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Assessment of the Adoption of Mordern Agricultural Technologies Among Crop Farmers in Kwara State

Adewumi Israel[1*], Falola Abraham[2], Abdulrahman Ololade[3], Friday Amarachi[4]

[1]*Chief Lecturer, Department of Agricultural Education, Kwara State College of Education, Oro, Nigeria*

[2]*Associate Professor, Department of Agricultural Economics & Farm management, University of Ilorin, Nigeria*

[3]*Senior Lecturer, Department of Agricultural Economics & Extension, Kwara State University, Malete, Nigeria*

[4]*Lecturer, Department of Agricultural Economics and Extension, Kwara State University, Malete, Nigeria*

Corresponding Author
E-Mail ID: adewumiisreal@gmail.com

ABSTRACT

Despite the potential benefits of modern agricultural technologies to farmers, the rate of adoption has remained low. Therefore, this study assesses the factors influencing the adoption of modern agricultural technologies in Kwara State, Nigeria. Specifically, the study aims to: identify the modern agricultural technologies available to crop farmers; assess the level of adoption of these technologies; investigate the factors influencing their adoption; and examine the constraints faced by farmers in adopting them. The study employed descriptive statistics and multivariate regression analysis. The results show that the majority of the farmers are male, and most have at least a primary level of education. The findings indicate a low rate of adoption of modern technologies among farmers. The regression analysis revealed that age, educational level, farm size, and membership in farmers' associations are the main factors influencing the adoption of these technologies. Based on the findings from the study. It's therefore recommending policies that encourage youth participation in agriculture should be more introduced, that can enhance the educational capacity of farmers, also public awareness and support services for the expansion of farm sizes should be re-emphasized.

Keywords: *Assessment, adoption, agricultural technology, farmers*

INTRODUCTION

Nigeria's agricultural sector continues to grapple with low productivity, largely due to the persistent use of traditional farming implements and limited adoption of modern agricultural technologies. Despite the availability of innovative tools and research outcomes from institutions like the Agricultural Development Programme (ADP) in 1975, National Centre Agricultural Mechanization (NCAM) established in 1990 with various agricultural research institutes, these technologies often fail to reach or be adopted by the final users' smallholder farmers. Unto today Agriculture remains the central to the economic growth and food security in Nigeria and other developing countries. From every indication agriculture not only contributes to national GDP but also provides means of livelihoods for over 70% of the rural population. From the literature as of 2024, approximately 30.1% of Nigeria total workforce equating to over 25million individual are engaged in agriculture. This

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makes agriculture the largest employment sector in the country [8,9,23]. To sustain growing yarning for agricultural output, integration of sustainable agricultural innovations, particularly **Modern Agricultural Technologies (MATs)**, is essential to addressing food shortage and nutrition insecurity, improving productivity, and promoting environmental sustainability.

MATs encompass a broad range of practices and technologies that improve both on-farm production and post-harvest processes. These include the use of improved seed varieties**,** modern irrigation systems**,** conservation agriculture**,** soil fertility enhancement**,** integrated pest and weed management**,** and digital agricultural tools [4,27]. The goal is not only to boost yields but also to ensure food safety and long-term ecological balance.

According to Sennuga et al. (2021)**,** MATs have a direct impact on smallholder productivity and household food security by increasing yield per hectare and reducing unit costs of production.[25,26] Technologies like precision agriculture**,** climate-smart practices**,** and mobile-based extension services are increasingly recognized for their transformative potential. Nevertheless, adoption remains hindered by factors such as limited access to credit, inadequate extension services, high input costs, and insufficient farmer [22].

Furthermore, Levisohn and colleagues (2019) emphasize that modern crop management technologies especially those targeting improved varieties, soil fertility, water use efficiency, and pest control are key to raising output and reducing the cost of production. [14,15] These technologies result in substantial increases in farm income when properly adopted and scaled. To bridge the gap between availability and adoption, there is a pressing need for policies that support access to affordable inputs, strengthen agricultural extension systems, and promote public-private partnerships in technology dissemination. Digital platforms and mobile tools should also be leveraged to reach remote farming communities with relevant and timely information. Although an improved agricultural technology that enhances sustainable production of food and fiber has made the dynamics of technical change in agriculture to be an area of intense research since the early part of twentieth century (Leeuwis *et al.*, 2022). Since smallholder farmers in developing nations face numerous constraints, these technologies are especially pertinent to them and should be prioritized for development. For example, these farmers reside and work in regions with poor soil and little to no rainfall. Furthermore, institutions and infrastructure like loans, extension services, input and product markets, and irrigation are typically underdeveloped [18,24]. The productivity level has decreased as a result of small-holder farmers' reliance on conventional agricultural techniques.

For example, smallholders who employ conventional farming methods account for more than 70% of maize production in most developing nations [18]. Because local varieties have low potential yields, most maize is grown under rainfed conditions, irrigation is used sparingly, little to no fertilizer is applied, and pest control is inadequate, these farmers typically achieve very low crop yields [25].

Globally, there is a great need to boost agricultural productivity and sustainability, yet there is a dearth of knowledge about the precise ways to accomplish this goal. In a similar way, research has been done on the adoption process and the effects of new technologies on small-holder farmers. Despite being viewed as a key means of

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escaping poverty in the majority of developing nations, improved agricultural technology is frequently adopted slowly, and many components of adoption are still poorly understood [5] Simtowe, 2011).

STATEMENT OF THE PROBLEM

It is widely recognized that the pathway to Africa's economic development lies in the innovation, diffusion, and utilization of agricultural technologies [2]. In Nigeria, the National Policy on Agriculture (NAP, 2013) was designed to promote the adoption of such technologies. Recently, the government has made substantial investments in agricultural research and extension service developing high-yielding crop varieties, delivering extension services to rural communities, and removing import duties on key agricultural inputs like fertilizer.[7]Despite these efforts, the rate of agricultural technology adoption particularly in arable production remains significantly low. For instance, data indicate that only about 10% of farming households purchase improved seed varieties annually, and a mere 5.3% consistently use fertilizer (NBS, 2023). More recent research confirms that adoption levels have stagnated, rarely surpassing the 10% threshold [11,21]. This slow pace of adoption has critical implications on food production, especially among rural households that rely heavily on agriculture for subsistence. A decline in productivity forces many developing countries to depend on food imports. However, limited access to alternative income-generating opportunities means they are often unable to afford imported food. Additionally, reduced agricultural output drives up commodity prices, increasing food insecurity not only in rural areas but also among poor urban populations.

To enhance productivity per unit of input, two strategic approaches are necessary: increasing average productivity and reorganizing the use of productive resources within the existing production frontier [16]. Technological integration such as agricultural mechanization, use of improved seeds, fertilizers, and irrigation can shift or expand this frontier, enabling consistent and sustainable food production at the community level.

Despite the overwhelming emphasis by government agencies and public and private research institutions on improving agricultural technology adoption, uptake remains insufficient. Bridging this gap will require aggressive adoption of modern appropriate technologies that address the real needs of smallholder farmers.

Thus far, the potential benefits of modern agricultural technologies such as increased crop yields, reduced labour costs, and improved food security, the adoption of these technologies by Kwara State households' rural farmers remains relatively low (Olatoye & Adelekan, 2020; Yusuf *et al*., 2021). Some of the factors hindering the adoption of modern agricultural technologies in Kwara State include lack of awareness, inadequate knowledge and skills, high cost of inputs, and inadequate extension services [11]. This study therefore sought to provide answers to these research questions.

- What are the modern agricultural technologies available to the rural households' farmers in Kwara State?
- What are the factors influencing the adoption of modern agricultural technologies among crop farmers in Kwara State?
- What are the constraints militating the adoption of modern agricultural technologies among crop farmers in Kwara State?

OBJECTIVES OF THE STUDY

The main objective of the study is to assess the adoption of modern agricultural

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technologies among rural households' farmers in Kwara State. While the specific objectives of the study were to:

- Identify the modern agricultural technologies available to crop farmers in Kwara State.
- Investigate the factors influencing the adoption of modern agricultural technologies among crop farmers in Kwara State.
- Identify the constraints militating the adoption of modern agricultural technologies among farmers in Kwara State.

METHODOLOGY

Study Area

This study was carried out in Kwara State, Nigeria. The State lies between 8° 30' & 5° 00' N of the equator. Kwara State, one of the north-central States of the country was created on 27th May, 1967. As reported by the 2006 census, the total population stood at 2.37million people (NPC, 2006).

The state shares boundaries with Oyo, Osun, Ondo, Kogi, Ekiti and Niger State. It also shares an international boundary with Benin Republic. The State comprises 16 Local Government Areas (Asa, Edu, Baruten, Ekiti, Ifelodun, Ilorin-East, Ilorin-South, Ilorin-West, Irepodun, Isin, Kaiama, Moro, Offa, Oke-Ero, Oyun, Pategi) with a land mass of about 36,825 square kilometers. Two distinct seasons operating in a humid tropical climate are prevalent: rainy and dry season.

The dry season spans between November and March while the rainy season commences in April and spans through to October. It means annual rainfall is about 1500mm while minimum average temperature ranges between 21.1°C & 25°C. With vast tracts of arable land and rich, fertile soil, Kwara State is predominantly an agrarian state. Agricultural production is largely peasant and small scale relying heavily on the use of manual labour equipped with crude implements. Use of mechanization is also practiced to some extent among farmers.

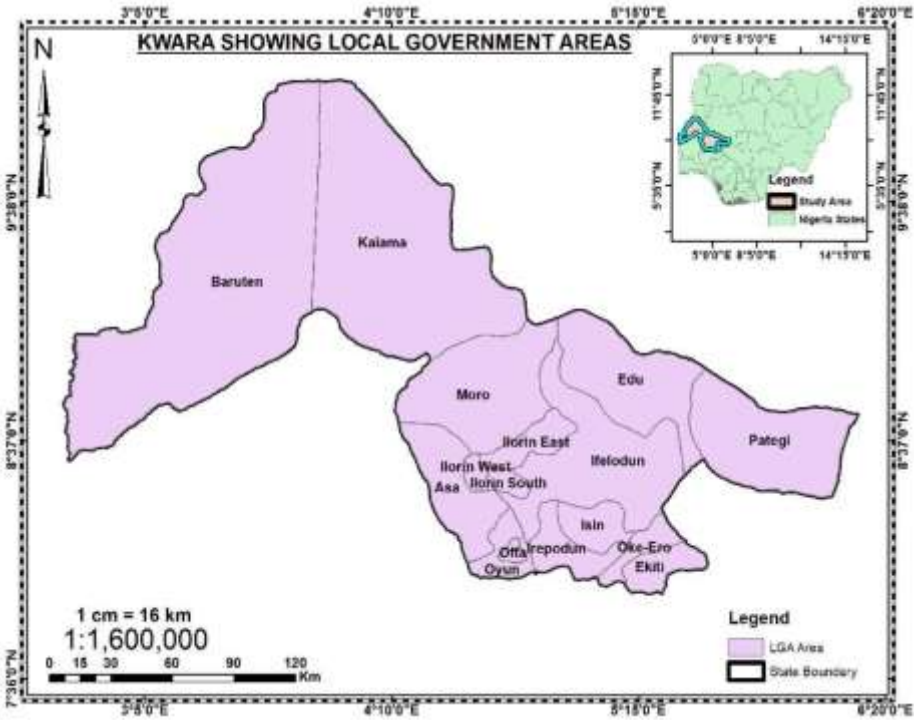


Fig. 1: *Map of Kwara State.*

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Study Population
The target population for the study was arable crop farmers

Sampling Techniques
A three-stage sampling technique was used in the selection of samples that provided the data for this study. In the first stage, three Local Government Areas (Asa, Ifelodun and Ilorin East) were randomly selected, followed by the random selection of six communities from each LGAs. At the final stage, ten arable crop farmers were randomly selected from each community and a total sample of 180 respondents was used.

Methods of Data Collection
The primary data for this study was collected using a structured interview scheduled to obtain pertinent information for the study. Information was also sourced from pre-existing literature in the subject area including journals, textbooks, magazines and the internet.

Analytical Techniques
Descriptive analysis
Descriptive analysis was employed to describe the socio-economic characteristics of the respondents, to identify the level of adoption of modern agricultural technology in the study area. This was accomplished by the use of measures of central tendency such as frequencies, percentages, means and charts.

Likert analysis scale
The ranking of constraints experienced by crop farmers on the adoption of modern agricultural technology was done using the number of counts received for each constraint which were expressed as percentage. The constraint with the highest number of counts will be ranked as first and that with the lowest points will be ranked last.

Multivariate logistic regression
Multivariate logistic regression was used to identify the factors influencing the adoption of modern agricultural technologies in the study area. Regression is the amount of change in value of one variable associated with a unit change in the value of another variable. Multiple regression analysis will therefore be used to determine the effect of changes in the explanatory variable on the dependent variable i.e. adoption of modern agricultural technologies.

The multiple regression equation is specified as follows:

$$Y = \boldsymbol{\beta_\theta} + \boldsymbol{\beta}_1X_1 + \boldsymbol{\beta}_2X_2 + \boldsymbol{\beta}_3X_3 + \boldsymbol{\beta}_4X_4 + \boldsymbol{\beta}_5X_5 + \ldots \boldsymbol{\beta}_nX_n + \mu$$

Where**:** Y = Level of adoption of modern agricultural technologies
X_1 = Age of respondents (years)
X_2 = Years of Formal Education (measured in year of successful schooling)
X_3 = Household size (measured in number of people living in the same household)
X_4 = Extension Visit (measured in number of contacts in the past one year)
D_1 = Gender (measured as a dummy variable, 1 if male, 0 if otherwise)
D_2 = Marital Status (measured as a dummy variable, 1 if married, 0 if otherwise)
D_3 = Membership of association (measured as a dummy variable, 1 if member, 0 if otherwise)
X_5= Income measure in Naira (₦)
$\boldsymbol{\beta_\theta}$=constant term
μ = Error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics
Table 1 reveals a pronounced gender disparity among the farming population, with males accounting for 96.67% of respondents and females comprising only 3.33%**.** This indicates **a** male-dominated farming **sector** in the study area. The underrepresentation of women highlights

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the persistent gender gap in access to land, inputs, and decision-making in agriculture. This finding aligns with recent studies [10,19], which emphasize that empowering women in agriculture could significantly enhance productivity and rural livelihoods.

The age distribution of respondents is notably diverse, with the largest proportion (31.6%) falling within the 41–50 age range. Younger farmers (≤ 40 years) offer potential for the adoption of innovations due to their higher technological receptiveness, while older farmers (≥ 61 years) contribute traditional knowledge and long-term experience. This generational mix presents an opportunity for knowledge transfer and innovation scaling, supporting the observations of Okafor & Ibe (2022), who noted the value of age diversity in enhancing agricultural resilience. [2-]

The marital status distribution indicates that **72.5%** of the respondents are married**,** suggesting the influence of family structure on farm operations. Family-based labor remains critical, particularly in rural settings where mechanization is limited. Large household sizes, particularly those between 6 to 10members (47.5%)**,** imply the availability of family labor, but they may also reflect higher dependency ratios and resource demands, consistent with the findings of Musa et al. (2023). [17]

In terms of educational attainment**,** 48.6% of the respondents have a primary education, followed by 34.08% with secondary education. Education is a crucial determinant of a farmer's ability to understand and adopt modern agricultural technologies. The relatively low educational levels observed could hinder effective technology adoption and limit access to agricultural extension services and information platforms. This is in line with recent research [1] emphasizing that farmers with higher education levels are more likely to engage with extension agents and adopt improved practices. The implication of this results is that there is need for educational interventions and adult learning programs to bridge the knowledge gap in farming communities.

Table 1: *Distribution of their Socioeconomic Characteristics (N=180).*

Socioeconomic characteristics	Categories	Frequency	Percentage	Mean
Gender	Male	174	96.67	
	Female	6	3.33	
Age (years)	≤ 40	68	43.3	
	41 - 50	53	31.6	
	51 - 60	35	16.7	44.65
	≥ 61	25	8.4	
Marital Status	Single	17	10.0	
	Married	152	72.5	
	Divorced	1	6.7	
	Widowed	11	7.5	
Household size	≤ 5	32	26.7	8.79
	6-10	77	47.5	
	11-15	37	14.2	
	≥ 16	34	11.6	
Educational Level	No formal education	12	6.70	
	Primary education	87	48.60	
	Secondary education	61	34.08	
	Tertiary education	20	10.61	

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Years of Experience	≤ 5 6 – 10 11 – 15 ≥16	20 38 26 96	11.1 31.6 14.4 63.3	29.87
Farm Size	≤ 3 4 – 6 7 – 9 ≥10	106 46 14 14	71.7 21.7 3.3 3.3	3.06
Access to credit facilities	Yes No	39 81	32.5 67.5	
Access to Extension	Yes No	0 180	0 100	
Member of Association	Yes No	55 125	30.73 69.44	

A notable percentage of respondents (63.3%) have over 16 years of farming experience. The presence of experienced farmers underscores the potential for knowledge transfer within the community. The majority of respondents have farm sizes of 3 acres or less (71.7%). The size of the farm has direct implications for income potential and resource management.

The data shows that a significant proportion of respondents (67.5%) do not have access to credit facilities. Limited access to credit can be a significant barrier to investment in farming activities. None of the respondents reported having access to extension services. The absence of access to extension services suggests a gap in knowledge dissemination, emphasizing the need for improved extension services to provide farmers with essential information and support. Also, approximately 30.73% of respondents are members of an association. Association membership offers potential benefits in terms of resources and networking, suggesting that promoting membership could improve the competitiveness and well-being of farmers.

Identification of Modern Agricultural Technologies Available to Crop Farmers

The result in table 2: revealed that precision agriculture involves using advanced technology to optimize farm operations, and the absence of several key components suggests that the farms in question may not be fully utilizing these technologies. The absence of GPS technology implies that these farms are not employing precise location tracking and mapping. This can have significant implications, as GPS technology is crucial for creating accurate field maps, tracking equipment, and ensuring efficient resource allocation. Without GPS, the farms may struggle with less accurate data collection and suboptimal resource management.

The lack of sensors indicates that these farms are not harnessing the power of data collection from various aspects of the farm environment. Sensors are essential for monitoring soil conditions, crop health, weather, and other critical factors affecting agricultural productivity. The absence of sensors could result in limited data, making it challenging to make informed decisions about irrigation, fertilization, and pest control. The farms not using satellite imagery are missing out on a valuable tool for monitoring and assessing crop conditions from a macroscopic perspective. Satellite imagery provides a bird's-eye view of the fields, helping farmers identify issues such as drought

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stress, disease outbreaks, or uneven crop growth. Without access to this technology, decision-making may be less informed, and timely responses to field conditions may be compromised.[3]

Table 2: *Distribution of Respondent by available technology.*

Item	Yes (%)	No (%)
Precision Agriculture		
GPS	0	100
Sensors	0	100
Satellite Imagery	0	100
Internet of things	0	100
Artificial Intelligence	0	100
Drones	0	100
Cloud Connectivity	0	100
Data Analytics	0	100
Genetic Engineering		
Improved seed varieties	3.33	96.67
Farm Mechanization		
Tractors	75.56	24.44
Combine harvester	0	100
Seeder and Planters	0	100
Irrigation systems	0	100
Harvesting Machine	4.44	95.56
Agrochemicals		
Fertilizer	77.22	22.78
Herbicides	95.0	5.0
Insecticide	68.33	31.67

FACTORS INFLUENCING THE ADOPTION OF MODERN AGRICULTURAL TECHNOLOGIES

Table 3 presents the factors that influenced the adoption of new technologies by the farmers in the study area across various categories, such as improved seed varieties, mechanized equipment, irrigation systems, agrochemicals, and precision farming and protection measures. The table shows that age, access to credit, farm size and educational level were the significant factors that determined the adoption of MATs. The coefficient of determination (R^2) was 0.4078. This indicates that approximately 41% of the variation in dependent variables was explained by the hypothesized independent variables.

The relationship between age and technological adoption is complex. Younger farmers were more likely to adopt mechanized equipment and protection measures, possibly due to greater openness to change and innovation. This finding is consistent with research in various agricultural contexts. For instance, a study by Adeleke (2023) found that younger farmers in Ethiopia were more likely to adopt improved maize varieties. Similarly, research in India by Kumar et al. (2021) indicated that younger farmers were more inclined to adopt modern agricultural practices. [13] In contrast, age did not significantly influence the adoption of improved seed varieties and Precision Farming. These results highlight the need for tailored strategies to target different age groups to ensure wider technology

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adoption. Educational level significantly influenced adoption across all technologies except irrigation systems. This is supported by a study by Feder and Umali (1993) who found that education significantly influenced the adoption of new technologies in Philippine agriculture. Policymakers should invest in education and extension services, especially targeting areas where educational levels are low. Training programs can bridge the knowledge gap, empowering farmers with the understanding necessary for technology adoption.

Additionally, farming experience played a role in technology adoption, with more experienced farmers favoring mechanization. This implies that experienced farmers are more aware of the benefits of technology. This insight is supported by a study by Akpan et al (2023) in Bangladesh who found that experienced farmers were more likely to adopt modern rice farming technologies. Tailoring training and support programs to the experience level of farmers can facilitate better technology adoption.

Table 3 shows that larger farms adopted a broader range of technologies, indicating economies of scale. This also highlights the challenges faced by small farms. Larger farms adopting a broader range of technologies due to economies of scale is a common observation. This concept is supported by economic theory and empirical research. For instance, research by Jayne et al. (2023) in Kenya highlighted the relationship between farm size and technology adoption.[12] Policymakers should focus on providing financial and infrastructural support to smaller farms, enabling them to access resources, credit, and technology. Specialized programs targeting small farms can level the playing field.

The significant influence of access to credit underscores the importance of financial support in enabling farmers to invest in modern technology. A study by Doss et al. (2003) in Ethiopia emphasized the importance of credit in technology adoption. Access to credit is crucial for farmers to invest in modern technologies. Policymakers should focus on improving credit accessibility, ensuring that farmers have the necessary financial resources to adopt and utilize technology effectively. Also, membership in farmers' associations positively affected technology adoption, emphasizing the role of collective action and group support. A study by Barrett (2012) in Kenya highlighted the role of collective action in technology adoption. Promoting or establishing such associations can create a conducive environment for technological adoption.[6] Farmers can sh are knowledge, pool resources, and collectively invest in modern agricultural practices.

Table 3: *Factors influencing the rate of adoption of Modern Technology Using Multivariate Regression Model.*

	Improved seed Varieties		**Mechanized Equipment**		**Irrigation System**		**Agrochemicals**		**Precision Farming**		**Protection Measures**	
Variables	**B**	**S.E**	**B**	**S.E**	**B**	**S.E**	**B**	**SE**	**B**	**SE**	**B**	**SE**
Intercept	0.042	0.125	-0.307	0.220	-0.034	0.106	0.941	0.130	0.024	0.050	0.028	0.150
Gender	0.002	0.00	0.074	0.1	-0.003	0.00	-	0.1	0.0	0.0	0.004	0.1

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		2		69		2	0.006	01	04	39		15
Age	0.005	0.091	0.001**	0.003	-0.035	0.082	0.003	0.022	-0.001	0.039	-0.005**	0.002
Educational Level	-0.02	0.026	0.578	0.036	0.043**	0.018	-0.001	0.007	0.014*	0.008	0.035	0.025
Household size	-0.007	0.018	0.003*	0.011	0.004	0.005	0.002	0.002	-0.003	0.003	0.004	0.008
Farming Experience	-0.007	0.006	0.005***	0.003	0.003*	0.002	-0.004**	0.008	-0.000	0.001	0.004*	0.002
Farm size	0.036***	0.007	0.108**	0.014	0.037***	0.007	-0.020**	0.057	0.005	0.003	0.076***	0.010
Access to Credit	0.152***	0.007	0.277	0.095	0.103***	0.046	0.087	0.034	-0.012	0.022	0.248***	0.065
Farmers Association	0.157	0.049	0.866	0.057	0.043	0.028	-0.028	0.130	0.022*	0.013	0.027	0.039
No of Obs = 180	*R^2=0.4078*	*F=14.03*	*P = 0.000*									

**** at 1% significant level, ** at 5% significant level, * at 10% significant level*

Constraints Militating the Adoption of Modern Agricultural Technologies

This section presents the results in table 4: constraints militating the adoption of modern agricultural technologies. Some of these constraints are reported in Table 4. About 97.19% of the respondents reported that high initial investment costs constituted a very severe constraint to adopting new technologies. Meanwhile, at least 97.2% of the respondents reported that lack of access to credit/finance also constituted a very severe constraint to adopting modern agricultural technologies. A similar challenge faced by the farmers was poor communication channels by extension agents. This was reported by 93.82% of the farmers as being very severe. Limited availability of technology in the local market constituted very severe, severe and not severe to 52.25%, 18.54% and 11.24 of the respondents respectively. The result of the study indicated that inadequate infrastructure constituted about 76.53% of the constraints militating the adoption of these technologies by farmers in the study area. Lack of awareness about the benefits was another constraint as reported by 63.69% of the farmers. Furthermore, lack of incentives from the government constituted a very severe limitation to the adoption of MATs by 98.32% of the farmers. Table 4 equally indicated that insufficient land constituted a little limitation to the adoption of MATs by 76.4% of the respondents while 14.05% lamented that insufficient land limited its adoption among them.

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Table 4: *Constraints Militating the Adoption of Modern Agricultural Technologies.*

Constraints	**VS**	**S**	**MS**	**NS**	**NP**	**Weighted Score**	**Mean**	Rank
High initial investment costs	171 (96.07)	2 (1.12)	1 (0.56)	1 (0.56)	3 (1.69)	546	5.0	1st
Lack of access to credit/finance	170 (94.97)	4 (2.23)	3 (1.68)	1 (0.56)	1 (0.56)	545	5.0	2nd
Limited availability of technology in the local market	93 (52.25)	33 (18.54)	29 (16.29)	20 (11.24)	3 (1.69)	461	4.22	5th
Insufficient technical knowledge/training	78 (43.58)	62 (34.64)	25 (13.97)	12 (6.70)	2 (1.12)	444	4.07	8th
Inadequate infrastructure (e.g., power supply, roads)	70 (40.22)	65 (36.31)	31 (17.32)	10 (5.59)	1 (0.56)	445	4.08	7th
Concerns about potential environmental risks	52 (29.05)	71 (39.66)	33 (18.44)	18 (10.06)	5 (2.79)	414	3.79	9th
Lack of awareness about the benefits	59 (32.96)	55 (30.73)	34 (18.99)	25 (13.97)	6 (3.35)	401	3.67	10th
Lateness in supplying input	74 (42.05)	73 (41.48)	17 (9.66)	7 (3.98)	5 (2.84)	451	4.17	6th
Poor communication channel by extension agents	167 (93.82)	8 (4.49)	-	2 (1.12)	1 (0.56)	544	4.99	3rd
Lack of incentives from government	171 (95.53)	5 (2.79)	-	1 (0.56)	2 (1.12)	543	4.99	4th
Not better than previous practices	11 (6.15)	8 (4.47)	15 (8.38)	115 (64.25)	30 (16.76)	225	2.33	12th
Insufficient land	11 (6.18)	14 (7.87)	17 (9.55)	79 (44.38)	57 (32.02)	225	2.36	11th

VS = Very severe; S = Severe; MS = moderately severe; NS = Not severe; NP = Not a problem

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CONCLUSION

The adoption of modern agricultural technologies by farmers are determined by a number of socioeconomic and farm-related factors. These include age, educational level, and farm size, farming experience, access to credit and association membership. Others include access to extension agents. These are coupled with some constraints ranging from institutional to infrastructural bottlenecks.

RECOMMENDATIONS

Based on the findings from the study, the following interventions are recommended in order to improve the adoption of modern agricultural technologies by crop farmers:

1. Government and financial institutions should provide affordable and accessible credit facilities tailored to the needs of smallholder farmers. This could include low-interest loans, microfinance programs or grants for adoption of technology. Farmers themselves should also be ready to adopt and directly contribute towards the adoption of modern technologies.
2. Government agencies should provide incentives, such as subsidies or grants, to encourage farmers to adopt modern agricultural technologies. This incentive can help offset initial investment costs and make new technologies more affordable.
3. Rural infrastructures, including roads, transportation and storage facilities should be improved by the government and other necessary stakeholders so as to ensure that farmers have timely access to inputs and markets that will in turn facilitate the adoption of new practices and technologies.
4. The promotion of farmers' associations should be done. While the study indicated a negative correlation between membership in farmers' associations and technology adoption, further research is needed to understand the reasons behind this. Farmers' associations should be encouraged to embrace innovation and provide training and support for their members in adapting new technologies.
5. Extension agents need to strengthen their services. They should be well-trained, readily available to farmers and equipped with up-to-date knowledge on modern agricultural practices.

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