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IMPLICATION OF THE ADOPTION OF IMPROVED RICE VARIETIES ON FARMERS' WELL-BEING IN OGUN STATE, NIGERIA

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ABSTRACT

Adoption of innovation and agricultural technology is expected to transform the livelihood outcome of farmers. But, in the case of smallholder farmers, the assumption has not been evident as expected. In this study, we investigated the effects of adoption of Improved Rice Varieties (IRV) on poverty status of rice farmers in Ogun state, Nigeria. Sampling about 200 rice farmers from the clusters. Primary data was obtained through the use of well-structured questionnaire and interview schedule. Descriptive statistics, Foster Greer Thorbecke (FGT) and Instrumental Variable Regression methods were used to analyze the data. Findings indicated that most adopters were ages averaged at 46.82 years and 45.52 years for non-adopters. Educational levels were for both adopters and non-adopters was high, which may support higher adoption rate of agricultural innovations. Farming experience is also a factor, with adopters averaging 21.2 years compared to 19.56 years for non-adopters. The poverty analysis reveals that 25% of rice farmers were below the poverty line, with adopters significantly less likely to be poor. Also, the regression analysis shows that the adoption of improved rice varieties negatively influence poverty, reducing the poverty gap among farmers. The key factors influencing poverty include sex (p=0.023), farming experience (p=0.041), and contact with extension agents (p=0.004), adoption of IRV ((p=0.066), discontinuity of IRV (p=0.049) and agricultural information (p=0.052). The study recommends promoting educational programs and training workshops on modern farming techniques, improving interactions between farmers and agricultural extension agents, and strengthening extension services to provide up-to-date information and technical support.

Keywords: Adoption; Improve Rice Varieties; Poverty; Instrumental Variable

INTRODUCTION

About 60% of the world's workforce makes their living from agriculture which is also a business that directly affects food security, health, and nutrition through market connections and direct consumer spending (Poole, 2017). Smallholder agriculture accounts for 60% of global agriculture and is the primary source of employment and income for 70% of the world's impoverished who reside in rural areas, making it one of the major economic vocations in the world (Poole, 2017). Agriculture is still a crucial industry in Africa, and the prosperity of this sector has a direct impact on social welfare, economic growth, food security, and the reduction of poverty, especially in Sub-Saharan African nations where smallholder farmers predominate (Mango et al., 2017).

Rice is one of the major cereals in Nigeria with which many rural people obtained their livelihood. According to Abdulmumini *et al.,* (2021), it is among the most essential agricultural foods for more than half of the world's population. All income groups consume rice and global rice consumption is projected to increase by between 4-6% from 6 in 2018 to around 6.7 million tons by 2019 (Global Agricultural Information Network [GAIN], 2018).

Despite Nigeria's abundance of resources, data show that the country's rate of poverty has been rising since the 1980s (Omotola, 2008). Nigeria's rising rates of poverty and widening income disparities are not keeping up with the country's GDP. As per the National Bureau of Statistics (2010), around 100 million people, or 60.9% of Nigeria's population, live in extreme poverty, compared to 54% in 2004. Less than $1 is the daily income for this group of people. Between 2004 and 2010, there was a 4.1 percent nationwide increase in income disparity. It is well known that despite the efforts of several administrations in the past and present to reduce poverty in Nigeria, there has been no improvement in the standards of life for the populace, particularly for those residing in rural areas.

The population in rural areas is more vulnerable to illness, starvation, deprivation, lack, and early death due to the high rate of income poverty there.

Poverty remains a battle to be won for the reason that the contribution of rural people livelihood is far less to the expectation. In the Less Developed Countries (LDCs) such as Nigeria and the Sub-Saharan Africa (SSA) at large, economic policy heavily depend on agriculture for poverty reduction and income growth (World Bank Group, 2014). African Development Bank/AfDB (2014), contends that African population living in poverty has fallen larger than 50% in 1981 unlike that of in 2012 which was reduced to 45%. Of which around 48% of the Sub-Saharan countries populations were found under food insecurity. One solution recommended to come up out of this abject poverty is boosting agriculture. However, production and productivity of the agricultural sector in SSA is low due to low technological adoption and techniques among others (Abraham et al., 2014; Berihun et al., 2014; Gashaw et al., 2014; Tsegaye 2012; Lulit et al., 2012; MoFED 2012).

The decision of rice farmers to use these IRVs could be based on different factors. These include the ability of farmers to understand the costs and benefits as well as other attributes of the technology, while factors such as labour, capital, and access to agricultural credit could be a hindrance to farmers' adoption of IRVs. Literature on adoption has focused on farmer and farm-specific orientation. Adoption has also been influenced by factors such as risk and uncertainty, farmer preferences, transaction costs, and rationing of complementary inputs such as fertilizer, among others (Minot et al. 2007; Simtowe *et al.* 2019).

Better seeds are crucial for encouraging technology adoption and increasing agricultural output in smallholder agriculture. In many sub-Saharan African (SSA) countries, inadequate seed supply networks impede access to improved seed varieties; these networks have been identified as impediments to the widespread adoption of improved seed varieties (Salihu et al., 2022). According to Loevinsohn et al. (2012), adoption is the process of incorporating a new technology into an established practice. To put it another way, adoption refers to embracing novel approaches that deviate from established norms. It is unfamiliar to smallholder farmers to cultivate enhanced rice types. They could buy regular seeds from the market or recycle existing seeds. Adoption of technology is heavily reliant on awareness and education.

Rice farming is a critical agricultural activity in Ogun State, Nigeria, where it significantly contributes to the livelihoods of many rural households. However, poverty remains a pervasive issue among rice farmers in the region. Despite efforts to improve agricultural productivity, traditional rice varieties often result in low yields and limited economic gains. The adoption of improved rice varieties has been proposed as a potential solution to enhance productivity and income. Hence, there is limited empirical evidence on the actual impact of these improved varieties on the poverty status of rice farmers in Ogun State. Though, Adeyemi *et al.,* (2020) and Bello *et al.,* (2020) used different methodology to estimate the impact of adoption of IRV on farmers' productivity, but this study aims to investigate the effect of adopting improved rice varieties on the poverty status of rice farmers in this region, thereby providing insights into whether such agricultural innovations can contribute to poverty alleviation.

Thus, this study investigated the effects of adoption of improved rice varieties on poverty of rice farmers in Ogun state, Nigeria. It specifically examined the poverty status of adopters and non-adopters of IRV and analyzed the effect of adoption of improved rice varieties on poverty status of rice farmers.

METHODOLOGY

This study was carried out in Ogun state, Nigeria. According to NPC (2006), the State is located approximately 100 kilometers from Lagos, the primary commercial and industrial hub of Nigeria, and 740 kilometers from Abuja, the federal capital area of Nigeria. Politically, Ogun State is made up of 20 Local Government Areas, with a total land area of 16409.26 sq/km (NPC, 2006). Ogun State is endowed with fertile soils, which are primarily composed of forest savannah in the north and swamp forest in the south.

For most arable crops, two season farming is feasible due to the double maxima rainfall. Numerous arable crops, including pepper, tomato, cassava, rice, maize, yam, and coco yam, are supported by the rainfall pattern. Traditional agriculture is the primary industry (Onasanya, 2008). It is impossible to overstate the significance of agriculture in Ogun State. Agriculture remains the main stay of the economy of the state.

The people of Ogun State are mainly farmers producing food crops and cash crops such as maize, cassava, melon, beans, cocoa, rubber, palm oil, maize, coffee, Kolanut, plantain and pawpaw. These entire crops are produced in all parts of Ogun State in various degrees. The State Government provides land and essential services to individuals and cooperate farmers. Also, livestock production range from small ruminant, poultry, pigs, rabbits, large ruminants and fisheries.

Multistage sampling technique was used in the selection of respondents for the questionnaire administration. The stage was the purposive selection of Ogun state. Ogun state is one of the rice production hub in southwest Nigeria, this inform the decision of its choice. The second stage was random sampling of two agricultural zones out of the four zones in the state. In the third stage four (4) local government areas were randomly selected from the two zones. The fourth and last stage was proportionate selection of 200 farming households from each of the local government areas which constitute the sample size.

Foster Greer Thorbecke (FGT) Poverty Index

FGT poverty index was employed to ascertain the poverty status of the respondents and this will be used to disaggregate them into poor and non-poor categories. It has become customary to use the Pα measures in analyzing poverty. Following the adoption of Foster, Greer and Thorbecke FGT (1984) class of poverty measures, households' total monthly expenditure was used to determine households' poverty status. The poverty line was constructed as two-thirds of the mean monthly per-capita expenditure of all households. This approach has been used by individuals and institutions, for example, Alawode *et al.* (2016), Oni and Yusuf (2008) and NBS (2005). Hence, non-poor households are those whose monthly expenditure is above or equal to two-thirds of the mean per capita expenditure of all households while those whose per capita expenditure was below two-thirds of the mean monthly per capita expenditure were classified as poor. The measures relate to different dimensions of the incidence of poverty. P_0, P_1 and P_2 were used for head count (incidence), depth and severity of poverty respectively. The three measures were based on a single formula but each index puts different weights on the degree to which a household or individual falls below the poverty line. The mathematical formulation of poverty measurements as derived from Foster, Greer and Thorbecke (1984) is estimated as:

$$Y_i = \alpha X_i + \beta T_I + \varepsilon_i$$

Where $Y_{i,}$ where Yi is an effect outcome variable for rice farmer i and is a vector of observable control covariates. βi is a binary variable representing whether farmer i adopted rice variety (=1 for adopter, 0 otherwise), X is a vector of parameters to be estimated, T is the adoption effect parameter to be estimated, and εi is the unobserved error term. To isolate the part of the treatment variable that is independent of other unobserved characteristics affecting the outcome, Two-Stage Least Squares (2SLS) approach to IVs was used. The first stage was to regress the treatment on the instrument Z, the other covariates in the equation, and a disturbance, εi. This process is known as the first-stage regression:

$$T_i = \gamma Z_i + \varphi X_i + U_i$$

The predicted treatment from this regression, ^T, therefore reflects the part of the treatment affected only by Z and thus embodies only exogenous variation in the treatment. ^T is then substitute for treatment in the equation to create the following reduced-form outcome regression:

$$Y_i = \alpha X_i + (\gamma Z_i + \varphi X_i + U_i) + \varepsilon_i$$

IV (also known as two-stage least squares, or 2SLS) estimate of the program impact is then ^βIV.

RESULTS AND DISCUSSION

Table 1 presented the socio-economic characteristics of rice farmers in the study area. The age-group revealed that most of the adopters of improved rice varieties fell between the age group of 31 – 40 years while most of the non-adopters fell between the age group of 30 years and less. The mean age was found to be 46.82 and 45.5 years for the adopters and non-adopters respectively. This implies that most of the adopters were older farmers than the non-adopters who were younger. Hence majority of the rice farmers in the study area were in their active age. More so, the younger and active famers were likely to adopt new innovation faster than older farmers as the ability of a farmer to bear risk, adopt innovation and do manual work was reported by many literatures to decrease with age (Nwaru, 2004 and Idiong 2006). This is in line with the findings of Ogunya *et al.*, (2017) where the mean age of rice farmers was found to be 54.09 years.

The table also revealed the sex distribution of adopters and non-adopters of improved rice varieties. The study showed that more of the respondents for both the adopter and non-adopters of improved rice varieties were male with 86.21% and 96.15% respectively. This implies that men were more involved in rice farming than women counterpart in the study area. This could be as result of high level of drudgery involved in farming activities and also due to the fact that female do not own land, due to cultural belief in the study area. However, the study adduced that the involvement of men in rice production than the women may be because the cultural setting in the area allows the men to access productive inputs such as land than females except where the household head is female. This is in line with the findings of Saka and Lawal, (2009) where majority of the rice farmers are male.

Furthermore, the findings revealed that most of the adopters of improved rice varieties were married (90.36%), single (55.56%), widowed (100%), divorced (66.67) and separated (100%). While 9.64%, 44.44% and 33.33% were married, single and divorced respectively for the non-adopters. The indicated that most of the rice farmers were married. This implies that majority of the rice farmers are family oriented, which will bring about increase in the number of household size leading to the use of family labour thereby reducing the cost of labour. This is similar to the findings of Adenuga *et al.,* (2016) where majority of the rice farmers were found to be married. Also, the findings revealed the educational level of rice farmers in the study area. The result showed that 80%, 86.36%, 92.16% and 100% of the adopters had primary, secondary, tertiary and no formal education respectively. This implies that the level of literacy is high among rice farmers in the study area because most of the respondents had one form of formal education or the other, and there is potential for increased rice production since education is expected to drive farmers to have access to information on new agricultural innovation which can be adopted to enhance their productivity.

In addition, the table showed the farming experience of rice farmers in the study area. The findings revealed that 70%, 62.50%, 66.67%, and 94.12% of the adopters of improved rice varieties had farming experience of ≤5, 6 – 10, 11 – 15, and greater than 15 years respectively. While 30%, 37.50%, 33.33% and 5.88% of the non-adopters had farming experience of ≤5, 6 – 10, 11 – 15, and greater than 15 years respectively. The mean farming experience was found to be 21.2 and 15.56 years. This implies that the farmers in the study area are experienced in rice farming. Generally, farmers count on their wealth of experience as an asset to increase productivity since it helps them to adopt improved technologies (Ezedinma, 2000). This is in contrary with the findings of Saliu *et al.,* (2016) where the mean farming experience was found to be 14 years.

Poverty levels among Farming Households in the Study area

The Table 2 presented the distribution of respondents by their poverty status. The establishment of poverty line and choice of an index to measure poverty are the two ways of measuring poverty. In addition to the measurement of poverty line, an appropriate measurement of poverty must reflect three basic elements namely; headcount ratio or poverty incidence (P_0), depth or gap of poverty (P_1) and

poverty severity or intensity (P_2). This is reflected in the degree to which the per capita expenditure of the household falls below the poverty line. The total per expenditure for the 200 rice farmers was found to be N2,484,036.36, mean per capita expenditure was found to be N124,200.18.

The poverty line was computed as 2/3 of the mean per capita expenditure of the household which was N82,800.13. However, any household monthly expenditure below the poverty line was describe as being poor while any household above or exact amount in the poverty line is describe as non-poor.

Therefore, with a poverty line of N82,800.13, the headcount ratio or poverty incidence (P_0) was 0.25. This implies that 25% of rice farmers in the study area were below the poverty line and relatively poor. The poverty depth or gap (P_1) was 0.122, this value indicated that 12.2% of the respondents were below the poverty line and therefore required an improvement in their income to reach the poverty line. The poverty severity or intensity (P_2) was 0.072, this indicates that 7.2% of the rice farmers in the study area were severely poor.

Poverty Status of adopters and non-adopters of improved rice varieties in the study area

Table 3 presented the poverty status of adopters and non-adopters of improved rice varieties in the study area. The table showed that most (81.71%) of the adopters are non-poor while the 18.29% of the adopters were poor. Whereas, the table also revealed that 68% of the non-adopters were poor and 32% were non-poor.

Analysis of the effect of Adoption of Improved rice varieties on poverty status of rice farmers

Various diagnostic tests were performed including the validity test, the relevance of the instrument and so on. The validity of the instrumental variables (i.e. whether they satisfied the two conditions of instrument relevance and instrument exogeneity) was examined. The relevance of the instruments was tested in the first-stage regression. As a rule of thumb, the F-statistic of a joint test whether all excluded instruments (the variables in z_i which are not in xi) are significant should be bigger than 10 in cases of a single endogenous explanatory variables. In case of a single instrument and a single endogenous explanatory variable, this implies that the t-value for the instrument should be bigger than 3.2 or the corresponding p-value should be below 0.0016. The result on Table 1 shows an F-value of 14.23; which indicated that the instruments were not weak.

The Table 4 presented the analysis of the effect of adoption of improved rice varieties on poverty status of the respondents. In the study area, sex, farming experience and contact with extension agent were found to be variables influencing adoption decisions of improved rice varieties significantly and positively. All the three factors mentioned above as determinants of adoption were significantly different among adopters and non-adopters. The variable representing sex was found to be positive and significant at 5% indicating a direct relation with adoption. This implied that household heads that are male are more likely to adopt improved rice varieties. Also, the variable representing farming experience was found to be significant at 5%, this implied that an increase in farming experience will increase the likelihood of the respondents to adopt improved rice varieties. Furthermore, the variable representing contact with extension agent was found to be positive and significant at 1%, this implied that an increase in the farming experience will increase the probability of the respondents adopting improved rice. The predicted values generated from the first stage regression analysis result were included as an explanatory variable in the second stage regression in order to control for endogeneity. On the other hand, farm size was found to be negative and significant at 10%, this indicated an inverse relationship with adoption of improved rice varieties.

This implied that an increase in farm size will increase the probability of adoption of improved rice varieties.

For adoption of IRV, we have adopters who continue the use of the technology till the time of this study and we equally have those that have disengaged the use of the IRV due to some factors.

Here, adoption of IRV reduces poverty among the adopters compare to non-adopters; this was evident from the sign and coefficient of those that discontinue the use of IRV. The coefficient was positive which deeply signifies that there is increasing chance of poverty with discontinuity of IRV in the study area. Also, the result revealed the significance of agricultural information on poverty status of the respondents. A number of research have shown the importance of information to agricultural productivity, marketing of agricultural produce and even agricultural value addition chain. The coefficient of Agricultural information was found significant at 10% level of confidence and the coefficient was negative; the result indicated that agricultural information reduces the likelihood of poverty in the study area. Agriculture is the basic livelihood of most of the people in the study area and the result confirmed that agricultural information will enhance their decision in production which will invariable transform to better livelihood outcome provided all other variable are held constant.

CONCLUSION

In conclusion, thoughtful of endogeneity problem and counterfactuals, the study employed instrumental variable regression model to estimate the effect of adoption of improved rice varieties on poverty status of rice farmers in the study area. We found out that education is endogenous to poverty. Though, there are evidences that adoption of improved rice varieties increases the living standard of the adopters, the constraints of income, nearness to inputs centre and availability of the improved rice afford some farmers to discontinue from the technology. The need to promote educational programs and training workshops that will focus on modern farming techniques, risk management is highly essential and improvement in the frequency and quality of interactions between farmers and agricultural extension agents in order to significantly boost the adoption of improved rice varieties.

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Table 1: Socio-economic Characteristics of Respondents

Variables	Adopters	Non-Adopters
Age group		
≤30	11 (57.89)	8 (42.11)
31 – 40	38 (84.44)	7 (15.56)
41 – 50	55 (91.67)	5 (8.33)
Above 50	71 (93.42)	5 (6.58)
Mean = 46.82 and 45.52		
Sex		
Male	150 (86.21)	24 (96.15)
Female	25 (13.79)	1 (3.85)
Marital Status		
Married	150 (90.36)	16 (9.64)
Single	10 (55.56)	8 (44.44)
Widow	7 (100.00)	0 (0.00)
Divorced	2 (66.67)	1 (33.33)
Separated	6 (100.00)	0 (0.00)
Educational level		
Primary	12 (80.00)	3 (20.00)
Secondary	114 (86.36)	18 (13.64)
Tertiary	47 (92.16)	4 (7.84)
No formal Education	2 (100.00)	0 (0.00)
Farming Experience		
<=5	7 (70.00)	3 (30.00)
6 – 10	10 (62.50)	6 (37.50)
11 – 15	14 (66.67)	7 (33.33)
>15	144 (94.12)	9 (5.88)
Mean	21.2	15.56

Source: Field Survey, 2023

Table 2: Poverty levels among farm households

Poverty Index	Farmers Index	Percentage (%)
Poverty incidence (P_0)	0.25	25
Poverty depth (P_1)	0.12	12
Poverty severity (P_2)	0.07	7
Poverty line = 82,800.13		

Source: Field Survey, 2023

Table 3: Poverty Status of Respondents in the Study Area

Poverty Status	**Adopters**	**Non-adopters**
Non-poor	143 (71.71)	8 (42.00)
Poor	32 (28.29)	17 (58.00)
Total	175 (100.00)	25 (100.00)

Source: Field Survey, 2023

Table 4: Effect of adoption of Improved Rice varieties on Poverty status of Rice Farmers

Variables	**Coefficient**	**Std. Err.**	**z-value**	**Prob/>/z**
Constant	0.4172	0.1872	2.23	0.021**
Age	-0.0005	0.0042	-0.13	0.775
Sex	-0.1768	0.0805	-2.20	0.023**
Household size	0.0170	0.0218	0.78	0.430
Education	-0.0023	0.0218	-0.11	0.873
Farming experience	-0.0103	0.0051	-2.01	0.041**
Farm size	-0.0550	0.0304	-1.81	0.071*
Adoption of IRV	-0.0185	0.0099	-1.87	0.066*
Discontinuity from IRV	0.0706	0.0357	1.98	0.049**
Awareness of IRV	-0.0604	0.0563	-1.07	0.321
Membership	0.0712	0.0989	0.72	0.467
Contact with Extension agent	0.1813	0.0622	2.92	0.004***
Distance to input centre	-0.0047	0.0164	-0.29	0.768
Available produce market	-0.0177	0.0209	-0.84	0.420
Agricultural information	-0.1871	0.0978	-1.91	0.052*
Access to irrigation facilities	-0.0425	0.0177	-2.40	0.014**

Source: Field Survey, 2023

Table 5: First-stage regression summary statistics

Variable	**Shea Partial R^2**	**Partial R^2**	**F(2, 198)**	**P-value**
Adoption	0.2289	0.2289	14.23	0.0035

Source: Field Survey, 2023