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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Understanding the Nexus of Extension Teaching Methods and Adoption of Improved Agricultural Production Technologies: Empirical Evidence from Cowpea Farmers in Kogi State, Nigeria*

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Abstract

This study assessed the nexus of extension teaching methods and the adoption of improved production technologies. A three-staged sampling technique was used in selecting two hundred (200) cowpea farmers. Primary data obtained using the Kobocollect toolbox was analyzed with adoption score/index and ordered probit regression model. Findings from this study showed that 79 % of the respondents were males while 21 % were females. The mean age among cowpea farmers was 49 years. Furthermore, 90.5 % of the respondents adopted the recommended seed rate, 87 % adopted the recommended planting date, and 84.5 % adopted the recommended weeding time. Most (20.5 %) of the respondents had an adoption score and index of 8 and 0.57; while 1.5 % of the cowpea farmers recorded an adoption score and adoption index of 10 and 0.7. Also, 45 % of the cowpea farmers were in the low adoption category, and 27.5 % of each of the sampled cowpea farmers were found in the medium and high adoption category. Individual extension teaching method (β = 1.192), mass extension teaching method (β = -0.189), a combination of individual, group and mass extension teaching methods (β = 0.044), gender (β = -0.124), farming experience (β = -0.019), and income (β = -0.00000276) significantly influenced the extent of adoption of recommended cowpea production practices. The study concluded that individual, and a combination of individual, mass and group extension teaching methods have positive effects on the extent of adoption of recommended cowpea production practices. Amongst others, the study recommended the use of these teaching methods by both private and public extension agents in disseminating information on improved farming practices.

Keywords: Adoption, Cowpea, Extension teaching methods, Kogi State, Probit regression model, Smallholder farmers

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1. Introduction

Nigerian agriculture is dominated by smallholder farmers (FAO, 2018). This characteristic has resulted in low harvest because most farmers cannot access or in some cases, pay for improved farming technologies with its multiplier effect on productivity and income (Ezeh et al., 2012; Uzokwe, 2015). As a result of low harvest and return, the levels of investment in farms have been very low, leading to abject poverty among these farmers (Eze, et al., 2010; Shaibu et al. 2023). Consequently, the improved farming technologies that are needed to increase food production and preservation do not get to smallholder farmers appropriately. The extension officers are mandated to reach out to the farmers to help them in their decision-making. The method used in reaching out to the farmers is as important as the technologies to be disseminated to the farmers.

Rees et al. (2000) and Garforth (2001) argued that agricultural knowledge and information of smallholders are complex, diverse, and vary from area to area, depending on the area's agroecology and agricultural enterprises. Their studies indicated the necessity for a comprehensive investigation of extension teaching methods at agroecological or sub-national levels, even along various agricultural enterprises. There is thus a need to empirically establish the nexus of agricultural extension teaching methods and the adoption of agricultural production technologies with a focus on cowpea farmers.

Farmers are often blamed for poor adoption of extension services because they are averse to change and hold traditional values. Additionally, the successes or failures of extension delivery services are usually measured with respect to the level of adoption without considering the effectiveness of the extension agents (Adejo, et al., 2019) and the method adopted in reaching out to farmers. According to Nwalieji and Nnabueze, (2018); the ability to communicate, the attitude of the extension worker, the frequency of contact with farmers, and field responsibility are the features of an effective extension agent. These conditions, however, depend on how the improved technologies are spread to the farmers. The effectiveness of technology adoption such as improved seeds also depends on effective communication which is critical to information dissemination (Oladele, 1999; Nogay and Azabagaoglu, 2024); for communication to be effective, there must be feedback. The feedback reveals if the communication and the methods used have any effect on the adopters of technologies.

Most studies have focused more on the effectiveness of extension agents and service delivery (Ahmed and Adisa, 2017; Nwalieji and Nnabueze, 2018; Ebenehi and Ahmed, 2019) without particular attention to the effects of the methods used in delivering extension services to the farmers, specifically, cowpea farmers in Kogi State. A good extension method carefully selected especially where the farmers have little to no formal education can motivate the farmers to participate in the extension activities. Obibuaku and Hursh (1994) studied extension message-delivering methods in Nigeria without focusing on the effects of the extension methods on farmers' adoption of innovation. Tenebe and Mundi (2008) attempted to assess the effects of extension teaching methods in Bauchi State, Nigeria, but the findings were based on simple descriptive statistics. Aside from geographical differences, the present study used advanced econometric tools, such as the ordered probit regression model to establish the relationship between extension teaching methods and farmers' extent of adoption of recommended cowpea production practices with an expected influence on increased productivity.

Furthermore, cowpea was chosen in this study due to its significance as an important legume crop in Nigeria and its contribution to the country's economy. Nigeria remains a leading producer of cowpeas in the world with a production of 3.6 million tons in 2021, over 45% of global production (FAOSTAT, 2023). Despite the country's production, Nigeria is still the largest consumer of cowpea grains with significant imports from countries like the Republic of Niger, Chad, and Cameroon (Mohammed et al., 2020). Cowpea farmers in Nigeria reported an average yield of about 600 kg ha^{-1} compared to a recommended yield of 1500-2500 kg ha^{-1} (ICRISAT, 2017).

Cowpea is an important food security crop and contributes to farmers' livelihoods as most of the smallholder farmers depend on this crop for economic and nutritional purposes (Bolarinwa, 2022). The crop is grown for food, vegetables, fodder, green manure, and cover crops, hence, it has implications for farmers' standard of living (Osipitan et al., 2021). According to Nordhagen et al. (2023), cowpea is a major source of protein due to the unaffordability of animal protein sources by the most vulnerable population. The critical role of cowpeas in Nigeria's food security crusade and the country's agri-food system forms part of the essence of this study.

This study aims to assess the nexus of extension teaching methods and the adoption of improved cowpea production technologies in Kogi State, Nigeria. The specific objectives are to:

i. ascertain the extent of adoption of recommended cowpea production practices in the study area;

ii. determine the effects of extension teaching methods on the extent of adoption of recommended cowpea production technologies.

2. Materials and Methods

2.1. Study area

This study area is Kogi State, Nigeria. The State is in North Central, Nigeria and found on latitude $6^0$30'N and $8^0$5'N and longitude $5^0$51'E and $8^0$00'E. The study area has a total population of about 5 million people (using the state projected growth rate of 3%) (NPC, 2006). Kogi State agricultural location has four zones (A, B, C, and D) as delineated by the Kogi State Agricultural Development Project (Kogi ADP) efficient extension administration.

2.2. Population and sampling procedure

The population for this study comprised all the cowpea farmers in Kogi State, Nigeria. The multi-staged sampling technique was used in selecting the respondents (cowpea farmers). In stage one, one (1) extension block was purposively selected from each of the common four agricultural zones in the State. Each block was selected based on the level of cowpea production. This gave four (4) agricultural blocks for the study. The second stage involves the random selection of five (5) extension cells from each block to give twenty (20) extension cells. Stage three involves the random selection of ten (10) cowpea farmers from each cell. A sample size of two hundred (200) respondents was used for the study.

2.3. Data collection

Primary data collected with a semi-structured questionnaire was administered to the respondents using an android-enabled Kobocollect toolbox mobile application. This application enabled accurate data collection from sampled locations and on-the-spot data assessment for relevant correction. Data were collected by the researcher and trained research assistants from the selected agricultural blocks. The research assistants were properly trained on the content of the questionnaire and the use of the Kobocollect toolbox to approach the farmers in their local dialect and apply relevant research ethics. Four (4) research assistants with prior knowledge of the use of the Kobocollect toolbox were carefully selected.

2.3. Data analysis

The data were analysed using descriptive and econometric tools. The extent of adoption of recommended cowpea production technologies by the respondents was determined using the adoption index/score, while the nexus of extension teaching methods and extent of adoption of recommended cowpea production practices was established using the ordered probit regression model.

Following Olumba and Rahji, (2014) and Ajayi et al. (2016), the adoption index was calculated as specified below:

$$AI = \frac{n_{rec}}{N_{rec}} \quad \text{(Eq. 1)}$$

Where n_{rec} = number of recommended cowpea production practices adopted by a particular farmer, and N_{rec} total number of recommended cowpea production practices.

For the adoption score, a cowpea farmer scores one for each recommended practice adopted (Olumba and Rahji, 2014; Ajayi, 2016). Following Agwu (2006), the extent of adoption was obtained from the adoption score as given: high adoption (> 7 score); medium/moderate adoption (score = 4 – 7 score); and low adoption (< 4 score).

The ordered probit model can be generally stated as:

$$Y_i^* = X_i\beta_i + \varepsilon_i \quad \text{(Eq. 2)}$$

Where Y_i^* is unobserved. What is observable is:

$$Y = 0 \; if \; Y_i^* \leq 0 \quad \text{(Eq. 3)}$$

$$= 1\ if\ 0 < Y_i^* \leq \mu_1$$

$$= 2\ if\ \mu_i < Y_i^* \leq \mu$$

$$= j\ if\ Y_i^* \geq u_j - 1$$

The observed ordinal variable (dependent variable) takes on values 0– 2, indexing the extent of adoption (high = 2, moderate = 1, low = 0).

β= estimated parameter

Ɛ = error term

Xi = individual farmer's characteristics (these characteristics were selected based on existing studies, theoretical and conceptual frameworks of this study).

X_1 = Individual extension teaching method (1 if used by extension agents, otherwise, 0)
X_2 = group extension teaching method (1 if used by extension agents, otherwise, 0)
X_3 = mass extension teaching method (1 if used by extension agents, otherwise, 0)
X_4 = Indiv+group+mass (1 if used by extension agents, otherwise, 0)
X_5 = gender (1 = male; 0 otherwise)
X_6 = education (years)
X_7 = land ownership (1 = owned/inherited, otherwise, 0)
X_8 = trust in extension agents (1 if the respondent has trust in extension agents, otherwise, 0)
X_9 = age (years)
X_{10} = membership of association (1 if a member of any farming association, otherwise, 0)
X_{11} = farming experience (years)
X_{12} = household size (number)
X_{13} = farm income (₦)
X_{14} = extension visits (number per farming season)
$Ɛ_i$ = error term

3. Results and Discussion

3.1. Socioeconomic characteristics of cowpea farmers

Description of respondents' socioeconomic variables are presented in *Table 1*.

The involvement of more males than females in cowpea production could be associated with the difficult nature of the various activities involved in cowpea production. Such activities include land clearing, bed preparation/ridging, weeding and pest/disease management. The higher involvement of males in cowpea production could also be because of their easy access to land and other productive resources for agricultural purposes. This finding agrees with Ebenehi et al. (2018) when they reported that 81.13 % of crop farmers in Niger State were male. The mean age of 49 years could be seen as an active age required for most agricultural activities. The reported mean age in this study is similar to the mean age of about 51 years as reported by Canan and Uluışık (2024) among Turkish vegetable farmers. The involvement of married respondents in cowpea production could be a plus in the adoption of agricultural innovations for productivity enhancement. Sarı Gedik and Yılmaz (2023) reported that about 77% of young farmers in Türkiye were married. This is evident as household members could serve as the source of readily available labour and help in various production activities on the cowpea farms.

The majority (73.5%) of the respondents had a first-school leaving certificate (primary school education). Education could influence decision-making on cowpea farms as regards recommended practices. Educated cowpea farmers could read and interpret instructions and labels on farming inputs which will enhance their understanding and subsequent adoption. The mean household size among cowpea farmers in the area was seven members. The mean household size recorded in this study is the same as the national average of seven members per household as reported by the National Bureau of Statistics (NBS, 2019). Expectedly, farming (67.5 %) was the major occupation among the respondents. Another major occupational activity engaged by the respondents was trading (24.5 %). This result shows that most of the respondents took farming as their main occupation. This finding is in tandem with Adejo et al. (2019) who reported the same pattern among households in Kogi State. The average farm size for cowpea production in the area was 2.5 hectares. This confirms the smallholding feature of cowpea farmers in the study area. The finding agrees with Shaibu et al. (2020) who found a mean farm size of 2.49 hectares among crop farmers in Kogi State, Nigeria. The reported number of years spent farming in this study agrees with Idrisa et al. (2012). Increased farming experience is expected to be directly proportional to the adoption of agricultural innovations. The mean annual income of the respondents from cowpea production was ₦92, 320.00 ($194.36).

Table 1: Descriptive Statistics of Cowpea Farmers

Socioeconomic Characteristics	Frequency, n = 200	Percentage	Mean/Mode
A. Sex			
Female	42	79.0	Male
Male	158	21.0	
B. Age (years)			
25 – 35	39	19.5	
36 – 45	24	12.0	
46 – 55	74	37.0	49 years
56 and above	63	31.5	
C. Marital Status			
Married	170	85.0	Married
Unmarried	30	15.0	
D. Educational Qualification			
No formal education	02	1.0	
First School Leaving Certificate (FSLC)	147	73.5	Primary
Secondary School Certificate (SSCE)	21	10.5	education
Tertiary educational certificate	30	15.0	(FSLC)
E. Household size (number of persons)			
1 – 5	69	34.5	
6 – 10	63	31.5	7 persons
11 – 15	68	34.0	
F. Major Occupation			
Farming	135	67.5	Farming
Civil service	16	8.0	
Trading /business/marketing	46	24.5	
G. Farm size (hectares)			
Below 2	50	25.0	
2 – 4	71	35.5	2.5 hectares
Above 4	79	39.5	
H. Farming Experience (years)			
1 – 15	30	15.0	
16 – 30	20	10.0	23 years
30 and above	150	75.0	
I. Income from Cowpea Production (₦ ➔			
Naira)	121	60.5	
50, 000 and below	34	17.0	92.320.00
51,000 – 100,000	45	22.5	
Above 100,000			

Source: Field Survey, 2021 NOTE: Naira is Nigeria's official currency. 1 USD = 475 Nigerian Naira (as of the time of survey in 2021).

3.2. Extent of adoption of recommended cowpea production practices

Table 2 shows the frequency count on the adoption of recommended cowpea farming practices by the respondents.

Generally, the result in *Table 2* shows a high level of adoption of most of the recommended cowpea production practices by the respondents. The impressive adoption level found in this study could be associated with cowpea farmers' awareness of these recommended production practices through access to extension services and as observed during engagement with the respondents. This finding corroborates Simon et al. (2013) when they reported a high level of awareness of sustainable agricultural land management practices among farmers in Taraba State, and this led to an adoption rate of over 60%. The authors reported that 95.7% of the respondents were aware of intercropping and posited that the high level of awareness is an added advantage to agricultural extension, as awareness of a practice is the first step in learning how to use it, followed by the interest stage which urges the clientele to seek more information about the practice.

Table 2: Frequency distribution on the extent of adoption of recommended cowpea production practices

	Recommended Practices	Frequency	Percentage	Ranking/ Remark
i.	Recommended seed rate	181	90.5	1st
ii.	Recommended planting date	174	87.0	2nd
iii.	Recommended weeding time	169	84.5	3rd
iv.	Recommended rate for the application of pesticide	158	79.0	4th
v.	Recommended plant spacing	143	71.5	5th
vi.	Recommended harvesting time	142	71.0	6th
vii.	Recommended storage	121	59.5	7th
viii.	Recommended spacing depth	119	59.5	8th
ix.	Recommended stored pesticides	112	56.0	9th
x.	Use of improved cowpea variety	107	53.5	10th
xi.	Recommended practice for disease control	103	51.5	11th
xii.	Recommended herbicide for weed control	88	44.0	12th
xiii.	Recommended seed treatment before planting	85	42.5	13th
xiv.	Recommended rate of fertilizer application	21	10.5	14th

Source: Field Survey, 2021

Cowpea farmers in the study area highly adopted the recommended seed rate (90.5 %), recommended planting date (87 %), and recommended weeding time (84.5%). Cowpea farmers were familiar with the planting of 2 or 3 cowpea seeds per hole with two major planting periods (onset of early rain and late September). Two weeding regimes were also commonly practised by the respondents using hoes; the first weeding using hand hoes is carried out two weeks after planting followed by a second weeding in six weeks. During the field survey, it was observed that cowpea farmers who adopted the use of herbicide for weed control majorly applied glyphosate and paraquat. This finding agrees with Agwu (2006) who carried out a similar study in Abia State, Nigeria.

The result further indicated that the use of recommended stored pesticides (56 %) was fairly adopted by the respondents. A possible explanation for the adoption of this recommended practice could be farmers' knowledge of such practice. The associated cost of purchasing pesticides and their availability could also form part of the reasons for the fair or moderate adoption of recommended cowpea-stored pesticides. Stored pesticides are chemicals used to control the pests of cowpeas during storage. The recommended pesticides for storage of cowpea include Actelic 25 E.C, Actelic 2% dust, and Phostoxin tablet. It was however observed during the field survey that, cowpea farmers in the study area used recommended cowpea storage structures such as steel drums/tins, polythene bags, and local silos. This finding agrees with Sabo et al. (2014) who reported low adoption of cowpea storage management practices among farmers in Mubi, Nigeria.

The low adoption of recommended herbicide application (44 %), seed treatment (42.5%), and recommended fertilization rate (10.5%) will have implications on output. Herbicides are chemical substances for the control of unwanted plants. Herbicides applied immediately after planting are pre-emergence herbicides; while herbicides applied after weed emergence are post-emergence herbicides. This finding disagrees with Ajanya et al. (2014) in analyzing the adoption of glyphosate herbicide for the control of spear grass in Kogi state. The authors reported that 84.7% of yam farmers adopted the technology. The deviance in this finding and that of Ajanya et al. (2014) could be associated with the focus crop and farmers' economic situation. The result on herbicide however agrees with Okwoche et al. (2011) who reported that 47.72% of rural farmers in Kogi State, Nigeria adopted roundup (glyphosate) generally and with a preference level of 40.57% from among many other types of herbicides. The finding of this study is also in tandem with Imoloame (2013) who reported that 45.3% of crop farmers in Kwara State used more post-emergence herbicides due to the high level of root and tuber crop production in the area.

From *Table 2*, cowpea farmers' adoption score and adoption index were calculated as shown in *Table 3*. The adoption index is the ratio between the number of recommended cowpea production practices adopted by an individual farmer, and the total number of recommended cowpea production practices under study (in this case, 14 recommended cowpea production practices). *Table 3* shows that most (20.5 %) of the respondents had an adoption score and index of 8 and 0.57 respectively; while 1.5 % of the cowpea farmers recorded an adoption score and adoption index of 1 and 0.1, respectively. The adoption score and adoption index recorded in this study are similar to what was reported by Olumba and Rahji (2014) among plantain farmers in Anambra State, Nigeria.

Table 3: Adoption score and adoption index of cowpea farmers

Adoption Score	Adoption Index	Frequency	Percentage
1	0.1	10	5.0
2	0.14	25	12.5
3	0.21	20	10.0
4	0.29	33	16.5
5	0.36	17	8.5
6	0.43	21	10.5
7	0.50	19	9.5
8	0.57	41	20.5
9	0.64	11	5.5
10	0.71	3	1.5
Total		**200**	**100**

Source: Field Survey, 2021

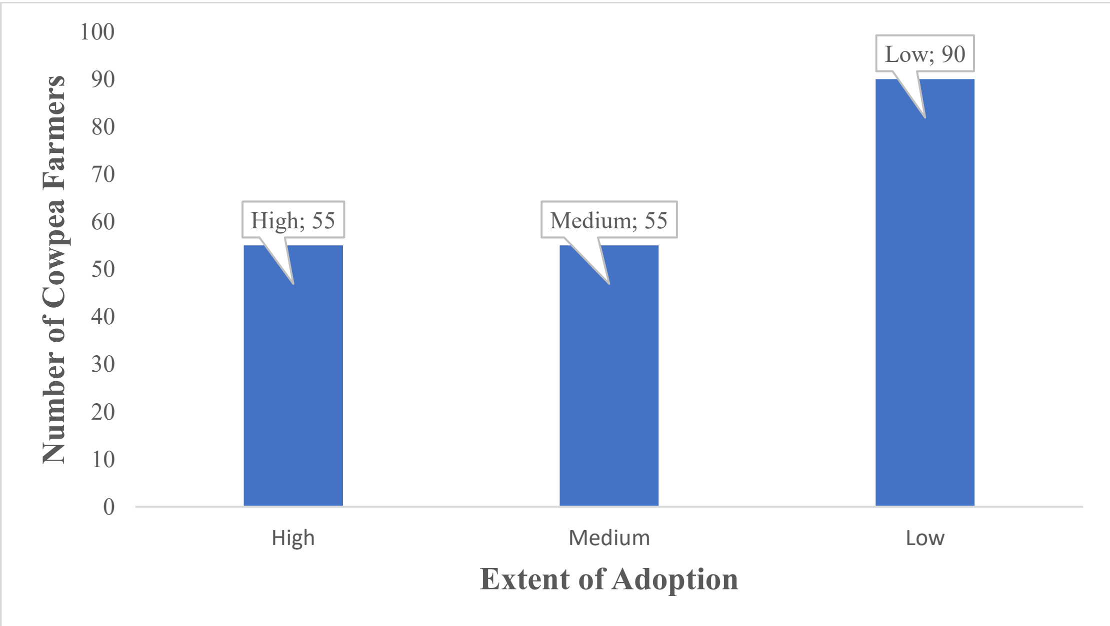

Figure 1: Extent of adoption of recommended cowpea production practices

Figure 1 shows the extent of adoption of recommended cowpea production practices. The categorization was done using the adoption score as presented in Table 2. From the result (*Figure 1*), 45 % of the cowpea farmers were in the low adoption category, while 27.5 % of each of the respondents were in the medium and high adoption category.

3.2. Effects of extension teaching methods on the extent of adoption

The output of the ordered probit regression model on the effect of extension teaching methods on the extent of adoption of recommended cowpea production practices among the respondents is presented in *Table 4*. The Log Likelihood Ratio (LR) Chi-square statistics of 78.21 was statistically significant ($p< 0.01$) at a 1 % level of measurement (99 % confidence). This implies that extension teaching methods and other included variables of cowpea farmers influenced their extent of adoption of recommended cowpea production practices. The ordered levels of adoption of recommended production practices by the respondents are reflected in the marginal effects' values. Adoption levels were ordered as low, medium, and high. The adoption score for individual cowpea farmers aided the categorization or grouping of cowpea farmers into these three groups. Estimates of the marginal effects were used because its coefficients have direct interpretation and hence aided discussion of the results. The result in Table 4 shows that the individual, group, and combination of individual, group and mass extension teaching methods generally have a positive influence on the likelihood of the extent of adoption, while the mass extension teaching method was inversely related to the extent of adoption. Five (5) of the included explanatory variables significantly influenced the extent of adoption at various levels. The probability level was at 5 % ($p<0.05$); that is, 95 % confidence level. These significant variables include individual extension teaching method, mass extension teaching method, a combination of individual, group and mass extension teaching methods, gender, farming experience, and income from cowpea production.

The coefficient of the individual extension teaching method was positively signed and significant at a 1 % level of significance. This means that the individual extension teaching method increases the likelihood of cowpea farmers' adoption of recommended production practices. The marginal estimates show that the use of individual extension teaching methods will decrease the likelihood of farmers being found in the; low adoption category by 36.8 % and increase the probability of being found in the medium and high adoption categories by 7.2 % and 29.7 %, respectively. This result further confirms the respondents' position on their preference for the individual extension teaching method method in comparison to the other teaching methods. This finding agrees with Nwalieji and Nnabueze, (2018) and Ebenehi and Ahmed (2019) when they reported that the individual extension teaching method is effective in delivering extension messages among farmers in Anambra and Kogi States, respectively.

Table 4 shows that the coefficient of the mass media extension teaching method is negative and significant at a 5 % level. By implication, the likelihood of adoption of recommended cowpea production practices reduces with the use of mass media in delivering extension messages. This finding could be associated with the respondents' low-level preference for mass media extension teaching methods as compared with other extension teaching methods. The marginal effect analysis indicates that the use of the mass media extension teaching method increases the probability of farmers being found in the low adoption category by 5.9 %; and decreases farmers' likelihood of being found in the medium and high adoption category by 1.1 % and 4.7 %, respectively.

The combined effect of individual, group and mass media extension teaching methods was positively signed and significant at 1 %. By implication, the likelihood of farmers' adoption of cowpea-recommended production practices increases with the combined use of these three extension teaching methods in delivering extension messages. Cowpea farmers in the study area would be quick to adopt recommended production practices when they have access to both individual, group and mass media teaching methods. The outcome of the marginal effect analysis reveals that the likelihood of cowpea farmers being found in the low adoption category decreases with the combined use of these three methods by 1.3 %. Further, the combined use of these three extension teaching methods favours the likelihood of cowpea farmers to be found in the medium and high adoption category by 0.3 % and 1.1 %, respectively.

The coefficient of years spent in cowpea farming as shown *in Table 4* was negative and significant at a 5 % level of significance. By implication, an increase in the number of years spent farming will decrease the likelihood of cowpea farmers adopting recommended cowpea production practices in the study area. Further analysis of the marginal effect shows that an increase in years spent farming will increase the chances of cowpea farmers being found in the low adoption category by 0.6 %. However, an additional year spent in farming cowpea will decrease the probability of cowpea farmers being found in the medium and high adoption category by 0.1 % and 0.5 %, respectively.

The coefficient of income from cowpea production was negative and significant at a 5 % level of significance. By implication, the naira increase in farm income from cowpea production will decrease the likelihood of cowpea farmers adopting recommended cowpea production practices. Further, the probability of cowpea farmers being found in the low and medium adoption categories increases by 0.000085 % and 0.000017 %, respectively, with a naira increase in farmers' income, while the likelihood of cowpea farmers being found in the high adoption category decreases by 0.000069 % with an increase in income from cowpea production.

Table 4: Output of the Ordered Probit Analysis on the Effect of Extension Teaching Method on Farmers' Extent of Adoption

Variables	Ordered Probit Estimate		Low Extent of Adoption		Medium Extent of Adoption		High Extent of Adoption	
	Coeff.	**Prob.**	**dydx**	**Prob.**	**dydx**	**Prob.**	**dydx**	**Prob.**
Individual method	1.192 (0.267)	0.000***	-0.368 (0.072)	0.000***	0.072 (0.021)	0.000***	0.297 (0.064)	0.000***
Group method	0.111 (0.267)	0.678NS	-0.034 (0.082)	0.677NS	0.007 (0.016)	0.679NS	0.028 (0.066)	0.677NS
Mass method	-0.189 (0.085)	0.026**	0.059 (0.026)	0.022**	-0.011 (0.006)	0.039**	-0.047 (0.021)	0.025**
Indiv+group+mass	0.044 (0.008)	0.000***	-0.013 (0.002)	0.000***	0.003 (0.001)	0.005***	0.011 (0.002)	0.000***
Gender	-0.124 (0.073)	0.090NS	0.038 (0.022)	0.083NS	-0.007 (0.005)	0.098NS	-0.031 (0.018)	0.089NS
Education	1.157 (0.783)	0.140NS	-0.358 (0.239)	0.134NS	0.069 (0.048)	0.151NS	0.288 (0.194)	0.138NS
Land ownership	0.055 (0.080)	0.496NS	-0.017 (0.025)	0.494NS	0.003 (0.005)	0.496NS	0.014 (0.020)	0.496NS
Trust	0.044 (0.178)	0.805NS	-0.014 (0.055)	0.805NS	0.003 (0.011)	0.806NS	0.011 (0.044)	0.805NS
Age	0.018 (0.376)	0.962NS	-0.005 (0.116)	0.962NS	0.001 (0.023)	0.962NS	0.004 (0.094)	0.962NS
Membership	0.005 (0.009)	0.606NS	-0.002 (0.004)	0.606NS	0.003 (0.001)	0.612NS	0.001 (0.002)	0.606NS
Farming experience	-0.019 (0.008)	0.021**	0.006 (0.003)	0.018**	-0.001 (0.001)	0.039**	-0.005 (0.002)	0.020**
Household size	-0.581 (0.359)	0.106NS	0.179 (0.109)	0.101NS	-0.035 (0.023)	0.132NS	-0.145 (0.089)	0.103NS
Cowpea farm income	-2.76e-6 (1.28e-6)	0.031**	8.54e-7 (3.84e-7)	0.026**	1.7e-7(8.2e-8)	0.043**	-6.9e-7 (3.2e-7)	0.030**
Extension visits	0.057 (0.052)	0.268NS	-0.018 (0.016)	0.265NS	0.004 (0.003)	0.283NS	0.014 (0.013)	0.266NS
LR Chi^2	78.21	0.000						
Log likelihood	-174.770							
Pseudo R^2	0.183							

Source: Authors' computation from field survey, 2021. Figures in parentheses are standard errors. *** and ** = significant @ 1% and 5% level, respectively. NS = Sot Significant.

4. Conclusions

The adoption of recommended cowpea production practices was relatively high for the recommended seed rate, recommended planting date, and recommended weeding time. The adoption of improved cowpea seed variety was moderate while recommended herbicide application recorded low adoption. The adoption of improved cowpea seed variety is significantly influenced by individual extension teaching method, mass extension teaching method, a combination of individual, group and mass extension teaching methods, farming experience, and income from cowpea production.

Based on findings, discussions and conclusions drawn from this study, the following policy recommendations are made.

1. For cowpea farmers to be found in the high adoption category, extension agents should consider focusing more on the individual extension teaching method in disseminating information on recommended cowpea production practices.

2. Extension agents should enlighten cowpea farmers on the need to adopt the following recommended cowpea production practices; use of improved cowpea seed variety, practice for disease control, herbicide for weed control, seed treatment before planting, and recommended rate of fertilizer application.

3. Since the individual and mass extension teaching methods significantly influenced the adoption of improved cowpea seed variety, it is advisable that extension agents should focus on these methods to enhance adoption rates.

Ethical Statement

There is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

We declare that there is no conflict of interest between us as the article authors.

Authorship Contribution Statement

Patrick and Damilola contributed to the project idea, design, and execution of the study. Damilola completed the survey. Ufedo and Damilola designed the instrument, analyzed the data and provided results interpretation. All authors wrote and approved the manuscript.

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