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EVALUATION OF ADOPTION OF IMPROVED RICE PRODUCTION TECHNOLOGIES BY SMALL SCALE RICE FARMERS IN KEBBI STATE, NIGERIA

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ABSTRACT

This study evaluated the adoption of improved rice production technologies by small scale rice farmers in Kebbi State, Nigeria. Multistage sampling technique was used to select 197 respondents from 12 villages where rice is produced in the State. Data were collected with the aid of a structured questionnaire and analyzed using descriptive statistics and logit regression. Results of the study revealed the means of age and household size of the respondents as 38.67 years and 11.83 people, respectively. The means of formal education was 6.99 years while that of years spent in rice farming was 17.06 years. Results of the study showed that 73% of the respondents did not have access to credit facilities with 52% of them perceiving that credit is highly important in the enterprise. Also, the findings of the study revealed that majority (95.43%) of the respondents were aware of seed of improved varieties while planting technology (95.43%) was the technology most adopted by the farmers. Insufficient credit facilities and non-membership of associations by farmers were the main constraints of the farmers. Years of formal education, years of rice farming and information sources used were the main factors affecting adoption of recommended improved rice production practices. The study recommended that farmers should be supported by credit facilities from government and non-governmental organizations in the study area.

Keywords: Adoption; improved technologies; small scale; Kebbi State

INTRODUCTION

Rice (*Oryza sativa*) is the most important food crop of the developing world. It is the staple food of more than half of the world's population. About 90% of rice is grown by

more than 200 million small scale rice farmers with farm size of less than 1 hectare with a value of more than US$150 billion per year. One-fifth of the world's population (more than 1 billion people) depends on rice cultivation for livelihood (World Bank, 2008).

Africa has become a big player in international rice markets, accounting for 32.5% of global rice imports. Africa's emergence as a big rice importer is explained by the fact that rice has become the most rapidly growing food source in sub-Saharan Africa where its consumption has been growing at 6% per annum over the years (FAO, 2012). Conteh *et al.* (2012) concurred that the relative growth in demand for rice is faster in this region than anywhere in the world due to population growth (4% per annum), rapid urbanisation, rising incomes and a shift in consumer preferences in favour of rice in urban and rural areas. Rice is an important economic crop and the major staple food for millions of people in Sub-Saharan Africa in general and Nigeria in particular (AfricaRice, 2012).

Nigeria's rice demand has been expanding with consumption levels growing significantly at 10.3% per annum with the estimated rice demand in 2008 is about 5.3 million tonnes and estimated annual production of 2.3 million metric tonnes (IRRI, 2010; Ayanwale *et al.*, 2011). The national rice supply-demand gap of 3 million metric tonnes is expected to be bridged by importation which has constituted serious drain on the nation's foreign exchange. Several factors have been attributed to the slow bridge in the demand and supply gap prominent among which include half of Nigeria's 170 million people live below the poverty line (UNPFA, 2015); the lack of high yielding varieties with good grain qualities, competition with imported rice, and inadequate post-harvest processing. Other factors are land degradation and inadequate land preparation, unreliable and uneven rainfall distribution, problems of weeds, insect pests, diseases, birds, and lack of training for key stakeholders. Also, much of the expansion has been in the rain fed systems, particularly the two major ecosystems that make up 78% of rice land in West and Central Africa (WCA).

Therefore, there is a renewed drive by the Federal Government of Nigeria to increase the production of high quality processed rice from 2.6 million tonnes in 2011 to five million tonnes by 2015, thereby adding one million additional jobs to the agricultural sector in the process (FMARD, 2011).

Yields of upland and lowland rain-fed rice per hectare are low, averaging 1.8 tonnes per hectare while rice under irrigation farming system is 3.0 tonnes per hectare. This is comparatively low in contrast to 3.0 tonnes per hectare from lowland and upland and lowland farming systems, and 7.0 tonnes/ha from irrigation systems in Senegal and Cote d' voire (Defoer *et al.*, 2004). However, the productivity of farmers can be increased by adoption of improved production technologies or improvement in production or both (Idiong, 2007; Awotide *et al*., 2010). Ani (2002) observed that adoption of agricultural technologies could provide the gateway of increasing production thereby raising farmers' income most of whom live in the rural areas.

As Nigeria is aiming at self-sufficiency in rice production and elimination of the rice imports, it is important to study the adoption of rice production technologies among farmers in Kebbi State of Nigeria where there is dearth of empirical studies on the adoption of these improved technologies by rice farmers. This study, therefore, evaluated adoption of improved rice production technologies by small scale rice farmers in Kebbi State, Nigeria. This study specifically aimed at describing the socio-economic characteristics of the farmers, ascertained the level of awareness of improved rice production technologies adopted by the farmers, determined the factors influencing adoption of the technologies,

and identified the constraints to the use of improved rice production technologies by the farmers in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted in Kebbi State, North Western Nigeria. Kebbi State is situated at 11° 30′ 0″ N, 4° 0′ 0″ E. It has two dominant seasons wet and dry. The wet season lasts from April to October in the south and May to September in the north; while the dry season lasts for the remaining period of the year. Mean annual rainfall is about 800mm in the north and 1000mm in the south. Temperature is generally high with mean annual temperature of about 26°C in all locations. However, during the harmattan season (December to February) the temperature can go down to about 21°C and up to 40°C during the months of April to June. Kebbi State was created on 27 August, 1991. The state is bordered by Sokoto State on the North-eastern axis, Niger State to the Southern part and Zamfara State to the East. Kebbi State has international border with Niger Republic to the West. Kebbi State has 21 Local Government Areas and occupies over 36,800 square kilometres. The vegetation of the state is Sudan and Sahel-savannah. The State has diverse ethnic groups among which are *Hausa, Fulani, Kabawa, Dakarkari, Kambari, Gungawa, Dandawa, Zabarmawa, Dukawa, Fakkawa and Bangawa.* Over 80% of the inhabitants are practicing animal husbandry and crop farming. They produce such crops as millet, sorghum, maize, rice, potatoes, groundnut and beans for subsistence; wheat, sugar-cane, cotton, and assorted crops and vegetables for cash which include garlic, onions, pepper and tomatoes among others (Iloeje, 2001).The area is also one of the main fish producing areas of the country. Thus a large number of people along the river basin engage in fishing as well.

Sampling Technique and Sample Size

The study used a multi-stage sampling technique. These levels are the Local Government Areas, the village and the farmer levels. In the first stage, 4 local government areas were selected from the state. The second stage involves selection of 3 villages purposively selected from each Local Government Area to give a sum of 12 villages. These areas were selected on the basis of being major rice cultivation areas. A population frame of 4891 rice farmers was obtained from Kebbi Agricultural Development Project from where 4% of the rice farmers were randomly selected from each of the 12 villages for enumeration for the study. This gave a total of 197 farmers who form the sample size for this study.

Data Collection and Analysis

Primary data for the study was collected through interview schedule using a structured questionnaire with the help of trained enumerators under the close supervision of the researcher. Focused group discussions were conducted with farmers to collect relevant information that was not captured in the questionnaire. Descriptive statistics such as range, ranking, means, percentage and frequency distributions, and logit regression were used to achieve the objectives of the study. The model is expressed as:

$Y = f(x_1,x_2,x_3,x_4,x_5,x_6,x_7,x_8,x_9,x_{10},U)$ Where

Y = adoption of improved technologies by the i^{th} farmer.
X_1 = Age of farmer in years X_2 = Sex X_3 = Household size X_4 = Years of education
X_5 = Years of rice farming X_6 = Membership of organisation X_7 = Access to credit
X_8 = Farm size in hectares X_9 = Preferred information sources X_{10} = Cost of information
U = error term.

Measurement of some Selected Variables

The dependent variable of the study is the adoption improved rice production technologies. It was measured as 1= adopt, otherwise = 0. The measurement of independent variables are Age of the farmer (years); Farm income (Naira); Household size (Number); Type of education (years); Farm size (hectares); Farming experience (years); Farm size (Hectares); Membership of cooperative (1 = member; otherwise = 0); Access to credit (1 = member; otherwise = 0) Frequency of contact or use of information source(s) (Number).

Table 1: Study Population and Sample Size

STATE	LGAs	Selected Villages	Population Frame	Selected Farmers (4%)
KEBBI	Argungu	Tungar Zazzagawa	321	13
		Sauwa	349	14
		Gulma	581	23
	Bunza	Zogirma	320	13
		Mai da hini	298	13
		Tungar dan nupe	356	14
	Augie	Augie	672	27
		Yola	401	16
		Bagaye	283	11
	Suru	Dakin-gari	502	20
		Zakkuwa	342	14
		KukanaYelwa	466	19
Total			4891	146

Source: Field survey data, 2015

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Rice Farmers

Age: Table 2 shows the socio economic characteristics of rice farmers. The result indicated that over half (53.30%) of the farmers were within active age range of 36-55 years. This age category was in line with those Bekele (2005) referred to as economically active age groups. The mean age of the rice farmers was 38.67 years.

Gender: Also, 97.95% of the rice farmers were male while 2.05% were female. This result could be due to the poor gender mainstreaming in many societies of developing countries like Nigeria where women have low access to agricultural and institutional resources and services. This is in consistent with the findings of Salihu (2006) that men dominated the agricultural workforce in the North-west region of Nigeria.

Table 2: Socio-economic characteristics of rice farmers (n=197)

Variable	Frequency	Percentage	Mean
Age(years)			
Less than or 25	24	12.18	
26-35	40	20.30	
36-45	50	25.38	38.67
46-55	55	27.92	
56-65	11	5.58	
More than 65	17	8.63	
Sex			
Male	193	97.95	
Female	4	2.05	
Household size(persons)			
1-5	42	21.32	
6-10	73	37.06	
11-15	55	27.92	11.83
16-20	15	7.61	
>21	12	6.09	
Educational status			
Informal education	57	28.93	
Formal education	100	50.76	
Non-formal education	40	20.55	
Years of formal education			
6-10	24	12.18	6.99
11-15	61	30.96	
16-20	15	7.61	
Membership of association			
No	69	35.03	
Yes	128	65.07	
Farm size (hectares)			
<1	77	39.09	
1-3	57	28.93	2.17
4-6	28	14.21	
7-9	26	13.19	
>9	9	4.79	
Years of rice farming experience			
1-10	63	31.98	
11-20	76	38.58	17.06
21-30	31	15.74	
31-40	18	9.14	
>40	9	4.79	
Credit access			
No response	32	16.24	
Yes	144	73.10	
No	21	10.66	
Credit perception			
No response	18	9.14	

least important	15	7.61
less important	19	9.64
Important	43	21.83
Very important	102	52.05

Source: Field survey data, 2015

Household size: The mean of household size is 11.83 persons implying high food consumption and availability of family labour. Mean family size contrasts sharply with average rice farming household size of 6.14 observed by Adedeji, *et al.* (2013) in Adoption of NERICA in Ogun State, Nigeria.

Educational attainment: Findings in Table 2 also revealed that most (50.76%) of the rice farmers had formal education. Sani and Bagana (2007) have reported that exposure ratio of 5.7 of farmers to education shows the potential for increased awareness and adoption of recommended practices among the rural populace, since adoption of new technology is a function of education.

Cooperative membership: The study also shows that over 65% of the rice farmers were not members of any associations. Membership of associations was shown to be one of the most important variables in adoption of cereal crop production innovations in Benue state, Nigeria (Odomenem and Obinne, 2010).

Farm size: Over a third of the farmers had farm size of less than 1 hectares implying that rice farming is mainly done by small-scale farmers. The mean rice farm size is 2.17 ha. This finding is in consonance with that of Saka and Lawal (2009) which reported average farm size of 2.6 hectares. Rahemeto (2007) also observed that the larger the farm, the more the probability of seeking and using new farm technologies.

Rice Farming Experience

The findings in Table 2 reveal that most (38.58%) of the rice farmers in the study area had 11- 20 years of farming experience while only 4.79% had over 40 years' experience of rice farming. The mean farming experience was 17.06 years and the willingness and ability to try new ideas is expected to increase with increase in farming experience. Balarabe (2012) has observed that farming experience might help farmers boost crop production through knowledge acquired over the years in rice farming.

Access to Formal and Informal Credit Facilities

Analysis of the rice farmers' access to formal and informal credit facility revealed that 73% of the rice farmers do not have access to any form of credit facility. Access to credit would enhance and increase rice production. This finding is in agreement with findings of Ademiluyi *et al*. (2008) who noted that access to loans and other financial incentives will certainly improve farmers' scale of production.

Awareness of Improved Rice Production Technologies by Rice Farmers

Multiple response analysis is a frequency analysed when there can be more than one response per variable to a question. Rather than treat the successive responses as separate variables, multiple response analysis allows these responses to be combined and

collectively analysed as observed with the rice production technologies. Results in Table 3 shows that the seed of improved varieties (95.43%), planting techniques (86.80%) and storage methods (81.86%) were ranked first, second and third respectively by the rice farmers as the main technologies they are aware of. This high level of awareness on these technologies may be a pointer to the possibility of high adoption of these technologies in contrast to the technologies that are least known by the respondents as reported in Table 4.

Table 3: Distribution of farmers based on awareness of improved rice production technologies (n=197)

Variables	Percentage
Seed of improved varieties	95.43
Planting techniques	86.80
Water management	62.44
Fertilizer application	78.68
Pest and disease control	73.09
Harvesting techniques	67.01
Storage methods	82.23

Source: Field survey data, 2015 *Multiple response recorded

Improved Rice Production Technologies Adopted by the Respondents

Table 4 shows technologies the farmers have successively adopted. These include planting technologies (95.43%), seed of improved varieties (78.77%) and storage methods (66.44%). The least adopted technologies by the farmers are water management (42.64%), harvesting method (33.84%) and fertilizer application (41.12%) respectively. This might be in agreement with findings of Ramayah and Mohammed (2004) who observed the decision to accept or reject an innovation is based on some trade-off of sorts between perceived benefits of the system to the user and the complexity of learning ways of using the system.

The low adoption rate of fertilizer application (41.12%) might be due to farmers use of varying doses of fertilizer, which is in most cases was less than the recommended rate. This might be due to the high cost or non-availability of fertilizer to farmers. The technologies with low adoption values may imply that the respondents have not known their relevance to their production. However, the low adoption of some of the technologies could just be a matter of choice.

Table 4: Distribution of farmers based on adoption status of improved rice production technologies (n=197)

Variables	Adopters	Non Adopters
Planting techniques	188 (95.43%)	22(11.17%)
Water management	84(42.64%)	84(42.64 %)
Seed of improved varieties	155(78.77%)	13(6.60%)
Fertilizer application	81(41.12%)	86(43.65%)
Pest and disease control	124(63.96%)	54(27.41%)
Harvesting techniques	107(54.31%)	67(33.84%)
Storage methods	131(66.44%)	49(24.87%)

Source: Field survey, 2015 multiple responses used

Factors Influencing Adoption of Improved Rice Production Technologies

The findings from the study in Table 5 indicate positive relationship between age and adoption of technologies by the rice farmers where the coefficient is significant at 1% level of significance suggesting a positive influence of adoption. Thus, an increase in age in one year will increase the level of adoption by 0.11. This is because younger farmers are not risk averse and are liberal in venturing into new ways of doing things. This result was in line with the finding of Kafle and Shah (2012) who reported a positive relationship between age and adoption of improved potato varieties in Bara District of Nepal. Membership of associations is negative which is contrary to the expected sign that the coefficient on membership of agricultural associations should be positive. This might be due to non-participation of most of the farmers in associations implying decrease access to acceptance of improved rice technologies.

A negative relationship was however, observed between farm size and adoption of improved rice production technologies subsequently, farm size is significant at ($P<0.05$) and negatively related to adoption of improved rice production technologies which imply that adopting improved rice production technologies increases for farmers with large farms than those with smaller farms. This result is in conformity with the finding of Etwire *et al.* (2013) who observed that farm size significantly and positively affects the decision to adopt a recommended agricultural practice as an adaptation option to climate change and variability by smallholder farmers in northern Ghana.

The results of the study further show that farming experience had positive influence on adoption of improved rice production technologies ($p<0.01$). This agreed with the findings of Sani and Bagna (2007) that experience in farming had significant influence on the adoption of improved rice varieties. In other words, farmers with long experience in farming are more inclined to adopt improved rice technologies.

Results of the study also indicate that household size of farmers had positively and significantly influenced adoption of improved rice production technologies ($p<0.1$). This could probably be due to the fact that large family size is assumed to be an indicator of farm labour availability in the family. This is in agreement with Anne *et al*. (2012) who also found a positive relationship between household size and adoption of improved agricultural production technologies. Also, total cost of technology has a significant but negative influence on adoption of improved rice technology at 5% level. The negative coefficient implies that the potential for adopting the technologies decreased by a factor of 0.13. This means that for every increase in the cost of adopting the technologies there is a corresponding decrease in the probability of adoption. This is probably because a greater proportion of the farmers depend on farming as their major source of livelihood. Thus, any additional cost to their current production expenses may discourage them from adopting such technologies. This finding is in line with Odoemenem and Obinne (2010) that the coefficient of cost of technology was negatively related to the adoption of improved cereal crop production technologies in Benue State, Nigeria.

Number of years of formal education of the rice farmers was significant ($p< 0.05$) and positively influenced the adoption of technologies by the rice farmers. This confirms the *a priori* expected sign of increase in adoption with increase in years of formal education. It also suggests that a unit increase in years of formal education increases the likelihood of the rice farmers to adopt the technology by 55% (marginal effect) which is in consonance with Ersado *et al.* (2004). Access to credit in the study area was however, fairly

significant ($p<0.01$) but positively related to the rate of adoption of improved rice technology as stated by Sisay*et al.* (2013) who also reported a positive relationship between amount of credit received and adoption of modern technology in Ethiopia.

Table 5: Ordered logistic model analysis of determinants of adoption of improved rice production technologies

Variable	Parameter estimate	Marginal effects	Standard error	Probability
Age	2.17	0.11	1.11	0.04**
Gender	0.89	0.33	1.37	0.48
Years of formal education	4.73	0.55	1.52	0.00***
Household size	0.03	0.00	0.31	0.81
Years of rice farming	1.13	-0.05	0.34	0.00***
Farm size	-3.81	-0.17	1.39	0.04**
Membership of org.	-1.45	0.06	1.25	0.25
Access to credit	0.03	0.00	0.45	0.53
Cost of technology	-2.21	-0.13	1.31	0.06*
Information sources	4.72	0.55	1.50	0.00**
Constant	-7.90		4.19	0.05
N =139; Pseudo R^2=0.69; LR chi^2=81.59				

Constraints to the Use of the Improved Rice Production Technologies

Some technologies have some constraints which limit their complete usage. The adoption and continuous use of improved technologies is the ultimate goal of any agricultural entity. It is thus imperative that technologies developed should not be complex to a point where the further usage is jeopardized.

Table 6: Distribution of respondents based on constraints to use of improved rice production technologies (n=197)

Technology	Frequency	Percentage
Seed of improved varieties	33	16.75
Planting techniques	13	6.60
Water management	21	10.66
Fertilizer application	85	43.15
Pest and disease control	10	5.08
Harvesting techniques	12	6.09
Storage methods	21	10.66

Source: Field survey, 2015

Findings in Table 6 reveal that 43.41% of the respondents had problem in the use of a technology. These technologies include fertilizer application (43.28%), seed of improved varieties (16.92%) and improved storage techniques (11.93%). However, the technologies that have least problems in their usage were pest and disease control (4.98%), and

harvesting techniques (5.87%). This finding seems to be in agreement with that of Mapiye (2006) which showed adoption of some technologies is impeded by high cost and low availability of farm inputs.

CONCLUSION

Evidence from the study confirms adoption of various improved technologies by the rice farmers, who are mostly younger in age, more educated, and had small farm size. Seeds of improved varieties was the technology respondents are most aware of while planting technology was the most adopted technology. Years of rice farming and information sources used were found to positively and significantly relate to adoption recommended improved rice production technologies. The main constraints encountered by the respondents in adoption of the improved technologies are credit unavailability, non-membership of cooperative associations and difficulty in use of some technologies. Therefore, the study recommends that policy efforts should be made to link farmers with certified seeds companies and also provide farmers with subsidized fertilizers. It is also recommended that participatory extension approaches should be encouraged to disseminate improved rice production technologies in the study area.

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