



## **ADOPTION OF AGRICULTURAL TECHNOLOGIES AMONGST AFRICAN DEVELOPMENT BANK COMMUNITY-BASED AGRICULTURE AND RURAL DEVELOPMENT PROJECT BENEFICIARIES IN NIGERIA**

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### **ABSTRACT**

The study examined factors which influence adoption of modern agricultural production technologies among African Development Bank-Community Based Agriculture and Rural Development Programme (AfDB-CBARDP) beneficiaries in Nigeria. To achieve this objective, multi stage sampling procedure was employed where a total of 1,020 farmers/project beneficiaries across the 5 project Implementing Units were selected. The data was estimated using the logit regression. Logit model was used in the study. Result of the maximum likelihood estimates of the Logit regression model has indicated that the relationship between income and improved technology adoption was shown to be positive and statistically significant. Farming experience was also positively related to adoption of the improved technologies and statistically significant at 1% level. The study also reveals that adoption of improved farming technologies increases with credit availability. Farm size on the other hand was negatively related to adoption of fertilizer technology but positively related to seed, post-harvest and livestock improvement technologies at 1% significant level. Correspondingly, the coefficients for improved seed and livestock technologies were positively related to the farmer's age at 5% significant level. The findings of the study further revealed that profitability of the enterprise is the major reason for technology adoption by the beneficiaries and is considered very important (3.7\*). Output/yield and product marketability was the second and most important reasons for technology adoption having a weighted mean scores value of 3.1\* and 3.3\*, respectively. Likewise, among the bundles of technology disseminated under crop sub sector, varietal attributes related to early maturity was adjudged to be important motive for the adoption (2.7\*). Inaccessibility of the technology or high cost of production were cited prominently as the main reasons for non-adoption of a particular technology (\*Reason  $\geq 2.5$ ). These findings have important implication. The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilize these technologies should always be consider when scaling up innovation practices.

**Keywords:** Adoption; Factors, Agricultural technologies, AfDB-CBARDP, Logit model.

### **INTRODUCTION**

Nigeria's economy has a modern segment dependent on oil earnings, overlaid by a traditional agricultural and trading economy. Despite Nigeria's rich natural resources, poverty is widespread and Nigeria's basic social indicators place it among the 20 poorest countries in the world. Recent UNDP report (Human Development Report, Nigeria 2008 -2012 shows that Nigeria's HDI value for 2012 is 0.471 in the low human development category, effectively positioning the country at 153 out of 187 global countries/ and territories. The Nigerian agricultural sector is characterized by low level of technology adoption which in turn contributes to the low agricultural productivity in the country. This is indeed worrisome given the plethora of interventions by successive governments, multi-lateral and donor agencies working to implement several programmes aimed at promoting technology adoption among farmers. It is obvious that the wealth earned from oil industry has not trickled down to the wider



population. Economic growth since the early 1970s has been erratic, driven primarily by the fluctuations of the global oil market.

Nigeria has diverse and rich vegetation capable of supporting wide varieties of agricultural enterprises. The country is also blessed with reasonably abundant rainfall of between 300 mm to about 4000 mm per annum, as well as an extensive coastal region that is very rich in fish and other marine products. Despite Nigeria's rich agricultural resource endowment, the agricultural sector has been growing at a relatively low rate. According to National Food Security Programme (2008) document, less than 50% of the country's cultivable agricultural land is under cultivation, and only 7% (220,000 ha) of irrigable land is under irrigation. Even then small holder and traditional farmers who use rudimentary production techniques, cultivate over 90% of this land. Average yields of major staple crops are below that of other developing countries. This means that Nigeria is yet, to fully utilize its natural resource base, particularly land for agricultural production. The country's ability to fully utilize its agricultural production potential therefore, depends on the innovativeness of actors in the agricultural sector, particularly farmers.

The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilize these technologies are also critical. Unfortunately, the Nigerian agricultural sector is characterized by low level of technology adoption which in turn contributes to the low agricultural productivity in the country. This is indeed worrisome given the plethora of interventions by successive governments, multi-lateral and donor agencies working to implement several programmes aimed at promoting technology adoption among farmers. Unraveling the reasons for low technology adoption among farmers requires that the factors that influence their decisions to adopt or not to adopt modern agricultural production technologies be identified. This study therefore examines the different factors that influence the adoption of modern agricultural production technologies among African Development Bank Community Based Agriculture and Rural Development Programme (AfDB-CBARDP) beneficiaries in the 5 states of Adamawa, Bauchi, Gombe, Kaduna and Kwara States. These technologies include; crop technology, post-harvest, livestock and fisheries.

## **MATERIALS AND METHODS**

### **The Study area**

The AfDB-CBARDP is an integrated agriculture and rural development Project designed to improve the livelihoods and living conditions of the rural poor with emphasis on women and other vulnerable groups. Most of the stakeholders are engaged in agriculture. The Project in Nigeria is made up of five participating States of Adamawa, Bauchi, Gombe, Kaduna and Kwara. In each selected State, the Project is been implemented in nine (9) Local Government Areas (LGAs) and three (3) Rural Village Area (RVA) per LGA, giving a total of 45 LGAs and 135 RVAs, respectively.

### **Instrumentation**

The study instrument was designed based on the existing agricultural technology adoption literatures and technologies introduced by the Project. The study instrument was divided into 2 sections. The first section was designed to identify beneficiary's demographics and other socioeconomic characteristics like age, household size, farm size, educational status and level of household income. The second aspect of the survey instrument deals specifically with technology adoption variables. Both primary and secondary data sources were used to collect information using closed and open-ended structured questionnaires.

### **Sampling Techniques**

Multi stage sampling procedure was employed for the study. The first stage involved purposive selection of LGAs and RVAs where there are contiguous Project activities in order to ensure all technologies introduced by the Project are reasonably captured. The fact that adoption of certain technologies is highly localized and weather dependent in some instances predisposes the selection criteria. In each State, 3 LGAs were selected and in each LGA, 2 RVAs were in turn purposively selected, making a total of 6 RVAs/LGA. In the 2ND stage, 34 farmers/Project beneficiaries were selected randomly from each RVA to give a total of 204 respondents per State Altogether, 1,020 farmers/Project beneficiaries were selected for the study.

### Tools for Data Analysis

Numerous studies have examined the influence of socio-economic variables on farmers adoption decisions of agricultural technologies using either the probit/logit model or the ordinary least squares linear regression model. Logit model was adopted however in this study. Using the logit model, the factors that influence farm households' decisions to adopt modern agricultural production technologies were estimated. The use of the logit model for this analysis is consistent with the literature on adoption (Rogers, 1983; Alston *et al.*, 1995) which describes the process of adoption as taking on a logistic nature.

The implication for applying the logit model in this study is that, a Project beneficiary would decide to adopt modern agricultural production technologies at a given point in time when the combined effects of certain factors exceed the inherent resistance to change in him/her. The preference for the probability model (logit) to the conventional linear regression models, in analyzing the factors influencing the decisions of farm households to adopt modern agricultural production technologies is based on the fact that, the parameter estimates from the former are asymptotically consistent and efficient. The estimation procedure employed also resolves the problem of heteroscedasticity and constrains the conditional probability of making the decision to adopt technology to lie between zero (0) and one (1). Logit model is chosen over probit model in this study primarily because of its mathematical convenience and simplicity (Greene, 2008) and the fact that it has been applied in similar studies by Green and Ng'ong'ola (1993); Boahene *et al.* (1999); Nkonya *et al.* (1997); Shakya and Flinn (1985); Feder *et al.* (1985); and Rogers (1995). The empirical model for the logit model estimation is specified as follows:

$$Y_i = \log \frac{F_i}{1-F_i} = \alpha + \beta X_i + X_i \quad \dots(1)$$

where;  $X_i$  is the combined effects of  $X$  explanatory variables that promote or prevent farmers' decision to adopt modern agricultural production technologies. The use of the logit model for this analysis is consistent with the literature on adoption (Griliches, 1957).

$\log \frac{F_i}{1-F_i}$  = The log-odds in favour of farm households' decision to adopt modern agricultural production technologies;  $X_1 \dots X_i$  are factors that promote or prevent farm households' from adopting modern agricultural production technologies and are defined as follows:  $X_1$  Farm size in hectares;  $X_2$  = age;  $X_3$  = family size;  $X_4$  = income level;  $X_5$  = years of formal education;  $X_6$  = Gender of respondent, dummy (1 = Man; 0 = Otherwise);  $X_7$  = Access to credit, dummy (1 = Has access to credit; 0 = Otherwise);  $X_8$  = Access to extension services, dummy (1 = Has access to extension; 0 = Otherwise).

Furthermore, to determine farmer's reason for adoption of the various technologies disseminated by AfDB-CBARDP, a four-point Likert-type scale which was used by Cook and Fish (1981) was applied. The four (4) points on the scale were weighted according to the degree of relevance to technology adopted. The following scaling procedure was adopted: very important = 4; important = 3; less important = 2, and not important = 1. The value of the four



responses were added and further divided by 4 to obtain 2.5, which was regarded as the mean cut point. Reasons with mean scores below 2.5 were regarded to be not important while reason with mean scores equal to 2.5 or above were regarded as important. Descriptive statistics were also computed for some selected variables. All the models were estimated using SPSS version 19.

## RESULTS AND DISCUSSION

### Determinants of Adoption of Improved Agricultural Technologies

Table 1 shows the maximum likelihood estimates of the Logit regression explaining the determinants of adopting improved technology among beneficiaries of AfDB-CBARD project. The technologies studied were improved seed technology, fertilizer application, and post-harvest and improved livestock technologies. Variables included in the model comprised farmer characteristics, economic and institutional factors that are likely to influence adoption of new innovations. The result shows positive influence of age on seed, fertilizer, post-harvest and livestock improvement technologies adoption. The coefficients of seed and livestock technologies in relation to farmer's age were significant at 5% while those of fertilizer and post-harvest technologies were significant at 1% level. Indicatively, technology adoption increases with farmer's age. It was however, thought that younger farmers would be more likely to adopt new technologies due to their flexibility for accepting new ideas than their older counterparts. The possible reason for this deviation might be that older farmers are mostly those with large farm lands and may have accumulated enough savings and wealth of experience over the years that would warrant them to afford the extra cost that is associated with the new technology.

The coefficient of sex was positive and not statistically significant except for livestock technology. This indicates that sex was not an influencing determinant for adoption of seed, fertilizer and post-harvest technologies among the AfDB-CBARDP beneficiaries it was however, significant in adoption of livestock technology. This implies that adoption of improved livestock technology is gender sensitive in favor of male farmers. It is conceivable that males are the dominant livestock farmers in the study area and are there for more likely to adopt improved management practices.

Marital status was positively related to adoption of improved technologies but significant only with regards to adoption of seed technology. The benefit of using improved seed among other benefits is the increased output per hectare. The motive is likely to be more appealing to married individuals especially when the farm is the source of food for the family.

The coefficient of household size was positive and statistically significant with regards to seed and fertilizer technology adoption. The positive effect implies that households with more members were more adopters than those with few members. Large household size is an indicator of family labor availability on one hand and an indicator of vulnerability when the members are mostly children or aged. The implication of this finding is that households with large members need to grow more food for feeding the family and for the market to finance household expenses. Therefore, adoption of improved seed and fertilizer (an important yield enhancing material) technologies among large households is economically justifiable. Moreover, any extra labor required as a result of the technology could be effectively provided.

Education coefficient was also positively related to adoption of seed, fertilizer, post-harvest and livestock technologies and statistically significant. The positive relationship indicates that adoption increases with level of education. Impliedly, educated farming households are more likely to adopt modern agricultural production technologies than those without.

**Table 1:** Maximum Likelihood Estimates for Determinants of Technology Adoption

<b>Coefficients Variable</b>	<b>Seeds</b>	<b>Fertilizer</b>	<b>Post-harvest</b>	<b>Livestock</b>
Constant	2.2891** (0.9257079)	3.0576*** (0.5679619)	2.6319*** (0.4692175)	1.1277*** (0.2466937)
Age	0.0361** (0.0145368)	0.0452*** (0.0128947)	1.5341*** (0.2097149)	0.0314** (0.0116407)
Sex	0.0420 <sup>NS</sup> (0.271579)	0.0774 <sup>NS</sup> (0.2216565)	0.7704 <sup>NS</sup> (0.2234047)	0.4862** (0.242267)
Marital Status	1.9098*** (0.3141255)	0.6105 <sup>NS</sup> (0.3490183)	0.0134 <sup>NS</sup> (0.02270110)	0.0353 <sup>NS</sup> (0.0201215)
Household size	0.1687*** (0.0474816)	0.2222*** (0.0563311)	0.0032 <sup>NS</sup> (0.0216086)	0.5669** (0.2262821)
Education	0.6552** (0.301564)	0.1922*** (0.0568221)	0.0489*** (0.0144097)	0.1143** (0.0557126)
Major Occupation	0.4942*** (0.1015067)	1.0938*** (0.4265727)	0.4262*** (0.0599117)	0.3256 <sup>NS</sup> (0.1694308)
Farm Income	0.6082*** (0.2168422)	0.8218*** (0.2006668)	0.0434** (0.1847569)	0.5494*** (0.065555)
Other Income	0.1209** (0.0577759)	0.2796*** (0.0565586)	1.8965*** (0.014188)	0.617 <sup>NS</sup> (0.3053088)
Membership in Coops.	0.0730*** (0.0218661)	0.0425*** (0.01305572)	0.0469*** (0.5288028)	0.477*** (0.0161306)
Experience	0.0527*** (0.0161611)	0.0455*** (0.0132544)	0.2429*** (0.0146254)	0.2160*** (0.0139961)
Farm size	0.2449*** (0.0672211)	-0.0447** (0.)	0.0819*** (0.0599543)	1.9724*** (0.0557563)
Access to Market	0.6724*** (0.2473179)	0.2143*** (0.0594307)	0.2242 <sup>NS</sup> (0.275163)	0.3978*** (0.5095351)
Credit	0.0612*** (0.0158307)	0.5292*** (0.1764178)	0.4287 <sup>NS</sup> (0.3001747)	0.2996** (0.1804606)
Extension	0.2869*** (0.0627923)	0.8520*** (0.2817167)	1.5938** (0.1882147)	1.3941 <sup>NS</sup> (0.2876606)
Training	2.9941*** (0.5230925)	2.3400*** (0.45391040)	2.6319*** (0.341662)	1.1277*** (0.3369023)

\*\*\*Significant at 1%. \*\*Significant at 5%; NS = Not Significant; Figures in parenthesis are standard errors

Source: Field Data, 2013

The coefficient of farming as major occupation was also positively related to adoption of improved technologies. Adoption of improved seed, fertilizer and post-harvest technologies were statistically significant. The coefficient on livestock technology however was not significant. This result is indicative of the relevance of the significant technologies to the main occupation of a farmer. When farming is the major occupation of an individual, it is theoretically plausible for such person to adopt practices that have direct influence on his source of livelihood.

The relationship between income and improved technology adoption was shown to be positive and statistically significant. This means that the more the income of a farmer, the more likelihood of improved technologies adoption. It must be born in mine that improved technologies adoption is associated with increases in production cost resulting from the purchase of additional inputs like seed and fertilizer. Cash-constrains farmers will definitely find it difficult to meet this extra financial requirement of such technologies.





With the exception of improve livestock technology, additional income from other sources also has positive and significant relationship with adoption of seed, fertilizer and post-harvest technology adoption. This is in line with the fact that farmers with other sources of income are more likely to adopt the improved technologies as money could easily be made available from other sources for the purchase of the technology. Membership in cooperatives was positive and statistically significant with adoption of seed, fertilizer, post-harvest and livestock technologies. This connotes that adoption of agricultural technologies increases with increased membership in social organizations such as cooperatives and farmers groups. It must be born in mine that membership in cooperatives could increase or enhance one's knowledge of existence of improved practices which can make access to these practices easier.

Farming experience was also positively related to adoption of the improved technologies and statistically significant at 1% level. Thus, it could be posited that increase in farmer's experience increases his level of technology adoption. Some of the technologies like fertilizer were not new to farmers with more years of experience in farming. It was shown that fertilizer was introduced into the farming system of Nigeria as far back as the 1930s, therefore, innovations relating to fertilizer use are not likely to be detested.

The coefficient of farm size was negatively related to adoption of fertilizer technology and significant at 5% level but positively related with seed, post-harvest and livestock improvement technologies. The negative coefficient is instructive to the fact that increase in farm size decreases adoption fertilizer technology. The explanation to this could stem from the fact that fertilizer is expensive and sometimes difficult to come by. Hence the negative relationship could be a proxy to explaining the application of less than recommended doses when farms are large in relation to the fertilizer at hand. Field data in the Project area revealed that the recommended fertilizer application rate for maize is 500 kg/ha; legume 300 kg/ha, which is par below the recommended practice.

The access to market was positive and significant to adoption of improved farming technologies except for post-harvest technology that was not significant. Market access is an important factor in crop and livestock production. Access to market makes it possible for a farmer to purchase the improved technology and also dispose extra increase in output that could be due to the use of the technology. Conversely, poor access to market could limit farmer's adoption of seed, fertilizer and livestock technologies.

The study also reveals that adoption of improved farming technologies increases with credit availability. The coefficients of credit (Table 1) were statistically significant. The statistical significance of the coefficients indicates the importance of credit to adoption of seed, fertilizer and livestock technologies. This is theoretically plausible given that procurement of these technologies requires money to invest in their finances. Therefore, if that money is made available, the tendencies for using it to acquire improve farming technologies increases. Credit therefore, plays a significant role in adoption of new innovation especially where money is required for the investment. Increased access to institutional factors like credit can therefore help farmers surmount short-run liquidity constraints and increase technology adoption. Many studies have found access to credit to have strong influence on technology adoption.

The coefficient of extension support and training were positively related and statistically significant ( $P \geq 0.01$ ) to adoption of the improved technologies. The statistical significance of these variables indicates that adoption increases with extension contact and farmer training. Access to extension services is critical in promoting adoption of modern agricultural production technologies because it can counter balance the negative effect of lack of education in the overall decision to adopt some technologies. It can therefore create the platform for acquisition of the relevant information that promotes technology adoption. In other words, access to information through extension services reduces the uncertainty about the

technology's performance, hence may change individual's assessment from purely subjective to objective over time thereby facilitating adoption.

### Assessment of Improved Technology Adoption

The level of improved technology adoption by the Project beneficiaries is highlighted in Table 2 and Table 3 and was derived by assessing farmers reason for adopting the various technology disseminated by AfDB-CBARDP using a four-point Likert-type scale. The data computed indicated that profitability of the enterprise is the major reason for technology adoption by the beneficiaries and is considered very important (3.7\*). Output/yield and product marketability was the second important reasons for technology adoption having a weighted mean scores value of 3.1\* and 3.3\*, respectively. Among the bundles of technology disseminated under crop sub sector, varietal attributes related to early maturity was adjudged to be important motive for the adoption (2.7\*).

**Table 2:** Reason for improved technology adoption

Reasons for adoption	Mean scores
Profitability	3.7*
Marketing	3.3*
Output/yield	3.1*
Disease resistant	1.6
Drudgery reduction	2.0
Early maturity	2.7*

Note: \*Reason  $\geq 2.5$

Source: Field data, 2013

On the flip side, reasons proffered for not adopting a particular technology varied widely, depending on the nature of the technology and socio-economic characteristics of the respondents. As presented in Table 3, inaccessibility of the technology, lack of capital or high cost of production and in adequate knowledge were cited prominently as the main reasons for non-adoption of a particular technology (\*Reason  $\geq 2.5$ ). These findings have important implication. The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilize these technologies should always be considered when scaling up innovation practices. In a related study, Caswell *et al.* (2001) has reported that the cost of modern agricultural production technologies is negatively related to the probability of adoption. Impliedly if the new technology is costly, farmers may probably not be inclined to adopt it. This study however does not find any evidence which suggest that new technologies are being rejected on the strength of religious or cultural practices. This implies that the process of demand driven development as enshrined in the Project appraisal document have been fully implemented to the later.

**Table 3:** Reason for non-adoption of improved technology

Reason for non-adoption of improved technology	Mean scores
Inaccessibility	2.5*
Lack of capital or high cost of production	2.9*
Lack of knowledge	2.6*
Religious or cultural practices	0.0
Uncertainty	1.5

Note: \*Reason  $\geq 2.5$

Source: Field data, 2013



## CONCLUSION AND RECOMMENDATIONS

It was concluded that adoption of the improved technologies increases with credit availability. The coefficients of credit were statistically significant. The statistical significance of the coefficients indicates the importance of credit to adoption seed, fertilizer and livestock technologies. Credit therefore, plays a significant role in adoption of new innovation especially where money is required for the investment. Increased access to institutional factors like credit can therefore help farmers surmount short-run liquidity constraints and increase technology adoption. Many studies have found access to credit to have strong influence on technology adoption.

The findings of the study further revealed that profitability of the enterprise is the major reason for technology adoption by the beneficiaries and is considered very important (3.7\*). Output/yield and product marketability was the second important reasons for technology adoption having a weighted mean scores value of 3.1\* and 3.3\* respectively. Among the bundles of technology disseminated under crop sub sector, varietal attributes related to early maturity was adjudged to be important motive for the adoption (2.7\*). Inaccessibility of the technology, lack of capital or high cost of production and lack of knowledge were cited prominently as the main reasons for non-adoption of a particular technology (\*Reason  $\geq 2.5$ ). These findings have important implication. The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilize these technologies should always be consider when scaling up innovation practices. The study recommended:

1. Increase the rate of adoption of the AfDB-CBARDP supported technologies and increase productivity of small-scale farmers, there is a need to improve farmers' level of education, training, extension support and access to credit.
2. More credit should be made available to the communities to acquire the necessary technologies
3. The need to scale up introduced technologies such as improved seeds in all the communities as they were found to be simpler, profitable and affordable.

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