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Research Article

Effects of Utilization of Improved Rice Production Technologies on Productivity among Smallholder Farmers in Niger State

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Abstract
This study examined the level of utilization of improved rice production technologies on productivity among Smallholder rice farmers in Niger State, Nigeria. Data were collected on the socio-economic characteristics of Smallholder farmers, accessibility of improved rice technologies, benefits derived productivity of Smallholder farmers and utilization of improved rice technologies. Using a multistage sampling procedure, 120 respondents were sampled and data were obtained with the aid of a questionnaire and interview schedule. Descriptive and inferential statistics were used to analyze data. Results showed that the majority (36.7%) of the respondents were in their productive age with an average age of 37 years. Majority, (86.7%) were married, while most (66.7%) of the respondents had access to improved rice technologies. The study also revealed that (78.3%) utilized the improved rice technologies, (85%) derived high benefits and (78.3%) had a high level of productivity. There is a significant relationship between utilization of improved rice technologies and productivity r = (0.721; P≤ 0.000). The study recommends that farmers need continuous access to improved rice technologies to boost their productivity. There is also a need for the government and stakeholders to provide adequate training to smallholder farmers on the use of improved rice technologies for more productivity.

Keywords: *Accessibility, Benefits, Productivity, Technologies, Utilization*

Introduction
Rice (Oryza_sativa) is a cereal crop and a staple food that is consumed globally by 50% of every household (Akinniran and Faleye,2020). Rice belongs to the seed of the grass species Oryza sativa or Oryza glaberrima and of the grass family Gramineae, a large monocotyledonous family of some 600 genera and around 10,000 species. (Ajala & Ghana 2015).

The African rice is known to have originated from the wild rice (O. barthii) about 3500 years ago and domesticated in the inland delta area of Nigeria from where it spread to other parts of Africa (Onu, 2018). Also, it is important to note that rice is not only meant for consumption, but also source of income generation and employer of labour for the poor. In rice producing areas, rice production provides employment for more than 80% of the inhabitants in various activities along the production/distribution chain from cultivation to consumption (Ajoma et al., 2016).

Rice is cultivated in almost all agro-ecological zones of the country, as it is part of one major cereal crop produced by Nigeria farmers. In terms

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of comparative advantage Ajah J and Ajah FC (2014), identified that rice can be grown in flooded and non-flooded soils because it has both lowland and upland varieties that can adapt to different agro-climatic and soil conditions. A breakdown of the arable land shows that about 4.6 million hectares are suitable for rice cultivation, of which1.8 million hectares (39%) is presently used for rice cultivation. (Demont. 2013)

According to Federal Office of Statistics (1999), smallholder farmers are farmers whose production capacity falls between 0.1 and 4.99. Smallholder farmers operate at subsistence level due to lack of funds to support their farming activities. They contribute greatly to the Nigerian agricultural sector and deserve every support to boost their rate of production, supply raw materials to agro-allied industries, and ensuring food security.

Improved rice technologies are methods and practices that affect rice production. Improved technologies are seen as a way of boosting farmers income in most of the developing countries because they resulted into increase farm yield and income. (Magret and Samuel 2015). Unfortunately, the majority of smallholder farmers rely on traditional methods of production and this has reduced their level of productivity. (Akinsuyi,2011) opined that 80% of rice production is from smallholder farmers who are the major supplier of food to Nigerians. These farmers generally obtain very low crop yields due to the use of local varieties. Most of the rice is grown under rain-fed conditions and irrigation is not frequently used, little or no fertilizer application and pest control is not adequate. (Muzari, Gatsi, and Muvhunzi, 2012). Hence, there is the need to assess their level of utilizing improved rice production technologies. Fasoyiro and Taiwo (2012) also identified that smallholder farmers are the major producers of rice as far as rice production is concerned but their production is considered low due to the fact that it has not been able to meet up with the demand of the population. Studies have shown that socio-economic status which include level of education, parental occupation, socio status all affect the level of utilization of improved rice technologies. (Tiku, Sanusi, Adedeji and Ebira, 2017). Also, FAO (2013) found out that there are several barriers to the adoption of agricultural technologies such as large investment costs, lack of assess to information and extension services, the risk associated with the technology, and how long it takes to benefit from the technology.

Ezeh et al 2022, in their work on Farmers Utilization of Improved Rice Production Technologies in Ebonyi State, Nigeria using descriptive statistics of mean, identified that the most utilized rice production technologies are: use of improved rice varieties, fertilizer application, use of agrochemicals, modern rice milling equipment, timely transplanting and use of standard depth and spaces. The assessment of improved rice production technologies will not only boost rice production and ensure self-sufficiency in rice production but will also reduce importation of rice and generally lead to food security in Nigeria. It is against this backdrop this research work seeks to provide answers to the following research questions: What are the socioeconomic characteristics of smallholder rice farmers in the study area? Do farmers have access to improved rice production technologies in the study area? What are the benefits derived from the utilization of improved rice production technologies in the study area? What is the level of utilization of improved rice technologies among Smallholder farmers in the study area? Does utilization of improved technologies affect the productivity of Smallholder farmers in the study area?

Materials and Methods

This study was carried out in Niger State. The state lies between Latitude 08°10’N and 11°30’N, Longitude 006°20’E and 009°03’E. It consists of a distinct dry and wet season and an annual rainfall of between 1,300mm and 1,600mm. The temperature varies between 26°C and 38°C. The vegetation is Guinea Savannah with a mixture of trees, shrubs, herbs and grasses. The soil is of low to medium fertility level and can be used for growing cereals, roots and tree crops (Ojohomon et al, 2006). Farming is the major occupation of majority of the dwellers. They are into production of cereals with particular interest in rice, sorghum and maize; legumes, root and tree crops, horticulture and spices. Niger State has a population of 3,954,772 people according to

Nigeria Population Commission, (NPC, 2006). The population of the study consist of rice farmers in the study area.

Multistage random sampling technique was used to draw the respondents for the study. The first stage of sampling involved random selection of two out of the three Agricultural Development Program (ADP) zones, namely zone 1 & 2. The second stage involved a random selection of three (3) rice producing Local Governments from each of the 2 selected ADP zones. The third stage involved a random selection of 20 respondents from each of the 6 selected rice producing Local Government Area. This made a total of 120 respondents. A structured questionnaire was used to collect data from the respondents based on the objectives of the study. The following variables were measured:

Respondents' accessibility to rice production technologies is defined in terms of how obtainable are the rice technologies and this was obtained as always accessible, rarely accessible or not accessible with scores of 2, 1 and 0, respectively, and they were measured on nominal scale of trichotomous response.Benefit derived implies the advantages from the use of improved rice production technologies and was obtained with the scores of 1 to any correct response while zero was assigned to any incorrect response. Mean scores of16 was generated and respondents above the mean score was categorized as having high benefit while those below the mean score was categorized as having low benefit.

The utilization of rice production technologies is the use of advanced method of rice production which was ascertained by presenting a list of improved production technologies to the respondents. Responses were assigned in a scale of 'frequently used', 'occasionally used' and 'never used'. Smallholder farmers productivity level was determined by providing them with the following indicators: increase in breakage level, cleanliness of rice grain, germination percentage of rice grain, improved rice grain colour, improved grain size, increase production output per hectare, decrease production output per hectare, no difference in production per hectare with a response option of yes or no.

Data collected were analysed using descriptive statistics which include frequency distribution, percentage and mean also inferential statistics such as Pearson Moment Correlation (PPMC)was used to determine the relationship between utilization and productivity.

To determine relationship between utilization of improved technology and productivity PPMC is expressed as follows:

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

Where: r= correlation coefficient
x_i = values of the x-variable in a sample
$\dot{X}$ = mean of the values of the x-variable
y_i = values of the y-variable in a sample
$\bar{Y}$ = mean of the values of they-variable

Results and Discussion

Table 1 presents the relevant socio–economic characteristics of respondents. The results reveals that 36.7% of the smallholder rice farmers were within the age range of 21 – 30 years with an average age of 37 years. Most of the smallholder rice farmers were in their active and productive age which will make them more productive and receptive to new technologies, while older farmers may be more resistant to change. This corroborates the findings of (Abdullahi, 2012), who found out that age can affect the adoption of new and improved rice farming technologies, which can impact productivity and profitability. Table 1 also shows that most (86.7%) of the respondents were married,11% were single and 0.8% separated. Being married is believed to afford farmers the opportunity to make productive decisions on adoption of innovative technologies with their immediate families. The result of the study further revealed that 35% of farmers had 1-10 years of experience in the productions and rice farming business, 45% had between 11 – 20 years of rice farming experience, 15% had between 21 – 30 years of rice farming experience while the most experienced respondents in rice farming constitute 5% and they have at least 31 years of rice farming experience. This implies that the rice farmers are experienced enough to make productive decisions of adopting and utilizing rice production technologies. This is in line with a study by the Food and Agriculture Organization

(FAO, 2014) which found that rice cultivation is deeply embedded in the cultural status of Niger State, and that many farmers have been cultivating rice for generations. Table 1 also revealed that majority (67.7%) of the rice farmers cultivated farm size between 0.5-2.0 hectares. Farm size determines the productivity and the use of improved technology by farmers.

Table 2 indicates that timely transplanting of seedlings with mean of 1.95, land preparation (1.88), tillage operation (1.83), fertilizer application (1.83), milling technology (1.78) and improved rice varieties (1.74) were accessible by the respondents. Accessibility of these improved rice production technology influenced the smallholder rice farmers' choice to opt for the best performed variety among several other varieties available, improved their production practices, enhanced their increasing output per area of land and income over the years. In line with previous findings, a study by Akinola et al. (2020) found that improved rice production technologies such as improved seed varieties, chemical fertilizers, and pest control methods are readily accessible to smallholder rice farmers in Nigeria. The study noted that the accessibility of these technologies has led to increased utilization among smallholder rice farmers thus, improving their livelihood and the economy at large.

The utilization of improved rice production technologies by respondents as shown in Table 3 reveals that tillage operations with the mean value of (1.97), milling technology (1.89), fertilizer application (1.88) and improved processing (1.83) are mostly utilized by the respondents, which influence their output and income. The study further noted that farmers who adopted improved technologies such as improved seed varieties, inorganic fertilizers and herbicides achieved high yields while those who did not adopt these technologies achieved low yields. This corroborates the study conducted by Mustapha et al (2012) who found out that majority of the smallholder rice farmers in Nigeria utilize improved rice production technologies for their production and they recorded higher yields compared to those who did not adopt them.
The result in Table 4 shows that majority of the respondents (78.3%) had high utilization of improved rice production technologies for their production. This Implies that rice may gain more economic value in the markets and thereby increasing the profitability of smallholder rice farmers. In line with previous findings, a study by Akinola et al. (2020) also supports the idea that majority of smallholder rice farmers in Nigeria utilize improved rice production technologies. The study reveals that farmers who adopted improved technologies such as improved seed varieties, inorganic fertilizers, and pest control methods recorded higher yields compared to those who did not adopt them. The study also noted that the use of improved technologies had a positive impact on the income of smallholder rice farmers.
Result from Table 5 shows that the majority (65.0%) of smallholder rice farmers highly benefited from increase in farm income, increase in production (86.7%), knowledge acquisition (92.5%), adoption of improved rice technologies (68.3%), rural infrastructure (78.3%) and expansion of farmland (88.3%) with the use of Improved Rice Production technologies. Income generation is a major aim of every business and the uses of improved rice production technologies have been beneficial to smallholder rice farmers in this category. Economically, when income generation increase, expanding the business scope and opportunity will be achievable and more profits will be generated. Also, improved rice production technologies have also been a great tool in enlightening and educating smallholder rice farmers in Nigeria. The increased yields and improved quality of rice resulting from the use of improved production technologies translate into increased income for farmers. (Mustapha et al 2012).

The result in Table 6 reveals that (100%) of the respondents had high increase in production output per hectare, reduction in breakage level of rice grain produced (95.0%), has improved the cleaned rice grain produced (95.0%), improved colour of rice grain (92.5%), improved size of grain produced due to improved variety (70.0%), germination percentage of rice (95.0%) and low decrease in production output per hectare (81.7%). Studies have shown that improved rice production technologies also lead to improved grain quality and output. For example, the use of mechanized harvesting equipment reduces grain damage,

resulting in higher quality rice (Ogunniyi et al., 2018).

Result in Table 7 shows that there was a significant relationship between utilization (r= 0.721; p≤0.000) of improved rice production technologies and rice productivity. The utilization of improved rice technology had a significant positive relationship with smallholder rice farmers which corroborates a study conducted by Tanko et al., 2019b that the adoption of improved rice production technologies, such as the use of improved seed varieties, fertilizer application, and improved water management, significantly increased farmers' productivity.

Conclusion

Most of the smallholder rice farmers were in their productive age and had agility for sustainable rice farming and they also utilized the improved rice production technologies for their production, they had access to improved rice production technologies in Niger State and highly benefited from improved rice production technologies with high productivity level. Government and stakeholders should provide adequate training for smallholder farmers on the use of improved rice technologies. Also, there should be continuous access of improved rice technologies to enhance more productivity.

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Table 1: Distribution of Respondents by Socio-Economic Characteristics

Variable	Frequency	Percentage (%)	Mean
Age			
20 – 30 years	44	36.7	37±11years
31 – 40 years	36	30.0	
41 – 50 years	23	19.2	
51years & above	17	14.1	
Marital Status			
Single	14	11.7	
Married	104	86.7	
Separated	1	0.8	
Divorced	1	0.8	
Years of Experience			
1 – 10 years	42	35.0	15±8 years
11 – 20 years	54	45.0	
21 – 30 years	18	15.0	
31years & above	6	5.0	

Source: Field survey, 2023

Table 2: Distribution of Respondents on the accessibility of Improved Rice Production Technologies.

Rice Production Technologies	**Always Accessible F(%)**	**Rarely Accessible F(%)**	**Not Accessible F(%)**	**Mean**	**SD**
Improved rice varieties	90 (75.0)	29 (24.2)	1 (0.8)	1.74	0.46
Fertilizer application	101 (84.2)	18 (15.0)	1 (0.8)	1.83	0.40
Use of agrochemicals	80 (6.7)	38 (31.7)	2 (1.7)	1.65	0.51
Modern storage facilities	4 (3.3)	3 (2.5)	113 (94.2)	0.09	0.39
Planting space	14 (11.7)	20 (16.7)	86 (71.6)	0.40	0.69
Planting depth practice	9 (7.5)	24 (20.0)	87 (72.5)	0.35	0.62
Mechanized harvesting	-	13 (10.8)	107 (89.2)	0.11	0.31
Use of irrigation method	44 (36.7)	56 (46.7)	20 (16.6)	1.20	0.71

Optimum seed rate	53 (44.2)	60 (50.0)	7 (5.8)	1.38	0.60
Rice milling technology	97 (80.8)	20 (16.7)	3 (2.5)	1.78	0.47
Land preparation	107 (89.2)	12 (10.0)	1 (0.8)	1.88	0.35
Nursery practices	77 (64.2)	44 (35.8)	-	1.64	0.48
Improved processing	62 (51.7)	55 (45.8)	3 (2.5)	1.49	0.55
Tillage operation	101 (84.2)	18 (15.0)	1 (0.8)	1.83	0.40
Timely transplanting	115 (95.8)	4 (3.3)	1 (0.8)	1.95	0.25

Source: Field survey, 2023

Table 3: Distribution of Respondents on the Utilization of Improved Rice Production Technologies

Rice Production Technologies	Frequently (%)	Occasionally (%)	Never (%)	Mean	SD
Improved rice varieties	85 (70.8)	34 (28.3)	1 (0.8)	1.70	0.48
Fertilizer application	105 (87.5)	15 (12.5)	0 (0.00)	1.88	0.33
Use of agrochemicals	74 (61.7)	44 (36.7)	2 (1.6)	1.60	0.53
Modern storage facilities	0 (0.00)	4(3.3)	116 (96.7)	0.03	0.18
Planting space	25 (20.8)	17 (14.2)	58 (65.0)	0.56	0.81
Planting depth practice	6 (5.0)	19 (15.8)	95 (79.2)	0.26	0.54
Mechanized harvesting	1 (0.8)	20 (16.7)	99 (82.5)	0.18	0.41
Use of irrigation method	52 (43.3)	48 (40.0)	20 (16.7)	1.33	0.73
Optimum seed rate	49 (40.8)	62 (51.7)	9 (7.5)	1.74	0.61
Rice milling technology	92 (76.7)	25 (20.8)	3 (2.5)	1.89	0.49
Land preparation	110 (91.7)	7 (5.8)	3 (2.5)	1.60	0.38
Nursery practices	72 (60.0)	48 (40.0)	-	1.50	0.49
Improved processing	64 (53.4)	52 (43.3)	4 (3.3)	1.83	0.57
Tillage operation	102 (85.0)	15 (12.5)	3 (2.5)	1.97	0.44
Timely transplanting	116 (96.7)	4 (3.3)	-	1.74	0.18

Source: Field survey, 2023

Table 4: Categorization of Respondents based on level of utilization of Improved Rice Production Technologies

Level of Utilization	Utilization score	F	%
Low utilization	8 – 18	26	21.7
High Utilization	19 – 26	94	78.3

Source: Field survey, 2023

NB: For Utilization score; mean = 19, minimum score = 8 and maximum score = 26

Table 5: Distribution of respondents based on benefits derived from the use of Improved Rice Production technologies

Rice Production Technologies	**High Benefit F (%)**	**Moderate Benefit F (%)**	**Low Benefit F (%)**	**Not a Benefit F (%)**	**Mean**
Increase in farm income	78 (65.0)	38 (31.7)	4 (3.3)	-	2.62
Increase in production	104 (86.7)	13 (10.8)	2 (1.7)	1 (0.8)	2.83
Knowledge acquisition	111 (92.5)	4 (3.3)	3 (2.5)	2 (1.7)	2.87
Adoption of improved rice technologies	82 (68.3)	33 (27.5)	4 (3.3)	1 (0.8)	2.63
Rural infrastructure	94 (78.3)	16 (13.3)	3 (2.5)	7 (5.8)	2.64
Expansion of farmland	106 (88.3)	10 (8.3)	4 (3.3)	-	2.82

Source: Field survey, 2023

Table 6: Respondents' category of benefits derived from the use of improved rice production technologies

Level of Benefit	Benefit score groups	F	%
Low Benefit	2 – 15	18	15
High Benefit	16 – 18	102	85

Source: Field survey, 2023.

NB: For Benefit score; mean = 16, minimum score = 2 and maximum score = 18

Table 7 Distribution of respondents based on Productivity level

Productivity	**High F (%)**	**Low F (%)**	**Mean**	**SD**
Reduction in breakage level of rice grain	114 (95.0)	6 (5.0)	0.95	0.22
Cleanliness of rice grain	114 (95.0)	6 (5.0)	0.95	0.18
Germination percentage of rice grain	114 (95.0)	6 (5.0)	0.93	0.44
Improved rice grain colour	111 (92.5)	9 (7.5)	0.93	0.24
Improved rice grain size	84 (70.0)	36 (30)	0.70	0.52
increase production output per hectare	120 (100)	-	1.00	0.00
decrease production output per hectare.	22 (18.3)	98 (81.7)	0.18	0.00
No difference in production output per hectare.	58 (48.3)	62 (51.7)	0.48	0.49

Source: Field survey, 2023

Table 8: PPMC Result showing relationship between utilization of improved rice production technologies and productivity of farmers

Variable	r	P	Decisions
Utilization and productivity	0.294	0.001**	S

Source: Field Survey, 2023