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FACTORS INFLUENCING ADOPTION OF FARO 58 RICE PACKAGE (NERICA 7) BY SMALL HOLDER FARMERS OF KATSINA STATE, NIGERIA

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ABSTRACT: *This study investigates the multifaceted factors that enhance the adoption of the FARO 58 rice package, specifically focusing on the NERICA 7 variety, among smallholder farmers in Katsina State, Nigeria. The FARO 58 rice package, known for its adaptability to diverse agro-ecological zones and improved yield potential, serves as a crucial element in enhancing food security and livelihoods within the region. Multi-stage sampling technique was used to arrive at a sample size of 220 respondents based on a sample frame of 2,630 farmers. Data obtained for the study were analyzed using descriptive and inferential statistics. The result of the study indicated that the average proportion of the respondents fall within the medium adoption category (0.34-0.66), 42.3% fall within the high adoption category (0.67-1.0), while only a small fraction of the respondents (6.4%) fall within the low adoption category. This could enable smallholder rice farmers to take advantage of access to agricultural information and technology adoption. Based on the findings of the study, it was concluded that farmers' socio-economic factors had a significant influence on their adoption of the FARO 58 rice production package in the study area.*

KEYWORDS: Adoption of FARO 58, Rice package, Smallholder farmer, NERICA.

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INTRODUCTION

Agriculture is a sector which helps in eradicating poverty through the provision of employment and food security to Nigerians. According to the West Africa Rice Development Agency (WARDA) (2005), the relative growth in demand for rice is faster in Africa than anywhere in the world and thus, sustainable increase in the production of rice is a national, regional and global concern.

Rice is from the family *Poaceae*, Genus *Oryza* and species *sativa L*. and *glaberrima*. The crop was introduced to West Africa in the early 19th century (Jirgi *et al*., 2009). Rice (*Oryza sativa*) is the most important staple food for about half of the human race and one-third of the world population depend on rice for about 50% of their daily calorie intake (Food and Agricultural Organization – FAO, 2011; National Cereals Research Institute – NCRI, 2010). The demand for rice in sub-Saharan Africa is growing faster than for any other grain, with both the rich and poor relying on it as a major source of calories (KATARDA, 2017). The country (Nigeria) has a potential land area of between 4.6 and 4.9 million hectares suitable for rice production, but only 1.7 million hectares or 35% of it is being cropped (Ojehomon, Adebayo, Ogundele & Okoruwa, 2009). The small number of hectares under cultivation is an indication that food sufficiency through rice production has not yet been realized as rice production is left in the hands of small holders whose output is inadequate (Federal Republic of Nigeria – FRN, 2016). According to Usman, Ango and Barau (2013), there is a need to enlighten farmers on the role of improved rice crop in alleviating poverty and malnutrition, and reaffirm the need to focus world attention on the role rice can play in providing food security and eradicating poverty.

Many studies (Odoemenem & Obinne, 2010; Omolehin, *et al*., 2007; Maxico *et al*., 2000; Habibu, 2015) have been conducted on rice technologies adoption in developing nations including Nigeria. However, because of variability in natural resources, culture, political system, traditions, beliefs and socio-economic factors, the factors affecting technology adoption differ across the locations. For instance, a review of technology adoption studies in Africa by Maxico *et al.* (2000) showed that the factors that affect technology adoption vary among the locations; also, a review of technology adoption by Ogunsumi and Ewuola (2015) shows that the factors affecting technology adoption are divided in to three, which include farmer specific and farmers' association, technology specific attributes, and farming objectives.

Adoption of Agricultural Innovations

The adoption of agricultural innovations is crucial to increase incomes and food output in developing countries following the dawn of the green revolution (Kamara & Akande, 2004). Strenuous efforts to increase the adoption of agricultural innovations, such as improved varieties of wheat, rice, maize, agro-chemicals, machinery, and irrigation among producers resulted in a significant increment in incomes and global food output. However, in practice, the approach also brought about some environmental issues, such as health and social problems, monoculture, and the growth of unsustainable farming systems (Dawson *et al.*, 2016). The successes and limitations of this approach have been subject to debates for several years, calling for more sustainable methods to increase food output and incomes. In this context, diversification toward underutilized crops and the adoption of environmentally sustainable practices has gained more attention, especially in developing regions like Sub-Saharan Africa (Mabhaudhi *et al.*, 2016). A major part of agricultural innovation research

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(Ejeta, 2010; Pingali, 2012; Guti *et al.,* 2018) focuses on widely consumed and traded cereal crops such as rice, wheat, and maize while the cereal crops that are important to African smallholders, commonly known as underutilized or orphan crops, such as millet and sorghum, receive less attention (Tadele, 2014). Underutilized crops are classified into cereal crops such as millet and sorghum, legumes, root, and fruit crops (Tadele, 2014) and usually described as varieties that have long received little attention from farmers, consumers, scientists, and policymakers (Padulosi *et al.,* 2013). Their cultivation used to be widespread in the past but was widely abandoned in favour of other modern crops today (Padulosi *et al.,* 2002). Further, they are mostly not traded to a significant extent and, if so, only with a limited geographical reach (Naylor *et al.,* 2004).

In recent years, a strand of literature works and strategies has emerged that promote particularly the underutilized cereal crops, including finger millet. It is argued that these could make an important contribution to food and nutritional security as well as to income generation to resource-poor farmers living in low productivity areas like the semi-arid climates of sub-Saharan Africa for several reasons (Padulosi *et al.,* 2013). Despite their low adoption, underutilized crops carry the potential to alleviate some of the most pressing issues in terms of food production in demanding agro-climatic conditions. Nevertheless, underutilized crops are also attached to major bottlenecks: low yields and high labour requirements compared to other crops that limit productivity and adoption of agricultural innovations among smallholder farmers (Awazi & Tchamba, 2018). Several studies (Langyintuo *et al*., 2012; Loevinsohn *et al*., 2013; Wairimu *et al.,* 2016) agreed that the adoption of agricultural innovations depends on a range of farmer, farm, and institutional as well as innovational characteristics, but studies addressing adoption problems affecting underutilized cereals are still scarce. A better understanding of the factors that affect farmers' adoption decisions on underutilized cereals like finger millet is necessary to design promising strategies to stimulate the adoption of these innovations (Akuduku, 2012).

Theories of Transferring and Adoption of Agricultural Package

Agricultural extension is aimed at transferring agricultural package and persuading farmers to adopt and use these packages on their farms, because farmers need those new and modern technologies to increase agricultural production in various types of agricultural crops and the improvement of quantities and qualities of consumer goods to the market (Ullah & Zafarullahkhan, 2014). The process of agricultural package transfer is done through two basic stages. The first one is the transfer and dissemination of agricultural packages to farmers and the second one is to convince farmers to adopt these packages on their farms (Tai, 2012). The process of transfer of agricultural packages and of persuading farmers to apply them on their farms needs to be done by specialists in agricultural extension who have practical experience in the dissemination of agricultural packages and know how to deal with farmers sociologically. This is done through training courses in various areas of agricultural extension and communication. The process can be therefore defined as a transfer of technologies integrating and interconnecting a series of sub-processes (Ann, 2013). According to him, the transfer processes include:

A transfer or delivery of new technology from the source to the target area, a process of localization or harmonization of package, which is intended to make the technical fit with the environmental conditions of the target area, and the package is compatible with the prevailing agricultural systems in the region through a test and confirmatory tests of the technique in the

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target area. It is also aimed at the promotion of the region, persuading farmers to adopt new packages, enabling them to apply the package in their farms and providing them with knowledge, skills and technical application requirements. Diagnosis and treatment of farmers' problems that may arise during the application and dissemination of the new package and the diagnosis of the new package based on its impact on the increase of productivity of producers living in rural areas will be taken into consideration by the extension workers (Ann, 2013). After the transfer of agricultural packages to farmers, which is based on their needs for those techniques, it becomes necessary to convince them to adopt these new agricultural techniques. It is the responsibility of the extension workers working with farmers to persuade farmers to embrace new packages disseminated.

The adoption of agricultural innovations is defined as a mental process, which consists of several stages and relates to the farmer's decision to accept or reject a particular technique (Rogers, 1997). The adoption process is a mental process through which an individual, when hearing about the new idea for the first time, embraces and makes it part of his behavior. Thus, the adoption process differs from the technology transfer process as the adoption process occurs within the individual thinking while transfer process or deployment comes before adoption (Rogers, 1997). Based on Qaisi (2005), the adoption process can be divided into five stages (stage of awareness, stage of interest, stage of evaluation, stage of trial, stage of adoption) The five stages do not always occur in the same image and some of them may not take place, such as the stage of experimentation (Qaisi, 2005). According to Al-liyla and Abdelazims (1987), the stages of adoption of agricultural technologies include:

Laggards or Late Adopters: They constitute 16% of the social system. Laggards accept agricultural techniques slowly because of their worries, fear for new agricultural techniques and ideas, and cannot take risk due to some socio-economic attributes.

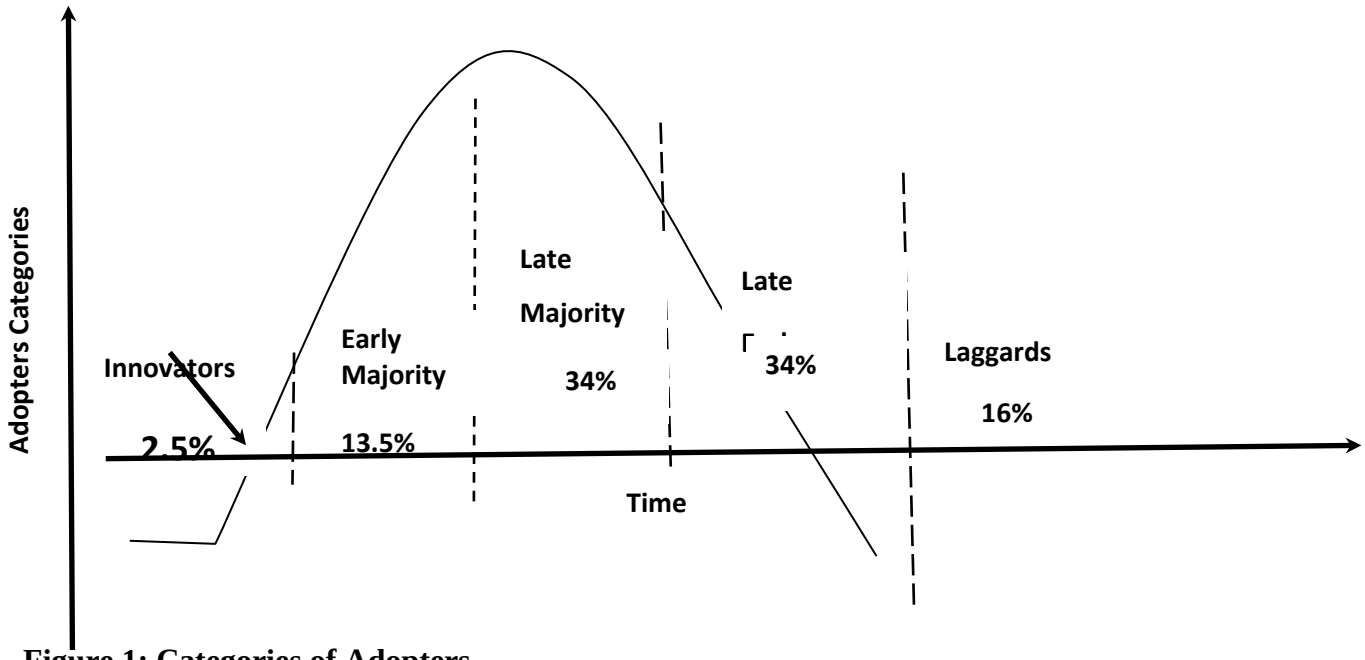

Figure 1: Categories of Adopters

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Concept of Agricultural Package in Respect to Adoption

Package is the application of knowledge for practical purposes. Generally, the package is used to improve human condition, the natural environment, or to carry out other socioeconomic activities (Swanson, Bentz, & Sofranko, 1997; Contado, 2003). Technology is often used broadly to encompass physical or biological structures or materials as well as management practices (Place & Swallow, 2000). Therefore, the transfer process for material technology is generally simpler than training and disseminating technical knowledge and management skills to large numbers of farmers who operate in different agro-ecological zones (Swanson *et al*., 1997). Technically approved technology has inherent qualities to improve product quality, increase production efficiency and heighten productivity. This implies that the potential benefits of technology are actualized only when it is successfully transferred to a large number of end users. When the perceived technology impact is positive, that is, economically positive and environmentally non-destructive, the technology is likely to be desired and enhanced (Contado, 2003).

Factors Influencing Adoption of Rice Production Package by Farmers

Several parameters have been identified as influencing the adoption behavior of farmers from qualitative and quantitative models for the exploration of the subject (Habibu, 2015). Adesina (2011) has identified that farm and technology specific factors, institutional factors, policy variables and environmental factors are considered and explained in the pattern and intensity of adoption of improved agricultural packages. Another study made by Ogunsumi and Ewuola (2015) also reported that the socio-economic status of farmers is positively and strongly related to adoption. This implies that the higher the socio-economic status of the farmers, the higher the tendency to adopt agricultural innovations. Over a decade of adoption studies have led to the categorization of adoption behavior into innovators, early adopters, early majority, late majority and laggard, and the adoption behavior of any agricultural package would follow a normal distribution curve in a given social system (Rogers, 2003). Mamuda *et al*. (2012) reported that security over land was among the factors that significantly affect the adoption of packages with a high marginal effect on the probability of adoption.

Hypothesis of the Study

HO_i: There is no significant relationship between socio-economic characteristics of rice farmers and level of adoption of improved rice production packages in the study area.

Objectives of the Study

The aim of this study is to analyze the factors influencing adoption of FARO 58 rice package (NERICA 7) by small holder farmers of Katsina State, Nigeria, while the objectives of the study are to:

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

ii. examine the roles played by the extension agents in dissemination of the FARO 58 rice production package by the farmers.

iii. assess the level of adoption of the FARO 58 rice production package by the farmers in the study area.

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iv.determine the factors that influence adoption of the FARO 58 rice package in the study area.

CONCEPTUAL FRAMEWORK OF THE STUDY

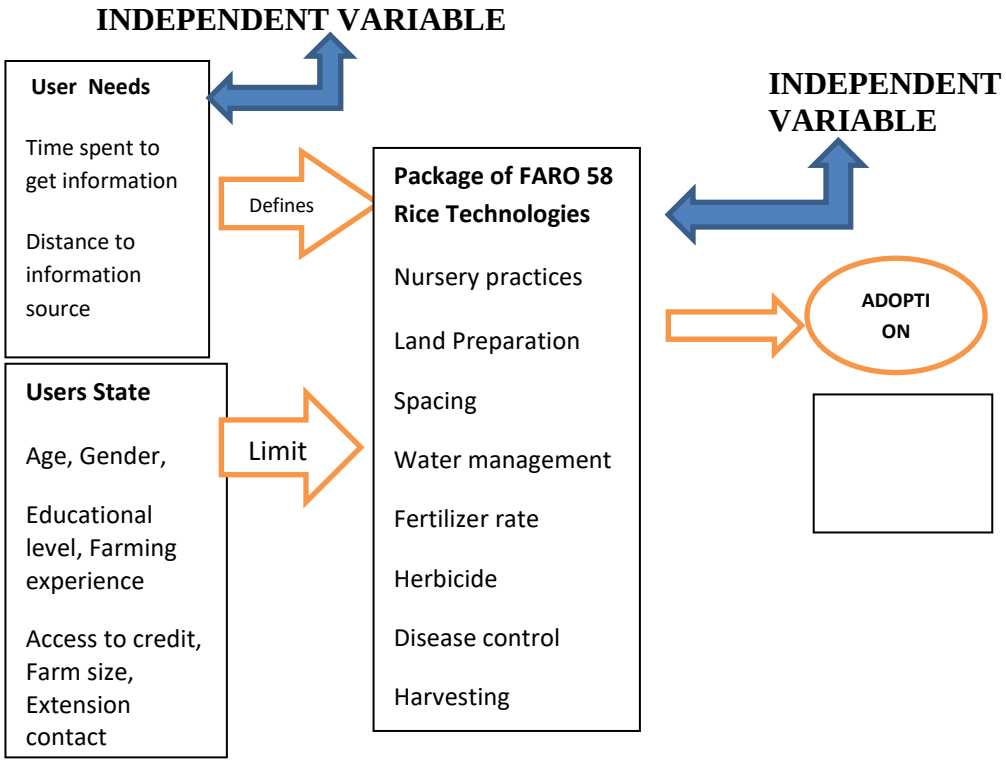

Figure 1: Lazy User Model Showing Relationship between Dependent and Independent Variables

RESEARCH METHOD

The Study Area

This study was conducted in Katsina State, Nigeria. The area falls within the Sudan Savannah agro-ecological zone of Nigeria. Katsina State has 34 local government areas. The state lies between latitude 12° 52'N and 13° 19'N and longitude 7° 16'E and 8° 43'E. Katsina State shares a common boundary with Niger Republic to the north, Kaduna State to the south, Zamfara State to the west and Jigawa State to the east. The climate of the study area is generally classified as semi-arid (Tomlinson, 2010) with a long dry season of about 7-8 months (November to May) and a hot rainy season lasting for 4 months (June to September). Temperatures are high in most parts of the year with the mean daily maximum temperature ranging between 27^0C to 40^0C occurring between (March to May) and the mean minimum ranging between 18^0C to 25^0C. The area has an average relative humidity of 60% and it is characterized by a unimodal rainfall pattern with most of the rainfall received between May and September, annually averaging below 700 mm (Tomlinson, 2010).

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Agriculture is the most important occupation of the people of the state; about 82% of the people in the study area are farmers operating mostly on a small scale with an average farm size of 1-2 hectares. Crops cultivated in the state include rice, millet, sorghum, maize, cowpea, groundnut, sesame, cotton (KTARDA, 2017).

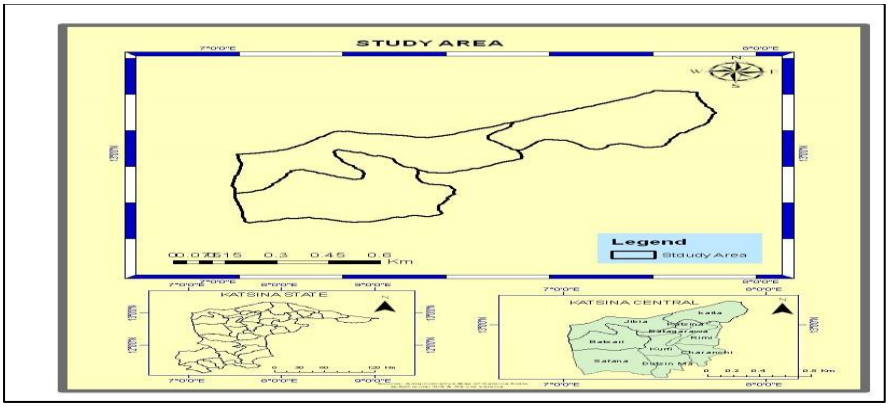

Figure 2: Map of the Study Area

Sample Frame of the Study

The sample frame for this study constituted 2,630 rice farmers in the study area. The sample was sourced from Katsina State Agricultural Development Zone – KATARDA.

Sampling Procedure and Sample Size

Reconnaissance survey was conducted to ascertain the rice producing local government areas in the state. Based on the survey, it was realized that Zone 1 of Katsina State Agricultural Development Programme (ADP) has 12 local government areas which, includes Rimi, Kaita, Batagarawa, Katsina, Daura, Zango, Baure, Mashi, Mani, Bindawa, Sandamu and Dutsi, and a sample frame of 2,630 farmers was obtained from the selected villages in the 3 selected districts of the LGAs. It is based on this premise that a multistage sampling technique was used to arrive at the sample size of the study.

In the first stage, Zone 1 of Katsina state ADP was purposively selected for this study due to the large number of rice farmers in the zone. In the second stage, purposive selection of three Local Government Areas (Rimi, Kaita and Ajiwa) was applied to obtain the LGAs out of all the local government areas in Katsina State ADP Zone 1 due to the high concentration of rice farmers in the area. The third stage involved random sampling of three districts from each of the selected LGAs. The fourth stage involved a random sampling of 3 villages each out of the selected districts. The fifth stage included a proportionate selection of 8% of the rice farmers from the selected villages; thus, the sample size of the study constituted 220 farmers.

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Table 1: Sample Frame, Sampling Procedure and Sample Size of the Study

Katsina state ADP Zone	Selected ADP Zone	LGAs in the Selected zone	Selected LGAs	Districts in the selected LGAs	Selected districts	No. of Villages in the selected districts	No. of selected villages from the districts	No. of farmers In the selected villages	Proportionate selection of 8%famers
Zone I	Zone I	Rimi	Rimi	Rimi Tsagero	Rimi	Masabo Kurabau Kadeji Gajeragiwa Kanyar Ubandaba Eka Arrey Cikakoshi Makurda Rimi	Masabo Gajeragiwa Kadeji	278 225 351	23 19 30
Zone II		Kaita	Kaita	Kaita	Kaita	Allemi Kaita Girka Yanhonho Kwangwami Makauraci Unguwar Jibo Gande Abdallawa	Abdallawa Girka Yanhonho	309 265 206	25 22 17
Zone III		Katsina Daura Zango Baure Mashi Mani Bindawa Jibia Sandamu Dutsi	Batagarawa	Mallamawa Ajiwa	Ajiwa	Barawa Yantaka Tafkin almu Magaji Shagumba Ajiwa Yarrakumma Turaji Kutare	Ajiwa Yarrakumma Shagumba	345 389 335	30 25 29
Total	**Zone I**	**12 LGAs**	**3LGAs**	**5 Districts**	**3 Districts**	**30 Villages**	**9 Villages**	**2,630**	**220**

Source: *Field Survey, 2019*

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Method of Data Analysis

Data generated for the study were analyzed using both descriptive (frequency, percentage, mean, and standard deviation) and inferential (Logit regression) statistics and adoption index.

Adoption Index

Adoption index shows the extent of use of a number of recommended practices by farmers, which is measured by adoption score (number of improved practices used) or by an adoption quotient (number of improved practices used over the total number of recommended practices). Score may be arbitrarily scaled to arrive at some categorization of adoption, for example, low, medium and high (Maiangwa *et al.,* 2007). For the purpose of this study, the adoption index will be calculated to obtain the level of using multiple practices from the following recommended components of the improved rice (FARO 58) package. The adoption index (AI) varies from 0–1 depending on the farmer's degree of adoption of the technology. On the basis of adoption index, respondent farmers will be classified into three categories, that is, low adoption = 0.01–0.33, medium adoption = 0.34–0.66 and high adoption = 0.67–1.0. The adoption score 0 indicates non adoption of improved rice production packages and the adoption score of 1 implies that the farmers adopted all the practices according to recommendation. If the adoption scores fall above the value of 1, it indicates that the farmers used some of the practices above more than what is recommended in the package. In order to determine the level of adoption of the package, adoption index of individual farmers was calculated using the following formula of adoption quotient (Tadesse, 2008):

$$AI_i = \sum_{i=1}^{n} \frac{\left(\frac{ENAi}{ENi} + \frac{LPAi}{LP} + \frac{SPAi}{SPi} + \frac{WMAi}{WMi} + \frac{FAAi}{FAi} + \frac{HBAi}{HBi} + \frac{DCAi}{DCi} + \frac{MHAi}{MHi}\right)}{Np}$$

where i = 1, 2, 3, 4, …, n, and n = total number of farmers

Np = Number of practices

AIi = Adoption index of the i^{th} farmer

ENAi = Nursery establishment by i^{th} famer

ENi = Nursery establishment recommended for the crop

LPAi = Land preparation by i^{th} farmer (number)

LPi = Land preparation recommendation for the crop (numbers)

SPAi = Spacing by i^{th} farmer (cm)

SPi = Spacing recommended for the crop (cm)

WMAi = Water management technology use by i^{th} farmer (cm)

WMi = Water management recommended for the crop (cm)

FAAi = Fertilizer rate by i^{th} farmer (bags/ha)

FAi = Fertilizer rate recommended for the crop (bags/ha)

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HBAi = Rate of herbicide used by i^{th} farmer (ml/liter)

HBi = Rate of herbicide recommended for the crop (ml/liter)

DCAi = Rate of disease control/ chemical applied by i^{th} farmer (ml/liter)

DCi = Rate of disease control recommended/ chemical application for the crop (ml/liter)

MHAi= Maturity and harvesting by i^{th} farmer

MHi= Maturity and harvesting period recommended for the crop.

Logit Regression Model

$Y = \beta_0 + \beta_1 X2 + \beta_2 X_2 + \beta_3 X_3 \quad . \ . \ . \ . \ . \ . \ . \ . + \beta_{10} X_{10} + e$

Y = Adoption level of improved rice production technologies (Dependent Variable).

where

X_1 = Age (in years)

X_2 = Educational level (years)

X_3 = Farming experience (in years)

X_4 = Household size (number of persons)

X_5= Membership of cooperative societies (numbers)

X_6= Farm size (ha)

X_7= Contact with extension agent

$\beta_1 - \beta_9 =$ = Regression coefficient.

e = Error term

a = Constant

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RESULTS AND DISCUSSION

Farm Size

Farm size is frequently analyzed as an important factor in many adoption studies. Farm size is an indication of social status and it influences many farmers' adoption of new agricultural technologies in the country. According to Balarabe (2012), farm size usually has an influence on agricultural technology adoption; in fact, some technologies are termed "scale defendant" because of their great importance in the adoption process.

Table 2: Distribution of Respondents According to Farm Size (n = 220)

Farm size (ha)	Frequency	Percentage	Mean	SD
1–2	121	55.0		
3–4	66	30.0	2.76 ha	1.504
5–6	29	13.2		
7 hectares and above	4	1.8		

Source: *Field Survey 2019*

Results presented in Table 2 shows that more than half (55.0%) of the respondents had a farm size of 1–2 ha, 30.0% of them had a farm size of 3–4 ha, 13.2% of the respondents had 5–6 ha of farm size and only few (1.8%) of the respondents had a farm size of 7 ha and above. The mean farm size among the rice farmers was 2.76 ha. These findings imply that the majority of the rice farmers in the study area had small plots of farmland from rice cultivation. This finding directly indicates the fact that rice production in Nigeria is characterized by small-scale production (Ughumba, 2013).

Farming Experience

Experience is a form of knowledge and skills that facilitates modern agricultural technologies in relation to adoption. According to Balarabe (2012), farming experience is expected to help farmers in boosting agricultural production through knowledge acquired from years of farming.

Table 3: Distribution of Respondents According to Land Acquisition (n = 220)

Land Acquisition	Frequency	Percentage
Purchase	4	1.8
Rent	37	16.8
Inheritance	179	81.4
Borrow	0	0.0
Rent	0	0.0

Source*: Field Survey, 2019*

Table 3 shows that the majority (81.4%) of the respondents acquired land through inheritance, 16.8% of the respondents acquired land through rent and only a few (1.8%) of the respondents acquired land through purchase. This finding implies that the majority of the respondents acquired their farmland through inheritance; this is because rural farmers rely on their parents for their agricultural properties, mostly land. This finding is in line with Ango, Ibrahim and Tambari (2017) who reported that the majority of the vegetable farmers acquired their land

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through inheritance; this is because it is the main means of acquiring land by the people in the study where land belonging to a deceased person is shared among his heirs.

Level of Adoption of FARO 58 Rice Package

Adoption index was used to calculate and obtain the level of adoption of the improved (FARO 58) rice package. The adoption index (AI) varies from 0–1 depending on the farmer's degree of adoption of the technology. Based on the adoption index, respondents were classified into three categories, that is, low adopters = 0.01–0.33, medium adopters = 0.34–0.66 and high adopters = 0.67–1.0.

Table 4: Distribution of the Respondents According to Level of Adoption of FARO 58 rice Package (n = 220)

Adoption Level	Adoption Index Range	Frequency	Percentage
Low adopter	0.01–0.33	14	6.4
Medium adopter	0.34–0.66	113	51.4
High adopter	0.67–1.0	93	42.3

Source: *Field Survey, 2019*

As presented in Table 4, above average proportion (51.4%) of the respondents fall within medium adoption category (0.34–0.66), 42.3% of the respondents fall within the high adoption category (0.67–1.0), while only a small fraction (6.4%) of the respondents fall within low adoption category (0.01–0.33). This implies that the majority of the respondents fall within medium adoption categories. This could be due to their socio-economic status, such as level of education, farm size, and farming experience, which were found to relate with adoption positively. Similar findings were reported by Tadesse, (2008), Singh *et al.* (2010) and Habibu (2015) on the study of adoption level and they reported that most of the farmers were found within medium level of adoption of agricultural technology due to their socio-economic factors.

Relative Advantage of FARO 58 Package over Local Variety

FARO 58 (NERICA 7) is an improved rice variety specifically grown in the upland area. The crop has a better adaptation to local stress, which may lead to high yield, grain quality, shorter growth duration of (100–110) potential and market value (NCRI, 2010).

Table 5: Distribution of Respondents According to Relative Advantage of FARO 58 Rice Technology Disseminated over the Local Variety (n = 220)

Relative Advantage	Frequency	Percentage
Early Maturity 209	41.9	
Increase in Yield	89	17.8
High seeds Vigor	201	40.3

Source: *Field Survey, 2019* *** 499** **Multiple Responses*

The result in Table 5 reveals that 41.9% of the respondents expressed early maturity as the reason behind adoption of FARO 58 rice over the local varieties, 40.3% of the respondents expressed high vigor of seeds while only a small fraction (17.8%) of the respondents indicate a high yield as the relative advantage of the package. This finding implies that most of the

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respondents adopted the FARO 58 rice package due to its importance in terms of early maturity, good seed quality and high yield.

Level of Satisfaction with the FARO 58 Rice Package

This shows the level by which respondents were satisfied with the rice production technology over the local varieties.

Table 6: Distribution of Respondents According to their Level of Satisfaction with FARO 58 Rice (n = 220)

Level of Satisfaction	Frequency	Percentage
Highly Satisfied	45	20.5
Satisfied	174	79.0
Not Satisfied	1	0.5

Source: *Field Survey, 2019*

The result presented in Table 6 reveals that the majority (79%) of the respondents were satisfied with the rice production technologies disseminated to them, 20.5% of the respondents were highly satisfied with the technologies disseminated and only few (0.5%) of the respondents were not satisfied with the technology disseminated. This finding implies that the majority of the respondents were satisfied with the improved technology disseminated to them and this could be due to early maturity, high seed vigor and high yield obtained from the disseminated rice production technologies. This finding is in line with Ango, Ibrahim and Tambari (2017) in their study of Roles of Agricultural Extension Workers in Disseminating Agricultural Technologies to Vegetable Farmers under Jibia Irrigation Project Katsina State where they reported that the majority (92%) of their respondents were satisfied with the technologies disseminated in their study area.

Factors Influencing Adoption of FARO 58 Rice Production Package

The factors influencing adoption of FARO 58 rice production package include socio-economic factors (such as, age, sex, farm size, educational level, farming experience), institutional factors (such as extension contact, access to credit, cooperative membership) and technology related factors (such as, compatibility, complexity, relative advantage, trial-ability and observability). Based on a study by Ogunsumi and Ewuola (2015), socio-economic status of farmers is positively and strongly related to adoption of disseminated agricultural technologies.

The result of the logistic regression model analysis shows that seven out of ten variables of the respondents were found to have a significant influence on the adoption of the FARO 58 rice production package at varying levels. These include sex, farm size, extension contact, association membership, compatibility, trial-ability and observability of results of the innovations.

The logit regression result in Table 4.6 shows that farm size had a significant relationship ($P < 0.001$) with adoption. This implies that farm size of the respondents had a significant influence on adoption of improved rice packages disseminated in the study area. This result is in agreement with Balarabe (2012) who reported that farm size of farmers is highly significant with the adoption of the improved maize production technologies.

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Sex of the respondents was also found to be significantly (P < 0.005) associated with the adoption of the introduced technology. This implies that sex has a significant influence on the adoption of improved rice packages in the study area.

Logistic regression analysis results further revealed a significant relationship (P < 0.05) between extension contacts with the adoption of improved rice packages. This implies that extension contact has a significant influence on the adoption of improved rice packages. The higher the number or frequency of visitation of extension agents to the farmers or vice versa, the higher the probability of adoption of recommended practices. This confirmed the findings of Oluwafemi *et al.* (2011), which reported that extension visits have an influence on the adoption of new agricultural technologies.

Association membership was also found to significantly relate (P < 0.001) with adoption of improved rice packages. This finding implies that membership of social organizations was an important factor in inducing farmers to adopt innovations. This finding is in correlation with Odoemenem and Obinne (2010) who reported that membership of farmers within a group provides them access to information on new packages and enables them to learn from each other on how to produce and market their crops.

Observability, compatibility and trial-ability were also found to be significantly associated (P < 0.001) with adoption. This implies that technology related factors have a significant influence on the adoption of improved rice varieties.

Hypothesis Test

There is no significant relationship between socio-economic characteristics of rice farmers and level of adoption of the FARO 58 rice production package in the study area.

The result in Table 6 shows that extension contact of the respondents with probability value of (P < 0.05), farm size (P < 0.001), sex (P < 0.05) and membership of association (P < 0.001) had a significant influence on adoption level of FARO 58 rice package at a level of significance of either (0.001) or (0.05). Therefore, it was concluded that some farmers' socio-economic characteristics (mention significant results here) had a significant influence on farmers' level of adoption of the FARO 58 rice package in the study area. Hence, the null hypothesis is rejected.

Table 6: Logistic Regression Result on Factors Influencing Adoption of FARO 58 Rice Package

Variables	Coefficient	Standard Error	Valid Statistics	P- Value
Constant	2.826	0.365	7.747	0.000***
Age	- 1.209	-1.106	- 1.093	0.246
Sex	0.679	0.264	2.572	0.006**
Farm Size	0.346	0.044	7.863	0.000***
Educational Level	0.018	0.051	0.359	0.654
Extension Contact	2.564	1.028	2.494	0.007**
Access to Credit	0.015	0.092	0.162	0.871
Membership Association	0.253	0.072	3.513	0.000***

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Compatibility	0.178	0.013	13.692	0.000***
Trial-ability	0.131	0.033	3.970	0.000***
Observability	0.142	0.022	6.454	0.000***

Source: *Field Survey, 2019* *P < 0.05%; ** P =<0.10%; ***P < 0.001%

CONCLUSION

The study concluded that an improved FARO 58 rice package was adopted by the respondents due to its early maturity appreciable output. Most of the socio-economic factors and few institutional and technology related factors significantly influenced the adoption of improved rice packages in the study area. The study also concluded that the majority of the respondents were satisfied and convenient with the package disseminated.

RECOMMENDATION

In view of the major findings of this study, the following recommendations were made:

i. Katsina Agricultural Development Agency (KATARDA) should focus attention on the crucial factors such as socio-economic, institution and technology related factors in the study, in their efforts to formulate development strategies and programmes for the improved rice package in the study area.

ii. The respondents should be encouraged to participate in several cooperative societies. This will enable smallholder rice farmers to take advantage of access to agricultural information and finance.

CONTRIBUTION OF THE STUDY TO KNOWLEDGE

i. This study has contributed to the understanding of the effect of socio-economic characteristics of smallholder rice farmers on adoption of the FARO 58 rice package.

ii. It also provides additional knowledge on the factors influencing farmers to adopt FARO 58 rice varieties in the study area.

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