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Research Paper

An Evaluation Of The Impacts Of Adopting Modern Technology Of Rice Farming On Output, Income And Farm Size In Makurdi Local Government Of Benue State

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ABSTRACT
The research centers on the impacts of new technological adoption on output income and farm size of rice farmers in Makurdi LGA of Benue State, Nigeria. A sample size of 100 rice farmers was sampled from five randomly selected council wards in Makurdi LGA of Benue State. Primary data on rice farmer's previous and present output income and farm size were collected through the instrumentality of structured questionnaire administered to rice farmers. The data collected were analyzed using descriptive statistics, t-test of mean difference and regression model. The result of the data analyzed shows that the majority (79.0%) of the rice farmers were male, a larger proportion (33%) of the rice sampled farmers belong to the age group of 31-41 years, 10.0% of the farmers were found to have gained tertiary education with average household size of 10 people. The average farm size after the adoption of technology was estimated at 3.5 hectares generating average annual farm income of N154.200. The results revealed that the major methods of rice production technologies adopted by farmers ranged from improved varieties, storage and application of fertilizers, pests and disease control proper seed rates, herbicides application and timely planting dates. The results revealed a significant difference (t= 2.67: p<0.05) in farmer`s rice output before and after adoption of rice technologies. Similarly, there was a significant difference (t=3.74, t=7.20, t=2.07) in farmers` annual income, farm size and rice income respectively before and after adoption of technology.
KEYWORDS*: Technology, Farming, Rice, Agriculture, Sustainable growth.*

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I. INTRODUCTION

The application of advanced technological practices to agricultural activities leading to higher productivity is one of the topical issues that have received global attention for the past decades (Collier & Dercon, 2014). The developed countries have been able to improve agricultural productivity via the adoption of modern technologies and access to productivity-enhancing resources such as land, markets and credit. Improved agrarian technologies adopted include weed and pest management, improved crop varieties, modern machine and farm equipment and conservation agriculture (Reardon *et al*. 2009; Asfaw *et al*. 2012; Sheahan & Barrett, 2017).

Lee (2005), observed that the adoption of agricultural technologies has the potential to increase farm yields, increase farmers' income and ensure food security. Despite, the benefits of improved agricultural technologies, adoption is low in most developing countries like Nigeria (Abebe *etal.*, 2013; Jayne & Rashid, 2013; Sheahan & Barrett, 2017). There are enormous impacts of modern technological application to agriculture as it plays an important role in a country`s economic growth, food security, poverty eradication and rural development. Agriculture is the major source of income for more than 2 billion people in the developing world (FAO, 2003). As such, a well developed agricultural research systems with a policy thrust of generating and disseminating improved technologies are capable of boosting smallholders' farmers' output and enhancing economic development of the rural populace (Richard, Jones & Annor, 2013). However, the smallholder's farmers rely on traditional methods of production and thereby obtain a very low crop yields because the local tools used by the farmers have low potentials yield. Most of the crops like maize is grown under rain- fed conditions and irrigation is used only in limited areas, little or no fertilizers are used and pest control is not adequate (Mazari etal., 2012).

Rice is an important stable food in Nigeria and i grown in all the States of the federation and Federal Capital Territory. According to Onyeke (2017), rice production varies from State to State and the prevalent types of rice production systems in Nigeria include rainfed upland, rainfed lowland, irrigated lowland, deep water floating and mangrove swamp. The adoption of improved varieties and other modern inputs to rice farmers is very important to reduce the rate of rice importation in Nigeria (Saka & Lawal, 2009).

Loevinsohn etal. (2013), posited that the most common areas of technology development and promotion for crops include new varieties and management regimes; soil as well as soil fertility management, weed and pest management, irrigation, and water management. By virtue of improved input/output relationships, new technology tends to raise output and reduces average cost of production which in turn results in substantial gains in farm income as noted by Challa, (2013). Adopters of improved technologies improve their productions leading to constant socio-economic development. The following factors has been associated with the adoption of new technologies; higher earnings, and lower poverty, improved nutritional status, lower stale food price, increased employment opportunities and also earnings for landless laborers (Kasire, 2010). Benue State is blessed with fertile and vast arable land as well as human resources for rice production. However, it seems that rice farmers in Benue State have not been able to explore all these favorable variables to farmers to adopt and achieve desirable increase in yield. This could be due to some problems such as the inability of the farmers to adopt improved seed varieties, credits, use of agrochemicals and other technologies, poor socioeconomic background of the farmers as asserted by Byron et al. (2005).

Despite the accepted evidence of the contribution of improved technologies to agricultural productivity, there exist some problems including poor adoption of technologies, and sparingly available empirical evidences of the factors influencing the farmers' adoption behaviors in Benue State. Consequently, it is the objective of this study to ask some pertinent questions: what are the socio-economic characteristics of the rice farmers? What is the awareness and adoption levels of rice technologies among farmers? What are the impacts of adoption of rice technologies on farm output and income?

Objectives

The broad objective was to assess the effects of adoption of modern technologies on rice farmers in Makurdi Local Government Area, Benue State.

The study specifically sought to:

i. Ascertain the awareness and adoption levels of improved technologies among rice farmers in the adopted villages.

ii. Examine the impact of adoption of rice technologies on farm output, income and farm sizes in the adopted villages.

II. LITERATURE REVIEW

Findings from majority of studies on the subject revealed the awareness and adoption levels of improved technologies among rice farmers and also the impacts of the adoption of improved technologies on farm output. In terms of empirical studies on the effect of adoption of agricultural technologies on technical efficiency level of farmers, different econometric techniques, crop types and agricultural technologies have been used with conflicting results. For example, Benedetti *et al.* (2019) based on the stochastic frontier analysis (SFA) found that adoption of fertigation system increased the level of technical efficiency among Italian farmers. In a similar study, Rahman & Norton (2019) applied SFA and found no significant effect of adoption of integrated pest management (IPM) on technical efficiency level of eggplant growers in Bangladesh using the metafrontier model.

Many researchers shares the opinion that the adoption of new agricultural technology, such as the high yielding varieties that kick started the green revolution in Asia, could lead to significant increases in agricultural productivity in Africa and stimulate the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (World Bank, 2008). The adoption of high yielding varieties according to Mendola (2007), has had a positive effect on household well-being. Asante *etal.* (2019) found that adoption of fertilizer increased the technical efficiency of maize farmers in Ghana. In a study carried out by Ogebe, etal. (2018), on the Impact of Agriccultural Extension on Adoption of Modern Technologies by Rice Farmers in Gboko Local Government Area of Benue State, showed that most rice farmers in the study area are (38%) are small-scale farmers with farm size ranges from 1-3 hectares and utilizing mostly family labor. Although the study found that households sizes of about 40% respondents were between 11-15 persons in each households. This is advantageous because households with larger active family members can offer farm labor. The higher the numbers of person in a household, the higher its labor force and farm sizes.

Arimi & Olajide (2016) investigated the differences between male and female adopters of improved rice production technology in Ogun and Ekiti States using t-test and the factor analyses. The result indicated that there was significant difference between male and female farmers' adoption of improved rice production technology in the study areas. Institutional, motivational, innovational, attitudinal, environmental and different socio-economic

variables are the key factors influencing male and female farmers' decisions on technology adoption. They concluded that these key factors need to be taken into consideration when expanded program on technology adoption is to be considered.

CARD (2012) identified traditional rice-cropping problems which include the use of low quality, mixed varieties seed leading to degradation over time in quality, high cost of fertilizer and difficulty in procuring fertilizer in the appropriate amount at the appropriate time, low level of knowledge and training, lack of irrigation facilities, lack of storage facilities, poor pests and disease management, ineffective farm implements, lack of access to institutional and infrastructural support and low farm mechanization.

III. MATERIAL AND METHODS

The study area

Benue state was created on February 3rd, 1976 from the former Benue-Plateau State with its headquarters in Makurdi. The State derives its name from River Benue, the second largest in the country and the most prominent geographical feature in the state. It is located in north-central geopolitical zone of Nigeria. It has a population of 4,780,389 (2006, census). The state is made up of several ethnic groups: Tiv, Idoma, Igede, Etulo, Abakpa, Jukun, Igbo, Hausa, Akweya,Nyiton and others. Benue State shares boundaries with Taraba State and the Republic of Cameroon in the North, Cross River and Ebonyi States in the East, Enugu and Kogi States in the South and Nasarawa State in the West. Most of the people are farmers; some of the crops grown are potatoes, cassava, yam, soya beans, rice, guinea corn, ground nuts, etc. Livestock rearing in the state include goat, poultry, cattle, etc. while the inhabitants of the riverside engage in fishery as their primary occupation. This earned the state the name "Food Basket of the Nation". The research was conducted in Makurdi Local Government Area of Benue State, Nigeria. It comprise of eleven council wards. The climate is tropical with dry and cold windy harmattan weather from November to March and rainy/wet season from April to October (Ministry of Agriculture, 2009).

Sampling technique and data collection method

The basic information for the analysis was obtained from primary data collected with the aid of a structured questionnaire. The instrument was pre-tested in four different rice producing communities, and validated by group of five experts. Five out of eleven (1) adopted wards were purposively selected being the most prominent rice producing communities in the state. The selected adopted wards were Ankpa/wadata, North Bank 1, North bank 11, Waromayo and Fildi. Twenty (20) rice farmers were randomly selected from each of the selected villages making a total of 100 rice farmers who constituted the sample size for the study. The classification of the rice farmers (adopters and non-adopters) was made possible based on their adoption decision of the production practices.

Analytical techniques

The study employed both descriptive and inferential statistics. Data were analyzed using a simple descriptive statistic (Frequency count and percentage, mean and likert-type scale) in achieving the research objectives.

IV. RESULTS AND DISCUSSION

Table 1: Socio-economic Characteristics of Respondents in the Study Area (n-100)

Variables	Frequency	Percentage
Sex		
Male	79	79.0
Female	21	21.0
Age (years)		
20-30	22	22.0
31-41	33	33.0
42-52	24	24.0
53-63	10	10.0
64-74	6	6.0
>74	5	5.0
Educational level (years)		
No education	23	23.0
Primary	26	26.0
Secondary	41	41.0
Tertiary	10	10.0
Household size (number)		
1-5	74	74.0
6-10	16	16.0
11-15	6	6.0

16-20	2	2.0
21-25	2	2.0
Farm size (ha)		
<1.0	24	24.0
1-2	51	51.0
3-4	14	14.0
5-6	11	11.0

Source: Survey Data, 2020.

The information summarized above showed that majority (79.0%) of the respondents are male while (21.0%) were females. The lower proportion of female farmers in the study area can be lined to the problem of land ownership as a result of cultural restrictions. This assertion is supported by Ogebe & Adanu (2018), who posits that farming is a male dominated profession. Majority of the respondents (63.3%) were married with average age of 46 years and average household size of 10 persons. This implies that majority of the respondents were within productivity age and can adequately use their enormous energy for agricultural activities. Russel (2004), supported this findings by asserting that larger family sizes guarantees food security while Jiang & Brawn (2005) posits that large family sizes hinders farm funding, feeding deficiencies and educational funding. Majority (41.0%) of the respondents had secondary education this has a lot implication on the application of modern technology on rice farming. Furthermore, (51.0%) of the farmers had farm size of 1-2 hectares, the mean farm size is 3.50 hectares. This implies that the surveyed farmers had limited farm land and as such requires effective use of the land to guarantee the desired output for both commercial and subsistence consumption.

Table 2: Level of Awareness and Adoption of Rice Technologies by Farmers in the Study Area. (n=100)

Crop	**Technologies**	**Aware**	**Not aware**	**Adopted**	**Not adopted**
Rice	NARICA I,II,III or IV	80 (80.0)	20 (20.0	60 (60)	20 (20.0)
	FARO (44)	64 (64.0)	36 (36.0)	48 (48)	16(16.0)
	ITA	54 (54.0)	46 (46.0)	30 (30)	24 ((24,0)
	Spacing	58 (58.0)	42. (46.0)	50 (50)	8 (8.0)
	Seed rate	57 (57.0)	43 (43.0)	42 (42)	1 (1-0)
	Chemical weed control (herbicides)	85 (85.0)	15 (15.0)	77 (77)	8 (8.0)
	Threshing	100(100.0)	0 (0.0)	98(98)	2 (2.0)
	Use of chemical fertilizer	100(100.0)	0 (0.0)	98 (98)	2 (2.0)

Source: Survey data, 2020

Table 2 showed that the use of chemical fertilizer had the highest level of awareness and adoption rate (98.0) among rice technologies introduced to the rice farmers. Similarly, there was high level of awareness (85%) and high adoption rates (77.0%) for chemical weed control (herbicide) and high adoption rate (94,0%) for threshing technologies in rice farming been introduced to the farmers in the study area. There was general awareness in the technology of use of herbicides among rice farmers in the study area. However, the adoption rate of this technology appears high. The reason for the high adoption rate of this chemical could be due to adequate skills of the farmers required for the operation of the sprayer. This agrees with the works of Ogebe & Adanu, (2018) who concluded that the technical skills required in handling the equipment used in mechanized farming can lead to high adoption by the rural farmers.

Table *3:* Impact of Adoption on Rice Output, Income and Farm Size before and After Adoption of Rice Technologies.

S/N	Variable	Period	Mean	N	DF	Std Dev.	Mean Diff.	t-value	Significance
1	Annual	After	154200	100	99	139352.35			
	Income	Before	66088.0	100	99	61785.05	88112.0	3.744	0.231****
2	Farm	After	3.50	100	99	0.4131			
	size (ha)	Before	1.50	100	99	0.41562	2.00	7.20	0.005***
3	Rice	After	99,112.0	100	99	87643.33			

	income(N)	Before	71,930.0	100	99	66.600	27182	2.072	0.231***
4	Rice	After	59,5469	100	99	48.98786			
	Output	Before	388967	100	99	34.24132	206,562	2.67	0.00*

Source: survey Data, 2020.
*** ($p<0.01$), ($p<0.05$).
*values in parenthesis are percentages

Table 3 showed that there was a significant difference in change in outputs of rice before and after adoption of technologies (t= -14.784: $p<0.05$). It therefore implies that rice technologies generally have a positive significant impact on rice output in the study area. In a related study, Ogebe & Adanu (2018), also found that introduction of technologies better the lots of farmers in terms of output. The table also revealed that the mean monthly farm income generated from the sales of farm produce after adoption of rice technology was N=597000 and found to be significantly greater (t=2.072: $p<0.05$) than that produced before adoption of technologies (250,000). This implies that rice technologies have made a positive impact on the livelihood of the adopted farmers.

The result also showed that farm size of rice farmed was found to be significantly greater 9t=7.20: $p<0.01$) than that before the adoption of rice technologies. The test of statistical difference indicates significance difference between the income before and after adoption of rice technologies. This may be due to introduction of new farming technology provided by the agency and farming inputs provided such as provision of improved seeds, fertilizer/ agricultural chemical given to the farmers.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Based on the findings, it could be said that integration of modern technologies to rice farming proved promising and effective in dissemination of improved rice production practices in the study area. This stemmed from the field demonstration, farmer participatory approaches. The common improved rice technologies stated as being adopted by farmers in the area include fertilizer application; agrochemicals weed control (herbicide) and high adoption rate, optimum seed rate in planting, respectively. Socioeconomic characteristics of the farmers are significantly associated with the stated adoption of the various improved rice production technologies in the area on the whole. This research work endorses the effectiveness of demonstration methods among the farmers, therefore their continuation of the application of the modern method is recommended for improved rice production that will meet up with high demands in the country as well as proliferation of improved practices and their benefits to larger number of farmers.

Based on the result of the study, the following recommendations are pertinent:

- Rice farmers should receive more training and knowledge about improved rice technologies through steady flow of information by rural Sociologists and Extension agents
- Rice farmers in the study area should be trained on how to handle herbicide equipment for effective application
- Female farmers should be allowed to access farm land so as to improve more participation in rice production in the study area
- Rice processing industries should be established by private organizations to encourage commercial farming to support adoption of more improved rice technologies.
- Farmers' incentives and supports should be accorded top priority in the scheme of agricultural programs in the country

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