues related to the high costs of pesticides and the inadequacy of funds to purchase the necessary pesticides for treatments. Variables such as "high cost of pesticide" (0.842), "Poor pesticides education" (0.828), and "inadequate fund to buy" (0.811) load heavily on this factor, emphasizing that economic constraints significantly hinder the use of pesticides. Logistical and procedural inefficiencies, explaining 21.22% of the variance, reflects of challenges related to delays and inefficiencies in the application pesticides. The variables that load strongly on this factor include "long procedure before pesticides are administered" (0.865), "prevalence of fake or adulterated pesticides" (0.827), and "registration procedure" (0.811). Communication and service accessibility, explained 14.16% of the variance, includes variables like "poor communication facilities" (0.873), "inaccessibility of service providers" (0.849), and "long distance to shops" (0.892). Lack of expertise and technical Know-How, explaining 9.31% of the variance, includes variables such as "lack of technical know-how" (0.844) and "lack of extension agent/expert" (0.621), suggesting that the absence of adequate expertise and training further limits the effective use of pesticides.

Recommendations

1. Extension agent should have contact with farmers at all times to enable them acquire knowledge of various pesticides and methods of application
2. Improving affordability, streamlining procedures, enhancing communication and service access, and providing better training and expertise are essential to overcoming farmers challenges in adoption of pesticides.
3. There is need to get more extension agents on the field to continue to sensitize farmers on the merit and demerits of pesticides used.

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