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ASSESSMENT OF ADOPTION OF IMPROVED FARO-44 RICE PRODUCTION TECHNOLOGIES AMONG RURAL FARMERS IN ADAMAWA STATE, NIGERIA

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Abstract

The study assessed adoption of improved Faro-44 rice production technologies among rural farmers in Adamawa State, Nigeria. A total sample size of 329 respondents was selected for the study using multi—stage sampling technique. The data were collected from primary source using structure questionnaire. The data were analysed using descriptive statistics such as frequency, means and percentages and inferential statistics such as Double hurdle regression. The results of the socio-economics characteristics of the respondents showed that majority (74.47%) were males, average mean of 42 years, mostly married (75%) and majority (81.76%) attained varied levels of formal education. On awareness and utilization of Faro-44 rice production technologies, the results revealed that majority (82.67%) of the respondents were aware of Faro-44 rice production technologies and were utilizing the technologies. The results of the Double hurdle probit and truncated analysis showed that age ($p<0.01$), access to credit ($p<0.01$), farm size ($p<0.01$), output ($p<0.01$), access to extension services ($p<0.01$) and off-farm income($p<0.01$) were variables that influenced adoption of Faro-44 rice production technologies. Similarly, for the truncated regression analysis, access to credit ($p<0.01$), major occupation ($p<0.01$), farm size ($p<0.01$) and output (($p<0.05$) were variables that influenced intensity of adoption of Faro-44 rice production technologies. The constraints to adoption of Faro-44 rice production technologies

include drought (0.609), poor soil fertility (0.547), insufficient land(0.619), poor extension services(0.586) among others. It was also found that age, access to credit, major occupation, off-farm income, farm size, access to extension services and farm output were factors influencing adoption of faro-44 rice variety in the study area. Based on the findings of this research, it can be concluded that awareness and adoption level of faro-44 rice variety was high in the study area. This was because majority of the respondents were educated, married and young in terms of age. It was recommended that the government should employ more extension workers, because the ratio of extension workers to farmers is very low. Financial institutions such as banks and other agricultural agencies should provide credit facilities to rice farmers at a single digit interest rate so as to boost their production.

Keywords: Adoption, Faro-44, production, technologies , rural farmers

1.0 Introduction

Agriculture is one of the most important sectors contributing to economic development of Nigeria. Although the sector had suffered neglect since the discovery of oil in the 1970s when it was contributing about 60% of the Gross Domestic Product (GDP) (Olaoye, 2014), the sector remains relevant, contributing about 21.9% to Nigeria's GDP in 2019 (World Bank, 2021). Between 1960 and 1969, the agriculture sector contributed about 61.65% to the Nigerian gross domestic product (GDP) and later declined to 23.89% (Ahungwa et al., 2014). This means that increasing farmers' agricultural productivity in Nigeria will help increase farmers' income, provide food to the population, provide raw materials to the allied agro-industries and increase the share of the agricultural export.

Rice, botanically known as Oryza spp is one of the major staple cereals with more than 3.5 billion people depending on it for their daily calorie intake (International Rice Research Institute(IRRI), Africa Rice and International Center for Tropical

Agriculture(CIAT), 2010). It is estimated that the rice production must increase by 114 million metric tonnes by 2035, but farmers must achieve it under significant threats from climate change coupled with decreasing amount of available agricultural land, labour, and water for agriculture and increased costs of all inputs. Increasing global food production with minimal adverse impact on resources and the environment is the greatest challenge for food security. Hence, for ensuring food and nutritional security of the rice-growing world, it is essential to make consistent efforts to understand and develop innovative rice production technologies that are resource use efficient, higher net income generation and environmentally friendly.

Rice is a staple food in many countries of the World and Africa in particular and it constitutes a major part of the diet in many African countries. It is an important staple food crop in the continent, whose growing demand poses an economic challenge for the African continent [African Agricultural Technology Foundation (AATF), 2012]. Rice belongs to the grass family called Poaceae of the plant kingdom. Domesticated rice comprises two species, namely; Oryza sativa and Oryza glaberrima. These plants are native to tropical and subtropical Southern Asia and South- eastern Africa. The plant can grow in diverse environments, but grows faster and more vigorously in wet and warm conditions (AATF, 2012).

High yielding rice varieties are imperative in Nigeria to feed the growing population. However, adopting high yielding seed varieties seems to be low in Nigeria (Kormawa et al., 2002). The food self-sufficiency ratio fell from 98% in the early 1960s to 18.75% in 2019 (Export, 2019), thus increasing the poverty level among farmers. Poor adoption rates of high yielding seed varieties are evident in the productivity gap of most staple crops in Nigeria and other countries.

In a bid to address these problems, research institutes such as International

Institute of Tropical Agriculture (IITA) and National Cereals Research Institute (NCRI) introduced high yielding varieties in order to boost food security. One of the improved high yielding rice varieties released for utilization in Nigeria is FARO 44 (Sippi), which is a lowland rice variety. It was observed that despite the efforts to increase rice productivity, a significant number of households do not use these technologies. When a new farming practice is introduced in a community, not all people adopt at the same time, some farmers no matter what will continue their farming based entirely upon traditional agriculture (Ani et al., 2008). Mbanaso (2010) opined that technologies released by research institutes are not likely to be accepted by the farmers if they are not compatible with the farmers' conditions. These conditions are accessibility to the technologies either in the form of availability of resources to purchase needed inputs or in the form of the relevance and appropriateness of the technologies to their needs, capabilities and environmental conditions.

Farmers in Nigeria need to adopt improved farming techniques in order to improve rice production. Poor adoption of rice techniques by farmers would eventually lead to high cost of production with corresponding low yield, but if farmers adopt improved techniques, there would be increased productivity. This depends to a large extent on the speed with which technology is transferred from the source to the ultimate end users. Despite efforts to brings innovations to farmers, there seem to be low level of adoption of improved technologies, particularly among rice farmers in the study area. This low level of adoption may not be uniform across the Local Government Areas, while some local government areas may be at the early stage of adoption, others may be at the late stage of adoption.

The study has provided answers to the following research questions:

i. What are the socio-economic characteristics of rice farmers in the study area?

ii. What is the level of awareness of FARO-44 rice production technologies among rice farmers?

iii. What are the factors determining adoption of FARO-44 rice variety?

iv. What are the constraints to adoption of FARO-44 rice variety in the study area?

2.0 Objectives of the Study:

The broad objective of the study was to assess adoption of improved FARO-44 rice production technologies among rural farmers in Adamawa State, Nigeria.

The specific objectives of the study were to:

i. describe the socio-economic characteristics of rice farmers in the study area;

ii. ascertain the level of awareness of FARO-44 rice production technologies among rural rice farmers;

iii. determine factors influencing adoption of FARO-44 rice variety among rural farmers;

iv. identify constraints to adoption of FARO-44 rice variety in the study area.

3.0 Methodology

The study was carried out in Adamawa State, Nigeria. Adamawa State is one of the thirty-six States in Nigeria and is located in the North-eastern part of the country. The State was created on the 27th of August 1991 from the then Gongola State and lies between Latitude 7^{0} and 11^{0} N and between Longitude 11^{0} and 14^{0}E, covering a geographical area of about 38,700 km^{2}(Adebayo, 1999; Adamawa State Government, 20216)The State shares international boundary with the Cameroon Republic along its Eastern side and also shares local boundary with Taraba State in the South and West, Gombe State in the North-West and Borno State to the North. Adamawa State has a tropical wet and dry climate. The dry season lasts for a minimum of five months (November-March), while the wet season spans from April to October. The mean annual rainfall in the State ranges from 700mm in

the North-west, to 197mm in the Southern part of the State (Adebayo et al., 2012; Adamawa State Government, 2016). The State is naturally divided into two ecological zones; the Guinea and Sudan Savannah zones.

Politically, the State is divided into three Senatorial zones (South, Central and North) which consist of 21 Local Government Areas (Adamawa State Government, 2016) and it is also divided into four ADP zones (Zones I, II, III and IV) and has an estimated population of about 4,438,628 million people, who are mostly residing in rural areas (NBS, 2018).

Primary data were used for this study and were collected through the administration of structured questionnaires to the respondents, who were mainly rice farmers. The target population comprised all rice farmers in the State. Stratified, purposive and random sampling techniques were employed for the selection of 329 respondents for the study. Firstly, the population of the study was stratified into four (4) based on the already existing Agricultural Development Project (ADP) Zones (1-4) in the State. Purposive sampling was used to select 8 Local Government Areas and twenty four communities across the four ADP zones known for high rice production.

4.0 Results and Discussion.

4.1 Socio-economic characteristics of rice farmers.

Table 1 revealed that most (53.49%) of the respondents fell within the age range of 30-39 years, 20.06% fell within 40-49 years. These age categories constituted majority (86.16%) which is less than 50 years and with the mean age of 44 years. This implies that majority of respondents have fallen within their productive and energetic age bracket. The fact that the largest number of the respondents were found to be within these age groups between 20-49 is an indication that these farmers were active enough to

participate in Faro-44 rice farming. This result agrees with Pur et al. (2016) who revealed that people between 20-50 years are in their economically active age to undertake various activities in farming.

Table 1 revealed that majority (74.47%) of the respondents were males, while female constituted 25.53%. The relatively high percentage of male respondents is expected because males dominate most of the farming activities in most rural communities in Nigeria (Attah and Ejembi, 2015). Also, Michael et al. (2015) and Obota et al. (2022) affirmed that there are more male-headed households in rural Nigeria than female headed-households. Table 1, also shows that majority (75.38) of the respondents were married, 12.16% were single, 1.82% were divorced and 10.63% were widows/widowers.

Table 1 further reveals that majority (71.86%) had one form of formal education or the other. This implies that majority of the respondents were literate and this can enhance their level of adoption of Faro-44 rice production technologies. The distribution of the respondents based on farm size is presented in Table 1. The result shows that majority (57.14%) of the respondents had farm size of between 1-3 hectares, 19.76% had farm size of 4-6 hectares, 5.16% had farm size of 7-10 hectares, 17.93% had less than 1 hectare. The mean farm size of the respondents was estimated at 2.66 hectares. This is an indication that rice farmers in the study area are engaged in small-scale farming, hence could lead to land fragmentation. Also, adoption cost, risk perception, labour requirement and human capital requirements are definitely reduced.

Table 1 reveals that 44.07% of the respondents had between 6-10 persons in their households, 36.17% had household size of between 1-5, while 9.12%, 7.59% and 3.03% had between 11-15 people, 16-20 persons and above 20 people in their households, respectively. The mean household size was estimated at 8, this indicates

that household size in the study area is fairly large. The supply of family labour is more among larger households than smaller households, hence there will be more people working on farms, thereby reducing the cost of hired labour.

Table 1 also reveals that majority (78.41%) of the respondents had no access to credit facilities, while only 21.58% had access to credit facilities and ability to expand production.

Table 1: Socio- Economic Characteristics of the Respondents (n=329)

Variables	Frequency	Percentage	Mean
Age(years)			
20-29	50	15.19	
30-39	176	53.49	
40-49	66	20.06	
50-59	18	5.47	
60-69	12	3.65	44 years
Sex			
Male	40	12.16	
Female	248	75.38	
	6	1.82	
Marital Status	35	10.63	
Single			
Married			
Divorced	60	18.24	
Widow/ Widower	55	16.27	
	88	26.74	
Educational Status	126	38.29	
No formal Education			
Primary			
Secondary	59	17.93	
Tertiary	188	57.94	
	65	19.76	
Farm size (ha)	17	5.16	
<1			
1-3			
4-6			
7-10	119	36.17	
			2.66
Household size(number)			
1-5	10	3.03	
6-10			
11-15			
16-20			
21-above			
			8.23
Access to Credit			
Access	71	21.58	
No Access	258	74.41	

4.2 Level of awareness about FARO 44 Technologies

Table 2 reveals that the respondents were fully aware of bird control (72.79%), broadcasting method (70.88%), transplanting method (59.99%), pest control (62.95%), use of tractor (74.55%), weed control (67.83), winnowing (70.88%), harvesting (67.28%) planting with 20cmX20cm (69.56%), land preparation (65.8%) and drying (76.12%).

Table 2: Distribution of Respondents by Level of Awareness of Faro – 44 Rice Production Technologies (n=329)

Variables	Level of Awareness (n=272)			Utilization	Rank
	High (3)	Moderate (2)	Low (1)	Index (%)	
Land preparation	150 (55.15)	80 (29.41)	42 (14.71)	65.8	12
Ploughing & harrowing	172 (63.24)	70 (25.74)	30(11.03)	70.89	5
Use of tractor	200(73.52)	39(14.34)	33(12.13)	74.55	3
Transplanting method	130(47.79)	80(29.41)	62(22.79)	59.99	14
Planting with 20cmX20cm	166(61.03)	73(26.84)	33(12.13)	69.56	9
Broadcasting method	182(66.91)	50(18.38)	40(14.71)	70.88	6
Fertilizer application	170(62.50)	72(26.47)	30(11.03)	70.58	8
Weed control	197(72.43)	60(22.06)	15(5.51)	67.83	9
Pest control	145(53.31)	70(25.74)	57(20.96)	62.95	13
Bird control	185(68.01)	57(20.96)	30(11.03)	72.79	4
Harvesting	160(58.82)	70(25.74)	42(14.71)	67.28	10
Threshing	200(73.52)	50(18.38)	22(8.09)	76.17	1
Winnowing	172(63.24)	70(25.74)	30(11.03)	70.88	6
Drying	188(69.12)	60(26.06)	24(8.82)	76.12	2

4.3 Factors influencing adoption of Faro-44 rice production technologies

Table 3 presents factors that influence adoption of FARO-44 rice variety. The adoption probabilities are ascertained through the first stage of Cragg's double-hurdle model, which is the Probit model. Whereas, the truncated regression model identified the factors that affect adoption level of FARO-44 variety. The adoption probability decision of farmers is being positively influenced by access to credit, farm size, output, access to extension services, and off-farm income. On the contrary, older farmers tend to adopt less. While the farmer's education, sex and major occupation are insignificant in the probit and the truncated models, age, access to extension services and off-farm were

incomewere insignificant in the truncated model. The results of the truncated regression model revealed that access to credit, major occupation, farm size and output positively affect the level of adoption of FARO-44 rice variety.

Age

Age of the adopter is supposed to be a determinant of adoption of new technology. However, contention on the direction of the effect of age on adoption exists with researchers finding mixed effects of age. From Table 3, the age variable has been found to be statistically significant at age ($p<0.01$) level but negatively influenced the decision to adopt FARO-44 rice variety and associated technologies. This result is in conformity with the study conducted by Pagnani (2019) who reported negative relationship between age and adoption of Banana Xanthomonas Wilt (BWT) control package in Uganda. The negative effect of age could stem from the fact that as farmers grow older, there is an increase in risk aversion and a decreased interest in trying innovations.

Access to credit

Access to credit facilities is another variable that significantly influences both the probability of adopting FARO-44 rice variety and level of adoption (Table 3). Access to credit is significant at ($p<0.01$) level and may help farmers decide in favor of adoption. For resource-poor farmers, fulfilling the entire capital requirement for rice cultivation from their own sources is very difficult. Assurance of some financial support may encourage farmers in this regard. The positive impact of credit on adoption is well documented in literature (Hoang and Nguyen, 2023; Obot et al., 2022; Sharna et al., 2020; Langyintuo and Mekuria, 2005).

Major Occupation

When farmers use agriculture as their major occupation, it has a highly significant and positive impact on adoption (Table 3). Those farmers are more conscious to adopt any

new agricultural technology but once they adopt and comprehend its benefits, they tend to adopt more of that technology to gain more profit.

Off-farm income

The coefficient of off-farm income is statistically significant at ($p<0.01$) level. This implies that farmers with off-farm income are more probable to adopt FARO-44 than the farmers with no off-farm earnings (Table 3). This finding is however, inconsistent with the findings of Ghimire et al. (2015) who reported negative effect of off-farm income on adoption of improved rice varieties in Central Nepal. Similarly, Sharna et al. (2020) also reported a negative effect between off-farm income with probability to adopt an innovation. They argued that farmers who have off-farm income sources are indolent to adopt improved chickpea variety due to the devotion of non-agricultural activities that provide them with more profit.

Farm size

The variable of farm size positively affects the probability of adoption of FARO-44 rice variety (Table 3). Farm size is significant at ($p<0.01$) level, since the large farmers are more capable to experiment with new varieties due to their higher risk-taking ability and better financial resources, they may adopt new technologies faster than small scale farmers.

Access to extension services positively affects both probability and adoption of FARO-44 rice variety (Table 3). This finding suggest that through regular contact with extension agents and farmers' association meetings, rice farmers could learn about new technologies. Access to extension services is significant at ($p<0.01$) level, it is in consonance with the findings of Obot et al. (2022), Bello et al. (2021), and Mariano et al. (2012) who reported positive effect of access to credit and adoption of rice production technologies. Access to extension service serves as information source,

which provides veritable knowledge about the improved variety and its production technique that ensure farmers about the certain benefits of new technology.

Farm output

The output from farmers' field significantly affected the probability of adoption and level of adoption of FARO-44 rice variety at 1% and 5% levels, respectively (Table 3). This agrees with the finding of Weyessa (2014) who reported significant effect of yield on adoption and intensity of adoption of improved rice variety in Ethiopia. Crop yield is one of the important attributes considered by farmers in evaluating new varieties of crops. If farmers believe that new varieties are superior in terms of yield compared to local varieties, they may more likely adopt and widely use them.

Table 3: Factors Influencing Adoption of Faro -44 Rice Production Technologies

Variables	Probit		Truncated	
	Coefficient	Standard Error	Coefficient	Standard Error
Age	-0.0191063***	(0.007222)	-0.0832147	(0.1268203)
Education	0.0223475	(0.0204036)	-0.0808088	(0.3418332)
Sex	-0.0887791	(0.2064365)	3.150677	(3.610432)
Membership of Association	0.0560459	(0.1882743)	-5.10664	(3.129155)
Access to Credit	0.9797794***	(0.2177727)	6.140173***	(2.364881)
Major Occupation	0.3495631	(0.2619894)	2.527958***	(0.680276)
Farm Size	0.3517532***	(0.0642593)	4.509366***	(1.340501)
Output	0.0003666***	(0.0000603)	0.0013226**	(0.0006351)
Access to Extension Services	0.5852895***	(0.2111226)	-2.809217	(3.436968)
Off Farm Income	0.3995771***	(0.2190306)	1.196142	(4.068382)
Constant	0.5151417	(0.5077878)	90.08569***	(8.996821)
Log Likelihood Function	-1260.3556			
Wald Chi2(10)	72.68			
Prob>Chi2	0.000***			

Note: The probit model and the truncated regression model are tier -1 and tier -2 of Cragg's double -hurdle, respectively. Figures in parentheses are standard errors ** and *** indicate significance at 5% and 1%, respectively.

4.4 Constraints to adoption of Faro-44 rice production technologies

Table 4 shows three major categories of constraints to adoption of Faro-44 rice production technologies. These are socio-economic constraints (Factor 1), technological constraints (Factor 2) and institutional constraints (Factor 3). In factor 1, the constraints that had significant influence on Faro-44 rice production technologies include drought (0.608*), poor soil fertility (0.547*), insufficient land for cultivation (0.619*), poor extension services (0.595*), high cost of labour (0.467*), lack of processing facilities (0.585*), poor transportation system (0.403*). In factor 2, the technological constraints such as: lack of awareness of improved technologies (0.420**), unavailability of improved seeds (0.478**), poor extension services (0.586**), flood in farm (0.543**), birds destroying rice (0.581**), lack of good marketing (0.448**), distance to the market (0.436**) and lack of mechanized farm equipment (0.576**) were the major constraints. In factor 3, the institutional constraints such as lack of credit facilities (0.458***), lack of storage facilities (0.429***), high cost of chemicals (0.337***) and pest attack (0.433***), problem of bad roads (0.509***) were the major constraints.

A similar result was obtained by Mohammed (2019) in the analysis of faro-44 rice technologies adoption among farmers in Niger State, Nigeria.

Table 4 Constraints to Adoption of FARO - 44 Rice Production Technologies among Rural farmers in Adamawa State.

Variables	Factor 1	Factor 2	Factor 3
Lack of awareness of improved technology (LOAOIT)	-0.009	0.420**	0.024
Drought (DRO)	0.609*	0.140	-0.046
Poor soil fertility (PSF)	0.547*	-0.012	0.154
Lack of credit facilities (LOCF)	0.222	0.023	0.458***
Unavailability of improved seeds (UOIS)	0.030	0.478**	0.246
Poor extension Services (PES)	0.070	0.586**	0.045
Insufficient land for cultivation (ILFC)	0.619*	0.029	0.160
High cost of labour (HCL)	0.595*	-0.101	-0.097
Lack of storage facilities (LOSF)	0.199	0.027	0.429***
Lack of Process facilities (LOPF)	0.467*	-0.050	0.083
High cost of chemical (HCOC)	0.033	0.066	0.246
Unavailability of fertilizer (UOF)	0.585*	0.134	-0.337***
Poor transport system (PTS)	0.403*	0.010	-0.153
Pest Attack (PA)	0.247	0.081	-0.433***
Flood in farm (FIF)	-0.119	0.543**	-0.197
Birds destroying rice (BDR)	-0.040	0.581**	0.001
Problem of bad roads (POBR)	0.042	0.109	-0.509***
Lack of good marketing (LOGM)	0.004	0.448**	0.073
Distance to the market (DTTM)	-0.064	0.436**	-0.294
Lack of Mechanized Farm equipment (LOMFE)	0.066	0.576**	-0.039

Rotation Method: Varimax with Kaiser Normalization
*Factor 1: Socio -economic constraints.
**Factor 2: Technological constraints.
***Factor 3: Institutional constraints.

5.0 Conclusion and Recommendations

5.1 Conclusion

Based on the findings of this research, the result of the study shows that awareness and adoption level of faro-44 rice variety was high in the study area. This was because majority of the respondents were educated, married and young in terms of age. The study shows that age, access to credit facilities, major occupation, off-farm income, farm size, access to extension services and farm output were factors influencing adoption of faro-44 rice variety in the study area. The respondents preferred irrigated farming than rain-fed because it is more profitable than rain-fed farming.

5.2 Recommendations

It was recommended that Adamawa State Government should employ more extension workers and credit facilities should be granted to rice farmers at a single digital interest rate.

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