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ADOPTION DETERMINANTS OF IMPROVED FARMING TECHNOLOGIES: AN ASSESSMENT OF RURAL RICE FARMERS IN KOGI STATE, NIGERIA

U.M. Shaibu*, and Y.A. Shaibu
Department of Agricultural Economics and Extension,
Kogi State University Anyigba, Nigeria
*Email: brave.monday@yahoo.com,Tel.: +2347036989023

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ABSTRACT

This study assessed the adoption of improved rice production technologies by rural farmers in Kogi State, Nigeria. Specifically, the study described the socioeconomic characteristics of rice farmers, assessed the level of adoption of improved rice production technologies, and determined the effect of selected variables on the level of adoption of improved rice production technologies in the area. Using random sampling technique, 240 rural rice farmers were selected from two of the four agricultural zones in the State. Structured questionnaire was used to collect the required information. Data obtained were analysed using descriptive statistics and Ordinary Least Square (OLS) multiple regression analysis. The findings of the study showed that 74.2% of the farmers were male with an average age of 44 years. Rice farmers in the area had a mean farming experience of 27 years and operated on an average farm size of 2.7 hectares. Furthermore, 77.4% and 60.5% of the farmers adopted the use of improved rice varieties and timely transplanting respectively. The level of adoption of improved rice production technologies among rice farmers was directly determined by age (β=2.02), education (β=3.58), credit (β=0.24), and extension contact (β=0.92) at P < 0.001. The coefficients of marital status (β=-2.92), and household size (β=-0.57) inversely determined rice farmers' adoption score for improved rice production technologies at P < 0.001. Rice farmers in rural areas of the State generally adopted the use of improved rice varieties and were however not satisfied with the recommended line spacing of 20cm – 25cm. Credit access, extension contact, amongst others determined farmers' adoption of improved rice production technologies. Credit provision with fair conditionalities was recommended.

Keywords: Adoption, Credit, Extension Contact, Rice, Rural, Variety, Spacing

INTRODUCTION

Rice (*Oryza sativa*) is no doubt the world's most important food crop being the staple food of over 50 percent of the world population; indicatively, India, China and a number of other countries in Africa and Asia (FAO, 2006). It is one of the major cereals in developing nations such as Nigeria, especially in the producing areas, where it provides employment and income for more than 80% of the inhabitants as a result of the activities that take place along the production and distribution chains from cultivation to consumption (Umeh, 2015).

Considering its vast agricultural land and suitable ecology, Nigeria is endowed to produce enough rice to satisfy domestic demand and has the potentiality to export to other countries (Babafada, 2003). However, the demand usually surpasses supply. The limited capacity of the Nigerian rice sector to meet the domestic demand has been attributed to several factors; notable among them is the declining productivity due to low adoption of improved production practices. Consequently, a wide gap exists between potential and actual yield per hectare. Accordingly, (Oyekami, *et. al,* 2008) and (Nwite, *et. al,* 2008) in separate studies reported that adoption of technologies and improved management practices should lead to substantial yield increase in rice production. This invariably underscores the significant role that technology adoption stands to play in attaining the much needed growth in the Nigerian rice sub-sector considering the recent ban on the commodity by the Federal Government of Nigeria and the following hike in price.

In a bid to increase the adoption and or dissemination of production technologies to the consumers of agricultural research, the World Bank aided the establishment of Agricultural Development Project (ADP) which is available in all the states of the federation and the Federal Capital Territory, Kogi State inclusive. Despite this effort, it seems that rice farmers in Kogi State have not been able to achieve desirable increase in yield due to consistent use of traditional technologies in neglect of improved production practices disseminated. Empirical evidence (Umeh, 2015; Fashola *et.al,* 2007) showed that while some farmers use improved practices, a reasonable number still rely on traditional methods thereby subjecting majority of them to unbearable low yield. This was attributed to: lack of knowledge of improved practices as well as scarcity and cost of the necessary rice supporting inputs. Hence, there is the need to make a case for rural rice farmers in Kogi State, Nigeria.

METHODOLOGY

The study area is Kogi State, Nigeria. The State is located in the central region of Nigeria with its headquarters at Lokoja, which is situated at the Confluence of rivers Niger and Benue making the State to be popularly known as the Confluence State. The distance from Lokoja to the Federal Capital Territory, Abuja is approximately 193 kilometres (National Bureau of Statistics, NBS 2011). Kogi State has three senatorial districts (Western, Central and Eastern senatorial districts). The State consists of 21 Local Government Areas and located between latitude $6^0$30'N and $8^0$5'N and longitude $5^0$51'E and $8^0$00'E. Kogi State has a total population of about 4,205,546 people in 2014 (using the state projected growth rate) (NPC, 2007). It has 2,774,700 hectares of land (NBS., 2011) but only about 0.5 Million hectares are under cultivation (Kogi State Economic Empowerment and Development Strategy, KOSEEDS, 2004). The major crops grown in the State are rice, yam, cassava, maize, sorghum, millet, cowpea, pigeon pea, groundnut, bambaranut, cocoyam, sweet potato, beniseed, melon, banana, plantain and cotton. Fruits and leafy vegetables such as okra, pepper, fluted pumpkin and spinach are also cultivated in the area. Tree crops grown in the state include: cashew, oil palm, citrus, coffee, and kola nut. Major animals reared are cattle, sheep, goats, and poultry. Fishing is very common along the riverine areas.

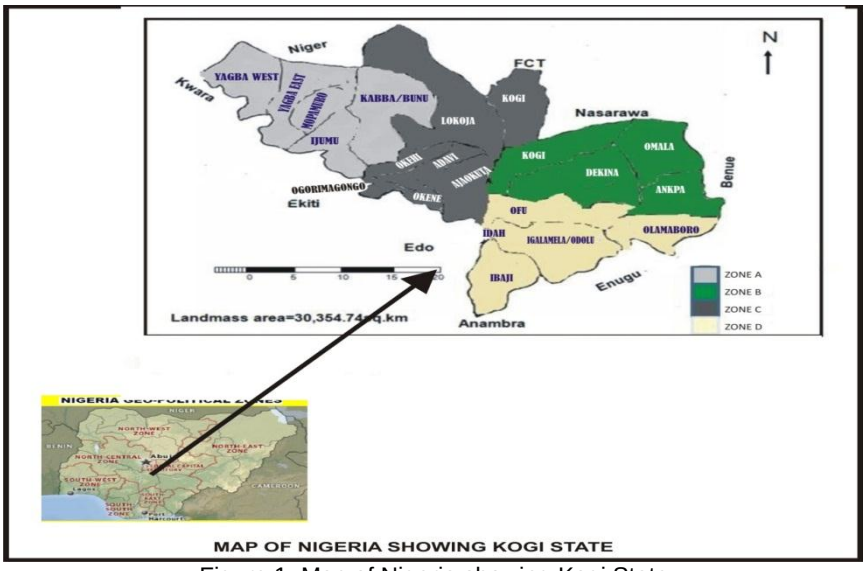

Figure 1: Map of Nigeria showing Kogi State

The target population for this study was over 5000 registered rice farmers with Kogi State. Kogi State comprises of four agricultural zones: Zone A-Aiyetero-Gbede, Zone B-Anyigba, Zone C-Kotonkarfe and Zone D-Alloma zones. A four staged sampling technique was used. In the first stage, two (2) zones out of four (4) zones were purposively selected due to their popularity in rice production. These are Zones D and B. In the second stage, two blocks each from the selected zones were purposively selected to give a total of four blocks. The blocks were selected due to their level of rice production. In the third stage, four cells each from the blocks were randomly selected to give a total of sixteen (16) cells. In the fourth stage, 15 registered rice farmers were selected from each cell using simple random sampling technique to give a total sample size of 240 respondents. Structured questionnaire and interview was used to collect information from the sampled respondents. Data obtained were coded and anlaysed using SPSS version 20.0.

Adoption Model

Adoption model was used to determine the level of adoption of improved rice production technologies by rural farmers in the state. This was achieved using the seven steps adoption model as adopted by Madukwe, (1995), and Agwu, (2000) in Mbanaso (2010). The farmers were asked to show their adoption stage for the different rice production technologies. These are the response categories and corresponding weighted values: Not aware= 0, Aware =1, Interest = 2, Evaluation =3, Trial= 4, Adoption= 5, Rejection = 6.

Total adoption score for each farmer was calculated by summing the adoption scores for the various technologies. In calculating farmers score, rejection with a weighted value of six was converted to zero to give a meaningful interpretation to the result (Agwu, 2000 in Mbanaso, 2010).

Ordinary Least Square Multiple Regression Analysis

Effect of selected socioeconomic variables on the level of adoption of improved rice production technologies was achieved using Ordinary Least Square (OLS) multiple regression analysis. Three functional forms: linear, semi-log, and double-log were tried and the lead equation chosen based on econometric criteria such as number of significant variables, F-value, value of the coefficient of determination (R^2) and conformity with *apriori* expectation. The OLS model used is specified below:

$Y=f\ (Xs)$

$Y= f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_7, X_8, u_i)$

Linear form

$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \mu$

Semi-logarithm form

$Y = \alpha + ln\beta_1X_1 + ln\beta_2X_2 + ln\beta_3X_3 + ln\beta_4X_4 + ln\beta_5X_5 + ln\beta_6X_6 + ln\beta_7X_7 + ln\beta_8X_8 + \mu$

Double-logarithm form

$lnY = \alpha + ln\beta_1 X_1 + ln\beta_2 X_2 + ln\beta_3 X_3 + ln\beta_4 X_4 + ln\beta_5 X_5 + ln\beta_6 X_6 + ln\beta_7 X_7 + ln\beta_8 X_8 + \mu$

Where:

Y= individual farmer's total adoption score as obtained from the adoption model

α = constant term

$\beta_1 - \beta_8$ = regression coefficients

X_1 = age: (measured in year)

X_2 = Sex; (male = 1, female = 0)

X_3 = education; (measured by the number of years spent in formal education)

X_4 = marital status, (1 for being married and 0 otherwise)

X_5 = household size (measured by the number of people living under one roof)

X_6 = credit; (dummy variable for receiving credit = 1 and 0 for not received).

X_7 = farm size (hectares of land for rice production, measured in hectares)

X_8 = Extension contact (measured by number of times visited by extension agent in the last one year)

μ = error term

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Rural Rice Farmers

The socio-economic characteristics of rural rice farmers in the state are described in Table 1. The result shows that there were more male rice farmers (74.2%) than their female (25.8%) counterparts, probably due to lack of control over productive resources by women or other socio-cultural reasons as reported by (Olukosi, 2005). The average age is 44 years. This indicates that the majority of the respondents are within their active and productive ages hence can invest or afford new practice or idea. Majority (96.7%) of the farmers were married with an average household size of 5 members. Household size influences the availability of family labour for agricultural operations, since the main source of labour for a typical traditional farmer is his immediate dependents. It is therefore expected that, household size would influence the adoption of agricultural technologies, especially where joint labour is needed. High level of education among rice farmers in the area could portend high level of adoption of improved rice production technologies. This finding is in line with Apata *et al.,* (2010) when they reported a high level of education in rural farming households. The high level of experience among rice farmers in the area may increase their level of production, because the more experienced a farmer is, the more efficient he is supposed to become and vice versa. The long period of farming experience could also increase their knowledge, experience and subsequent adoption of rice production technologies. The average rice farm among rice farmers in the area was 2.7 hectares, this further underscore the fact that crop production in rural areas and Nigeria is still at the subsistence level. Most farmers are into farming venture as source of livelihood and not necessarily for commercialization. The low annual rice farm income also attest to the fact that rice farming in the study area is still at the subsistence level.

Level of Adoption of Improved Rice Production Technologies

The level of adoption of improved rice production technologies in the study area are presented in Table 2. The result shows that majority (77.4%) of the respondents adopted the use of improved rice varieties, while 12.6% were at the trial stage. The high level of adoption for improved rice varieties as a productive technology in rice production could have a multiplier effect on increased farm output and productivity.

The result further shows that 21.5% of the respondents were at the trial stage in the application of fertilizer as an improved production technologies in the area. Tooraj and Sahel (2011) indicated that lack of access to availability and timeliness of fertilizer delivery discourages adoption. Table 2 also shows that 12.8% of the respondents were at the awareness stage of transplanting method with the recommended planting distance of 20cm – 20cm or 25cm – 25cm. Similarly, only 5.5% were at the adoption stage while the bulk (81.7%) of the population rejected this recommended planting space. Rice farmers who rejected this recommended planting space said that it was time consuming and did not give space for planting large farms lands. This findings is in line with Ellen and Kel (2008), when they indicated that farmers were less likely to practice transplanting method if the size of the cultivated land are large, because it is a more labour-intensive way of crop establishment than direct seeding.

Determinants of the Level of Adoption of Improved Rice Production Technologies

Ordinary least square multiple regression analysis was used to determine the effects of selected socio-economic characteristics of rice farmers on their level of adoption of improved rice production technologies. The result obtained is shown in Table 3. After some econometric consideration, the double-log functional form was chosen as the lead equation. Hence, discussion will be based on the output of this functional model. The result of multiple regression analysis indicates an R^2 of 0.752 or 75.2 percent. This shows that about 75.2 percent of the variation in level of adoption of improved rice production technologies in Kogi State was determined by the socio-economic characteristics of the rural farmers. The remaining 24.8% is attributed to error term. Indicatively, the close relation of R^2 to adjusted R^2 is an indication that the explanatory power of the independent variables cannot be exaggerated. Furthermore, the overall effect of the independent variables on the dependent variable was indicated by F-statistics which was significant at 1 percent level and also an evidence to show that the models are well-specified. From the result of the analysis, all the socio-economic variables examined were positively signed except household size and marital status.

Age (X_1)

The coefficient of age was positively signed ($P < 0.001$). This implies that the higher the age of farmers, the higher their level of adoption of improved rice production technologies. In essence, adoption is high with

increased age. This finding agrees with Asadu (2011) who reported similar findings among farmers in Enugu State, Nigeria.

Table 1: Distribution of Respondents According to Socioeconomic Characteristics

Variables	Frequency	Percentage	Mean
Gender			
Male	178	74.2	
Female	62	25.8	
Total	**240**	**100**	
Age			
26 – 35	28	11.7	
36 – 45	112	46.7	
46 – 55	98	40.8	
56 – 65	02	0.8	**44 years**
Total	**240**	**100**	
Marital status			
Single	02	0.8	
Married	232	96.7	
Widowed	06	2.5	
Total	**240**	**100**	
Household size			
1-5	146	60.8	
6-10	94	39.2	
Total	**240**	**100**	**5 members**
Educational status			
Non-formal	08	3.3	
Primary	42	17.5	
Secondary	138	57.5	
Tertiary	52	21.7	
Total	**240**	**100**	
Major Occupation			
Farming	92	38.3	
Civil Service	82	34.2	
Trading	32	13.3	
Artisanship	34	14.2	
Total	**240**	**100**	
Farming Experience			
1-10	24	10.0	
11-20	214	89.2	
21- 25	02	0.8	
Total	**240**	**100**	**27 years**
Farm Size (hectare)			
0.1 – 2	74	30.8	
2.1 – 4	132	55.0	
4.1 – 6	34	14.2	
Total	**240**	**100**	**2.7 hectares**
Annual Income			
50,000-100,000	44	18.4	
110,000-200,000	158	65.8	
210,000 and above	38	15.8	
Total	**240**	**100**	**168, 041**

Source: Field Survey, 2016

Sex (X_2)

The coefficient of sex was positively related to adoption of improved rice production technologies ($P < 0.001$). This implies that the adoption level increases with male rice farmers. That is, more men were likely to adopt improved rice production technologies than the female farmers. This finding may not be unconnected with the high number of male rice farmers compared to their female counterpart. Additionally, most of the decisions in terms of innovation adoption are carried out by the men (Adah, 2015).

Marital Status (X_4)

The coefficient (β=-2.916) of marital status was negatively signed ($P < 0.001$). The inverse relationship of this variable with adoption level of improved rice production technologies is an indication that adoption score tends to reduce with married rice farmers in the area. Marital status could signify readiness to accept responsibilities and stay put on a particular profession. Additionally, members of the family could serve as source of labour for various activities involved in rice production. This finding is in contrary to the findings of Mohammed *et al.* (2014) when they reported a direct relationship between marriage and adoption of agricultural technologies.

Household Size (X_5)

The result on household size implies that a unit increase in household size decreases the level of adopting rice production technologies by 0.572 (57.2%). This finding agrees with that of Sani *et al* (2014) and Ofuoku *et al* (2009) who reported similar result among farmers in Kano and Delta states respectively.

Credit (X_6)

The coefficient of access to credit was positively signed ($P < 0.001$). This direct relationship implies that level of adopting rice production technologies increases with increase in rice farmers' access to credit facilities. This finding is not surprising and it is in line with the *apriori* expectation as credit is essential for the purchase and maintenance of improved rice production technologies. This finding underscores the role of credit in the adoption of agricultural innovations. Farmers may be willing to adopt new technologies; they could however be constrained with the financial involvement to adopt such innovation. This finding agrees with Adah (2015) who reported a positive relationship between credit availability and adoption of improved oil palm processing technologies in Kogi state, Nigeria.

Table 2: Percentage Distribution of Respondents Based on Level of Adoption of Selected Improved Rice Production Technologies

Improved Rice Production Technologies	Not Aware	Aware	Interest	Evaluation	Trial	Adopt	Reject
Use of improved varieties	-	0.7	8.4	0.9	12.6	77.4	-
Use of agrochemicals	13.3	9.3	15.0	15.5	34.3	11.5	1.1
Zero tillage	35.4	42.5	11.8	-	6.8	3.5	-
Fertilizer application	21.3	10.9	10.0	15.5	21.5	20.8	-
Proper spacing	-	12.8	-	-	-	5.5	81.7
Improved nursery	72.1	4.6	2.4	-	10.0	10.9	-
Timely transplanting	20.8	10.9	5.4	1.5	0.9	60.5	-
Line planting	37.5	30.5	10.8	14.9	-	1.8	4.5
Urea deep placement	58.3	40.2	1.5	-	-	-	-
Planting depth	57.1	20.5	10.0	-	11.8	0.6	-
Optimum seed rate	58.8	10.5	15.5	0.5	-	14.6	-
Fertilizer inculcation	77.1	10.0	5.5	-	7.4	-	-
Improved processing	82.5	15.5	-	-	-	2.0	-
Use of modern rice milling	86.7	13.3	-	-	-	-	-

Source: Field Survey, 2016

Table 3: OLS Regression on the Effect of Socioeconomic variables on level of Adoption of Improved Rice Production Technologies

Variables	Linear	Semi-Log	Double-Log
Constant	955.018	-12335.151	1.006
	(1.292)	(-6.056)	(1.146)
Age (X_1)	80.163	4533.848	2.022
	(9.281)***	(11.274)***	(11.66)***
Sex (X_2)	3754.266	-6799.084	3.576
	(5.865)***	(-10.665)***	(13.01)***
Education (X_3)	-2.644	134.971	0.104
	(-1.33)	(0.774)	(1.38)
Marital Status (X_4)	-2349.012	-5177.819	-2.916
	(-6.325)***	(-11.755)***	(-15.36)***
Household size (X_5)	-101.142	-1868.472	-0.572
	(-4.626)***	(-13.265)***	(-9.41)***
Credit (X_6)	0.058	573.520	0.244
	(13.775)***	(4.712)***	(4.66)***
Farm size (X_7)	11.873	-211.642	0.016
	(0.672)	(-1.964)*	(0.35)
Extension Contact (X_8)	-294.765	1383.483	0.922
	(-5.061)***	(3.984)***	(6.16)***
F-value	116.951***	88.129***	77.123***
R^2	0.816	0.776	0.752
Adj. R^2	0.809	0.768	0.743

Source: Computed from Field Survey, 2016

Note: Figures in parenthesis are the t– values. ***, ** and * denote 1, 5 and 10 percent level of significance respectively

Extension Contact (X_8)

Number of extension visit in a farming season was directly related to adoption of rice production technologies. By implication, an increase in the number of extension visit will increase the adoption score for improved rice production technologies. Extension contact increases rice farmers' level of awareness and knowledge on improved rice production technologies which could possibly lead to its adoption. This finding agrees with Onemolease and Alakpa (2009) who found that the frequency of extension contacts promotes the adoption of improved technologies.

CONCLUSION

It can be concluded that rice farmers in rural areas of the State generally adopted the use of improved rice varieties and timely transplanting. However, they were not satisfied with the recommended line spacing of 20cm – 25cm. The variables which significantly determined the adoption of improved rice production technologies and consequently vital in predicting farmer's adoption behaviour were sex, age, marital status, household size, credit access and extension contact.

Based on the findings, it is recommended that: government and financial institutions should provide enough credit facilities with a bit relaxed collateral and other conditionalities to rice farmers in the State; perhaps, there could be an improvement in the on-going loan facility to rice farmers in the State. Also, the current ban on the importation of processed rice into the country by the Federal Government should not be relaxed as it will stimulate domestic rice production and hence, adoption of improved rice production technologies towards meeting the domestic demand. Additionally, the extension agency should intensify awareness campaigns and sensitization of rice farmers on pertinent production technologies. To create further awareness and stimulate interest, there should be regular information dissemination in various languages on radio, television, bulletins and leaflets.

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