Determinants of Rice farmers' Technology Utilisation in Ekiti and Ogun States, Nigeria: Implication for Achieving Sustainable Increase in Rice Production as well as Food security.

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Abstract: This paper identifies determinants of rice farmers' technology adoption and utilization in Ekiti and Ogun states, Nigeria. This is predicated on the fact that farmers' decision on technology adoption and utilisation is slow, and sometimes technology which could have improved rice production in Nigeria was not fully adopted. This realization has caused increased attention to be directed at the technology adoption process. If certain groups are not using new technologies, or adopting them at a lower rate, then we need to determine why, because only by understanding the reasons will we be able to develop improved technologies that are appropriate and acceptable for all. Primary data were used for this study. A survey was carried out to obtain data from the farmers. The data collected were analysed by using frequency count, mean, percentage and regression. A multiple regression model was estimated on data collected in order to identify variables that determine farmers' technology adoption and utilisation. From the estimation, the significant variables which determine farmers' technology utilisation were households size (β=-0.19), access to functional market (β=0.27), income (β=0.17), farm size (β=0.17), extension services (β=0.13) and environmental factors (β=0.15). For improving farmers' technology utilisation and the enhancement of sustainable rice production in Nigeria, determinants of improved technology utilization amongst poor resource farmers should be considered. Successful agricultural development depends on effective extension services. Government should employ more village extension workers and provide efficient means of transportation to be able to reach out to the farmers in their villages.
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1. Introduction

Agricultural production in developing countries faces many hindrances and challenges such as poor agricultural practices, inefficiencies in information delivery, records maintenances between farmers and traders, and lack of information on the use of best agricultural practices among farmers (Abdul, 2013). Nigeria agriculture is faced with various problems that prevent reasonable development and cause decline in agricultural sector.

This decline is due to the nature of its production and the problems underlying its improvement (Adejare & Arimi, 2013). The decline in agricultural production resulted into food insecurity in most of developing nations especially Nigeria. The challenge of food insecurity and hunger in Nigeria has become more severe ever than before due to low food production and increase human population. The Nigerian population as shown by the Nigerian Population Commission (NPC, 2006) increases from 88.2 million in 1992 to 140 million in 2006, while food production has not kept pace with increase in population. This situation leads to food insecurity. The efforts to combat the problem of food insecurity has led to various researches into the development of technologies which are aimed at increasing food production (especially rice) to meet the needs of the people and even improve their living standard. According to Kassal (2000) and Oyemade (2003), technology is used to improve human condition, the natural environment or to carry out other socio-economic activities. Agricultural technology includes tools, equipment, agrochemical, management skills, and other processes that farmers need to increase production of food. Many governments and international agencies have invested in research and technology development to raise farmers' productivity. In spite of the potency of the new technologies, over the traditional, adoption rate has been slow in sub Saharan Africa (Saka and Lawal, 2009). Most of the rice technologies generated have not been embraced among farmers in Nigeria. This could be one of the reasons IFA (2007) posited that farmers in developing countries have been left behind by the rapid changes in agricultural technology adoption and utilization. It further stated that for farmers to keep track of these rapid changes, agricultural extension plays an important role in technological diffusion and adoption.

Adoption of any improved technology involves a process in which awareness is created, attitudes are changed and favourable conditions for adoption are provided (Ghosh, Goswami and Mazumdar, 2005).

Adoption is the stage of final decision by farmers to put into use a new idea or an innovation. In agriculture, adoption refers to the acceptance and use of new ideas, methods, practices, or techniques which provide a means of achieving constant increase in farm output and income (Karrem, 1999; Ogunfiditimi, 1981; Oladele and Adu, 2003). Adoption is concerned with the behaviour of individuals in relation to the use of technology, more particularly their reasons for taking to a technology at a point in time (Ghosh, Goswami and Mazumdar, 2005). Adoption behaviour of farmers requires consistency and steadfastness of farmers to the adopted practices. Farmers' adoption behaviour is the pattern of reaction displayed towards a technology and which determines acceptance and continuous utilization of individual components in the recommended package introduced to them. Adoption behaviour of farmers is expressed in terms of farmers' awareness, interest, trial, adoption, continued use, abandoned or total rejection of a technology with respect to time of putting the innovation into trial after their awareness (Ogunsunmi and Ewuola, 2005; Oladele and Adekoya, 2006). Period of innovation adoption in a social system led to the categorization of adoption behaviour into innovators, early adopters, early majority, late majority and laggards. This behaviour is based on validated studies that the adoption behaviour of any agricultural technology would follow a normal distribution curve in a given social system (Roger, 2003). It is possible for a farmer to be aware of a particular innovation but not to have interest in using it, or he might be waiting for other farmers to adopt the innovation before trying it. Such behavior does not mean well for rapid agricultural development and the nation food production system. Also, the adoption behaviour of farmers which is to make selective adoption of technology is an important component of innovation decision making process which has received little attention among researchers in Nigeria. Selective adoption of recommended technology will not allow the crop to produce maximally, which will reduce the farmers' productivity. Based on this it is necessary to examine the determinant of rice farmers' technology adoption and utilization in the study areas with hope of improving their innovation utilization in order to increase rice production, as well as achieving food security in the study areas.

Hypothesis of the study

H_{01}: There is no significant difference in technology utilisation by rice farmers in Ekiti and Ogun states, Nigeria.

2. Material and Methods

The study areas were Ekiti and Ogun states, Nigeria. Multi-stage sampling procedure was used to select respondents for the study. The first stage involved selection of ADPs zones where rice is grown in the two states. Abeokuta zone was purposively selected because of intensity of rice production in the zone. Three blocks were selected by simple random sampling technique from the eight blocks. Two cells were randomly selected from each block to have a total number of six cells. The six cells have 1,076 farmers; ten percent of the farmers were selected to have a total number of 108 respondents.

Ekiti state is divided into two agricultural zones namely, Aromoko and Ikole. Each of the zones has eight extension blocks. Each extension block has eight cells. Ikole zone was purposively selected because of its large scale involvement in rice production. Three blocks and two cells were randomly selected to give a total number of six cells. The six cells have 1,066 farmers. Ten percent of the farmers were selected to have a total of 107. This gives a total sample size of 215 respondents. Primary data were used for the study. Information on determinants of adoption of rice production technology was obtained from the respondents through interview schedule with the aids of questionnaire. The measuring instrument was pre-tested, and the alpha reliability coefficient of 0.86 was obtained. Information was obtained on personal characteristics of the respondents and attitude of farmers towards technology utilisation. Respondents were asked to indicate when they put the innovation into trial as well as their sources of information. When the innovation was first adopted as well the number of the technology practices adopted was used in grouping the adopters into innovator, early adopters, late adopter and laggard. Data collected were analysed through the use of descriptive and inferential statistical tools such as frequency count, percentage multiple regression to determine variable affecting rice farmers' technology utilisation. The regression model is shown below.

$Y = a + X_1 + X_2 + X_3 \text{----------} X_n + e$

Where Y = Farmers technology adoption/utilisation.

a = constant term

X_1-X_n = Independent variables.

X_1 = Education = Educated =1, Not educated = 0

X_2 = Age. Young =1, Old = 0

X_3 = Contact with the extension agents. Yes=1, No=0

X_4= Farm size. Large scale = 1, Small = 0

X_5 = Access to credit facilities Yes= 1, No = 0

X_6 = Access to functional market. Yes =1, No = 0

X_7 =Access to inputs. Yes= 1, No = 0

X_8 =Household size. Yes= 1, No = 0

X_9 = Compatibility with culture/ Existing practice. Yes= 1, No = 0

X_{10} = Divisibility of the innovation. Yes= 1, No = 0

X_{11} = Cost of the innovation. Yes= 1, No = 0

X_{12} = Environmental factor (Birds invasion). Yes= 1, No = 0
X_{13} = Quantity produced. (Actual yield obtained).
X_{14}= Provision of active extension services
X_{15} = Attitude towards technology utilization (favourable attitude (1), Unfavourable attitude (0)
e = error term

3. Results

Table 1 depicts respondents' sources of information on improved rice production technology in the study areas. These sources of information include radio (64.2%), television (57.7%), internet (20.5%), newspaper (30.2%), farmers' associations (92.6%), extension agents (73.0%) and friends (57.2%).

Table 1: Distribution of respondents on sources of information and frequency of receiving information on rice production technology.

Sources of information	Yes		Frequency of receiving information					
			Always		Occasionally		Never	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
Radio	178	82.8	77	35.8	101	47.0	37	17.2
Television	124	57.7	17	7.9	107	49.8	91	42.3
Newspaper	65	30.2	21	9.8	44	20.5	150	69.8
Farmers' association	199	92.6	133	61.9	66	30.7	16	7.4
Extension agents	157	73.0	69	32.1	88	40.9	58	27.0
Internet	44	20.5	2	0.9	42	19.5	171	79.5
Friends	123	57.2	38	17.7	85	39.5	92	42.8

Multiple responses
Source: Field survey, 2012.

Table 2: Distribution of respondents on adoption process in Ekiti and Ogun state, Nigeria.

Awareness	Frequency	Percentage
Yes	215	100.0
No	-	-
Total	215	100.0
Year of first adoption		
0-2	57	26.5
3-5	57	26.5
6-8	72	33.5
9-11	29	13.5
Total	215	100.0
Adopter category.		
Laggards	1	0.5
Late majority	-	-
Early majority Early adopter	10 55	4.7 25.6
Innovators	149	69.3
Total	215	100.0

Source: Field Survey, 2012.

Table 3: Distribution of respondents on their technology utilization in Ekiti and Ogun state, Nigeria.

Adoption of recommended practices	Adopted/Use	
	Frequency	Percentage
Improved seeds (FARO 43-57).	215	100.0
Planting date (June)	179	83.3
First inorganic fertilizer application	125	58.1
Second Inorganic fertilizer application (30kg P_2O_5/ha)	125	58.1
Spacing (None lodging 20cmx20cm)	154	71.6
Seed rate 3-5 seeds/ stand	168	78.1
Herbicides (Stan F-34, Risane)	100	46.5

Nursery dressing	143	66.5
Pesticides application (Fungicide Dithene)	120	55.8
Green manure Sesbania rostrata	103	47.9
Treatment of seeds with 12% salt solution for two minutes before sowing in the nursery.	164	76.3
First weeding	206	95.8
Second weeding	196	91.2
Third weeding.	160	74.4

Source: Field survey, 2012.

Table 4: Difference in level of technology utilisation among the farmers in Ogun and Ekiti States.

States	N	df	F-value	t-value	p-value	Mean difference	Std. deviation	Std. error difference
Ogun	108	213	1.40	-2.19	0.02	-0.562	1.733	0.129
Ekiti	107						2.017	

Source: Field survey, 2012.

Multiple regression for determinants of technology utilisation among rice farmers in Ekiti and Ogun states.

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	8.324	.766		10.860	0.000
Age	0.412	0.321	0.230	0.33	0.780
Household size	-.194	.066	-0.190	-2.913	0.004**
Educational level	.183	.125	0.095	1.462	0.145
Income	1.344E-005	.000	0.174	2.287	0.023**
farm size	.387	.179	0.168	2.166	0.031**
Quantity produced	-.024	.139	-0.013	-.170	0.865
provision of active extension services by ADP	.461	.124	0.132	2.133	0.021**
access to functional credit facilities	-.449	.421	-0.081	-1.067	0.287
access to functional market	.556	.470	0.270	3.147	0.002**
access to inputs	.308	.360	.067	.855	0.394
Cost of the innovation/affordability	-.588	.338	-.155	-1.739	0.084
Complexity of the innovation	-.183	.315	-.048	-.581	0.562
Compatibility with culture/ Existing practice	-.104	.286	-.026	-.364	0.716
Divisibility of the innovation	.247	.327	.065	.756	0.450
Birds invasion	.285	.130	.145	2.202	0.029**
Attitude towards technology utilisation	.201	.160	.115	0.16	0.390

Source: Field survey, 2012.

4. Discussions

Table 1.0 shows the sources of information on improved rice production technology available to farmers in the study areas. The result shows that majority of the respondents received information on improved rice production technology through different means which include the radio (64.2%), television (57.7%), internet (20.5%), newspaper (30.2%), farmers' associations (92.6%), extension agents (73.0%) and friends (57.2%). This implies that information on improved rice production technology is well communicated to the farmers through different means. The diverse nature of the sources of information should encourage the farmers to use the innovation in order to increase their production.

Sixty-four point two percent of the respondents received information on improved rice production technology from radio while 92.6% respondents indicated they received information from the farmers' associations. High frequency of information dissemination to farmers may change their behavior towards practising improved methods of farming. The

result also revealed that the majority (64.2%) of the respondents listened to radio, which implies that radio may be an effective medium of disseminating new agricultural innovation to farmers in the study areas. This finding is corroborated by Owolade and Arimi (2012) that radio is the cheapest and quickest means of passing information to a large number of farmers in Oyo state, Nigeria. Kock, Harder and Saisi (2010) also agreed that radio is an effective medium of communicating market information to farmers. Therefore, efforts should be made by extension agents to ensure they get feedback from the farmers.

The distribution of the respondents on awareness of improved rice production technology revealed that all the farmers were aware of this improved technology. This could be due to the fact that all the farmers were ADP farmers that had access to information on the technology.

Table 2 shows their first attempt on the improved technology, forty-seven percent of the respondents used it 6 to 11 years ago for the first time while 26.5% indicated 3 to 5 years ago. This result revealed that most of the respondents adopted the technology early such behavior is favourable to increase rice production in the study areas. It also implies that farmers are willing to use innovation that will improve their productivity. If such innovation satisfies their needs they will continue its use.

The distribution of the respondents on number of practices adopted revealed that 69.3% of the respondents adopted 12 to 14 practices while 0.5% adopted 1to 2 practices.

The distribution of the respondents according to their adoption behavior shows that 69.3% and 25.6% of the respondents were innovators and early adopters respectively. The favourable adoption behavior of the farmers could be due to the fact that the innovation was timely communicated to the farmers early through different communication channels. Using different communication channels in passing information to farmers may encourage them adopt innovation promptly.

Table 3 reveals improved rice production technology use by farmers in the study areas. Apart from improved rice seed which is generally adopted or use by the respondents, other components of the technology such as fertilizer and insecticide applications were not all adopted by the respondents. The reason for not using the technology as recommended by extension agents could be attributed to difference in their socio-economic characteristics. Failure of farmers to adhere by recommended practices has serious implications for agricultural production and food security in the study areas.

Table 4 reveals that there is a significant difference in farmers' level of technology utilisation in Ogun and Ekiti States ($t = -2.19$, $p=0.02$). The difference in the level of technology utilisation in the two states could be due to difference in their cultural practices. Farmers in Ogun state are more accustomed to planting Ofada variety unlike their counterpart in Ekiti state who are well disposed to the use of improved variety.

Table 5 shows the regression analysis of the determinants of improved rice technology utilisation in the study areas. The R square value of 0.548 indicates that 55 % of the total variation in the factors affecting farmers' technology utilisation was explained by the model. The multiple R-value of 0.74 also shows that there is a strong correlation between the independent variables (factors) and farmers' technology utilisation. The F-value is 5.219, $p= 0.000$, this indicates that the independents variables are significant explanatory variable of the dependents variable. The independent variables were very important in predicting farmers' technology utilisation. Farmers' access to functional markets has greatest Beta value of 0.270. The positive relationship observed between the variable and technology adoption implies that the greater the farmers access to market opportunity the greater the tendency to use improved rice technology to increase their production. Household size ($\beta=-0.19$), income ($\beta=0.17$), farm size ($\beta=0.17$) and birds invasion on farmers' farm significantly affect their technology utilization ($\beta=0.15$). This implies that the larger the household size the less the household in question adopt or use improved rice production technology on their farms. This is because most of the farming activities are carried out by household members. This finding is corroborated by Adejare and Arimi (2013) who asserted that farming activities in Nigeria is mostly carried out by household members. Increase in farmers' income enable them purchase improved technology which is capable of increasing their productivity. Similarly, the larger the farmers' farms size the higher their likelihood of adopting improved rice production technology. This finding is supported by Balogun (2008) who reported positive correlations between farmers' farm size, income and their technology adoption in Nigeria. Birds invasion on the farmers' farm affects their technology utilisation ($\beta=0.130$). Birds reduce rice yield on the farm, the less farmers encounter the problem of birds feeding on their crop the more they adopt technology to produce more rice.

In conclusion, the determinants of rice farmers' technology adoption and utilisation in the study areas include income, household size, access to functional market, and the invasion of birds on the farmers' plantation field. Birds' invasion is the most severe environmental factor affecting rice production

in Nigeria. It reduces farmers' yield on the field. Active extension services changes farmers' innovation adoption behavior. Farmers are usually quite rational and make systematic use of information available to them. Decision of farmers to adopt innovation depends on the available information at his/her disposal.

The following recommendations are put forward based on the findings of the study for improving farmers' technology adoption/utilisation and the enhancement of sustainable rice production in Nigeria. Resource poor farmers should be considered when formulating and implementing agricultural policies. Government policy on fertilizer distribution, tractor hiring services, improved seeds, insecticide, and herbicides should not be politicized; they are to be made available to farmers in sufficient quantity at appropriate time and affordable price. When developing innovation, the technology should not be too complex to understand and it must conform to the existing practices of the farmers and taste of the consumers. Successful agricultural development depends on effective extension services. Government should employed more village extension workers and provide efficient means of transportation to be able to reach out to the farmers in their villages.

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