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FACTORS INFLUENCING ADOPTION OF IMPROVED RICE PRODUCTION TECHNOLOGIES BY RICE FARMERS IN SOKOTO STATE, NIGERIA

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ABSTRACT

The study investigated the factors influencing adoption of improved rice production technologies by rice farmers in Sokoto State, Nigeria. The research involved 203 respondents from four Local Government Areas and 12 villages that were randomly selected. Questionnaires were used to collect data which were interpreted using descriptive and inferential statistics. Results revealed that the mean age and household size of the respondents were 39.77 and 12 years, respectively. The mean duration of formal education was 4.54 years while that of years spent in rice farming was 19.08 years and 70.44% don't have access to credit with 52% perceiving credit as highly important in rice farming. Also, 98.03% of the respondents were aware of seed of improved varieties while planting technologies was the most adopted technology by farmers. The logit estimate established years of formal education, years spent in rice farming, sources of information, farm size, and age as determinants of adoption of improved rice production technologies in the study area. The main constraints encountered by the respondents are credit unavailability, non-membership of associations and difficulty in use of some technologies. The study recommended that farmers should be supported with credit facilities by government and non-governmental organizations in the study area.

Keywords: Adoption; Rice; Improved technologies

INTRODUCTION

Rice (*Oryza sativa*) is harvested from more than 159 million hectares annually and has twice the value of production in the developing world as any other food crop with a value of more than US$150 billion per year. By 2040, 112 million tonnes will be required to meet the growing global demand. 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 minimum of 6% per annum over the years (FAO, 2012). It also concurred that the relative growth in demand for rice is faster in Africa region than anywhere in the world. This is due to population growth, rising incomes and a shift in consumer preferences in favor of rice in urban and rural areas.

In Nigeria, demand for rice has been expanding with consumption levels growing significantly at 7.3% per annum. The demand for rice is growing faster than production in the country, thus making the country depended on imported rice to meet the high demand. Several factors have been attributed to the slow bridge in the demand and supply gap prominent among which include the fact that over 62% of Nigeria's 170 million people living below the poverty line (UNPFA, 2015); the lack of high yielding varieties with good grain qualities, competing 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.

Expert knowledge developed from national agricultural research system has been widely assumed to be central in increasing food production in Nigeria (Oyekanmi *et al*., 2008). This realisation led several research institutions to develop appropriate agricultural technologies with the aim of boosting farmers' productivity in animal and crop production in many developing countries. Various research findings have thus been adapted for dissemination to motivate farmers to adopt these improved production technologies.

Rice production has been expanding at the average rate of 3.49% per annum in Nigeria from 2002 to 2011 with 70% of the production increase due mainly to land expansion and only 30% being attributed to an increase in productivity (AfricaRice, 2012). Since area expansion and irrigation have already become a minimal source of rice output, growth will depend more on yield increasing technological change. Ani (2002) observed that adoption of agricultural technology could provide the gateway of increasing production thereby raising farmers' income most of whom live in the rural areas. However, Saka and Lawal (2009) observed that adoption rate of improved technologies in Nigeria is low and is capable of truncating the complete self-sufficiency in rice production by 2015. Umar *et al.* (2009) also revealed that farmers' technology adoption behaviors remain a source of concern as they do not mostly adopt the practices recommended by the several research agencies.

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 Sokoto State of Nigeria where there is dearth of empirical studies on the adoption of these improved technologies by rice farmers. It has also been reported that very low adoption of productivity enhancing technologies has dwarfed efforts to reduce rural poverty by increasing farmers' output (World Bank, 2008). This challenge makes it imperative for studies to identify the inhibiting and facilitating factors to adoption of these technologies in the study area.

The broad objective of the study was to examine the adoption of improved technologies by rice farmers in Sokoto State of Nigeria. The specific objectives are to describe the socio-economic characteristics of the rice farmers in the study area and examine the awareness and adoption levels of the improved rice production technologies. Others were to determine factors influencing adoption of improved rice production technologies by the rice farmers and identify the problems associated with adoption of improved rice production technologies by rice farmers in Sokoto State, Nigeria.

MATERIALS AND METHODS

The Study Area

The study was conducted in Sokoto State, Nigeria. The state is located in the Sudano-Sahelian ecological belt of Nigeria with few scattered trees and grasses covering about 30% of the ground. It is situated within Longitude 11° 3' to 13° 50 E and Latitude 4° to 6° 40' N. The State occupies about 25,973 square kilometers. It shares common borders with Niger Republic to the North, Zamfara State to the East, and Kebbi State to the South-west. The wet season last from June to September with annual rainfall ranging from 500 to 800 mm while mean annual temperature is 34.5 °C with dry season temperature usually exceeding 40 °C. Livestock farming and arable crop production and marketing are the major occupations of the populace. Local crafts such as blacksmithing, weaving, dyeing, carving and leather works also play an important role in economic life of the people.

Sampling Techniques

The multi-stage sampling technique was used because of the heterogeneous nature of the study. In the first stage, four Local Government Areas (LGAs) were purposively selected having the highest rice production activities in the state. Three villages were also purposively selected based on the highest rice production activities in the LGAs making 12 villages. The villages had an estimated population of 5068 rice farmers as obtained from Sokoto Agricultural Development Project. Four percent (4%) of the rice farmers were randomly selected for the study, which gave a sample of 203 farmers for this study.

Table 1: Study population and sample size

LGA	Village	Estimated Population	Sample Size (4%)
Wurno	Huchi	292	12
	Yar'wurno	533	21
	Lukwa	298	12
Goronyo	Taloka	272	11
	Goronyo	723	29
	FuraGarke	356	14
Tambuwal	Tambuwal	455	18
	Romo	362	14
	Dogon-daji	462	18
Rabah	Gandi	391	16
	Rabah	558	22
	Mai-kujera	366	15
Total		5068	203

Data Collection and Analysis

Primary data were collected through face-to-face interviews using a structured interview schedule that was filled up by recruited and trained enumerators under the close supervision of the researcher. Focused group discussions were conducted in a separate session with farmers to further authenticate and validate information in the questionnaire.

Descriptive statistics (range, ranking, means, percentage and frequency distributions) and ordered logistics regression were used to analyse the data.

RESULTS AND DISCUSSION

Distribution of Socio-economic Characteristics of Farmers

The mean and percentages of socio-economic characteristics are shown in Table 2. The results showed that 29.56% of the farmers were within the age range of 46-55 years. Mean age of the rice farmers was 39.77 years while the maximum and minimum ages were 79 and 17 years, respectively. This implies that most of the rice farmers were young agreeing with Yahaya (2007) that farmers in the age range of 20-55 are the most active group in agricultural activities. Also, 97.47% of the rice farmers were male. The family size distribution of the rice farmers has shown that most (36.95%) are within family size of 6-10 with mean family size of 12 implying high food consumption and availability of family labour. Mean family size contrasts with average rice farming household size of 6.14 observed by Adedeji, *et al.* (2013). The study revealed that 50.74% of the rice farmers had formal education while 28.57% had informal education. Only 20.69% of the rice farmers had acquired non-formal education. Further analysis of the rice farmers with formal education revealed that 50.7% had 11-15 years of formal education. The mean duration of formal education was 4.54 years. Sani and Bagana (2007) have reported that exposure ratio of 57% 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.

The study also showed 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). Focus group discussions with the farmers attributed low participation of farmers in associations to include politicisation of the association activities, non-recognition of benefits of membership and demise or non-existence of the associations. The study also showed that over one-third (39.92%) of the farmers had farm size of less than 1 ha implying that rice farming is mainly done by small-scale farmers. The mean rice farm size is 2.28. This finding is in consonance with that of Saka and Lawal (2009) which found average farm size to be 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 could be evaluated based on number of years spent on rice farming. It revealed that 38.42% of the rice farmers in the study area had 11- 20 years of farming experience. The mean farming experience was 19.08 years. The willingness and ability to try new ideas is expected to increase with increase in farming experience. Analysis of the rice farmers' access to formal and informal credit facility revealed that 73% do not have access to any form of credit facility This might suggest that lack of access to credit hinders the adoption of new technologies as farmers without cash and no access to credit will find it hard to cope with the cost of inputs and technical skills needed for management of improved rice farming. Over 52% of the farmers had perceived the role of credit facility in rice farming as very important. Focus group discussions with a cross section of the farmers indicated that access to credit would enhance and increase their production. This 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.

Table 2: Socio-economic characteristics of the rice farmers (n=203)

Variable	Frequency	Percentage
Age(years)		
<25	21	10.34
26-35	42	20.69
36-45	54	26.60
46-55	60	29.56
56-65	10	4.93
>65	16	7.88
Sex		
Male	199	97.47
Female	4	2.53
Household size		
1-5	43	21.18
6-10	75	36.95
11-15	57	28.08
16-20	15	7.39
>21	13	6.40
*Educational status		
Informal education	58	28.57
Formal education	103	50.74
Non-formal education	42	20.69
Years of formal education		
6-10	35	33.98
11-15	43	41.75
16-20	25	24.27
Membership of association		
No	71	34.90
Yes	132	65.02
Farm size		
<1	79	39.92
1-3	58	28.57
4-6	29	
7-9	26	12.81

>9	11	5.42
Years of Rice farming experience		
1-10	65	32.02
11-20	78	38.42
21-30	32	15.76
31-40	18	8.87
>40	10	4.92
Reason for rice farming		
Cash	10	4.92
Consumption	4	1.97
Cash and consumption	187	96.54
Credit access		
No response	25	12.31
No	143	70.44
Yes	35	17.24
Credit access perception		
least important	15	7.39
less important	19	9.36
Important	44	21.67
Very important	106	52.22

Source: Field survey data, 2015

Levels of Awareness of Improved Technologies by Respondents in Study Area

Table 3 revealed that the farmers (98.03%) were aware of the improved seeds varieties, planting techniques (92.12%) and storage methods (83.74%) which also ranked first, second and third, respectively.

Table 3: Distribution of farmers based on level of awareness of improved rice production technologies

Variables	*Frequency	Percentage
Seed of improved varieties	199	98.03
Planting techniques	187	92.12
Water management	121	59.61
Fertilizer application	155	76.35
Pest and disease control	147	72.41
Harvesting techniques	133	65.17
Storage methods	170	83.74

* Multiple responses used Source: Field survey, 2015

The technologies the respondents were most unaware of were water management (59.61%) and harvesting techniques (65.17%). The awareness may be due to the involvement of multiple sources of information used by the respondents. This high awareness level 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. The costs associated with these technologies might be responsible for the low percentages of its awareness among rice farmers.

Improved Rice Production Technologies Tried and Adopted by the Respondents

Table 4 showed main technologies the farmers have adopted. These include planting technologies (96.06%), seed of improved varieties (77.34%) and storage methods (67.49%) of the farmers had adopted these technologies. The very low adoption rate of fertilizer application (40.89%) might be because the farmers used varying doses of fertilizer doses which is in most cases was less than the recommended rate of four bags of NPK 20:10:10 or NPK 15:15:15 followed by two bags of urea per hectare. This might be due to the high cost or non-availability of fertilizer to farmers.

Table 4: Distribution of farmers based on adoption status of improved rice production technologies (n=203)

Variables	Adopters	Non Adopters
Planting variables	195 (96.06%)	31(15.27%)
Water management	92(45.32%)	117(57.64%)
Seed of improved varieties	157(77.34%)	18(8.87%)
Fertilizer application	83(40.89%)	120(58.82%)
Pest and disease control	132(65.02%)	75(36.95%)
Harvesting techniques	123(60.59%)	93(45.81%)
Storage methods	87(42.86%)	68(33.55%)

Source: Field survey, 2015; Total greater than n due to multiple responses

Factors Influencing Adoption of Improved Rice Production Technologies

The result of logit regression analysis in Table 5 showed that there is a positive relationship between age of the rice farmers and adoption of technologies by the rice farmers where the coefficient of 0.12 is significant ($P<0.01$). Thus, an increase in age in one year will increase the level of adoption by 0.12. This result was in line with the findings of Kafle and Shah (2012) who reported a positive relationship between age and adoption of improved potato varieties in Bara District of Nepal. Nonetheless, this disagrees with the findings of Odoemenem and Obinne (2010) that age was negatively correlated with adoption of improved cotton production technologies in Katsina State, Nigeria.

Membership of associations is a negative variable which is contrary to the expected sign on the on membership of agricultural associations that should be positive. This might be due to non-participation of most of the farmers in associations implying decrease access to acceptance of some improved rice production technologies. A negative relationship was however, observed between farm size and adoption of improved rice production technologies Subsequently, farm size is significant ($P<0.05$) and negatively related to

adoption of improved rice production technologies which implies that adopting improved rice production technologies increases for farmers with large farms than those with smaller farms

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

Variable	Parameter Estimate	Marginal Effects	Standard Error	P-value
Age	2.17	0.13	1.12	0.04**
Gender	0.92	0.32	1.34	0.46*
Years of formal education	4.75	0.56	1.52	0.00***
Household size	0.03	0.00	0.33	0.91
Years of rice farming	1.13	-0.05	0.34	0.00***
Farm size	-3.82	-0.16	1.37	0.03**
Membership of association.	-1.47	0.06	1.25	0.24
Access to credit	0.03	0.00	0.43	0.51
Cost of technology	-2.22	-0.15	1.33	0.06*
Information sources	4.75	0.55	1.52	0.00***
Constant	-7.89		4.19	0.05

Prob. > chi^2=0.00, * significant at 10% level, ** 5% level and *** 1%

The result of the study further shows that farming experience had positive influence on adoption of improved rice production technologies (P<0.01). The likelihood of adoption increases with increase in farming experience. The logit analysis also indicates that household size of farmers had positively and significantly influenced adoption of improved rice production technologies (P<0.1). Households with large family size may readily adopt new agricultural production technologies than those with smaller family size as labor is more available in large families as reported by with Anne *et al*. (2012) who also found a positive relationship between household size and adoption of improved agricultural production technologies. Results of the study also indicate that total cost of technology has a significant but negative influence on adoption of improved rice technology (P<0.05). The negative coefficient implies that the potential for adopting the technologies decreased by a factor of 0.15. This means for every increase in the cost of adopting the technologies there is a corresponding decrease in the probability of adoption. Number of years of formal education of the rice farmers was significant (P< 0.1) and positively influences the adoption of technologies by the rice farmers. This confirms the *a priori* expected sign. It also suggests that a unit increase in years of formal education increases the likelihood of the rice farmers to adopt the technology by 56%. 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. This was in tandem with the expected sign and economic theory. There is a slight positive relationship between credit access and adoption of improved rice production technologies in the study. Ademiluyi *et al.* (2008*)* had noted that access to loans and other financial incentives will certainly improve farmers' scale of production. A positive

relationship is also observed in the use of information sources and the probability of adoption of a new technology. Contact with the source is expected to have a positive effect on adoption based upon the innovation-diffusion theory.

Constraints of the Use of the Improved Rice Production Technologies

Some technologies have some constraints which limit their complete adoption. The adoption and continuous use of improved technologies is the ultimate goal of any technology. It is thus imperative that technologies developed should have relative advantage and be compatible to a point where the further usage is not jeopardized. About half (50.74%) of the respondents had issues with one technology or the other. Table 6 showed some of the respondents had some problem in use of some technologies which include fertilizer application (33.01%), seed of improved varieties (23.30%) and improved storage techniques (15.53%). However, respondents reported least problems with continuous adoption of technologies of pest and disease control (4.85%), and harvesting techniques (5.82%). 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.

Table 6: Distribution of respondents based on constraints of the use of improved rice production technologies (n=103)

Technology	Frequency	Percentage
Seed of improved varieties	24	23.30
Planting techniques	7	6.79
Water management	11	10.68
Fertilizer application	34	33.01
Pest and disease control	5	4.85
Harvesting techniques	6	5.82
Storage methods	16	15.53

Source: Field survey, 2015

CONCLUSION

Findings of the study revealed that respondents were younger in age, more educated, and had smaller farm size. Seeds of improved varieties are the technology respondents are most aware of while planting technology was the most adopted technology. The logit model estimate found that duration of formal education, years spent in rice farming, sources of information, farm size, and age had significant effect and are determinants of adoption of improved rice production technologies. The main constraints encountered by the respondents are credit unavailability, non-membership of associations and difficulty in use of some technologies.The study recommended that farmers should be supported by credit facilities by government and non-governmental organizations in the study area through maximizing group dynamics.

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