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Determinants of Adoption of Agricultural Technologies among Rice Farmers in Taraba State, Nigeria

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Abstract

The study investigated the determinants of adoption of selected agricultural technologies which included among others tractors, herbicides, insecticides and fertilizers among rice farmers in Taraba state, Nigeria. Specific objectives of the study were to describe the socioeconomic characteristics of the respondents and determine factors influencing adoption of these technologies. Multi-stage, purposive and simple random sampling techniques were employed in selecting 217 respondents. Frequency counts, percentages, means and Logit Regression Analysis were used to analyse the data. The results revealed that majority (60.83%) of the respondents were in their active age of less than 50 years, 80% had more than five years of farming experience, 82% were educated and 70% had land holdings of less than five hectares. The logit regression analysis showed that five variables were statistically significant at various probability levels. The significant variables were educational level, extension contact, membership of cooperative, income level and farm size. Except farm size, all of the five variables affect adoption of technologies positively. The coefficient of farm size was however negative; and run counter to *apriori* expectation. The study recommended that improved farm technologies be made available and affordable to farmers; opportunities for improving the level of incomes of the respondents needed to be provided and the present extension services delivery system needed to be enhanced. The farmers on their part should form cooperatives groups.

Keywords: *Technology, Adoption, Agriculture, Rice Farmers*

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Tijjani, A.Background to the Study

Majority of people in developing countries of the world depend on agriculture as a major source of livelihood. In Nigeria, agriculture remains one of the most important sectors in the economy as it provides 80% of employment opportunities and contributes 40% of the country's GDP. Subsistence production dominates most rural households, but this mode of agricultural production is known to be less productive and is associated with high demand of labour. Most agricultural technologies are developed to address these issues.

Nigeria is the largest producer of rice in the West Africa sub-region. Two or three decades ago rice was regarded as a ceremonial and luxuriant commodity, but today rice is no longer a luxury food. It is a basic staple to millions of Nigerians, with demand growing at an annual rate of 5%. Urbanization, changes in employment patterns, income levels, and rapid population growth have significantly contributed to the soaring demand of the commodity and the widening gap between its demand and supply.

Taraba state is predominantly agrarian in nature, with about 80% of its inhabitants depending on subsistence agriculture practices. The state is endowed with a vast land suitable for cultivation of varieties of crops and tubers. Specifically, rice is among the major crops being cultivated in the state. The estimated land area for rice cultivation in Taraba State was 375, 670.00 ha which was the highest in Nigeria, followed by Kaduna State (344,890.00 ha) and Niger State (330,670.00 ha) Despite the fact that Taraba State had the highest land area for rice cultivation, the quantity of rice produced in the State was less than that of Kaduna, Niger and Kano states. (National Bureau of Statistics, 2012). The low rice output in the State may be attributed poor adoption of agricultural technologies by rice farmers in the state among others. This has brought to the fore the imperative need to investigate the adoption of agricultural technologies in Taraba state.

The broad objective of the study was to analyze the determinants of adoption of agricultural technologies among rice farmers in Taraba state, while the specific objectives were to:

i. Describe the socioeconomic characteristics of the farmers; and
ii. Determine the factors that influence adoption of the agricultural technologies among the respondents.

Methodology

Area of the Study

The study was carried in Taraba State, Nigeria. The State has sixteen (16) Local Government Areas. It lies between latitudes 6.30 - 9.36 North and longitudes 9.10 -11.50 East The State has estimated population of three (3) million people and a landmass of 59,400 Square kilometers (Taraba State Government Diary, 2015).

Taraba State shares common boundaries with Bauchi and Gombe State to the North, Adamawa State to the North-East, Plateau State to the West and Benue state to the South-West and Eastern part of the State. It also shares International Boundaries with the Republic of Cameroun to the Southern and Eastern parts. Going by ethnological composition, Taraba State has over 200 ethnic grounds. Chiefly among them include Fulani, Hausa, Mambilla, Chamba, Jukun, Tiv, Jenjo, Kuteb, Mumuye, Wurkun among others (Taraba State Government, 2015).

The State has five vegetative zones which is particularly unique to it and these include Sudan Savannah, Guinea Savannah, Derived Savannah, High Forest and Mountain Forest. Farming is the predominant occupation of the people with communities living along major rivers (like rivers Benue, Taraba and Donga) undertaking fishing to complement. Both wet and dry season production are well established in the state. Major crops produced include Rice, Maize, sorghum, Beans, Yam, Cassava and vegetables.

Good road net work link most major towns in the state, especially the Local Government headquarters. Jalingo the State capital and indeed most other major towns in the State are adequately connected with the National Electricity grid. There is good number of hospitals (private and governmental), schools, Banks, Insurance companies and Markets in Jalingo. There are also small and medium scale enterprises, airport, print and electronic media outfits and good telecommunication net works (GSM). All these combine to improve the lots of the farmer and aid technology adoption among the farmers.

Sampling Procedure and Sample Size

The data for the study was mainly from primary source and was collected through the use of structured questionnaires. Multi stage, Purposive and Simple Random sampling techniques were used in the selection of respondents thus: In the first stage, two out of the three senatorial zones of Taraba State were randomly selected. The selected zones were the Northern and the Central Senatorial Zones. In the second stage, three and two LGAs were purposively selected from the Northern and Central Senatorial Zones respectively. Their selection was based on their predominance in rice production. The selected LGAs included Ardo-Kola, Lau, Karim-Lamido, Bali and Gassol LGAs. In the third stage, 250 farmers were randomly selected from the list of registered rice farmers in the selected LGAs. However, only 217 questionnaires were retrieved and used for the analysis

Data Analysis

The data were analyzed using frequency counts, means, percentages and Logit Regression Model (LRM). The LRM was found suitable because the dependent variable (Y) was a dichotomous variable that takes the value "1" for adoption, and "0" otherwise. Five agricultural technologies were perceived to be important for rice production in the area. These were the use of Tractor, Planter, Herbicides, Insecticides and Fertilizers. Any farmer that adopted three and more of these technologies was considered adopter and thus assigned a value of 1. Conversely, a farmer that adopted less than three of these technologies was termed as non-adopter and assigned 0. The logit equation (Greene, 1993) was written as:

$$\Pr(Y=1) = \frac{e^{\beta' x}}{1+e^{\beta' x}} \qquad (1)$$

with the cumulative distribution function given by

$$F(\boldsymbol{\beta}' x) = \frac{1}{1+e^{\beta' x}} \qquad (2)$$

Where;
$\boldsymbol{\beta}'$ represents the vector of parameters associated with the factors *x*.

The empirical model for the study was specified as:

$$Y_i = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon_i \quad (3)$$

Where:
Y_i = dummy (1 = adopted; 0 =otherwise)
X_1 = age (years)
X_2 = years of farming (years)
X_3 = farm size (ha)
X_4 = education (years of study)
X_5 = contact with extension agents (frequency)
X_6 = membership of cooperative (1= member, 0 = otherwise)
X_7 = Average monthly income (Naira)

To determine the quantitative effects of the independent variables on each technology, marginal effects were generated from stata 11 computer software. These effects (Greene, 1993) measure changes in the probability of adopting each technology due to a given changes in the relevant explanatory variable (Long, 1997).

Results and Discussion
Socioeconomic Characteristics
Table 1 shows selected socio-economic characteristics of the respondents. It reveals that 13% of the respondents were below the age of 30 years, 48% were between 30 – 49 years, 28% were between 50 – 59 years and 11% were above 60 years. This shows that 61% of the respondents were below the age 50 and 39% were above the age of 50 years. The implication of this finding is that most of the respondents (61%) were in their active age of production (≤ 50 years) and may be innovative. Younger people are generally risk takers and thus adopt innovations faster than the older ones who may be aversive to risks (Rogers, 1995). By implication, our respondents may be very innovative and could adopt most of the identified technologies. This finding corroborates with that of Ahmadu and Erhabor (2012) and Aboki, et al. (2013), who in their independent studies reported that majority of farmers in Taraba State were relatively younger (below 50 years of the ages). The results further revealed that majority (79%) of the respondents had more than five years of farming experience. This indicates that the respondents were no novices in rice production and were fairly experienced. They could be productive as theoretically management skills improve with experience. Farmers with higher experience may have better access to information and could be in a better position to evaluate new technology for adoption (Isaiah, et al., 2013).

Furthermore the results show that majority (82%) of the respondents were educated in one form or the other. Education positively affects adoption of new technology. Educated farmers are wiser, more rational and have better access to information than the non educated farmers. This enormously helps the educated farmer in making a decision to adopt a given technology. Although the respondents were mostly (82%) educated, they were predominantly (79%) small as scaled as they cultivate less than five hectares. This will have negative effect to

adoption. For instance, large farm machineries are not suitable for small scale production, and as such may not enjoy wide adoption among small scale producers. These findings are in line with those of Ahmadu and Erhabor (2012) and Aboki et al. (2013) who reported that agricultural production in Taraba State was dominated by small scale farmers.

Table1: Socio-economic Characteristics of the Respondents

Variable	Frequency	Percentage
Age (years)		
20 – 29	29	13.36
30 – 39	35	16.13
40 – 49	68	31.34
50 – 59	61	28.11
60 above	24	11.06
Total	**217**	**100**
Years of farming		
1 – 5	46	21.20
6 – 10	62	28.56
11 – 15	68	31.34
16 – 20	19	8.76
21 above	22	10.14
Total	**217**	**100**
Education level		
Non (illiterate)	40	18.44
Semi-formal	65	29.95
Primary	46	21.20
Secondary	29	13.36
Tertiary	37	17.05
Total	**217**	**100**
Farm size (ha)		
0.1 – 2.4	112	51.61
2.5 – 4.9	59	27.19
5 above	46	21.20
Total	217	100

Source: Field survey, 2016

Determinants of Adoption of Agricultural Technologies

The Logit regression analysis (using stata 11 software) shows that five variables out of seven were statistically significant at various probability levels (Table 2). Also, the chi- square value of 240.24 was to show that the likelihood ratio (statistics) were statistically significant ($p < 0.01$) suggesting that the model has strong explanatory power. The pseudo-R square was 0.8021 indicated that the explanatory variable explained over 80% of the variation in adoption of technologies. Also, the _hat was significant at 1% level while –hatsquare was not significant at 5% level, implying that the model was correctly specified.

Farm size was considered one of the most important factors that determine the adoption of innovation. Many researchers reported that farm size affect adoption of technology variously (negatively or positively). Those who reported positive effects included Uaiene et al., (2009)

and Mignouna et al, (2011) while those who reported negative effects were Yaron, et al., (1992) and Harper et al., (1990). However, the result of the logit regression analysis (Table 2) showed that farm size was statistically significant at 10% level but had a negative coefficient, with marginal effect of -0.0967. Meaning that as farm size increases by one hectare, the probability that farmers adopt agricultural technology decreases by 9.67%. This result was particularly interesting as it run counter to *apriori* expectation. However, this can be explained by the fact that majority (79%) of the respondents operated at small scale levels. The implication of small scale production on adoption of technology has been highlighted earlier (above). Other reasons could be attributed to the fact that most farmers do not know the actual sizes of their farms, and as such resort to only guesses in estimating the sizes of their farms. Also, there is free and inconsistent use of relevant units pertaining to farm size among farm communities in Nigeria. While a good number of farmers use acres in defining their farm sizes, others use hectares. In fact quite a number of farmers do not differentiate between hectares and acres, and as such use the two interchangeably (and freely)

Table 2 further revealed that the coefficient for years of education was positive and had significant influence on adoption of technology ($p< 0.01$). This is in conformity with *apriori* expectation, because education has been assumed to have a positive influence on farmers' decision to adopt new technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyze the benefits of the new technology. This finding is in line with that of Okunlola et al. (2011) who reported significance influence of education on adoption of new technologies by fish farmers in Akure, Ondo State.

The frequency of contact with extension agents was positively and statistically significant at 1% level (Table 2). The marginal effect of 0.192 indicated that as the frequency of contacts with extension agent increase by one unit, the probability that farmers adopt the technologies increases by 19.2%. This result is consistent with *apriori* expectation. Extension agents serve as conduit through which innovations are transferred from researchers to those that use them. They usually inform farmers about new technologies, benefits of the technologies and how to effectively apply the technologies. The finding is in line with the report of Akudugu et al. (2012) that clearly showed positive effect of extension contact on adoption of modern agricultural technologies in Ghana.

Furthermore, membership of agricultural cooperative was found to be positive and statistically significant ($p<0.01$). This implies that farmers belonging to cooperative groups were more likely to adopt agricultural technologies than their non cooperative counterparts. The result (Table 2) showed that as farmers change their mode of interactions from solitary to being members of a cooperative group, the probability of their adoption of agricultural technologies increases by 74.44%. Farmers within a social group derive many benefits such as information sharing, decision making, learning from one another, securing loans, and so on. These could help farmers adopt new and complicated technologies individually and in groups.

Lastly, income is among the important variables that affect adoption of technologies, especially the capital intensive technologies. The results (Table 2) showed that income had a positive coefficient and was statistically significant ($p<0.05$). As incomes of the respondents rises, their chances to procure new technologies also rise, and this influences adoption positively. Most of the technologies considered in this research were capital intensive and so, farmers with high capital disposition were more likely to adopt them.

Table 2: Logit Regression Result

Variables	Coefficient	St.error	Z	P >|z|	Marginal
x1 age	-.0623906	.0532512	-1.17	0.241	-.0154441
x2 years of farming	-.1234087	.7184464	-0.17	0.864	-.0305484
x3 farm size	-.3905966*	.142334	-2.74	0.006	-.0966877
x4 education	.0002332***	.0000573	4.07	0.000	.0000577
X5 extension contact	.7758268***	.1784372	4.35	0.000	.192047
X6 membership of org.	3.844789***	.9256031	4.15	0.000	.7444469
X7 income	.2431938**	.0850764	2.86	0.004	.0601998
Constant	-6.031006**	1.937373	-3.11	0.002	
Log likelihood	-29.628532				
LR chi2(7)	240.24				
Prob> chi2	0.0000				
Pseudo R2	0.8021				
_hat	0.000				
_hatsq	0.006				
estatgof	0.0000				

Source: computer printout; software Stata 11. (*) = 10%, (**) = 5%,(***) = 1%significant levels

Summary, Conclusion and Recommendations

The study investigated the determinants of adoption of selected agricultural technologies (tractors, planters, herbicides, insecticides and fertilizers) among rice farmers in Taraba State, Nigeria. Taraba state is well endowed with natural potentialities for rice production, yet the quantity of rice output in the State was far below its potentials and compares unfavorably with other States with similar resource endowment in the country. The needs to investigate why the State lags in rice production despite its favorable potentials informed this study. Multi-stage, purposive and simple random sampling techniques were employed in selecting 217 respondents. Data was analyzed using descriptive statistics and logit regression analysis. The results revealed that majority of the respondents were youths, about 80% having more than five years of farming experience, 82% were educated and 70% had land holdings of less than five hectares. The result from the logit regression analysis showed that five variables were statistically significant at various probability levels. Education, contact with extension agents, membership of organization and level of income have been found to affect adoption of agricultural technologies positively, while farm size was found to have negative effect on adoption.

It is therefore recommended that government and private sectors should make agricultural technologies readily available and affordable to the farmers. Also, the government should avail the respondents with better opportunities to rise their income levels by establishing skill acquisition centers where farmers could acquire new skills that will improve their productivities and other livelihoods. Other opportunities such as giving the farmers low interest/soft loans, provision of efficient marketing systems, and so on should also be explored. Extension service delivery should also be enhanced; and farmers on their part should be encouraged to form cooperatives groups while the existing ones should be strengthened.

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