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Effect of Agricultural Extension Services on Livelihood Diversification Outcomes of Smallholder Farmers in Southern Taraba, Nigeria

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Abstract

This study examined the effect of agricultural extension services on livelihood diversification outcomes of smallholder farmers in southern taraba, nigeria. Multistage and proportionate sampling techniques were used to select 243 respondents from Wukari, Donga, and Takum Local Government Areas. Data were collected using structured questionnaires and analyzed using descriptive statistics and multiple regression analysis. The findings revealed that 69.1% of the respondents were male, 66.2% were aged 31–50 years, 77.8% were married, 62.1% had at least primary or secondary education, 88.5% cultivated less than 5 hectares of land, and 58.4% belonged to cooperative societies. The results further showed that respondents practiced diverse livelihood strategies, with crop farming (81.5%), small-scale trading (77.8%), livestock production (72.4%), wage labour (71.2%), petty trading in agricultural inputs (67.9%), poultry production (65.0%), agro-processing (63.4%), food vending (60.5%), and cooperative savings schemes (58.4%) being the most dominant activities, while beekeeping (25.5%) and land leasing (30.5%) were the least practiced. The exponential regression model provided the best fit ($R^2 = 0.71$; Adjusted $R^2 = 0.69$; $F = 26.45$, $p < 0.01$), indicating that extension services had a positive and significant effect on livelihood diversification. Peer-to-peer knowledge exchange ($\beta = 0.289$), farm visits ($\beta = 0.301$), market information sharing ($\beta = 0.260$), and farmers' group meetings ($\beta = 0.240$) were the strongest determinants. The study concludes that extension services are effective strategies for improving livelihood diversification among smallholder farmers. It recommends strengthening extension services, improving farmers' access to credit and production inputs, promoting stronger farmer cooperatives, and integrating formal extension services with ICT-based communication platforms to enhance rural livelihoods

Keywords: Extension services, Livelihood diversification, Smallholder Farmers, Southern Taraba

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INTRODUCTION

Agriculture remains a vital sector in the Nigerian economy and continues to serve as the primary source of livelihood for the majority of rural households, the sector contributes significantly to food production, employment generation, poverty reduction, and rural development according to the (Food and Agriculture Organization 2022). Smallholder farmers account for a substantial proportion of food production in developing countries, particularly in Sub-Saharan Africa (FAO, 2021). Agricultural extension services play a fundamental role in facilitating agricultural development by disseminating innovations, technologies, and advisory services to farmers. Extension services are expected to improve farmers' knowledge, skills, productivity, and overall livelihood outcomes through effective communication and capacity-building programmes. The limitations associated

with formal extension systems have increased the need for participatory and community-based extension approaches capable of complementing public extension services. One such approach is the extension service approach. Extension services refers to a participatory extension system in which trained or experienced farmers disseminate agricultural knowledge, innovations, and practical skills to fellow farmers through peer learning, demonstrations, mentoring, and social interactions. According to Sah et al. (2021), farmer-to-farmer extension enhances local participation and encourages experiential learning among rural farmers. The approach is increasingly recognized as a sustainable and cost-effective strategy for agricultural information dissemination, particularly in areas with inadequate extension personnel

Extension services have become increasingly important in agricultural development programmes because farmers often trust and easily adopt information obtained from fellow farmers who operate under similar socio-economic and environmental conditions. Rogers (2003), in the Diffusion of Innovation Theory, explained that interpersonal communication channels and social networks play important roles in influencing innovation adoption among rural communities. Similarly, Davis et al. (2012) reported that extension systems improve farmer participation, strengthen local knowledge sharing, and facilitate wider dissemination of agricultural innovations. Through farmer groups, lead farmers, demonstration farms, exchange visits, and farmer field schools, rural farmers can access agricultural information, production techniques, and livelihood opportunities that may otherwise be inaccessible through formal extension channels.

Statement of the Research Problem

Several studies have demonstrated the positive contribution of extension services to agricultural productivity, technology adoption, and rural development. For instance, Davis et al. (2012) reported that farmer field schools and peer learning approaches significantly improved agricultural productivity and knowledge dissemination among rural farmers in East Africa. Likewise, Simpson and Owens (2002) found that farmer-led extension systems strengthened farmer participation and enhanced local capacity building in agricultural development programmes. In Nigeria, studies by Adepoju and Obayelu (2013) revealed that access to agricultural information and social networks contributed positively to livelihood diversification and household welfare among rural farmers.

Despite the increasing adoption of extension services in many rural communities, livelihood challenges among smallholder farmers continue to persist. Rural households increasingly diversify their livelihoods into non-farm and off-farm activities such as livestock production, petty trading, agro-processing, fishing, and wage labour in response to poverty, food insecurity, climate change, and declining agricultural productivity.

In Southern Taraba, smallholder farmers continue to face numerous livelihood challenges arising from inadequate access to extension services, low productivity, poor infrastructure, market constraints, insecurity, and rising production costs. Although informal farmer-led extension systems are increasingly used within rural communities, there is limited empirical evidence on the extent to which these extension services influence livelihood diversification outcomes among smallholder farmers in the area. Most previous studies on agricultural extension in Nigeria have focused mainly on technology adoption, crop productivity, and yield improvement, with limited attention given to livelihood

diversification outcomes.

Objectives of the Study

The broad objective of this study is to examine the effect of extension services on livelihood diversification outcomes among respondents in Southern Taraba, Nigeria. However, the specific objectives are to:

1. describe the socioeconomic profiles of the respondents
2. identify the livelihood diversification strategies adopted by respondents in Southern Taraba;
3. assess the effect of extension services on livelihood diversification outcomes among respondents;

METHODOLOGY

Description of the Study Area

The study was conducted in Southern Taraba, Nigeria. Taraba is located in the North-Eastern geopolitical zone of Nigeria and was created on 27th August 1991 from the former Gongola State (Taraba Government, 2022). It derives its name from River Taraba, which traverses the southern part of the state and contributes to its agricultural viability and ecological diversity. Geographically, Taraba lies approximately between latitude 6°25'N and 9°30'N and longitude 9°30'E and 11°45'E of the Greenwich Meridian. The state covers a total landmass of about 54,473 square kilometres, making it one of the largest states in Nigeria in terms of land area (Taraba Agricultural Development Programme, 2021).

Taraba shares boundaries with Adamawa State to the east, Benue, Nasarawa and Plateau States to the west, Bauchi and Gombe States to the north, and the Republic of Cameroon to the south and south-east (Federal Ministry of Agriculture and Rural Development, 2020). The southern senatorial zone comprises Local Government Areas which are Wukari, Takum, Donga, Ibi, Ussa, and Kurmi, which are characterized by fertile soils and favourable climatic conditions for agriculture. The climate of Southern Taraba is tropical, with distinct wet and dry seasons. Annual rainfall ranges between 1,000 mm and 2,500 mm, while average temperatures range between 28°C and 35°C depending on the season (Nigerian Meteorological Agency, 2021). These conditions support both crop and livestock production systems. According to the National Population Commission (2010), Taraba had a population of approximately 2,300,736 people during the 2006 census, with recent projections estimating the population to be over 3.6 million. The population of Southern Taraba is over 996,794, largely rural and Agrarian in nature, with the majority peoples dependent on agriculture for their livelihood.

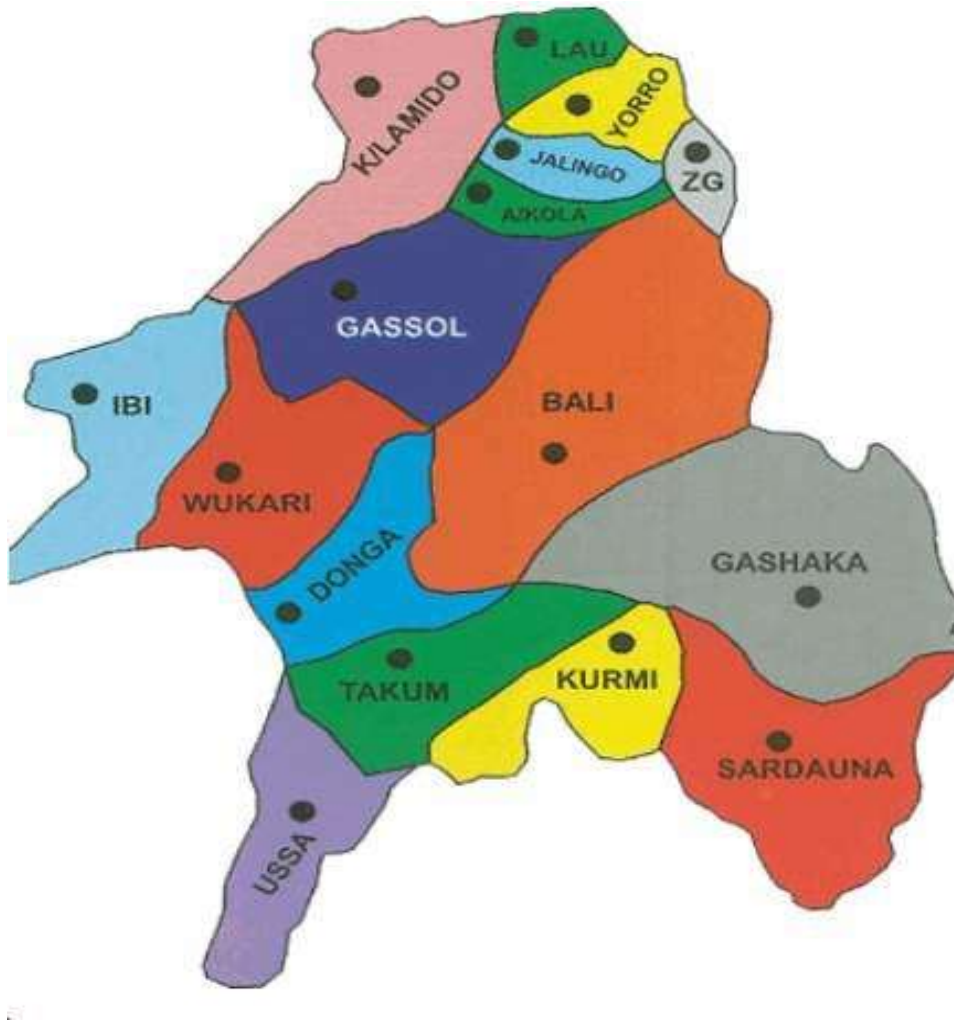


Figure 1: Map of Taraba showing the Study Area

METHODS OF DATA COLLECTION

Data were collected through the use of structured questionnaire designed in line with the study objectives.

3.3 Sampling Procedure and Sample Size

This study adopted a multistage sampling procedure to ensure the systematic and representative selection of smallholder farming households across the study area in Southern Taraba. In the first stage, Southern Taraba was purposively selected due to its high concentration of smallholder farmers and the widespread practice of extension activities. In the second stage, three Local Government Areas (LGAs) were randomly selected from Southern Taraba, namely Wukari, Donga, and Takum. In the third stage, a comprehensive list of farming

communities' wards within each was obtained from TADP Zone two Wukari. From this sampling frame, simple random sampling was used to select wards from each LGA. The selected wards were: Wukari LGA: *Avyi, Tsukundi, Kente, and Puje*, Donga LGA: *Mararaba, Akate, Nyita, and Suntai* and Takum LGA: *Manya, Chanchanji, Rogo, and Kashimbila*.

In the fourth stage, farming households were identified within each of the selected villages. In the final stage, the household heads within the selected households were interviewed as the respondent for the study. The sample was proportionately computed at 10% selected wards across three LGAs to ensure fair representation of each area.

Table 3.1: Distribution of Sample Size across Selected LGAs and Villages

Selected LGAs	Sampled Villages	Sample frame	10% Sample size
1. Donga	Akate	195	19
	Nyita	205	21
	Suntai	180	18
	Marraraba	210	21
2. Takum	Manya	215	22
	Chanchanji	198	20
	Rogo	192	19
	Kashimbila	175	17
3. Wukari	Ayyi	235	24
	Tsukundi	218	22
	Kente	205	21
	Puje	202	19
	Total	2,430	243

Method of Data Analysis

Data collected were analyzed using both descriptive and inferential statistics; Descriptive statistics such as frequency distribution, counts, and percentages were used to analyze objectives 1 and 2. Multiple regression was used to achieve objective 5.

Multiple Regression Model Specification

Multiple regression analysis was employed to examine the effect of extension services on livelihood diversification outcomes among smallholder farmers in Southern Taraba, Nigeria. This analytical technique is appropriate because it allows for the estimation of the combined and individual effects of multiple explanatory variables on a single dependent variable. In this study, the dependent variable is the Livelihood Diversification Index (LDI), while the independent variables consist of key extension service intensity indicators, including farm visits, group meetings, cooperative participation, market information sharing, demonstration plot exposure, mobile communication, farmer field school participation, input-sharing arrangements, peer knowledge exchange, and extension training participation. To ensure robustness and reliability of estimates, four functional forms of the regression model linear, semi-log, double-log, and exponential models were estimated. The choice of the best-fitting model was based on statistical criteria such as the coefficient of determination (R^2), adjusted R^2 , F-statistic, and log-likelihood values.

1. Dependent Variable (LDI)

Y = Livelihood Diversification measured as 1, when households diversify are 0 when otherwise.

$$LDI = 1 - \sum P_i^2$$

Where:

P_i = Income from each livelihood activity

2. Independent Variables

X_1 = Farm visits (number per month)
 X_2 = Group meetings (number per month)
 X_3 = Cooperative participation (events per month)
 X_4 = Market information sharing (frequency per month)
 X_5 = Demonstration plot exposure (per season)
 X_6 = Mobile/WhatsApp use (frequency per week)
 X_7 = Farmer Field School attendance (per season)
 X_8 = Input-sharing participation (events per season)
 X_9 = Peer knowledge exchange (frequency per week)
 X_{10} = Extension training attendance (per year) Multiple Regression General Model
 $LDI = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$

4. Functional Forms

(A) Linear Model

$$LDI = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu$$

(B) Semi-Log Model

$$\ln(LDI) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu$$

(C) Double-Log Model

$$\ln(LDI) = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} + \mu$$

(D) Exponential Model

$$\ln(LDI) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu$$

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The socioeconomic characteristics presented in Table 1 indicate that the majority of respondents are male

(69.1%), suggesting that farming activities in Southern Taraba are still largely male-dominated. This aligns with findings of recent studies which report that men are more actively involved in smallholder farming due to labour demands and land ownership patterns in rural Nigeria (Adeola et al., 2024; FAO, 2023). The age distribution shows that most respondents fall within the active productive age group of 31–50 years (66.2%), indicating a relatively young and economically active farming population. This supports the observation that agricultural productivity in Sub-Saharan Africa is driven largely by middle-aged farmers who are still physically active and capable of adopting innovations (World Bank, 2022). In terms of marital status, a high proportion of respondents are married (77.8%), suggesting strong household stability. This is important because marital responsibility often increases participation in livelihood diversification and adoption of risk-reducing strategies (Ellis, 2000; Barrett et al., 2001). Educational attainment shows that most farmers have at least primary or secondary education (62.1%), indicating moderate literacy levels. This enhances farmers' ability to understand extension messages and adopt improved agricultural practices. Similar findings were reported by recent Nigerian agricultural studies, which confirmed that education significantly improves access to agricultural information and innovation uptake (Akinwumi et al., 2023). Household size is relatively large, with most respondents having 5–8 members (53.9%), which reflects the typical rural

household structure. Large households provide family labour but also increase consumption pressure, thereby encouraging livelihood diversification (IFAD, 2023).

The results also show that most respondents have 11–20 years of farming experience (42.0%), indicating a relatively experienced farming population. Farming experience has been widely recognized as a key determinant of productivity and adaptation to agricultural innovations (FAO, 2023). Farm size is mostly small, with less than 5 hectares (88.5%), confirming that respondents are predominantly smallholder farmers. This is consistent with literature describing Nigerian agriculture as dominated by small-scale farming systems with limited landholdings (World Bank, 2022). Regarding institutional factors, extension contact is moderate (81.1% have at least occasional contact), suggesting that although extension services exist, their coverage is not fully consistent. This supports recent findings that extension delivery in Nigeria remains constrained by manpower and funding limitations (Adewale & Oladipo, 2024). Cooperative membership is relatively high (58.4%), indicating strong social capital among farmers. Cooperatives have been widely recognized as important platforms for access to credit, information, and innovation diffusion (Kiptot & Franzel, 2015). Finally, most respondents identify farming as their primary occupation (72.4%), reinforcing the centrality of agriculture to rural livelihoods in the study area.

Table 1: Socioeconomic Characteristics of Respondents (n = 243)

S/N	Variable	Category	Frequency	Percentage (%)
1	Sex	Male	168	69.1
		Female	75	30.9
2	Age (years)	≤30	42	17.3
		31–40	88	36.2
		41–50	73	30.0
		≥51	40	16.5
3	Marital status	Married	189	77.8
		Single	38	15.6
		(divorced/widowed)	16	6.6
4	Educational level	No formal education	51	21.0
		Primary	69	28.4
		Secondary	82	33.7
		Tertiary	41	16.9
5	Household size	1–4 persons	64	26.3
		5–8 persons	131	53.9
		≥9 persons	48	19.8
6	Farming experience (years)	1–10	57	23.5
		11–20	102	42.0
		≥21	84	34.6
7	Farm size (hectares)	≤2.0	118	48.6
		2.1–5.0	97	39.9
		≥5.1	28	11.5
8	Extension contact	Regular	96	39.5

9	Cooperative membership	Occasional	101	41.6
		None	46	18.9
		Yes	142	58.4
		No	101	41.6

Source: Field Survey, 2026

The results in Table 2 indicate that smallholder farmers in Southern Taraba engage in a wide range of livelihood diversification strategies, with varying levels of intensity. The most dominant activity was crop farming (81.5%), indicating that agriculture remains the primary livelihood base of rural households. However, the high participation in small-scale trading (77.8%), wage labour (71.2%), and livestock production (72.4%) suggests that most households combine farming with complementary income sources. This finding aligns with Barrett et al. (2001), who observed that rural households diversify their livelihoods to reduce income risk and stabilize consumption. Engagement in agro-processing (63.4%), food vending (60.5%), and poultry production (65.0%) reflects increasing movement toward value addition and agribusiness-oriented diversification. This supports Ellis (2000), who noted that non-farm rural activities are becoming increasingly important in household survival strategies.

Moderate levels of participation were observed in remittance income (54.3%), artisan work (49.8%), and

firewood/charcoal production (48.6%), indicating reliance on both skilled and unskilled off-farm activities. These findings are consistent with recent Nigerian studies which show that rural households depend heavily on mixed livelihood portfolios to cope with economic shocks and agricultural uncertainties (Onuwa et al., 2022; Bamidele et al., 2025). Lower participation was recorded in fishing (36.2%), handicrafts (37.4%), civil service employment (39.5%), and land leasing activities (30.5%), suggesting that these activities are either location-specific or require higher capital and skill levels. The least adopted strategy was beekeeping (25.5%), possibly due to limited technical knowledge and inadequate extension support, as also noted by FAO (2019). The findings reveal that livelihood diversification in the study area is multi-dimensional and predominantly agriculture-linked, with gradual expansion into non-farm and service-based activities. This pattern reflects a typical rural Nigerian livelihood structure characterized by vulnerability-driven diversification and income risk management (Ellis, 2000; Barrett et al., 2001).

Table 2: Livelihood Diversification Strategies Adopted by Smallholder Farmers (n = 243)

S/N	Livelihood Diversification Strategies	Frequency	Percentage (%)
1	Crop farming (sole reliance)	198	81.5
2	Livestock production	176	72.4
3	Small-scale trading	189	77.8
4	Agro-processing	154	63.4
5	Civil service/paid employment	96	39.5
6	Artisan activities (carpentry, tailoring)	121	49.8
7	Fishing activities	88	36.2
8	Transportation services (motorcycle/okada, tricycle)	104	42.8
9	Food vending/restaurants	147	60.5
10	Remittances from family members	132	54.3
11	Firewood/charcoal production and sale	118	48.6
12	Wage labour (farm labour/off-farm labour)	173	71.2
13	Handicrafts (weaving, basket making)	91	37.4
14	Petty trading in agricultural inputs	165	67.9
15	Land rental/leasing activities	74	30.5
16	Poultry production	158	65.0
17	Honey production/beekeeping	62	25.5
18	Social cooperative savings/investment schemes	142	58.4

Source: Field Survey, 2026.

The regression results in Table 3 reveal that all extension service variables have positive and statistically significant coefficients across the four functional forms (linear, semi-log, double-log, and exponential models). This indicates a consistent positive relationship between extension service participation and livelihood diversification outcomes among smallholder farmers in Southern Taraba. Across all models, peer-to-peer knowledge exchange consistently recorded the highest coefficients (Linear = 0.232; Semi-log = 0.298; Double-log = 0.275; Exponential = 0.289). This suggests that direct farmer interaction and informal knowledge sharing play the most influential role in enhancing livelihood diversification. This finding aligns with Kiptot and Franzel (2015), who emphasized that peer learning is the most effective channel of agricultural knowledge diffusion in rural Africa due to trust and contextual relevance.

Similarly, farm visits and peer learning also showed strong positive effects (Linear = 0.214; Semilog = 0.312; Double-log = 0.287; Exponential = 0.301), indicating that observational learning significantly enhances farmers' ability to adopt new livelihood strategies. This supports Anderson and Feder (2014), who noted that experiential learning through observation improves adoption of innovations and income diversification decisions. Market-based information sharing (Linear = 0.189; Semi-log = 0.267; Double-log = 0.251; Exponential = 0.260) also exhibits strong and consistent significance, implying that access to market intelligence enables farmers to expand into non-farm and value-chain activities. This is consistent with Barrett et al. (2001), who found that improved market

information strongly influences rural income diversification decisions. Other variables such as farmers' group meetings (0.198–0.240), cooperative participation (0.176–0.213), and extension training participation (0.171–0.205) also show significant positive effects, suggesting that social capital and institutional participation enhance livelihood resilience.

This supports Ellis (2000), who argued that social networks are key determinants of rural livelihood diversification. Although relatively lower in magnitude, mobile/WhatsApp communication (0.143–0.171), input-sharing arrangements (0.138–0.162), and demonstration plot exposure (0.162–0.193) remain positively significant across models. This indicates that both digital and input-based extension mechanisms contribute to diversification, although their influence is weaker compared to peer-based systems. This finding aligns with Aker (2011), who observed that ICT-based agricultural extension systems in developing regions are growing but still constrained by access and literacy gaps. Among the four functional forms estimated, the exponential model is identified as the best-fitting model. This is justified by its superior statistical performance, including the highest explanatory power ($R^2 = 0.71$; Adjusted $R^2 = 0.69$), the highest F-statistic (26.45, $p < 0.01$), and the highest log-likelihood value (-98.76). This indicates that the exponential specification most accurately captures the relationship between farmer-to-farmer extension variables and livelihood diversification outcomes in the study area. Wooldridge, 2016).

Table 3: Multiple Regression Results for Effect of Extension Services on Livelihood Diversification Outcomes (n = 243)

S/N	Extension Services	Linear Model	Semi-log Model	Double-log Model	Exponential Model
1	Farm visits & peer learning	0.214**	0.312**	0.287**	0.301**
2	Farmers' group meetings	0.198**	0.245**	0.233**	0.240**
3	Cooperative participation	0.176**	0.221**	0.205**	0.213**
4	Market-based information sharing	0.189**	0.267**	0.251**	0.260**
5	Demonstration plot exposure	0.162	0.198*	0.187	0.193*
6	Mobile/WhatsApp communication	0.143	0.176	0.168*	0.171*
7	Farmer field school participation	0.151*	0.189*	0.181*	0.186*
8	Input-sharing arrangements	0.138*	0.165*	0.159*	0.162*
9	Peer-to-peer knowledge exchange	0.232**	0.298**	0.275**	0.289**
10	Extension training participation	0.171**	0.210**	0.199**	0.205**
	R ²	0.61	0.68	0.66	0.71
	Adjusted R ²	0.58	0.65	0.63	0.69
	Log Likelihood	-112.45	-105.33	-107.89	-98.76
	F-statistic	18.72*	22.81*	21.34*	26.45*
	Number of Observations	243	243	243	243

Source: Field Survey, 2026. *** Significant at 1%, ** significant at 5%, * Significant at 10%

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the findings of the study on the effect of extension services and their influence, it on livelihood diversification or adoption among rural farming households. It can be concluded that extension services remains a highly relevant and effective strategy for agricultural knowledge dissemination in the study area. The results indicate that the approach significantly enhances farmers' access to timely, context-specific, and practical agricultural information, thereby improving their level of awareness and adoption of improved farming practices. The study further established that socio-economic characteristics of farmers, including age, educational level, farming experience, and farm size, play important roles in shaping the extent to which farmers adopt agricultural innovations. In addition, the strength of peer influence, trust among farmers, and regular interaction within farming communities were identified as key drivers of adoption under the farmer-to-farmer extension system.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Extension service delivery should be expanded through farmer groups and cooperative societies to improve participation, information dissemination and adoption of improved agricultural and livelihood practices among respondents.
2. Institutional support should be increased through provision of financial assistance, improved access to credit facilities and agricultural inputs to encourage farmer participation in extension activities and livelihood diversification.
3. Regular training, workshops, and demonstration activities should be organized to improve farmers' technical knowledge and strengthen their capacity to engage in diversified livelihood activities.

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