Greener Journal of Agricultural Sciences
ISSN: 2276-7770
Vol. 14(1), pp. 23-32, 2024

https://gjournals.org/GJAS

Determinants of Adoption of USAID Markets II Project's Agricultural Technology by Smallholder Farmers in Southwest, Nigeria.

Ogunjobi, V.O.

Department of Project Management Technology, Federal University of Technology Akure, Ondo State, Nigeria.

ARTICLE INFO

Article No.: *020124018*
Type: *Research*
Full Text: *PDF, PHP, HTML, EPUB, MP3*

Accepted: *03/02/2024*
Published: *07/02/2024*

Corresponding Author
Dr. (Mrs) Ogunjobi, V.O.
E-mail: *voogunjobi@ futa.edu.ng*

Keywords: *Agricultural technology, smallholder farmers, MARKETS II project, adoption.*

ABSTRACT

This study was conducted to assess the determinants of adoption of agricultural technologies introduced by MARKETS II project to small-holder farmers in Southwest, Nigeria. Specifically, the study assessed the level of adoption of USAID MARKETS II project's technologies and the also the factors determining the adoption of these technologies. Multistage sampling procedure was used to select a sample size of 525 farmers, out of which 254 were project participants and 271 were non- participants of the project. Questionnaires were used to collect the data from the respondents. The results were analysed using frequencies and percentages and Binary Logit regression. The results revealed that factors that determined the adoption of technologies introduced by MARKETS II project included educational status, farm size, farming experience, membership in cooperative societies, annual income and number of extension visits. However, farming experience had a negative relationship. Also, the agricultural technologies introduced by MARKETS II project were well adopted by the farmers as all the mean values (3.0833 to 4.6909) were greater than the weighted mean (3). The study therefore recommends that smallholder farmers should be encouraged to join cooperative societies as this was shown to boost their exposure to new technology and special educational facilities should also be provided for the farmers for them to achieve a higher level of education as this has implications for technology adoption.

1. INTRODUCTION

Agriculture plays a central role in stimulating economic growth, reducing poverty, and improving food and nutrition security in the world. Globally, the agricultural sector is an important area for economic development while economic history provides evidence that agricultural revolution is a fundamental requirement for economic growth (Stewart, 2000; Adesina, 2012; Alexandratos & Bruinma, 2012; Dada, 2014; Okunlola, 2019). A strong and efficient agricultural sector would enable a country to feed its populace, generate employment, earn foreign exchange and provide raw materials for industries. The agricultural sector has a multiplier effect on a nation's socio-economic and industrial structure because of the multifunctional nature of agriculture (Ogen, 2004; Dada, 2014, Mosa *et al.,* 2023). Smallholder agriculture means cultivating land primarily by farmers who own less than five hectares. It is an important sector especially in developing countries, because it contributes to food security and poverty alleviation.

The United States Agency for International Development (USAID) is the world's premier international development agency and a catalytic actor driving development results. USAID leads international development and humanitarian efforts to save lives, reduce poverty, strengthen democratic governance and help people progress beyond assistance. The objective of USAID is to support partners to become self-reliant and capable of leading their own developmental programmes. USAID and Chemonics International worked together in the Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) II project through large-scale commercial buyers and agricultural lending banks to help smallholders access training and high-quality inputs, such as seeds and fertilizers. MARKETS II launched in April 2012 to promote sustainable agriculture development via increasing private sector participation and investment, introduction of improved technology, raising income, increasing employment, attaining food security, and reducing poverty (USAID, 2013). Agricultural projects may be technology- oriented, which are to change the technical production potential; to broaden the resource base; to improve post harvest distribution; or institution building, at the Government level, project-management level and or the farmers' level (Vernon & Yujiro, 2014). The United States Agency for International Development (USAID) Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) II project is an example of such projects. The USAID MARKETS-II project is a demand driven agriculture systems facilitation project that took place in 26 states in Nigeria. The project was to assist farmers define their needed quality and quantity of inputs and also to mobilize firms such as seed and fertilizer firms, farm implements providers, extension services and credit providers to collaborate with government extension agents to provide training and capacity building programmes to the farmers. The project was also implemented to scale up agricultural technology interventions across different value chains while contributing to more inclusive, resilient and sustainable agricultural development (USAID,2017).

Problem statement

In Nigeria's agricultural system, a notable aspect is the significant share of farm production managed by smallholder farmers. Typically, these farmers own between 1 to 3 hectares and have restricted access to advanced farming technologies. (Ogunlela & Mukhtar, 2009, Nchuchuwe & Adejuwon, 2012). Many smallholder farmers lack the infrastructure and technical resources to improve yields and adopt modern production practices and marketing strategies, therefore there is a need for technologies that can help smallholder farmers gain the necessary tools and resources to improve their productivity and resilience to risk (Mosa *et al.,* 2023).

The Nigerian agricultural sector has suffered from years of poor management, inconsistent and poorly implemented government policies and projects (Amos, 2018, Ogunleye et al., 2018). It is also characterized and surrounded by illiterate farmers who live in rural areas, producing over 90 percent of the total food consumed and other agricultural products (Ogunjobi et al., 2022). The farmers' educational status gives them little or no room for improvement through scientific research, innovation and different agricultural development projects.

This study therefore is to evaluate the determinants of adoption of technology by smallholder farmers in Southwest, Nigeria, with special reference to the Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) 11 project. This is in view to maximizing the developmental outcomes of agricultural projects which will in turn stimulate economic growth, reduce poverty and increase food security consequent to achieving sustainable development goals.

METHODOLOGY

The study area for this research is Southwest Nigeria. Southwest, Nigeria is one of the geopolitical zones of Nigeria. It is made up of six States: Ekiti State; Lagos State; Ogun State; Ondo State; Osun state; and Oyo State. However, the study was limited to Ondo and Oyo states, because they were the intervention states of the MARKETS II project. The research design that was used for this study is the descriptive research design which involved survey research. In this survey research, the researcher selected a sample of respondents from the population and administered structured copies of questionnaire to them. Primary data were used for this

study. Structured questionnaires were used to collect the primary data from the respondents.

The population of the study comprises all cocoa, cassava and aquaculture farmers in the areas of intervention of MARKETS-II project in Southwest, Nigeria (Ondo, and Oyo states). The participants and non- participants of the project in these states that are involved in farming and processing of the value chains.

Multistage sampling procedure was used to carry out the sampling in stages. In the first stage, purposive sampling method was used to select Ondo and Oyo states out of the 6 states in Southwest Nigeria. These states were chosen because they were the areas of intervention of the USAID MARKETS II project. At the second stage, purposive sampling was also used to select the MARKETS II project intervention towns. At the third stage, stratified sampling technique was used to divide the population into groups based on the value chain (cocoa, cassava and aquaculture), the state and towns of intervention (35), then using the random sampling technique, a sample of 15 farmers were chosen per town.

Model Specification

Binary Logistic Regression model

Due to the dichotomous nature of the independent variable, the binary logistic regression model was employed to assess how a set of independent variables such as gender, age, household size, level of education, farm size, farming experience, annual income (farm and non- farm), access to credit and membership in cooperative society determined adoption of the agricultural technologies introduced by the MARKETS II project. This model has been used by (Hazra and Gogtay, 2017; Owusu, 2017). Adoption of MARKETS II technologies was conceptualized as bivariate, taking the value of 1 for respondents that adopted and 0 for no adoption. This was used as the dependent variable. Demographic variables as well as other variables were used as independent variable and specified explicitly in the model as:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + U \ldots\ldots\ldots\ldots\ldots (i)$$

Where; Y = Adoption of MARKETS II agricultural technologies (1 = Yes, 0 = otherwise)
β_0 = Constant
X_1 = Age of the farmer (years)
X_2 = Gender of the farmer (Male = 1 : Female = 0).
X_3 = Educational status of the farmer (Number of years).
X_4 = farm size (hectares)
X_5 = household size
X_6 = farming experience (Number of years)
X_7 = Membership of cooperatives (Yes = 1: No = 0)
X_8 = Annual Income (Amount in Naira)
X_9 = Access to credit (Yes = 1: No = 0)
X_{10} = Number of visits by extension agents
U = Error term

(i) Five point Likert Scale

A five point likert scale was used to assess the level of adoption of agricultural technology introduced by the MARKETS-II project: Very low = 1; low = 2; moderate = 3; high = 4; very high = 5.

The likert scale measuring instrument is represented by the formula:

$$\bar{X} = \sum fx/N$$

Where $\bar{X}$ = mean score
$\sum$ = summation sigh
f = frequency
x = number of nominal value of each response category
N = number of respondents

$$\frac{5+4+3+2+1}{5} = 3$$

Therefore the weighted mean is 3
Decision rule: Any mean value greater or equal to 3 means positive level of adoption as shown in Table 1.

Table 1: Likert Scale interpretation using mean score

Value	range allocation	Innovation adoption status
0.1-	1.0	Not adopted
1.1-	2.0	Slightly adopted
2.1-	3.0	Moderately adopted
3.1-	4.0	Mostly adopted
4.1-	5.0	Completely adopted

Adapted from Mohammad *et al.* (2014), Owusu-Manu *et al.* (2017)
Source: Field Survey, 2023

RESULTS AND DISCUSSION

Socio- Economic Characteristics of Respondents

Table 2 presents the Socio- economic characteristics of the respondents, both participants and non- participants of the MARKETS II project. It provided descriptive information on age, gender, educational qualification, marital status, family size, farming experience, land size, and membership of respondents in cooperative societies.

(i). Age of Respondents

Table 2 reveals the age distribution of the respondents, highlighting that the bulk of them fall within the 40 to 49

age range. Specifically, 27.2% of participants and a higher percentage of 36.2% of non-participants were within this age bracket. Notably, 12.2% of participants were under 20 years old, a segment not represented among the non-participants, suggesting a younger demographic involvement in the MARKETS II project. Additionally, 7.9% of participants and 1.5% of non-participants were aged between 20 and 29 years. The 30 to 39 age group comprised 23.2% of participants and 25.1% of non-participants, while 18.9% of participants and 30.3% of non-participants were between 50 and 59 years old. Those above 60 years constituted 10.6% of participants and 7% of non-participants.

This data indicates that a greater proportion of participants are under the age of 50 compared to non-participants, suggesting that participants are generally younger and more of them are in their prime productive years. This age factor could be influential in the easier adoption of technology among participants. These observations align with the research findings of Oladapo et al. (2012), Fanola and Fakayode (2014), Mazza et al. (2015), Balogun et al. (2016) and Akudugu *et al.,* (2023).

(ii). Gender of Respondents

According to the data presented in Table 2, the majority of both participant and non-participant farmers were male, with 65.2% of participants and 72% of non-participants being men. Conversely, women accounted for 34.8% of participant farmers and 28% of non-participants. These statistics indicate a higher representation of male farmers in both groups. This trend suggests that the farming of crops like cocoa and cassava, as well as aquaculture in Southwest Nigeria, is predominantly undertaken by men, possibly due to the demanding nature of these agricultural activities. This observation is in line with the findings from studies conducted by Oluwatusin (2014), Mazza et al. (2015), Abidogun et al. (2019) and Falana *et al*., (2023).
, which also highlight the male-dominated aspect of these agricultural sectors.

(iii). Educational Qualification

The educational attainment of the respondents, as outlined in Table 2, indicates varied levels of education between participants and non-participants. Specifically, 6.7% of participants and a higher 15.9% of non-participants had no formal education. Delving deeper, 23.2% of the participants completed primary education, while this figure was 33.6% among non-participants. Secondary education was attained by 30.7% of participants and 18.8% of non-participants. Vocational education was pursued by 5.9% of participants and 9.2% of non-participants. Notably, 33.2% of participants advanced to tertiary education, compared to 22.6% of non-participants. These figures suggest that participants generally had a higher level of education, with a greater percentage achieving tertiary education, whereas non-participants were more likely to have no formal education. This trend aligns with Mazza *et al.* (2015) Balogun *et al.* (2016) and Sanusi *et al.,* (2023) who observed that beneficiaries of the FADAMA project were typically more educated than non-beneficiaries. This difference in education levels could have implications for the adoption of technology and the effective management of agricultural businesses.

(iv). Marital Status

According to the data outlined in Table 2, the marital status of the respondents indicates that a significant proportion, consisting of 74.4% of participants and 93% of non-participants, were married. This high percentage of married individuals suggests a responsible approach to both farm management and accurate questionnaire completion. Among the participants, 21.6% were single and 2.4% were either divorced or separated. In contrast, 3% of the non-participants were single and 4.1% were divorced. The predominance of married respondents in this survey potentially reflects positively on the availability of family labor. This correlation is consistent with the findings of Balogun *et al.* (2011), Mazza *et al.* (2015) and Makka *et al.,* (2023) who noted that a high rate of married farmers indicates a commitment to work diligently for the welfare of their families.

(v). Household size

Examining how respondents are distributed based on the size of their households shows that the majority, comprising 62.6% of participants and 57.9% of non-participants, have households consisting of 4 to 6 individuals. Following this, 27.6% of participants and 15.9% of non-participants have between 7 and 10 members in their families. Additionally, households with 1-3 persons account for 9.8% of participants and 24% of non-participants. This trend suggests that the respondents have the advantage of family assistance, which potentially reduces their reliance on hired labour. This concept aligns with the findings presented by Balogun et al. (2011) and and Makka *et al.,* (2023).

(vi). Farming experience

Farming experience is crucial for the effectiveness of agribusiness ventures. Table 2 categorizes respondents by their years of farming experience, highlighting differences between participants and non-participants. A significant 37% of the participants reported having 16 to 20 years of farming experience. In contrast, the majority of non-participants had 11 to 15 years of experience. Among participants, a small proportion (2.8%) had less than 5 years of experience, 9.4% had 6 to 10 years, 13.4% had 21 to 25 years, and another 13.4% had over 25 years of experience. For non-participants, 17% had under 5 years of experience,

20.3% had 11 to 15 years, 20.7% had 16 to 20 years, 8.9% had 21 to 25 years, and 9.6% had more than 25 years of experience in farming. This distribution reflects the notion posited by Balogun *et al. (*2011) and Anyasi *et al.,* (2023) that greater farming experience enhances a farmer's ability to make more informed production decisions, thereby boosting their knowledge and productivity.

(vii). Farm Size

Table 2 presents data on the farm sizes of respondents in hectares. Among the participants, only 3.1% managed less than 1 hectare, whereas for non-participants, this figure was 12.6%. A significant majority (93.7%) of the participants had farms ranging from 1 to 5 hectares, reflecting the MARKETS II project's focus on smallholder farmers. A smaller portion, 2.8%, had farms between 6 and 10 hectares, and a mere 0.4% managed farms between 11 and 15 hectares. Similarly, the largest group of non-participants comprised those with farms of 1 to 5 hectares. Among the non-participants, 9.2% had farms of 6 to 10 hectares. It's noted that none of the respondents possessed farms larger than 15 hectares. This finding supports Okunlola's (2019) research, which highlighted the dominance of smallholder farmers in Nigeria's agricultural production system, responsible for a substantial part of agricultural output.

(viii). Membership of cooperatives

Cooperative societies play a crucial role in providing capital to farmers, thereby enhancing their income. As indicated in Table 2, membership in a cooperative society is notably higher among participants of the MARKETS II project, with 72.4% being members, compared to 57.2% of non-participants. This higher membership rate among participants suggests a stronger engagement in agricultural projects. Farmers believe that being part of a cooperative society affords them greater access to agricultural information, more affordable inputs, and improved extension services. This observation aligns with the research conducted by Balogun *et al.* (2011) and Ojiagu and Uchenna (2015).

Table 2: Socio- economic Characteristics of Respondents

	Participants		Non-Participants	
Characteristics	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
Age (Years)				
Below 20	31	12.2	0	0.0
20-29	20	7.9	4	1.5
30-39	59	23.2	68	25.1
40-49	69	27.2	98	36.2
50-59	48	18.9	82	30.3
60 and above	27	10.6	19	7.0
Total	**254**	**100.0**	**271**	**100.0**
Gender				
Male	166	65.2	195	72.0
Female	88	34.8	76	28.0
Total	**254**	**100.0**	**271**	**100.0**
Educational Qualification				
Primary school	59	23.2	91	33.6
Secondary School:	78	30.7	51	18.8
Vocational/ Technical	15	5.9	25	9.2
OND	45	17.7	37	13.7
HND	13	5.2	16	5.9
BSc, BA, BEd, BTech	27	10.6	8	3.0
Informal	17	6.7	43	15.9
Total	**254**	**100.0**	**271**	**100.0**
Marital status				
Married	189	74.4	252	93.0
Single	55	21.6	8	3.0
Divorce/ Separated	6	2.4	11	4.1
Others	4	1.6	0	0.0
Total	**254**	**100.0**	**271**	**100.0**
Family size				
1-3	25	9.8	65	24.0
4-6	159	62.6	157	57.9
7-10	70	27.6	43	15.9
Total	**254**	**100.0**	**271**	**100.0**
Farming experience (years)				
Below 5	7	2.8	46	17.0
6-10	24	9.4	55	20.3
11-15	61	24.0	64	23.6
16-20	94	37.0	56	20.7
21-25	34	13.4	24	8.9
25 and above	34	13.4	26	9.6
Total	**254**	**100.0**	**271**	**100.0**
Land size (hectares)				
<1	8	3.1	34	12.6
1-5	238	93.7	212	78.2
6-10	7	2.8	25	9.2
11-15	1	0.4	0	0.0
16-20	0	0.0	0	0.0
21-25	0	0.0	0	0.0
Above 25	0	0.0	0	0.0
Total	**254**	**100.0**	**271**	**100.0**
Membership of cooperatives				
No	70	27.6	116	42.8
Yes	184	72.4	155	57.2
Total	**254**	**100.0**	**271**	**100.0**

Source: Field Survey, 2023

Determinants of Adoption of Technology introduced by MARKETS II Project

Table 3 presents the statistical results from the binary logistic regression performed to assess the factors determining adoption of technology introduced to the farmers by the MARKETS II project in Southwest, Nigeria. The values of the model Chi- square and the Hosmer- Lemeshow statistics indicated that the selected variables fit the model well. The model containing all independent variables was statistically significant (97.629, $p < .001$), indicating that the model was able to distinguish between respondents who adopted the technology and respondents who did not adopt the technology. The model as a whole explained between 35.5% (Cox and Snell R^2) and 49.4% (Nagelkerke R^2) of the variance in technology adoption and correctly classified 76.9% of technology adoption. The results also show that the factors that significantly determined the adoption of technologies introduced to the farmers by the MARKETS II project include educational status, farm size, farming experience, membership in cooperative, annual income, access to credit and number of extension visits. Educational status with coefficient value, (1.109), farm size (0.339), farming experience, (-3.447), membership in Cooperative (1.825), annual income (0.002) access to credit (0.741) and number of extension visits (0.002). The positive value of educational status implies that the higher the educational status of the farmer, the higher the probability of farmers adopting the MARKETS II project's technology. The coefficient values also show that the more the farming experience the farmer has, the more likely it is that he adopts the project's technology. The significant and positive values of the farmers' farm size, membership in cooperative society, annual income, access to credit and number of extension visits imply that these variables were an important factor in inducing farmers to adopt the project's technology. However, the negative value of the coefficient of farming experience indicates that the more the farming experience a farmer possesses, the less likely it is for the farmer to adopt the project's technology. The results further show that the strongest determinant of farmers' adoption of technology was membership in cooperative society, recording an odds ratio of 6.203. The odds ratio of 1.002 for annual income indicates that for every additional increase in annual income, the odds of the farmer adopting the technology increased by a factor of 1.002, all other factors in the model being equal. Considering the farmers' farming experience, the odds ratio of 0.032 implies that the farmers with more farming experience are 0.032 times less likely to adopt the technology than the farmers with less farming experience. Considering the farmers' membership in cooperative societies, results show that the farmers who are members of cooperative societies are 6.203 times more likely to adopt the MARKETS II technology than those who are not members of any cooperative society. The results also show that the odds of a farmer adopting the technology is 3.032 times higher for the educated farmers than for the uneducated farmers, all other factors being equal. This means that the higher the level of education of the farmer, the more likely it is for the farmer to adopt the MARKETS II technology. Access to credit, extension visits and farm size also has a positive relationship to adoption of technology. For every additional increase in the farmers' access to credit, extension visits and farm size, the odds of a farmer adopting the technology increased by 2,099, 1.002 and 1.404 respectively.

Table 3: Binary logistic regression estimates of the determinants of adoption of MARKETS II project's agricultural technology

Code	Variables	Coefficient	S.E.	Sig.	Odds Ratio
X_1	Age	-1.569	1.291	.224	.208
X_2	Gender	.398	.436	.361	1.489
X_3	Educational status	1.109*	.669	.097	3.032
X_4	Farm Size	.339***	.114	.003	1.404
X_5	Household size	-.852	.850	.316	.426
X_6	Farming Experience	-3447***	1.265	.006	.032
X_7	Membership in Cooperative	1.825***	.409	.000	6.203
X_8	Annual Income	.002**	.001	.027	1.002
X_9	Access to Credit	.741*	.408	.069	2.099
X_{10}	Extension visit	.002*	.001	.027	1.002
	Constant	-1.904	1.252	.128	.149
Model Chi- square		97.629			
Hosmer- Lemeshow test:					
Chi- square		2.938			
Significance		.938			
Cox and Snell R^2		.355			
Nagelkerke R^2		.494			
Overall predicted percentage correct		76.9			

*, **, *** Significant at 10, 5, and 1 percent levels respectively. Source: Field Survey, 2023

Level of adoption of agricultural technologies introduced by MARKETS-II project in the study area

Table 4 shows the level of adoption of agricultural technologies provided by MARKETS-II project. All the mean values were greater than the weighted mean, 3, this implies that all the technology provided were well adopted. Training on optimal spacing of cassava stem cuttings when planting had the highest level of adoption (4.6909). Training on pruning and phyto-sanitary management of cocoa (4.6727). Training on intercropping (4.5683); provision of raised drying platform for cocoa (4.4667); new feeding techniques for aquaculture production (4.3333); provision of club to break open cocoa pods (4.2919); training on timely use of NPK, pesticide and herbicide for cassava (4.2837); access to new cultivation practices (4.2585); support to become certified under international cocoa standard (4.2122); new agronomic management practices (4.1519); access to farmers' association (4.1276); and access to training on integrated pest management (4.0151) were completely adopted. Furthermore, access to new processing techniques (3.9750); access to market outlet for easy sale of farm produce (3.8095); access to new marketing and storage techniques (3.6841); access to local market (3.6644); provision of improved smoking kilns for processing (3.5833); access to middle men to facilitate marketing (3.5114); access to Government buying agents (3.3356); training on pond water sanitation (3.2291); and access to improved water testing for aquaculture (3.0833) were mostly adopted. Following the Roger's innovation adoption classification, the adoption status from table 4.12 shows that 56.5% of the technologies introduced to the farmers by the MARKETS-II project were completely adopted, while 43.5% were mostly adopted. This study in tandem with the works of Ogbodo *et al*. (2021) which posited that rice farmers in Enugu state significantly adopted improved technology.

Table 4:Level of adoption of agricultural technologies introduced by MARKETS-II project

Technologies	introduced by MARKETS-II	Mean (X)	Adoption status
1.	Access to New cultivation practices	4.2585	Completely adopted
2.	Access to New processing techniques	3.9750	Mostly adopted
3.	Access to New Marketing and storage techniques	3.6841	Mostly adopted
4.	Access to Market outlet for easy sale of farm produce	3.8095	Mostly adopted
5.	Access to sales at Farm gate	3.6636	Mostly adopted
6.	Access to Middle men to facilitate marketing	3.5114	Mostly adopted
7.	Access to Local market	3.6644	Mostly adopted
8.	Access to Farmers' association	4.1276	Completely adopted
9.	Access to Government buying agents	3.3356	Mostly adopted
Technology introduced specifically for Cocoa			
10.	Provision of club to break open pods	4.2919	Completely adopted
11.	linking cocoa farmers with major procuring and processing companies	4.2261	Completely adopted
12.	Provision of raised drying platform	4.4667	Completely adopted
13.	Support to become certified under international cocoa standard	4.2122	Completely adopted
14.	Access to Training on integrated pest management	4.0151	Completely adopted
15.	Access to training on pruning and phyto sanitary management	4.6727	Completely adopted
Technology introduced specifically for Cassava			
16.	New agronomic management practices	4.1519	Completely adopted
17.	Training on optimal spacing	4.6909	Completely adopted
18.	Training on timely use of NPK, pesticide and herbicide	4.2837	Completely adopted
19.	Training on intercropping	4.5683	Completely adopted
Technology introduced specifically for Aquaculture			
20.	Access to Improved water testing	3.0833	Mostly adopted
21.	New feeding techniques	4.3333	Completely adopted
22.	Training on pond water sanitation	3.2291	Mostly adopted
23.	Provision of improved smoking kilns for processing	3.5833	Mostly adopted

Source: Field Survey, 2023

CONCLUSION

The study assessed the factors that determined the adoption of agricultural technologies introduced by MARKETS II project to smallholder farmers in Southwest, Nigeria. Based on the results, the factors that determined the adoption of technologies introduced by MARKETS II project included educational status, farm size, farming experience, membership in cooperative societies, annual income and number of extension visits. However, farming experience had a negative relationship. The results further show that the strongest determinant of the smallholder farmers' adoption of technology was membership in cooperative society among all the other determinants. Also, the results show that the agricultural technologies introduced by MARKETS-II project were well adopted by the farmers.

Recommendation

Based on the findings and conclusion of this study the following recommendations were made:

i). Smallholder farmers should be encouraged to join cooperative societies as this was shown to boost their exposure to new technology.
ii). Special educational facilities should also be provided for the farmers for them to achieve a higher level of education.
iii). Extension agents should be made to visit the farmers as at when due.

Acknowledgement

The support provided by Tertiary Education Trust Fund (TETFund) through Institution – Based Research (IBR) enabled us to conduct data collection, analysis, and interpretation, as well as cover expenses related to research materials, participant recruitment, and travel, where applicable. Their investment in this work has significantly contributed to the quality and impact of our research findings.

REFERENCES

Abidogun, O. G., Olajide B. R., Amujoyegbe, B. J., Bamire, A. S., Kehinde, A. D. & Gaya, I.(2019). Gender Involvement in Cocoa Farming Activities in South West Nigeria. *Ife Journal of Agriculture*. 31(1), 104-117.

Adesina, A. (2012). *Agricultural transformation agenda: Repositioning agriculture to drive Nigeria's economy*. Abuja: Nigeria Federal Ministry of Agriculture and Rural Development.

Akudugu M.A, Nkegbe P.K., Wongnaa C.A., Millar K.K. (2023). Technology adoption behaviors of farmers during crises: What are the key factors to consider? *Journal of Agriculture and Food Research,* Volume 14, 100694, ISSN 2666-1543,

Alexandratos, N. & Bruinsma, J. (2012). World agriculture towards 2030/2050: The 2012 Revision. Global Perspective Studies Team ESA Working Paper No. 12-03 June 2012 Agricultural Development Economics Division Food and Agriculture Organization of the United Nations.

Anyasi, C. F., Ajah, J., and Idu, E. E. (2023). Small-Scale Crop Farmers' Access to Farm Inputs in the North Central Zone, Nigeria*. Direct Research Journal of Agriculture and Food Science:* Vol. 8 8 (8), pp.288-294, ISSN 2354-4147

Amos, T. T. (2018). Agricultural production and productivity: The game changing food security paradigm in Nigeria. Inaugural Lecture Series 95 Federal University of Technology, Akure, Nigeria.

Balogun O.L., SA Yusuf, BT Omonona, VO Okoruwa (2011). Social capital and microcredit effects on poverty among the rural households in South west states, Nigeria. *Journal of Agricultural and Biological Science.*

Balogun, O. L., Ogunsina,I. J. Ayo-Bello T. A., Afodu O.J.(2018). Effect of social capital on productivity of cassava farmers in Ogun State, Nigeria. *Journal of Agricultural Sciences, Belgrade,* 63. 99-112. 10.2298/JAS1801099B.

Dada A.D. (2014). Evaluation of Technological Capability and Innovations in the Nigerian Cassava Processing Industry. An Unpublished Ph.D. Thesis Submitted to the African institute for Science policy and Innovation (AISPI), Faculty of Technology, Obafemi Awolowo University, Ile-Ife, Nigeria, 2014.

Falana, A.R., Aderounmu, A.F., Ayandokun, A.E., Adesokan, F.B., Majolagbe, M.O., Adelusi, F.T., Oke, O.O. and Ojo-Fakuade, F. (2023). Level of Awareness of Silkworm Rearing among Farmers in Ido Local Government Area, Ibadan, Oyo State, Nigeria. *Nigerian Agriculture Journal* ISSN: 0300-368X 54 (1). 149-155.

Fanola, A. and Fakayode S. B. (2014) Awareness and effects of climate change on cocoa production in Ondo State, Nigeria *International Journal of Applied Agricultural and Apicultural Research* Faculty of Agricultural Sciences, LAUTECH, Ogbomoso, Nigeria. IJAAAR 10 (1&2): 91-97

Hazra, A., & Gogtay, N. (2017). Biostatistics Series Module 9: Survival Analysis. *Indian Journal of Dermatology*, 62, 251 - 257

Makka, T. B., Murtala, N., Sani, M. H., & Haruna, U. (2023). Socio-economic characteristics of irrigated upland tomato (*lycopersicon esculentum*) farmers in Gombe state, Nigeria. *Journal of Agripreneurship and Sustainable Development*, *6*(2), 140–161. https://doi.org/10.59331/jasd.v6i2.443

Mazza M., Ekumankama O.O., & Okezie, C.A. (2015). Effect of Second National Fadama Development

Project on Farmers Productivity in Imo State, Nigeria. *Journal of Natural Sciences Research*, 5, 69-74.

Mosa S. S. and László, Berényi. 2023. E-Governance in Agriculture: A Framework on Digital Technology Adaptation by Smallholder Farmers. In Central and Eastern European eDem and eGov Days 2023 (CEEeGov 2023), September 14, 15, 2023, Budapest, Hungary. ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/3603304.3603341

Muhammad Waseem Riaz Marral[1], Muhammad Shahid Ibni Zamir[2] and Shahid Iqbal (2014). Impact of Phosphorous Levels and Different Tillage Systems on Yield and Economics of

Nchuchuwe, F. F. & Adejuwon, K. D. (2012). The challenges of agriculture and rural development in Africa: The case of Nigeria. *International Journal of Academic Research in Progressive Education and Development, 1* (3).

Ogbodo, I. H., Aguaguiyi, F. N., Nwafor M. O., G.O. Umebali, E.E. (2021). Determinants of Adoption of Improved Agricultural Technologies among Fadama Rice Farmer Cooperative Societies in Enugu State, Nigeria University-Led Knowledge and Innovation for Sustainable Development Nnamdi Azikiwe University Book Series on Sustainable Development.

Ogen, O. (2003). Patterns of economic growth and development in Nigeria since 1960 In: S.O. Arifalo and Gboyega Ajayi (Eds) (2003). Essays in Nigerian contemporary history. Lagos First Academic Publishers.

Ogunjobi V.O., Ojo O.J., Adebambo H.O. (2022) - Factors Determining Participation of Farmers In Agricultural Projects: Evidence From USAID Markets II Project In Southwest Nigeria *Quest Journals Journal of Research in Agriculture and Animal Science.* Volume 9 ~ Issue 7: 01-07 ISSN (Online) : 2321-9459

Ogunlela, Y. & Mukhtar, A. A. (2009). Gender issues in agriculture and rural development in Nigeria: The role of women. *Humanity and Social Sciences Journal*, *4* (1).

Ogunleye, O., Ajibola A., Enilolobo O. & Shogunle, O. (2018). Influence of road transport infrastructure on agricultural sector development in Nigeria. *Logistics & Sustainable Transport, 9* (1), 39-50. doi: 10.2478/jlst-2018-0004.

Ojiagu N. C. & Uchenna C. O. (2015). Effects Of Membership Of Cooperative Organisations And Determinants On Farmer Members' Income In Rural Anambra State, Nigeria *International Journal Of Scientific & Technology Research* 4(8), ISSN 2277-8616 28 IJSTR©2015 www.ijstr.org

Okunlola O. J. (2019). Transforming Nigerian Agriculture: Agricultural extension in the saddle. Federal University of Technology, Akure (FUTA) 112th Inaugural Lecture.

Oladapo, A., Shittu, A.M., Agbonlahor, M.U. and Fapojuwo O.E (2012) credit use and production efficiency of cocoa farms in Ondo State, Nigeria. *Nigerian Journal of Agricultural Economics* (NJAE) 3(1), 69 – 77

Oluwatusin, F. M. (2014). The perception of and adaptation to climate change among cocoa farm households in Ondo state, Nigeria. *Academic Journal of Interdisciplinary Studies* MCSCR Publishing, Rome-Italy 3 (1), 286- 295.

Owusu, M. (2017) The Determinants of Foreign Direct Investment Inflows in Ghana. Kwame Nkrumah University of Science and Technology, Kumasi. *The International Business & Economics Research Journal*, 12 (5), 573-584.

Owusu-Manu, D., Torku, A., Pärn, E., Addy, M., & Edwards, D. (2017). An Empirical Assessment of Innovation Practices of Quantity Surveying Firms in Ghana. *Journal of Construction Project Management and Innovation*, *7* (Supplement), 1843–1858. https://doi.org/10.36615/jcpmi.v7iSupplement.14.

Sanusi, L., Sanusi, J., Ibrahim, S., & Nawaf, A. (2023). Determination of Heavy Metals Concentrations in Soil and Tomato Plant (*Solanum lycopersicom*) from Ajiwa Fadama farms, Katsina State. *UMYU Scientifica*, *2*(4), 39–44. https://doi.org/10.56919/usci.2324.005

Stewart, R. (2000). Welcome address at the proceedings of the 7th world sugar farmers conference, Durban.

USAID (2013). *Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS-II).* 2013 First update April 2012 – March 2013. United States Agency for International Development (USAID) report.

USAID (2017). *Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS-II).* 2017 Final update April 2012 – March 2017. United States Agency for International Development (USAID) report.

Vernon, R. & Yujiro, H. (2014). Strategies for agricultural development. *Agricultural Experiment Station Scientific Journal Paper Series*, pp. 129-148.

Cite this Article: Ogunjobi, VO (2024). Determinants of Adoption of USAID Markets II Project's Agricultural Technology by Smallholder Farmers in Southwest, Nigeria. *Greener Journal of Agricultural Sciences*, 14(1): 23-32.