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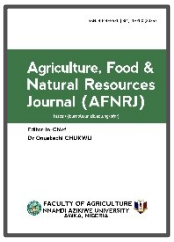

Original Article

Determinant of crop diversification among arable crop farmers in Kwara State, Nigeria

OPEN ACCESS

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ABSTRACT

Crop diversification is a key risk mitigation and income stabilisation strategy for smallholder farmers, yet its adoption remains a concern among farmers in Kwara State. This study examines the determinants of crop diversification among arable crop farmers in Kwara State. A multistage sampling technique was used to select 208 respondents from the study area. Primary data was collected using a semi-structured questionnaire and interviews and was analysed using descriptive statistics, multiple regression, and multinomial logistic regression. Findings revealed that the farmers were predominantly males with an average age of 44 years. Most of the farmers had secondary education and operated their farms with an average of 6.5 ha of land. Most (46.6%) of the farmers diversified into 4 – 7 crop types, majorly (67.8%) combining cereals, legumes, and tubers to manage risk. Results of multiple regression showed that diversification levels were influenced by age (p=0.022), years in school (p=0.002), marital status (p=0.037), farming experience (p=0.051), farm size (p=0.024), irrigation access (p=0.000), farm training (p=0.013), and market distance (p=0.002). Multinomial regression indicated that the choice of diversification into cereals and legumes was influenced by marital status (p=0.030), land tenure (p=0.034), and number of crops grown (p=0.017), while the choice to diversify into cereals and tubers was influenced by farm income (p=0.081), farming experience (p=0.099), access to extension agents (p=0.005), access to irrigation facilities (p=0.066), and number of crops grown (p=0.000). The study recommends strengthening access to credit, irrigation, and extension services for commercial-oriented diversification and training to promote profitable cropping systems among smallholder farmers.

KEYWORDS: *Extension Services, Income stabilisation, Irrigation Access, Risk Mitigation, Smallholder farming*

INTRODUCTION

Crop diversification has been described as a strategy to maximise the use of land, water, and other resources and for the overall agricultural development in the country (Barman *et al.,* 2022). It provides the farmers with viable options to grow different crops on their land. The diversification of agriculture is the outcome of the natural demands, as initially, the farmers are cultivating their land for the subsistence of their livelihood. Still, as the population increases and per capita land decreases, the diversification of agriculture begins (Sati *et al*, 2025). Daudu *et al.* (2019) pointed out that farmers' decisions are influenced by environmental, socioeconomic, and cultural factors as well as political climate. Crop diversification can increase farmers' resilience against the adverse impacts of climate change on food crops. The main purpose of crop diversification practices employed by farmers in the developing world is to avert crop loss due to ensure food security, increase farm incomes, and reduce vulnerability to poverty (Appiah-Twumasi & Asale, 2024; Komolafe *et al.*, 2022).

Crop diversification also provides better conditions for food security and enables farmers to grow surplus products for sale at the market and thus help to obtain increased income to meet other needs related to household well-being (Rubina *et al.*, 2018). Basantaray & Nanchariah (2017) observed that factors such as an increase in productivity, lower cost of production with efficient use of resources, an increase in cropping intensity,

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diversification towards high-value crops, and diversification towards other allied enterprises like livestock, fishery, sericulture, etc. contribute towards higher agricultural growth from within.

In practising crop diversification, arable crop farmers often experience a lot of challenges that limit the level at which they diversify and their choice of diversification practice. Existing studies, such as Onya *et al.* (2019), focused on how crop diversification affects the farmers' food security and not much was said about the factors responsible for these diversification choices. The study by Mzyece & Ng'ombe (2021) also examined the impact of crop diversification on the technical efficiency and income variability of farmers. Therefore, this study aimed to analyse the economic impact of crop diversification among arable crop farmers in Kwara State.

MATERIALS AND METHOD

Study Area

The Study was conducted in Kwara State, Nigeria. It is situated between latitudes 70°45' N and 90°30' N, and longitudes 20°30' E and 60°25' E (KWSMI, 2002). The state is located in the north-central part of Nigeria. It has 16 local government areas with a total land area of about 32,500 km^2. With an estimated population of about 3.55m (NBS 2017), Kwara State shares borders with Niger State to the north, River Niger to the east, Kwara State shares borders with Kogi, Oyo, Ekiti, and Osun States to the south. Crops including maize, yams, cassava, millet, rice, plantains, palm produce, cashews, among others. The Kwara State Agricultural Development Project (KWADP) divides Kwara into four agro-ecological zones based on cultural practices, ecological characteristics and administrative convenience.

Sampling and Sample Size

A multi-stage sampling technique was used for the study. The first stage involves the purposive selection of Zone C of the ADP zones. The second stage involves the random selection of four (4) local government areas in the Zone; the local government areas covered include Asa, Moro, Ilorin West and Ilorin South. The third stage includes the random selection of four (4) communities from each of the Local governments selected. The fourth stage includes the random selection of thirteen (13) arable crop farmers to get a total of two hundred and eight (208) respondents for the study.

Data Collection

Primary data sources were used for the study; Cross-sectional data were collected using a semi-structured questionnaire, which was supplemented with an oral interview. The questionnaire was used to deduce information on the socio-economic characteristics of the respondents, various factors including institutional issues, and household demographics.

Analytical Techniques

Multiple regression analysis

To investigate the factors influencing the level of crop diversification among arable crop farmers, multiple regression analysis was used. The model is expressed as follows:

$$CDC = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_{12} X_{12} + \varepsilon \quad (1)$$

Where; CDC = Crop diversification count measured as a proxy of number of crops diversify to X_1 = Age (Year), X_2 = Household size (Numbers), X_3 = Education level of the farmer (Years in School), X_4 = Farming experience (Years), X_5 = Farm size (Hectares), X_6 = Access to credit (Yes = 1, No = 0), X_7 = Access to Extension Services, X_8 = Access to irrigation (Yes = 1, No = 0), X_9 = Access to Farm Training (Yes = 1, No = 0), X_{10} = Farm Income (₦), X_{11} = Distance to market (km), X_{12} = Marital status (Married = 1, Not married = 0), β_0= Constant, β_{1-12}= Coefficient, ε= Error term

Multinomial regression analysis

Multinomial regression was employed to investigate the factors that determine the choice of diversification options among the arable crop farmers. The model is specified as

$$P(Y=j) = \frac{e^{\beta 0j+\beta 1jX1+\beta 2jX2+\ldots+\beta njXn}}{\sum_{k=1}^{J} \beta 0k+\beta 1kX1+\beta 2kX2+\cdots+\beta nkXn} \quad (2)$$

P(Y=j) = Probability of a farmer choosing diversification option j, j = Number of diversification categories. (cereal and legume = 1, cereal and tuber = 2, legume and tuber = 3, cereal, legume and tuber = 4), β_{0j}= Intercept for category j, βnj = Coefficients of explanatory variables for category j, X_1 = Age (Years), X_2 = Gender (Male = 1, Female = 0), X_3 = Marital status (Married = 1, Not married = 0), X_4 = Education level of the farmer (Years in School), X_5 = Farm size (Hectares), X_6 = Farm Income (₦), X_7 = Farming experience (Years), X_8 = Farm Tenure (Owned = 1, Lease = 0), X_9 = Access to agricultural extension services (Access = 1, Non access = 0), X_{10} = Access to irrigation (Yes = 1, No = 0), X_{11} = Farm Implement (Yes = 1, No = 0), X_{12} = Number of Crop Gown (Number)

RESULTS AND DISCUSSION

Socio-Economic Characteristics

The result from Table 1 revealed that arable crop production in Kwara State was predominantly done by men, as 83.2 % of the farmers were male, This showed that men continued to dominate arable farming in the study area, a finding consistent with recent studies across sub-Saharan Africa, which reported that male-headed households have greater access to production resources and decision-making power in agriculture (Adeosun *et al.,* 2025). The mean age of respondents was 44 years, with 42.8 % falling within the 31–40 years range. This implied that the majority of farmers were in their economically active age, suggesting the availability of labour and energy required for farm diversification. This age distribution agreed with the

findings of Jimoh *et al.* (2024). The average household size was 7 members, with 88.9% of respondents having fewer than 10 household members. This indicated moderate labour availability. A similar household composition was reported by Adesiyan & Kehinde. (2024). 52.9% of the respondents possessed 11 to 30 years of farming experience. The mean of which is 20 years reveals that most farmers were well experienced, which likely improves their ability to adapt and make decisions as regards diversification. This result aligns with the findings of Sumo *et al.* (2022).

Table 1: Frequency distribution of socioeconomic characteristics of arable crop farmers

Characteristics	Category	Freq.	%	Mean
Gender	Female	35	16.8	
	Male	173	83.2	
	Total	208	100.0	
Age (Years)	≤20	1	0.5	44.2
	21-40	89	42.8	
	41-50	63	30.3	
	≥51	55	26.4	
	Total	208	100	
Household Size	≤10	85	88.9	7
	11-20	21	10.1	
	>21	2	1.0	
	Total	208	100.0	
Farming Experience (Years)	≤10	66	31.7	20.2
	11-30	110	52.9	
	≥31	32	15.4	
	Total	208	100.0	
Farm Size (Ha)	≤5	138	66.3	6.5
	5.1-15	56	26.9	
	>15.1	14	6.7	
	Total	208	100.0	
Annual Farm Income (₦)	100,000-999,999	126	60.6	2,867,355.8
	1,000,000-10,000,000	75	36.1	
	>10,000,000	7	3.4	
	Total	208	100.0	

Field survey, 2025, %= percentage

Farm size distribution shows that 66.3% of the respondents cultivated less than 5 hectares of land, with an average size of 6.5 hectares. This shows the prevalence of smallholder farming, a limitation typical of Nigeria's agricultural landscape. Jimoh *et al.* (2024) similarly discovered that small farm holdings usually impede commercialisation and the intensity of crop diversification. 60.6% of the respondents earned between ₦100,000 and ₦1,000,000 annually as income; the average annual income was ₦2,867,355.76; this suggests that most farmers operated on a low to medium income scale. This pattern in income indicates limited access to productive resources and markets, similar to findings by Adesiyan & Kehinde. (2024),

Level of Crop Diversification

Table 2 reveals that about 46.6% of the respondents cultivate four to seven crop varieties. This trend shows that a majority of farmers only moderately varied their crop production, also implying that diversification was primarily practised as a survival or risk management strategy rather than as a commercial expansion plan by the farmers. The prevalence of moderate diversification suggested that most farmers tried to balance the benefits of risk reduction with the management constraints imposed by land size, capital, and labour availability. Mailumo *et al.* (2022) found similar results in their study on smallholder diversification, demonstrating that farmers tend to stick to a moderate crop-mix range due to limited productive resources and knowledge asymmetry.

Table 2: The level of crop diversification among arable crop farmers in Kwara state

Number of Crop Diversified into	Freq.	%	Mean
≤3	80	38.5	5
4-7	97	46.6	
>7	31	14.9	
Diversification Category			
Cereals and Legumes	14	6.7	
Cereals and Roots & Tubers	53	25.5	
Cereals, Legumes, and Root & Tubers	141	67.8	

Field survey, 2025%= percentage

The result also showed that diversification within crop groups was dominated by farmers cultivating cereals, legumes, and root & tuber crops, representing about 67.8% of the respondents. This pattern indicated a strong preference for mixed cropping systems that combined staple cereals with both protein-rich legumes and calorie-dense root and tuber crops, reflecting the need to ensure dietary diversity, income stability, and resilience to production shocks.

Factors Influencing the Level of Crop Diversification

Table 3 revealed that age had a negative and significant effect on crop diversification at the, indicating that older farmers were less likely to diversify their crop enterprises. This aligns with the findings of Mailumo *et al.* (2022), who observed that older farmers prefer to stick to familiar cropping patterns due to declining risk tolerance and reduced physical capacity to manage multiple crops. It was also observed that years spent in school negatively influenced crop diversification. More educated farmers were less likely to diversify, preferring specialisation in fewer crops. This finding corroborates Adebayo *et al.* (2018), who reported that education often promotes specialisation and commercial-oriented production rather than broad diversification among smallholder farmers.

Table 3: The factors influencing the level of crop diversification among arable crop farmers in Kwara State

Variables	Coefficients (B)	Std. Error	t-value	p-value
Constant	1.950***	0.250	7.800	0.000
Age	-0.011**	0.005	-2.200	0.022
Household Size	0.014	0.011	1.273	0.209
Years in School	-0.024**	0.008	-3.000	0.002
Farming Experience	0.009*	0.005	1.800	0.051
Farm Size	0.024**	0.011	2.182	0.024
Access to credit facility	0.132	0.090	1.467	0.143
Access to Extension Services	-0.078	0.110	-0.709	0.481
Access to irrigation facility	-0.398***	0.102	-3.902	0.000
Farm training	0.247**	0.099	2.495	0.013
Farm Income	-0.009	0.018	-0.500	0.493
Distance to market	0.021***	0.007	3.000	0.002
Marital Status	-0.081**	0.038	-2.132	0.037
Dependent Variable: Crop Diversification Count				
R^2=0.500, Adjusted R^2= 0.475				

*Field survey, 2025, ***= 1% Significance Level, **= 5% Significance Level, * =10% Significance Level*

Farming experience showed a positive influence, suggesting that farmers with longer farming experience diversified more. This was consistent with Mekuria *et al.* (2020), who reported that experienced farmers have greater knowledge of production risks, climate variability. The result revealed that farm size positively and significantly affected diversification. Farmers with larger landholdings were more capable of cultivating multiple crops, enhancing diversification. This supports Mailumo *et al.* (2022), who found that land availability is a key determinant of farmers' ability to diversify crop enterprises. Access to irrigation facilities was negatively significant, indicating that farmers with irrigation tended to diversify less. This finding is consistent with Mekuria *et al.* (2020), who reported that irrigation reduces production risk and encourages specialisation in high-value crops. Farm training positively influenced crop diversification, highlighting the importance of capacity building. This aligns with Mailumo *et al.* (2022), who emphasised that training improves farmers' knowledge of agronomic practices, enabling them to adopt diversified cropping systems effectively. Distance to market was positively significant, suggesting that farmers farther from markets diversified more to mitigate market access challenges and price fluctuations. This finding corroborates Adebayo *et al.* (2018), who noted that market constraints often drive smallholders to diversify as a risk management strategy.

Finally, marital status negatively influenced diversification, implying that married farmers were less likely to diversify, possibly due to higher household responsibilities and risk aversion. This is consistent with Mekuria et al. (2020), who found that household responsibilities can limit farmers' willingness and ability to manage multiple crop enterprises.

Factors Determining the Choice of Crop Diversification

The result from Table 4 revealed that several factors significantly determined the choice of crop diversification among arable crop farmers in the study area. For farmers growing only cereals and legumes, Marital status shows a positive and significant effect. It suggests that married households often face greater immediate food security pressures and a higher need for risk aversion strategies. This finding agrees with Chinalurum *et al.* (2024), who reported that marital status positively influences the choice of crop as married farmers prioritised stable, low-risk crop pairs to meet household consumption demands. This shows that owning a land had a positive significant influence in diversification to cereals and legumes. This result corroborates Afodu *et al.* (2019), who found that insecure land tenure arrangements increase the odds of diversification by discouraging the farmers from expansion into long-term crop groups. Number of crops grown has a negatively significant effect on the diversification category. This means that each additional crop group reduce the odds of stopping at cereals and legumes. This highlighted the self-reinforcing nature of diversification, where the addition of more crops builds momentum towards full diversification. This is consistent with the findings of Ayantoye *et al.* (2017), who found that higher existing crop counts predicted progression to more diversified portfolios.

For farmers growing only cereals and root & tuber crops, access to extension services shows a positive and significant effect. It suggests that the current extension messages may be emphasising the need for more cereals and root & tuber crops as climate-resilient options, inadvertently discouraging legume inclusion. This finding agrees with Gwandi & Adewuyi (2024), who reported that extension contact increased the probability of partial diversion through the promotion of some specific staple crop combinations. Access to irrigation facilities also shows a negative and significant relationship. Implying that irrigated farmers were less likely to stop at cereals and root and tubers as irrigation enables reliable production of water-intensive plants. This corroborates Ayandele *et al.* (2024), who found that irrigation access significantly reduces the odds of partial diversification by supporting year-round cropping. Number of crops grown once again shows a strong negative effect, showing

that each additional crop reduces the odds of this diversification category. This buttresses the path-dependent nature of the diversification decision. This is in line with the findings of Mekuria *et al.* (2020) that an increasing number of crops grown tends to increase the likelihood of full diversification. Farm income also shows a negative effect. This suggests that farmers with higher income are less likely to remain partially diversified as greater financial resources allow for investment in inputs needed for full diversification. This agrees with Gwandi & Adewuyi (2024), who reported that higher income levels reduce partial diversification by enabling broader cropping systems.

Table 4: The factors that determine the choice of crop diversification among arable crop farmers

Variables		B	Std. Error	Sig.	Exp(B)
Cereals and Legumes	Intercept	-4.093	3.618	0.258	
	Age	0.044	0.042	0.296	1.045
	Gender	0.576	1.224	0.638	1.780
	Marital Status	0.661**	0.305	0.030	1.936
	Education Level	0.026	0.077	0.738	1.026
	Farm Size	0.559	1.150	0.627	1.748
	Farm Income	-0.800	1.207	0.508	0.449
	Farming Experience	-0.068	0.051	0.180	0.934
	Land Tenure	2.477**	1.171	0.034	11.911
	Access to Extension Services	0.630	0.966	0.514	1.878
	Access to an irrigation facility?	0.737	0.820	0.369	2.089
	Farm implement	0.743	0.830	0.371	2.102
	Crop Diversification	-0.900**	0.378	0.017	0.407
Cereals and Roots & Tubers	Intercept	3.738**	1.765	0.034	
	Age	0.016	0.026	0.526	1.016
	Gender	-0.857	0.528	0.105	0.425
	Marital Status	0.237	0.195	0.224	1.268
	Education Level	0.060	.045	0.188	1.061
	Farm Size	-0.136	0.638	0.832	0.873
	Farm Income	-1.170*	0.671	0.081	0.310
	Farming Experience	0.043*	0.026	0.099	1.044
	Land Tenure	-0.479	0.435	0.270	0.619
	Access to Extension Services	1.609**	0.577	0.005	4.998
	Access to an irrigation facility	-1.012**	0.551	0.066	0.364
	Farm implement	-0.290	0.503	0.564	0.748
	Crop Diversification	-1.236***	0.244	0.000	0.291

The reference category is: Cereals, Legumes, and Root & Tubers.
Pseudo R-Square: Nagelkerke 0.561

*Field survey, 2025, ***= 1% Significance Level, **= 5% Significance Level, * =10% Significance Level*

CONCLUSION AND RECOMMENDATIONS

The study concluded that arable crop farming in Kwara State was predominantly carried out by middle-aged, moderately educated, and experienced male farmers, operating on small landholdings with limited access to credit and extension services. Most farmers practiced moderate crop diversification, primarily as a strategy for risk management rather than commercial expansion. It was revealed that experience, farm size, training, and market distance enhance levels of adoption, but reduced by age, education, marital status and irrigation which tend to promote crop specialisation.

Based on the findings from the study, it is hereby recommended that, the government should strengthen farmers' access to credit, irrigation, and extension services to enable smallholders to expand production capacity and increase engagement in diversified cropping systems across Kwara State. Extension programs should promote commercial-oriented crop diversification by improving farmers' technical capacity, market linkages, and business skills, facilitating a transition from subsistence-focused to profit-driven diversification.

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Authors' Contributions

AT conceptualised the study. AT, OYA & KA designed the experiment. AT collected data, performed data analysis, and wrote the first draft of the manuscript. AT performed literature searches and reviewed the first draft of the manuscript. All authors read and approved the final draft of the manuscript.

Ethical Statement

Not applicable

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