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# FACTORS INFLUENCING ADOPTION OF RICE PRODUCTION TECHNOLOGIES AMONG FARMERS IN SOUTHERN AGRICULTURAL ZONE OF NASARAWA STATE, NIGERIA

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***Abstract***
*The study assessed factors influencing the adoption of rice production technologies in the Southern Agricultural Zone of Nasarawa State, Nigeria. A multistage sampling procedure was used to draw 200 rice farmers from whom primary data were collected by field survey. Descriptive statistics and multiple linear regression were used for data analysis. The results revealed that many (62.5% ) of the farmers were 40 years and above, 99.5% were married, 75.5% attended formal education, 83.5% had 6 persons as household size, 62% had farming experience of 10 years and above, 70.5% had 2 hectares of cultivated rice farm, and 60% had no contacts with extension agents. Improved rice production technologies identified by farmers in the area included pesticides application (91.5%), handpicking of stubborn weeds (65%), and fertilizer application (31%). The level of adoption of rice production technologies by rice farmers in the area was low. The coefficient of extension contact (0.677: P< 0.01), annual income (0.002: P< 0.01) and farming experience (0.026: P< 0.05) were found influencing the adoption of improved rice production technologies in the area. The major constraints to the adoption of rice production technologies in the area were climate change (87%), cost of labour (64%) and inadequate capital (58%). The study concluded that adoption of improved rice production technologies in the area was low; and adoption is positively influenced by annual income, farming experience and extension contact. It was therefore recommended that training of rice farmers on improved production technologies and educating them on climate resilience practices should be adopted.*
***Keywords:*** *Adoption, Rice, Production technologies, Farmer.*

## Introduction

Rice remains one of the staple crops consumed in Nigeria in large volume per annum and the estimated consumption stands at five million metric tonnes of milled rice while annual consumption per capita stands at 29 kg and this has continued to rise at 11% per annum due to population and income growth. Out of this figure, about 2.8 million tons are produced locally, leaving a deficit of 2.2 million metric tons to be imported from other countries, including Thailand and India. Nigeria, therefore, spends over NGN365 billion annually to import rice into the country, thereby placing the country as the highest importer of rice in the world with attendant consequences on the hard-earned external reserves (FMARD, 2016). The high demand for rice consumption in the country was attributed to increase population growth, urbanization and income change (Onu *et al*., 2015).

The bulk of rice production in the country remains in the hands of smallholder farmers who are limited by capital, poor commodity market infrastructures and farm management skills to give higher yield despite the potentials of the available varieties to exceed the present average national yield of 1.7 MT/ha. The narrative, however, changed in 2015, when a ban was placed on the importation of rice by the government, thereby encouraging local production (Shulammite, 2018). This initiative, along with the Anchor Borrowers Programme, introduced by the same government has made Nigeria to be self-sufficient in rice production to some extent which was primarily driven by expansion of land area devoted into rice cultivation, but the national average yield per hectare is still low compare to other rice producing Countries of the World e. g Thailand, Vietnam, China etc. The low yield could be due to the attitudes of the farmers toward adoption of improved rice production practices/technologies (i.e. improved methods of planting, fertilizer application and other agronomic best practices), among other factors that would have culminate in higher yield (Abdulkareem, 2022).

Increased rice productivity can be achieved through farmer's adoption of improved agricultural technological innovation which includes high-yield variety, genetically modified crops, facilitating access to credit and insurance markets, irrigation facilities, along with good extension services. All these may

lead not only to better yield, income, labour-saving, efficiency, but also to improved production environment (e.g. mitigating effects on climate change) and health benefits (Amali *et al*., 2021).
In Nasarawa State for example, efforts have been made to spread improved rice varieties and other rice related technologies to farmers through the Nasarawa State Agricultural Development Programme, and the Value Chain Development Programme of the Federal Government of Nigeria/the International Fund for Agricultural Development to enhance rice productivity, among others (Abel, 2022). However, bulk of the rice farmers do not seem to use improved rice variety and rice related technologies, as some still indulge in traditional methods of planting (broadcasting) and fertilizer application which are characterized with problems of low productivity and poor standard of living for the farmer (Adenuga, 2014). No doubt that adoption of good agricultural practices in the production of rice will boost the yield and the economic status of the farmers. This study, therefore, examined the interplay of socioeconomic factors and farmers' adoption of improved rice production technologies in the Southern Agricultural Zone of Nasarawa State by describing the socioeconomic characteristics of the respondents; identifying improved rice technologies; assessing the level of adoption of rice improved technologies; and identifying the constraints to rice production in the study area.

**Methodology**
The study was conducted in Southern Agricultural Zone of Nasarawa State, North Central Nigeria. The Southern Agricultural Zone covers five Local Government Areas namely: Awe, Doma, Keana, Lafia, and Obi. Agriculture is the dominant occupation of the inhabitants of the zone. The major crops grown in the zone include yam, maize, rice, cowpea groundnut, melon, sesame, millet, soya beans, cassava etc.
The target population for the study was rice farmers in the Southern Agricultural Zone of Nasarawa State. A multistage random sampling procedure was employed for the study. First stage involved random selection of 4 LGAs out of the 5 LGAs in the zone. Secondly, a random selection of 2 villages each from the selected LGAs was done to get 8 villages and finally, 25% rice farmers were randomly selected from each of the selected villages, giving a total of 200 rice farmers.
Primary data were used for the study and data were obtained with the aid of a well-structured questionnaire. Data analysis was done using simple descriptive statistics (such as frequency, percentage, mean and ranking) and Multiple Linear Regression Model
The multiple linear regression equation is shown below:

$$Y_i = \Theta_0 + \Theta_1 X_1 + \Theta_2 X_2 + \Theta_3 X_3 + \Theta_4 X_4 + \Theta_5 X_5 + \Theta_6 X_6 + \Theta_7 X_7 + \mu \ldots\ldots\ldots\ldots (1)$$

Where,
Y= Dependent variable (level of adoption of improved rice production technology in %)

$$= \frac{\textit{Number of technologies adopted by an individual farmer}}{\textit{Total number of improved technologies available in the area}} \times 100$$

$X_1$-$X_7$ = Independent variables
$X_1$ = Age (years)
$X_2$ = Level of education (years)
$X_3$ = Farm size (hectare)
$X_4$ = Farming experience (years)
$X_5$ = Income (naira)
$X_6$ = Extension contact (number of visit per year)
$X_7$ = Output (Kg)
$\Theta_0$ = Constant ( population intercept)
$\Theta_1$ - $\Theta_7$ = Coefficients to be estimated
$\mu$= Error term

**Results and Discussion**
**Socio-economic Characteristics of the Respondents**
The results in Table 1 revealed that majority (39.5%) of the respondents were within the age bracket of 40 - 49 years, 30% were between 30-39 years, 23% were aged between 50-59 years; the mean age was 43

years. This depicts that rice farmers in the study area are productive and matured-minded adults who can take decisions on their own as regards the adoption of improved rice production technologies. It was also revealed that majority (69.5%) of the farmers were male while, 30.5% were female. This implies that males were more involved in the production of rice in the area than females. The finding is similar to Mustapha *et al.* (2012) who reported that many (57.5%) of the farmers were within the age of 41-50 years and majority (98.12%) were male, which they think may be due to the fact that male farmers are more energetic in handling the various operations involved in rice production. Result in Table 1 also indicated that many (69.5%) of the respondents were married, 16.5% were single, 8.5% were widow/widower, and 5.5% were divorced. This means that married persons are more into rice production in the areas. This agreed with Okeke *et al*. (2019) and Onyeneke (2017) who reported majority 82% and 76.30% of rice farmers in Ayamelum LGA of Anambra State and Imo State to be married. Many (38.5%) of the farmers had tertiary education, 20.5% obtained secondary education, 16.5% attended primary school, and 24.5% did not attend formal school. This implies that majority of the respondents are learned, since they had one form of formal education or the other. Table 1 further showed that majority (83.5%) of the respondents had between 1-10 persons in their households, 15% had between 11-20 household size, and only 1.5% had more than 20 persons as household size. The mean household size was six. This implies that many farmers in the area have small household sizes which may bring about the desire to acquire/hire labour to work on the farm, as rice production requires extra manpower to carry out its operations such as transplanting, cutting, threshing, winnowing, among others. This finding is contrary to Onyeneke (2017) who reported that 53.06% of rice farmers in Imo State, Nigeria had between 13-18 persons as household size.

Many (33.5%) of the respondents had experience in rice farming for 21-30 years, followed by 28.5% with experience of 11-20 years, 18% had both experiences of between 1-10 years and 30 years of experience, while 2% are new into rice with less than a year experience. This implies that many farmers in the area have cultivated rice for a long period of time hence, will be ready to try new technique/technology if they perceived that it is advantageous. This is in line with Chukwu *et al.* (2016) who reported that majority (43.33 %) of rice farmers in Ebonyi State, Nigeria had farming experience in rice production for 21-30 years with mean farming experience of 23 years. Table 1 showed that 70.5% of the farmers had farm size of between 1-5 hectares, 29% had less than a hectare and 0.5% had above 5 hectares with mean farm size of 2 hectares. This implies that rice farmers in the area are small-scale farmers. The relationship between the adoption of new farm technologies and size of a farmer's farmland is significant because, as small size of farmland may hinder the adoption of improved technology (Agbamu, 2006).

Table 1 also revealed that majority (75.5%) of rice farmers in the area were non-members of any cooperative society, while only 24.5% were members of cooperative groups. This could be due to inadequate knowledge of the farmers on the benefits of being a cooperative member or absent of farmers desired cooperative group in the area. Membership of cooperative is expected to assist farmers to get access to information on innovations, access to credit, and other production inputs easily. The result is contrary to Chukwu *et al.* (2016) who reported that majority (70.42%) of the rice farmers in Ebonyi State, Nigeria, were members of cooperative society. The results on extension contact showed that many (60%) of the respondents had no contact with extension agents, 36% had contact between 1-2 times with extension in a year, and only 4% had extension visits more than two times a year. Extension visit to farmers is an avenue for sharing knowledge and information with farmers on new/improved technologies in farming in order to increase their productivity and better their livelihoods. The result is contrary to Chukwu *et al.* (2016) who reported that many (59.58%) rice farmers in Ebonyi State, Nigeria had contact with extension.

Finally, many (41%) of the respondents indicated previous harvest as their source of seed for production i.e. some harvested seed from the last or previous years were preserved and stored for the next farming season. This method of obtaining seed is easier for the farmer because, it is at their disposal and the quality of what to expect is assured. The result also revealed that 19% indicated other farmers as their source of seed. Also, 16% got their seed from agro-input dealers, 13.5% from Nasarawa Agricultural Development Programme and 10.5% from open market. This agreed with Kakoty and Barman (2015) who reported self-retained seed, peer farmers, the State Agricultural Department, among others to be the most important sources of seed to rice farmers in Assam. Also, the study is in conformity with Govind *et al*. (2018) reported farm-saved seed by farmers, private seed dealers, research institute, Department of

agriculture/cooperatives, and authorized dealers as the major sources of paddy seed by farmers in Eastern Uttar Pradesh, India.

**Table 1: Socioeconomic Distribution of the Respondents.**

| Variable | Frequency | Percentage | Mean |
|---|---|---|---|
| **Age (years)** | | | |
| 20-29 | 6 | 3 | 43 |
| 30-39 | 60 | 30 | |
| 40-49 | 79 | 39.5 | |
| 50-59 | 47 | 23.5 | |
| 60 and above | 8 | 4 | |
| **Gender** | | | |
| Male | 139 | 69.5 | |
| Female | 61 | 30.5 | |
| **Marital status** | | | |
| Single | 33 | 16.5 | |
| Married | 139 | 69.5 | |
| Divorced | 11 | 5.5 | |
| widowed | 17 | 8.5 | |
| **Educational level ( years)** | | | |
| Non-formal education | 49 | 24.5 | |
| Primary | 33 | 16.5 | |
| Secondary | 41 | 20.5 | |
| Tertiary | 77 | 38.5 | |
| **Household size (No)** | | | |
| 1-10 | 167 | 83.5 | 6 |
| 11-20 | 30 | 15 | |
| Above 20 | 3 | 1.5 | |
| **Farming experience (years)** | | | |
| < 1 | 4 | 2 | |
| 1-10 | 36 | 18 | 23 |
| 11-20 | 57 | 28.5 | |
| 21-30 | 67 | 33.5 | |
| Above 30 | 36 | 18 | |
| **Farm size (ha)** | | | |
| < 1 | 58 | 29 | |
| 1-5 | 141 | 70.5 | 2 |
| Above 5 | 1 | 0.5 | |
| **Membership of cooperative** | | | |
| Yes | 49 | 24.5 | |
| No | 151 | 75.5 | |
| **Source of seed** | | | |
| Last/previous harvest | 82 | 41 | |
| Other farmers | 38 | 19 | |
| Agro-input dealer | 32 | 16 | |
| NADP | 27 | 13.5 | |
| Open market | 21 | 10.5 | |
| **Extension contact (No)** | | | |
| No contact | 120 | 60 | |
| 1-2 | 72 | 36 | |
| Above 2 | 8 | 4 | |

**Field survey, 2022**

**Improved rice technologies in the area**

Table 2 shows improved rice production technologies identified by the respondents in the study area. It was revealed that most (91.5%) of the respondents identified herbicide application as the most improved rice production technology practiced by farmers in the area, 65% identified handpicking of stubborn weeds, 31% indicated application of fertilizer and 14.5% identified suitable site selection as the improved rice production technologies in the area. From the result, it can be deduced that farmers in the area had poor knowledge of rice production technologies. This could be due to lack of awareness and exposure of the farmers on the practices of improved technologies in rice production. This is in line with Okeke *et al*. (2019) who revealed land preparation (x= 2.00), pesticides application (x=1.92), fertilizer application (x=1.86), herbicide application (x=1.84), use of improved seed varieties, seed selection, appropriate planting spacing, and planting depth with the means of 1.84, 1.80, 1.60, 1.56, and 1.51 respectively as some rice production technologies identified by women farmers in Ayamelun, Anambra State.

**Table 2: Identification of Improved Rice Production Technologies in the Area By The Respondents**

| Improved technologies | *Frequency | Percentage |
|---|---|---|
| Herbicide application | 183 | 91.5 |
| Handpicking of stubborn weed | 130 | 65 |
| Fertilizer application | 62 | 31 |
| Suitable site selection | 29 | 14.5 |
| Land preparation by tillage | 13 | 6.5 |
| Farm/field measurement | 9 | 4.5 |
| Plant spacing (20×20) | 4 | 2 |
| Improved seed variety | 4 | 2 |
| Nursery/transplanting | 3 | 1.5 |
| Bounding/water management | 1 | 0.5 |

**Field survey, 2022** ***Multiple responses**

**Level of Adoption of Improved Rice Production Technologies**

The results in Table 3 showed that majority (51%) of the respondents in the area adopted low technologies of improved rice production, 20% of the respondents adopted medium-scale level, 16% adopted a very low scale and, 13% adopted high scale level. The implication of this finding is that, there was a low level of adoption of improved rice production technologies by farmers in the area. This could be due to inadequate information/ exposure of the farmers to the practices of the improved technologies. The result of the finding disagreed with Okeke *et al*. (2019) who reported high level of adoption of rice production among women farmers in Ayamelun, Anambra State. It is also contrary to Mustapha *et al.* (2012), who reported an moderate level of trial on the adoption of improved rice production technologies in Jeer L.G.A. of Borno State, Nigeria, stating that majority (93.75%) of the farmers adopted use of weedicides, 77.50% adopted high yielding varieties, 75.00% adopted manual harvesting, 69.37% for early maturing varieties, 55.00% for broadcasting method, and 63.75% adopted bagging.

**Table 3: Distribution of respondents on their level of adoption of improved rice technology**

| Range % | Frequency | Percentage | Adoption scale or level |
|---|---|---|---|
| 10-20 | 31 | 16 | Very low |
| 30-40 | 101 | 51 | Low |
| 50-60 | 40 | 20 | Medium |
| 70-80 | 17 | 9 | High |
| 90-100 | 8 | 4 | Very high |

**Field survey, 2022** ***Multiple responses**

**Factors influencing adoption of improved rice production technologies**

Table 4 shows the multiple regression result of the socioeconomic determinants of the respondents' adoption of improved rice production technologies. The adjusted $R^2$ value was 0.637, implying that the independent variables explained 63.7% of the variation in the dependent variable.

The coefficient of extension contact (0.677) was positive and statistically significant at 1% level. This implies that an increase in the number of extension contact with farmers would probably bring about an increase in the adoption of improved rice production technologies by the respondents. It can also be deduced from the result that farmers who have access to extension services may be more likely to adopt the improved technologies because they might have been educated, trained and exposed to the technology packages. This agreed with Abubakar *et al*. (2019) and Umar *et al*. (2019) who reported extension contact to be a positive and significant determinant of adoption of rice production technology in Niger State and Kebbi States, respectively. Annual income (0.002) of the farmer was also positive and significant at 1% level, depicting that the higher an income of the farmer is, the more likelihood to adopt rice production technologies. That is, the more increase in the revenue from rice production by the farmers, the greater their chances of adopting improved technologies. Adequate fund is required and considered necessary in the practice of improved technologies. This would enable the adopter purchase inputs and equipment needed for the practice of the technologies. With higher income, chances of adoption are greater. The result agreed with Onyeneke, (2017) who revealed income to have positive and significant effect at 1% on the adoption of improved rice technologies in Imo State, Nigeria. Also, Adeyemi *et al*., (2020) reported farm income among other factors as significant, and had positive influence on adoption of improved rice varieties' adoption in South-West Nigeria. Furthermore, the coefficient (0.026) of farming experience was positive and significant at 5% level; indicating that the more the number of years in farming by the respondents, the greater the probability of adoption of improved rice production technologies. Longer experience may bring the desire to try new technologies so as to compare the benefits with the former and convince oneself on the better practice to adopt. Longer years in farming may also determine one's capability and capacity to adopt new technologies, due to more exposure and versatile knowledge in vital aspects of farming. This is in line with Umar *et al*. (2019) who reported farming experience among other factors to significantly and positively influence the adoption of improved rice production technologies in Kebbi State, Nigeria. Abbas and Jiang (2018) also reported farming experience to be a significant and positive influence to the adoption of improved rice variety in Sindh, Pakistan.

**Table 4: Factors influencing the adoption of rice production technologies**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| Constant | 3.953 | 0.686 | 5.760 | 0.000 |
| Level of Education | -0.104 | 0.260 | -0.399$^{NS}$ | 0.690 |
| Extension contact | 0.677 | 0.132 | 5.127*** | 0.000 |
| Farm experience | 0.026 | 0.012 | 2.149** | 0.033 |
| Farm size | 0.075 | 0.043 | 1.721* | 0.087 |
| Annual income | 2.12E-06 | 5.12E-07 | 4.132*** | 0.000 |
| Output | 0.000 | 0.000 | 1.479$^{NS}$ | 0.141 |
| Age | -0.004 | 0.017 | -0.273$^{NS}$ | 0.785 |
| F-statistic | 15.46780 | | | |
| R-squared | 0.637 | | | |

**Source: Authors regression result.**

**Note: *** =** Significant at 1%, ** = Significant at 5%, and NS= Not significant.

## Constraints to Rice Production in the Area

Table 5 presents the constraints to rice production in the study area, which include: effect of climatic change ranking 1$^{st}$; high cost of labour ranking 2$^{nd}$; inadequate capital ranking 3$^{rd}$; cost of inputs ranking 4$^{th}$, and poor extension contact ranking 5$^{th}$. Climate change had also been identified as the major threat to natural environment and agricultural sustainability in Nigeria and other regions of the world. It does not only affect agricultural production and prices, trade, and food sufficiency but also environmental conditions like water resources, land use and coastal infrastructures among others (Onu and Ikehi, 2016). According to Merem *et al.* (2017), climate change is one of the most serious long-term challenges to achieving sustainable rice yield. The result is similar to that of Okeke *et al*. (2019) who reported high flooding as a major constraint to adoption of improved rice production technologies in Ayamelun L.G.A

of Anambra State, Nigeria. Also, Rashid *et al.* (2019) identified late unset of rain as a major constraint hindering the adoption of rice technologies.

**Table 5: Constraints to rice Production**

| Constraints | Frequency | Percentage | Ranking |
|---|---|---|---|
| Climate change | 173 | 87 | 1st |
| High cost of labour | 128 | 64 | 2nd |
| Inadequate Capital | 115 | 58 | 3rd |
| Cost of inputs | 76 | 38 | 4th |
| Poor extension contact | 57 | 29 | 5th |

**Source: Field survey, 2022** ***Multiple responses**

## Conclusion and Recommendations

Adoption of improved rice production technologies in the area was found to be low. Socioeconomic factors which include annual income, farming experience, and contact with extension were significant and positively influenced the adoption of improves rice production technologies in the area. It was, therefore, recommended that; Extension organization in the state should plan and execute an enlightenment programme to educate and train farmers on the practices of improved technologies in rice production; Rice farmers should be acquainted with necessary knowledge about climate change and possible ways to mitigate its effects on their rice production; and Farmers should be given financial support to enable them adopt improved technologies with minimal hitches.

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