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Effect of Government Awareness Campaigns and Education Programs on Farmers' Decision to Switch from Chemical Pesticides to Bio pesticides

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ABSTRACT

This study examined the effects of government awareness campaigns and education programmes on farmers' decision to switch from chemical pesticides to bio pesticides in Adamawa State, Nigeria. Specifically, the study described the socioeconomic characteristics of the farmers and examined the effect of government awareness campaigns, farmer training programmes, and knowledge of the health and environmental risks of chemical pesticides on farmers' decision to switch from chemical pesticides to bio pesticides. Primary data were collected from 400 farmers using structured questionnaires and personal interviews. Purposive and multistage simple random sampling techniques were employed in selecting respondents. An inferential statistics, the logit regression analysis, was used to analyze the data. The findings revealed that awareness of government campaigns, participation in training programmes, improved knowledge of the health and environmental risks of chemical pesticides, educational status, farming experience, and membership in cooperative societies had positive and statistically significant effects at 5% significant level on farmers' decisions to adopt bio pesticides. The study concludes that effective government awareness campaigns and farmer education programmes play a vital role in encouraging the transition from the use of chemical pesticides to environmentally friendly bio pesticides. The study therefore recommends strengthening agricultural extension services, expanding farmer training programmes, improving access to affordable bio pesticides and protective equipment, and implementing supportive government policies to promote sustainable pest management and environmental protection.

Introduction

Government policies and institutional support play a crucial role in shaping farmers' perceptions and behavior towards pesticide use.

(Adegbola *et al.*, 2012) highlighted that lack of effective pesticide regulation and widespread availability of unregistered, often harmful chemicals exacerbate the risk faced by Nigerian

farmers. Nigerian government has to trace back to its advocate for Biopesticide use regulation to avert the risk on relying heavily on chemical pesticide. The synthetic chemicals pesticide, lindane was first introduced in Nigeria in the early 1950s. The influx of chemical-based pesticides was due to the need to boost agricultural productivity and crop yield due to rising urbanization and population. Therefore, pesticide use soared geometrically in 1960 after the country's accession to independence (Adegbola *et al.*, 2012; Abdullahi *et al.*, 2017). Over the years, the adverse effects resulting from excessive utilization of synthetic chemicals have become widely reported (Moshi *et al.*, 2017). Numerous studies have highlighted the toxic and persistent effects of pesticide residues on crop and food contamination along with soil and groundwater pollution (Anilmahsjan *et al.*, 2004; Walia *et al.*, 2017; Abdullahi *et al.*, 2017). In view of the above, there have been increased calls to discontinue the use of synthetic chemical pesticides in agriculture. Hence, the use of biopesticide is now advocated particularly in developing countries like Nigeria.

The current status of biopesticide utilization in Nigeria remains low despite its widely reported benefits for crop protection and disease management in agriculture (Oruonye *et al.*, 2010; Okwute, 2012; Ekefan and Eche, 2013). Okwute, (2012), identified, examined, and highlighted the potential of several plant-based sources of pesticide in Nigeria. The authors demonstrated that the leaf, bark, seed, root and fruits of over 30 plant species in Nigeria contain bioactive pesticide agents. The author identified the following plants as potential sources of bioactive agents for pesticide; *Azadirachta indica*, *Khaya senegaensis*, *Nicotiana tabacum*, and *Prosopis africana* (Okwute, 2012). Ekefan and Eche (2013), identified numerous indigenous biopesticide for use in pest management in

Nigeria, such plants like *Lonchocarpus* Spp *Derris elliptical*, *Chrysanthemum Cineranaefolium*, *Nicotina tabacum*, *Azadirachta Indica*, Citrus trees, *Shoenocaulon* and *Ryanair Speciosa*.

Despite this growing body of evidence on the availability and benefits of biopesticides, their adoption among farmers in Nigeria, including Adamawa State, remains low. Existing studies have largely focused on the toxicity of chemical pesticides and the biological potential of plant-based alternatives, with limited attention paid to the behavioural and institutional factors, particularly government awareness campaigns and farmer education programmes, that influence farmers' actual decision to switch from chemical pesticides to bio pesticides. This gap in knowledge limits the ability of policymakers and extension agencies to design effective interventions that promote biopesticide adoption. It is against this background that this study was carried out to examine the effect of government awareness campaigns and education programmes on farmers' decision to switch from chemical pesticides to bio pesticides in Adamawa State, Nigeria. Specifically, the study sought to describe the socioeconomic characteristics of the farmers and examine the effect of government awareness campaigns, education/training programmes, and other socioeconomic factors on farmers' decision to switch from chemical pesticides to bio pesticides.

Methodology

Study area

Adamawa State is located in northeastern Nigeria. It lies between latitudes 7° – 11°N of the equator and between longitudes 11° – 14°E of the Greenwich meridian (Adebayo, *et al.*, 2020). The State is segmented into twenty-one Local Government Areas (LGAs) which are further divided into four agricultural development

project (ADP) zones: It shares a common boundary with Borno State in the North, Gombe State in the Northwest and Taraba State in the South and West. It also has an International boundary with Cameroon Republic along its eastern borders (Madugu, 2022). The State covers a land area of about 39,741 km² and had an estimated total population of 4,902,100,2026 projection using a 2.7% annual growth rate from 2006-2036 (City population.de). Annual rainfall ranges between 900 to 1600 mm while maximum temperature range is between 39°C and 45°C. Available infrastructure includes road networks, electricity, hospitals, schools and research institutions.

Data Collection and Sampling Procedure

Mainly primary data was used for this study which was administered to farmers via a structured questionnaire augmented with personal interviews. Both purposive and multistage random sampling technique were used to select the respondents; In the first stage, all the four agricultural zones of Adamawa state were selected (zone 1,2,3, and 4) respectively. The second stage involved a simple random sampling to select two Local Governments (LGAs) within each zone to give the total of eight (8) Local Government Areas. The third stage involved a purposive sampling to select three wards from each of the eight LGAs that are engaged in agricultural activities to give the total of twenty-four (24) wards. The fourth stage involved a simple random sampling technique to select respondents from each of the twenty-four (24) selected wards. The sample size for the study was determined using the Taro Yamane (1967) formula, as modified and applied by Obianefo *et al.* (2022): $n = N / [1 + N(e_2)^2]$, where n is the sample size, N is the total farming population of the study area (543,648), and e is the margin of error (5%). This yielded a sample size of 399.8, approximated to four hundred

(400) respondents. The 400 respondents were then proportionately distributed across the four agricultural zones and the twenty-four selected wards based on the relative farming population of each zone, ranging from 20 respondents per ward in Zone 1 to 12-16 respondents per ward in Zones 2 to 4.

Analytical Techniques

Inferential statistics such as the logit regression analysis was used as analytical tool to achieve objective of this study. The explicit form of the Logit Regression is expressed as:

$$P_i = y^* = F(Z_{ii}) = F(\gamma + \sum \lambda I \times 1) = \frac{1}{1+e^{-Z}} \quad (1)$$

Where:

P_i = the probability that a farmers have access to agro-information

y^* is binary or dichotomous variable which implies that 1 for category of farmer switch/use biopesticide

Z_1 = the function of a vector of n explanatory variables and e = the base of natural logarithms which is approximately equal to 2.718 and

X_i = the i^{th} explanatory variables and are parameters to be estimated.

The Logit Model, according to Hosmer and Lemeshow (1989) can be written in terms of odds and log of odds, which makes the coefficients easier to understand. The odds ratio denotes the ratio of the probability (P_i) that a farmer switch/use biopesticide (1- P_i) that the farmer did not switch/use biopesticide:

$$P_i = \frac{1}{1+e^{-Z}} \quad (2)$$

Z_1 is the function of a vector of n explanatory variables and expressed as:

$$Z_1 = \beta_0 + \beta_1 X_1 \quad (3)$$

Where:

β_0 = intercept and

β_1 = vector of unknown slope coefficients the relationship between P_i and X_i which is non-linear.

Finally, the Logit Model is obtained by taking the logarithm of equation as follows:

$$\ln \left(\frac{p}{1-p} \right) = Y = a_0 + B_1 X_1 + \mu_i \quad (4)$$

Where:

$Y = (1 = \text{Farmer switched/uses biopesticide and } 0 = \text{Farmer did not switch/use biopesticide})$

X_1 = Awareness of government campaign promoting biopesticides

X_2 = Training attendance/workshop on biopesticides

X_3 = Knowledge improvement on environmental and health risks of chemical pesticides

X_4 = Government campaigns encourage farmers to adopt biopesticides

X_5 = Trust information provided by government agricultural agencies on biopesticides adoption

X_6 = Age

X_7 = Educational status

X_8 = Farming experience

X_9 = Access to credit facilities

X_{10} = Membership of cooperative society

X_{11} = Contact with extension agents

Results and Discussion

Result of the Effects of Government Awareness Campaigns and Education Programs on Farmers' Decision to Switch from Chemical Pesticides to Bio pesticides

Table 2 presents the marginal effects of government awareness campaigns and education programs on farmers' decision to switch from chemical pesticides to biopesticides. The result generally shows that awareness creation, training, education, and institutional support play an important role in influencing farmers' willingness to adopt safer and environmentally friendly pest control methods.

The Chi-square value of 134.59 with a probability value of 0.0000 indicates that the model is statistically significant, meaning the explanatory variables jointly influence farmers' decisions to adopt biopesticides. In addition, the Pseudo R^2 value of 0.4533 implies that about 45.3% of the variation in farmers' decisions to switch to biopesticides is explained by the variables included in the model. In practical terms, this means that government awareness programs, education, farming experience, and institutional factors substantially shape farmers' adoption behavior toward safer pesticide alternatives. The analysis of the study revealed that awareness of government campaigns promoting biopesticides had a positive and highly significant effect on farmers' decisions to switch from chemical pesticides to biopesticides, with a marginal effect value of 0.7623, Z-value of 4.74, and p-value of 0.000. This implies that increased awareness campaigns significantly increase the likelihood of farmers adopting biopesticides by approximately 76.2%. In practical terms, when farmers are continuously exposed to information through radio programs, extension campaigns, community sensitization, and agricultural outreach, they become more informed about the dangers of chemical pesticides and the benefits of biopesticides. Awareness reduces uncertainty and builds confidence in safer agricultural practices. This finding agrees with Madaki *et al.* (2024), who reported that pesticide information dissemination significantly improved farmers' knowledge and safety behavior in Ogun State, Nigeria. Similarly, Nwadike *et al.* (2021) found that awareness and safety education positively influenced pesticide handling practices among farmers in Northern Nigeria.

The study also showed that attendance at training programs and workshops on biopesticides positively and significantly

influenced farmers' adoption decisions, with a marginal effect of 0.6796 and a p-value of 0.000. This means that participation in training programs increases the probability of adopting biopesticides by about 67.9%. This result highlights the importance of practical learning and capacity building among farmers. In practice, farmers who attend workshops are exposed to demonstrations, handling techniques, and practical experiences that help them understand the effectiveness and application of biopesticides. Such training reduces fear of failure and increases adoption confidence. This finding is consistent with the work of Aminu *et al.* (2024), who found that agricultural training and extension services significantly improved technology adoption among farming households in Nigeria. Likewise, Liverpool-Tasie *et al.* (2017) observed that access to agricultural information and farmer education positively influenced technology adoption and household welfare among rural farmers in Nigeria. The variable on knowledge improvement regarding the environmental and health risks of chemical pesticides was also positive and statistically significant, with a marginal effect of 0.4704 and a p-value of 0.000. This implies that improved knowledge about the harmful effects of chemical pesticides increases the likelihood of adopting biopesticides by approximately 47.0%. Specifically, when farmers understand that chemical pesticides can lead to health problems such as respiratory diseases, skin irritation, poisoning, and environmental contamination, they are more likely to seek safer alternatives. This result suggests that health consciousness and environmental awareness are major drivers of behavioral change among farmers. The finding supports the study of Adeola *et al.* (2025), who reported that awareness of pesticide-related health risks significantly influenced pesticide use behavior among

farmers in Southwestern Nigeria. Similarly, World Health Organization (2023) emphasized that increased awareness of pesticide health hazards encourages safer pest management practices among agricultural workers globally.

Furthermore, the result indicated that the statement "government campaigns encourage farmers to adopt biopesticides" had a positive and statistically significant effect, with a marginal effect of 0.3001 and p-value of 0.033. This means that government campaigns increase the likelihood of adoption by about 30.0%. This finding demonstrates that public agricultural policies and awareness efforts can motivate farmers to embrace sustainable farming practices. Government campaigns often provide reassurance, legitimacy, and technical guidance that encourage farmers to trust new agricultural innovations. In practical terms, farmers are more willing to adopt biopesticides when government agencies actively promote and support them through media campaigns and agricultural programs. This result aligns with Kehinde and Ogundeji (2022), who found that institutional support significantly improved farmers' adoption of improved agricultural practices in Nigeria. Similarly, Akinyemi *et al.* (2025) reported that government-backed agricultural interventions positively influenced farmers' productivity and technology adoption.

The study shows that age had a positive but weakly significant effect, with a marginal effect of 0.0092 and p-value of 0.062. This implies that older farmers are slightly more likely to adopt biopesticides than younger farmers. Older farmers may have accumulated more farming experience and may better appreciate the long-term health and environmental consequences of chemical pesticide use. However, the weak significance suggests that age alone is not a strong determinant of adoption. This finding

supports Nwadike *et al.* (2021), who found that older farmers were more cautious about pesticide exposure and more likely to adopt safer handling practices. The result further showed that educational status positively and significantly influenced farmers' adoption decisions, with a marginal effect of 0.3551 and p-value of 0.019. This means that educated farmers are more likely to switch to biopesticides by approximately 35.5%. Education improves farmers' ability to understand instructions, evaluate risks, and access agricultural information. In human terms, educated farmers are more open to innovation and better positioned to appreciate the environmental and health benefits of biopesticides. This finding agrees with Kehinde *et al.* (2018), who found that education significantly influenced adoption of improved agricultural technologies among cocoa farmers in Southwestern Nigeria. Similarly, Madaki *et al.* (2024) observed that educational attainment positively affected farmers' pesticide safety behavior and awareness in Ogun State, Nigeria.

Similarly, farming experience had a strong positive and statistically significant effect on adoption, with a marginal effect of 0.4528 and p-

value of 0.000. This indicates that experienced farmers are more likely to adopt biopesticides. Farmers with many years of farming experience may have witnessed the long-term effects of chemical pesticides on crops, human health, and soil quality, thereby encouraging them to adopt safer alternatives. Experienced farmers also tend to possess better managerial skills and practical knowledge. This finding is consistent with Kehinde *et al.* (2018) and Akinyemi *et al.* (2025), who reported that farming experience positively influenced agricultural technology adoption and productivity among Nigerian farmers. Membership in cooperative societies had a positive and statistically significant effect, with a marginal effect of 0.0821 and p-value of 0.019. This indicates that farmers belonging to cooperatives are more likely to adopt biopesticides. Cooperative societies facilitate information sharing, training opportunities, group learning, and access to agricultural innovations. In practical terms, farmers often learn from one another within cooperative groups, making adoption easier and less risky. This finding agrees with Liverpool-Tasie *et al.* (2017), who found that cooperative membership positively influenced technology adoption and welfare among rural farmers in Nigeria.

Table 1: Socioeconomic Characteristics of the Respondents

Characteristic	Category	Frequency (n=400)	Percentage (%)	Mean
Sex	Male	257	64.3	
	Female	143	35.8	
Age (years)	≤ 20	8	2.0	43
	21–30	78	19.5	
	31–40	161	40.3	
	41–50	119	29.8	
	> 50	34	8.5	
Marital status	Single	61	15.3	
	Married	299	74.8	

	Divorced	14	3.5	
	Widow/widower	26	6.5	
Household size	≤ 5	120	30.0	8
	6–10	174	43.5	
	11–15	76	19.0	
	> 15	30	7.5	
Level of education	Non-formal education	37	9.3	
	Primary	25	6.2	
	Secondary	198	49.5	
	Tertiary	140	35.0	
Primary occupation	Civil servant	147	36.8	
	Farming	148	37.0	
	Trading	56	14.0	
	Artisan	49	12.3	
Farm size (hectares)	≤ 1.0	32	8.0	3.3
	1.1–2.0	254	63.5	
	2.1–3.0	67	16.8	
	3.1–4.0	19	4.8	
	4.1–5.0	13	3.3	
	> 5.0	15	3.8	
Farming experience (years)	≤ 5	22	5.5	17
	6–10	90	22.5	
	11–15	100	25.0	
	16–20	88	22.0	
	> 20	95	23.8	
Access to credit	Yes	117	29.3	
	No	283	70.8	
Cooperative society membership	Yes	164	41.0	
	No	236	59.0	
Contact with extension agents	Yes	93	23.3	
	No	307	76.7	

Source: Field Survey, 2026

Table 2: Result of Marginal effects of government awareness campaigns and education programs on farmers' decision to switch from chemical pesticides to biopesticides

Impact of government awareness campaigns and education programs	dy/dx	Std. Err	Z-values	P-values
Awareness of government campaign promoting biopesticides	0.7623	0.1609	4.74	0.000**
Training attendance/ workshop on biopesticides	0.6796	0.1756	3.87	0.000**
Knowledge improvement on environmental and health risks of chemical pesticides	0.4704	0.1289	3.65	0.000**
Government campaigns encourage farmers to adopt biopesticides	0.3001	0.1404	2.14	0.033**
Trust information provided by government agricultural agencies on biopesticides adoption	0.0383	0.0354	1.08	0.280
Age	0.0092	0.0049	1.87	0.062
Educational status	0.3551	0.1519	2.34	0.019**
Farming experience	0.4528	0.1057	4.28	0.000**
Access to credit facilities	0.1547	0.10547	1.46	0.143
Membership of cooperative society	0.0821	0.0351	2.34	0.019**
Contact with extension agents	-0.0007	0.0060	-0.12	0.907
Chi-square value	134.59			
Probability of Chi-square value	0.0000			
Pseudo R ²	0.4533			

Source: Field Survey, 2026

Note; ** is significant at 5% probability level

Conclusion and Recommendations

The study concludes that government awareness campaigns and education programmes significantly influence farmers' willingness to switch from chemical pesticides to biopesticides. Farmers who received adequate information, participated in training programmes, and understood the environmental and health risks associated with chemical pesticides were more likely to adopt safer and more sustainable pest management practices. Interestingly, while general awareness of government campaigns was significant, farmers' trust in information provided specifically by government agricultural agencies

was not a significant determinant of biopesticide adoption, suggesting that the credibility of the message source may matter less than the consistency and reach of the awareness effort itself, an issue worth further investigation. Therefore, it is recommended that:

1. Both private and public agricultural extension services should be strengthened to provide regular training, practical demonstrations, and technical guidance that will improve farmers' knowledge and confidence in adopting biopesticides.

2. Farmers should be encouraged to join cooperative societies, as these groups facilitate access to agricultural information, training opportunities, farm inputs, and financial support needed to promote biopesticide adoption.
3. Partnerships among government agencies, research institutions, non-governmental organizations, and the private sector should be strengthened to deliver effective education programmes that encourage farmers to switch from chemical pesticides to safer biopesticides.

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