

Accessibility and Determinants of Public Agricultural Extension Services Among Farmers in Kaduna State, Nigeria

A.B. Aminu, M.O. Akinola, N.M. Saddiq & A. Gomina

Department of Agricultural and Rural Development,
Faculty of Agriculture.

Ahmadu Bello University, Zaria

****Correspondence Author: abdoulb213@gmail.com|08065571257****

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Abstract

This study examined the accessibility and determinants of public agricultural extension services among farmers in Kaduna State, Nigeria. A multistage sampling technique was used to select 625 farmers from a population of 682,869, comprising 281 beneficiaries (45%) and 344 non-beneficiaries (55%). Primary data were collected using structured questionnaires and analyzed using descriptive statistics, Likert scale, and binary logistic regression. The results showed notable socio-economic differences between beneficiaries and non-beneficiaries. Male farmers were more represented among beneficiaries (47.24%), while females dominated among non-beneficiaries (59.03%), indicating gender disparity in access. Beneficiaries also had higher farm income (₦283,797) compared to non-beneficiaries (₦73,822), and were more likely to belong to cooperatives (48.41%). However, age, household size, and years of schooling showed minimal variation between the groups. The level of access to public agricultural extension services was moderate (grand mean = 3.48), with strong access to advisory services such as crop management (3.63), soil fertility (3.57), and agronomic practices (3.61), but weak access to training, demonstrations, ICT-based services (3.25), and inclusive services for women (3.19) and youth (3.12). The logistic regression results revealed that gender ($\beta = 0.391$), education ($\beta = 0.076$), farm income ($\beta = 0.00005$), farming experience ($\beta = 0.019$), farm size ($\beta = 0.167$), and cooperative membership ($\beta = 0.058$) significantly influenced access to extension services. The model was statistically significant ($LR \chi^2 = 41.83$, $p < 0.001$) with a pseudo R^2 of 0.19. The study concludes that access to public agricultural extension services in Kaduna State is moderate but uneven, with disparities driven by socio-economic and institutional factors. Based on these findings, it recommends that government and extension agencies promote gender- and youth-inclusive programs, strengthen farmer education and training, and support cooperative development to enhance equitable access and improve extension service effectiveness.

Keywords: Agriculture; Extension; Accessibility; Farmers; Determinants; Kaduna; Nigeria

Introduction

Agricultural extension services are central to improving farm productivity, facilitating technology adoption, and enhancing rural livelihoods in developing countries (Anderson & Feder, 2007; Ragasa *et al.*, 2019). In Nigeria, where agriculture remains a major source of employment and food security (FAO, 2022), public extension systems serve as a key channel for disseminating

innovations and advisory services to smallholder farmers (Agbamu, 2016). Evidence shows that access to extension services significantly improves farmers' productivity and adoption of improved practices (Abdulwahab *et al.*, 2023; Adebayo *et al.*, 2017). Despite their importance, access to public agricultural extension services remains uneven, particularly among smallholder farmers. Accessibility is influenced by a range of socio-economic and institutional factors, including education, farm size, income, gender, and membership in farmer organizations (Akinwale *et al.*, 2021; Adewuyi *et al.*, 2023; Okeke *et al.*, 2022). Studies have also highlighted persistent structural challenges such as inadequate extension personnel, weak research-extension linkages, and poor infrastructure, which limit effective service delivery (Swanson & Rajalahti, 2010; Chekene & Shehu, 2025). In Kaduna State, agriculture is a dominant livelihood activity supported by diverse agro-ecological conditions and a large farming population (Kaduna State Government, 2023; Aminu, 2021). However, farmers in the state face significant constraints in accessing extension services, including institutional inefficiencies and limited outreach (Adebayo & Oladimeji, 2022; Lai-Solarin *et al.*, 2024). Variations in farmers' socio-economic characteristics further create disparities in access, with implications for equity and agricultural development (Doss *et al.*, 2011; Atsbeha & Gebre, 2021). While previous studies have examined extension access and its outcomes in Nigeria, there is still a need for context-specific evidence that jointly considers farmers' characteristics, their level of access, and the determinants of such access within Kaduna State. Addressing this gap is important for improving the effectiveness and inclusiveness of extension service delivery. Therefore, this study describes the socio-economic and institutional characteristics of farmers, examines their level of accessibility to public agricultural extension services, and identifies the factors influencing such access in Kaduna State, Nigeria. The findings will provide useful insights for policymakers and stakeholders seeking to strengthen extension systems and improve service delivery among smallholder farmers.

Methodology

The study area

The study was conducted in Kaduna State, located in the North-West geopolitical zone of Nigeria, between latitudes 9°02'–11°32' N and longitudes 6°15'–8°50' E. The state shares boundaries with Katsina, Kano, Bauchi, Plateau, Nasarawa, Niger, and Zamfara States (Kaduna State Government, 2023). Kaduna State has a projected population of about 10 million people in 2025, based on the 2006 census figure of 6.1 million and an annual growth rate of approximately 3% (National Population Commission, 2006). Agriculture is the dominant livelihood, with most farmers engaged in smallholder crop and livestock production, supported by favorable agro-ecological conditions (Aminu, 2021; Addah, 2023). The state operates an established Agricultural Development Programme (ADP) system, providing a suitable context for analyzing farmers' access to public extension services. However, challenges such as limited extension coverage and infrastructural constraints persist (Adebayo & Oladimeji, 2022; Daikwo *et al.*, 2024).

Sampling procedure and sample size

A multistage sampling technique was employed. First, four Agricultural Development Programme (ADP) zones (Birnin-Gwari, Maigana, Lere, and Samaru-Kataf) were purposively selected based on agricultural intensity and extension presence. Second, two LGAs were randomly selected from each zone, giving eight LGAs. Third, 40 farming communities were selected, and finally, farmers were randomly drawn from sampling frames obtained in each community.

The sample size was determined using Yamane's (1967) formula:

$$n = \frac{N}{1 + N(e)^2} \dots \dots \dots (1)$$

Where: n = required sample size; N = total population of registered farmers = 682,869; e = level of precision (sampling error) = 0.04 (4%)

$$n = \frac{682,869}{1 + 682,869(0.04)^2} = \frac{682,869}{1,094} \approx 625$$

Thus, a total of 625 farmers was selected for the study. Out of this, 281 (45%) were beneficiaries of public agricultural extension services (PAES), while 344 (55%) were non-beneficiaries, ensuring adequate representation for comparative analysis.

Table 1: Population and sample size distribution of crop farmers in the study area

Zone	LGA	Communities	Sample Frame	Farmers (Sampled)	PAES (45%)	Beneficiaries PAES (55%)	Non-Beneficiaries
Birnin-Gwari	Birnin	8	92,000	85	38	47	
	Giwa	8	88,000	85	38	47	
Maigana	Soba	6	84,000	80	36	44	
	Kubau	4	78,000	75	34	41	
Lere	Lere	7	72,000	70	32	38	
	Kudan	5	77,000	75	34	41	
Samaru-Kataf	Kachia	4	78,500	80	36	44	
	Jama'a	4	76,369	75	33	42	
Total	8	40	682,869	625	281	344	

Field survey, 2025

Method of data collection

Primary data for the study were collected through the use of a structured questionnaire administered to farmers in the study area. The questionnaire was designed to capture information on farmers' socio-economic and institutional characteristics, their level of access to public agricultural extension services, and factors influencing such access. Data collection was carried out with the assistance of trained enumerators to ensure accuracy and clarity of responses. In addition, key informant interviews were conducted with selected extension agents to complement the survey data and provide insights into the functioning of the public extension system. The use of structured instruments and trained personnel is consistent with established practices in agricultural extension research (Adebayo *et al.*, 2017; Ragasa *et al.*, 2019).

Analytical techniques

Descriptive Statistics

Descriptive statistics were used to describe the socio-economic and institutional characteristics of crop farmers in the study area. Tools such as frequency distribution, percentages, means, and standard deviations were employed to summarize variables including age, education, household size, farm size, and membership in farmer-based organizations. This approach is widely used in agricultural and extension studies to provide a clear understanding of respondents' characteristics and data distribution (Adegeye & Dittoh, 2006; Ehiwario *et al.*, 2024).

Likert Scale Technique

A Likert scale technique was employed to examine the level of farmers' accessibility to public agricultural extension services. Farmers rated their level of access using a 5-point scale: Very High Access (5), High Access (4), Moderate Access (3), Low Access (2), and Very Low Access (1). Mean scores for each item were computed using the standard Likert formula:

$$X^- = \frac{\sum(F.X)}{N} \dots \dots \dots (2)$$

where: X^- = mean score, F = frequency of responses, X = assigned Likert value, and N = total number of respondents. A cut-off mean of 3.0 was used for decision-making; mean values ≥ 3.0 indicate high access, while values < 3.0 indicate low access. This method is commonly applied in extension studies to quantify access and perceptions (Chianu *et al.*, 2012; Adebayo *et al.*, 2017).

Logistic regression

To examine the factors influencing farmers' access to public agricultural extension services in Kaduna State, a binary logistic regression model was employed. Logistic regression is appropriate when the dependent variable is dichotomous in this case, whether a farmer has access to Public Agricultural Extension Services (PAES) or not. The model estimates the probability of access as a function of socio-economic and institutional characteristics of farmers. The general form of the logistic regression model is expressed as:

$$P(Y_i = 1) = \frac{e^{\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_{11} X_{11i}}}{1 + e^{\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_{11} X_{11i}}} \dots \dots \dots (3)$$

or equivalently in logit form:

$$\text{logit}(P_i) = \ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \sum_{j=1}^k \beta_j X_{ji} + \epsilon_i \dots \dots \dots (4)$$

Where: P_i = probability that the i^{th} farmer has access to PAES (1 = access, 0 = no access), β_0 = intercept term, β_j = coefficients of the explanatory variables, X_{ji} = independent variables representing socio-economic and institutional characteristics of farmers, ϵ_i = error term, X_1 = Sex (male=1, female=0), X_2 = Age (years), X_3 = Educational level (years of schooling), X_4 Household Size, X_5 Years of Farming Experience, X_6 Annual Income (in naira), X_7 Farm size (ha), X_8 Access to credit (Yes=1, No=0), X_9 = Extension Services (1 if yes, 0 if no), X_{10} = Membership of cooperative (1 = member, 0 = non-member), X_{11} = Distance to nearest extension office (km)

Results and discussion

Socio-economic and institutional characteristics of farmers in the study area

Table 2 presents the socio-economic and institutional characteristics of farmers in the study area, disaggregated by access to Public Agricultural Extension Services (PAES). The results reveal notable differences between beneficiaries and non-beneficiaries of PAES across key characteristics. Male farmers constituted a higher proportion of beneficiaries (47.24%) compared to females (40.97%), while females dominated among non-beneficiaries (59.03%), indicating gender disparity in access, consistent with Doss *et al.* (2011) and Atsbeha & Gebre, (2021) who found that women face socio-cultural constraints limiting extension access. The mean age of beneficiaries (44.5 years) and non-beneficiaries (43.7 years) shows minimal variation, suggesting age is not a major determinant, aligning with Adewuyi *et al.* (2023) who reported that age mainly reflects active farming participation. Education levels show slight differences, with beneficiaries more represented at primary level (48.82%) and similar mean years of schooling (8 years), supporting Adebayo *et al.* (2017) that education enhances understanding and adoption of innovations. Household size averaged 7 persons for both groups, though larger households were more common among non-beneficiaries (58.54%), confirming Adegeye & Dittoh (2006) that household size does not guarantee institutional access. Beneficiaries had slightly higher farming experience (23 vs. 22 years) and farm size (5.2 ha vs. 5.0 ha), supporting Akinwale *et al.* (2021) and Kassie *et al.* (2020) that experience and scale improve engagement. A major difference exists in farm income, with beneficiaries earning ₦283,797 compared to ₦73,822 for non-beneficiaries, reinforcing Ragasa *et al.* (2019) that extension improves productivity and income. Cooperative membership was higher among beneficiaries (48.41% vs. 39.68%) and credit access slightly higher (45.74% vs. 44.62%), aligning with Chianu *et al.* (2012) and Banful *et al.* (2010) that social and financial capital enhance access.

Table 2: Socio-economic and institutional characteristics of farmers by access to public agricultural extension services (PAES)

Variable	Beneficiaries			Non-Beneficiaries			Mean SD	±
	Freq.	%	Mean ± SD	Freq.	%			
Gender								
Male	188	47.24		210	52.76			
Female	93	40.97		134	59.03			
Age (years)			44.5 ± 14.4				43.7	±
20–29	55	42.31		75	57.69		14.4	
30–39	58	47.15		65	52.85			

40–49	56	44.09	71	55.91	
50–59	57	42.86	76	57.14	
60–69	55	49.11	57	50.89	
Education (years of schooling)					
			8 ± 4.7		8 ± 4.8
No formal education	15	39.47	23	60.53	
Primary (1–6)	103	48.82	108	51.18	
Secondary (7–12)	107	43.85	137	56.15	
Tertiary (13–16)	56	42.42	76	57.58	
Household size			7 ± 2.7		7 ± 2.5
Small (1–4)	70	49.65	71	50.35	
Medium (5–8)	126	45.16	153	54.84	
Large (9–11)	85	41.46	120	58.54	
Farming experience (years)					
			23 ± 12.3		22 ± 12.5
1–10	58	42.34	79	57.66	
11–20	65	41.67	91	58.33	
21–30	72	51.8	67	48.2	
31–40	86	44.56	107	55.44	
Farm size (ha)			5.2 ± 2.7		5 ± 2.7
Very small (<1)	14	38.89	22	61.11	
Small (1–2.99)	60	43.48	78	56.52	
Medium (3–4.99)	60	44.44	75	55.56	
Large (≥ 5)	147	46.52	169	53.48	
Marital Status					
Single	48	40.34	71	59.66	
Married	209	46.14	244	53.86	
Divorced	12	50	12	50	
Widowed	12	41.38	17	58.62	
Farm Income (₦)			$283797 \pm 82,191$		$73822 \pm 134,809$
Low (50,000–100,000)	2	4.88	39	95.12	
Medium (100,000–300,000)	159	35.41	290	64.59	
High (300,000–500,000)	120	88.89	15	11.11	
Cooperative Membership					
Non-member	98	39.68	149	60.32	
Member	183	48.41	195	51.59	
Credit Access (₦)					
No credit	195	44.62	242	55.38	
Accessed credit	86	45.74	102	54.26	

Source: Field survey, 2025

Level of farmers' accessibility to public agricultural extension services

Table 3 presents farmers' perceptions of their level of accessibility to Public Agricultural Extension Services (PAES) in Kaduna State. The grand mean of 3.48 indicates moderate accessibility to PAES. Farmers reported strong access to advisory services such as crop

management (3.63), soil fertility (3.57), pest control (3.54), and agronomic practices (3.61), as well as input guidance (3.50) and timely information (3.55). However, they were uncertain about access to demonstrations (3.49), training programs (3.48), follow-up (3.45), credit linkage (3.39), and group activities (3.42). ICT-based access (3.25) and inclusiveness, gender (3.19) and youth (3.12) were also weak. These findings support Miine *et al.* (2023) that advisory services enhance productivity, while Ojo *et al.* (2025) found that lack of complementary services reduces effectiveness. The inclusiveness gap aligns with Phiri *et al.* (2022), who reported persistent gender and youth barriers.

Table 3: Farmers' Perception of level of accessibility to Public Agricultural Extension Services (PAES)

Aspect of PAES delivery	SD	D	UD	A	SA	WM	WMS	Remark
Support on crop management	15	28	49	112	77	1021	3.63***	Agree
Support on soil fertility management	18	32	52	108	71	1008	3.57***	Agree
Support on pest and disease control	16	34	56	107	68	996	3.54***	Agree
Support on agronomic practices	17	30	50	110	74	1012	3.61***	Agree
On-farm demonstrations	20	36	55	102	68	982	3.49**	Undecided
Guidance on input use (seeds, fertilizers, agrochemicals)	19	35	57	101	69	988	3.50***	Agree
Training programs (workshops, field days, Farmer Field Schools)	22	34	53	102	70	980	3.48**	Undecided
Trainings and demonstrations relevant to my farming activities	18	31	50	109	73	1005	3.57***	Agree
Easy access to extension agents when needed	21	33	52	105	70	992	3.51***	Agree
Extension agents follow up on previous advice and training	23	35	54	97	72	978	3.45**	Undecided
Extension agents link to input suppliers	19	30	51	108	73	1007	3.57***	Agree
Extension agents link to credit or financial support services	25	38	52	95	71	960	3.39**	Undecided
Extension agents provide timely information on seasonal activities	18	32	50	110	71	1002	3.55***	Agree
Extension agents respect farmers' views and concerns	17	29	48	112	75	1015	3.63***	Agree
Group extension activities such as cooperative meetings	22	36	55	97	71	974	3.42**	Undecided
Information through community radio or SMS messages	28	47	56	91	59	914	3.25**	Undecided
Gender-sensitive extension support	30	52	58	78	63	890	3.19**	Undecided
Women and youth have equal access to extension services	32	55	60	73	61	870	3.12**	Undecided
Extension agents encourage innovation and adoption of new technologies	21	33	49	108	70	994	3.52***	Agree
Grand mean						WM	WMS	

Note: * Disagree (WMS of less than 2.50), ** Undecided (WMS between 2.5 to 3.49) and *** Agree (WMS of 3.50 and above) WS = weighted score, WMS= weighted mean score, SDA=strongly disagree, DA=disagree, UD=Undecided, A=Agree, SA=strongly agree

Factors that influence farmers' access to public agricultural extension services

Table 4 presents the logistic regression estimates of socio-economic and institutional factors influencing farmers' access to Public Agricultural Extension Services (PAES) in Kaduna State. The results reveal which characteristics significantly affect the likelihood of farmers benefiting from extension services, based on coefficients, odds ratios, and significance levels. The model is statistically significant (LR $\chi^2 = 41.83$, $p < 0.001$) and explains about 19% of the variation in access (Pseudo $R^2 = 0.19$), suggesting that these factors meaningfully contribute to understanding access patterns. The results show that several variables significantly influence access to PAES. Gender ($\beta = 0.391$, OR = 1.48, $p < 0.10$) indicates males are more likely to access services, consistent with Atsbeha & Gebre (2021). Education ($\beta = 0.076$, OR = 1.08, $p < 0.01$) and farm income ($\beta = 0.00005$, $p < 0.01$) positively influence access, supporting Adebayo *et al.* (2017) and Abdulwahab *et al.* (2023). Farming experience ($\beta = 0.019$, OR = 1.02, $p < 0.10$) and farm size ($\beta = 0.167$, OR = 1.18, $p < 0.10$) are also significant, aligning with Akinwale *et al.* (2021). Cooperative membership ($\beta = 0.058$, OR = 1.06, $p < 0.05$) further enhances access, confirming Chianu *et al.* (2012). These results lead to rejection of the null hypothesis.

Table 4: Logistic Regression Estimates of Factors Influencing Farmers' Access to Public Agricultural Extension Services (PAES)

Variable	Coefficient	Std. Error	z-value	Odds Ratio
Age	-0.011	0.01	-1.10	0.99
Gender	0.391	0.218	1.79*	1.48
Marital status	0.184	0.197	0.93	1.20
Years of schooling	0.076	0.028	2.71***	1.08
Household size	0.029	0.033	0.88	1.03
Farm income (₦)	0.00005	0.000015	3.33***	1.00
Farming experience (years)	0.019	0.011	1.73*	1.02
Farm size (ha)	0.167	0.089	1.88*	1.18
Years of cooperative membership	0.058	0.023	2.52**	1.06
Amount of credit received	0.000003	0.000002	1.50	1.00
Constant	-2.314	0.769	-3.01	
Log likelihood	-424.72			
LR $\chi^2(9)$	41.83			
Prob > χ^2	0.0001			
Pseudo R ²	0.19			

Note: *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.

Conclusion and recommendations

The study concludes that farmers in Kaduna State have moderate access to public agricultural extension services, with stronger access to advisory services but weak access to training, demonstrations, ICT-based services, and inclusive support. Access is significantly influenced by education, income, gender, farm size, farming experience, and cooperative membership, indicating that both socio-economic and institutional factors shape extension reach. The observed disparities, particularly along gender and resource lines, suggest that extension delivery remains uneven and not fully inclusive. Based on the findings, the following recommendations were made to government, extension agencies, and development stakeholders:

- Given the finding that male farmers are more likely to access extension services than females,

extension agencies should implement gender- and youth-sensitive programs, including targeted outreach and recruitment of female extension agents to improve inclusiveness.

- ii. Since education significantly enhances access to extension services, Agricultural Development Programmes (ADPs) and relevant institutions should intensify farmer training, extension education, and capacity-building initiatives to improve farmers' ability to access and utilize information.
- iii. As cooperative membership positively influences access, government and NGOs should promote and strengthen farmer-based organizations and cooperatives to facilitate better access to extension services, information sharing, and institutional support.

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