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Determinants of Adoption of Improved Rice Production Technologies in Ebonyi State of Nigeria

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Abstract
Ebonyi State is a major rice producing State in Southeast Nigeria. In recent times, rice production in the area has fallen short of the demand due to low yield ascribed to low adoption of improved production technologies disseminated by the Agricultural Development Programme (ADP) of the State. This study was undertaken to investigate the determinants of adoption of improved rice production technologies in Ebonyi State of Nigeria. Multi-stage random and systematic sampling techniques were used to select a total of 240 (two hundred and fourty) rice farmers from the three agricultural zones of the State. Primary data were collected with the aid of a well-structured questionnaire and interview schedule; and analyzed using both descriptive and inferential statistics. The result obtained shows that rice farmers in Ebonyi State are aware of field-level improved rice production technologies such as the use of improved varieties (91.67%), use of agrochemicals (87.50%), zero tillage (85.42%), fertilizer application (83.33%) e.t.c. but, experienced gap in knowledge down the production value chain. The result of multiple regression analysis indicates a high co-efficient of multiple determination, R^2 of 76.6 percent was obtained. This indicates that about 76.6 percent of the variation in level of adoption of improved rice production technologies is influenced by the socio-economic characteristics of the respondents. Most of the independent variables met a priori expectations and were statistically significant at 5% and 1% levels of significance. Such variables that determine the adoption of these technologies include: gender, age, marital status, household size, e.t.c. A null hypothesis tested at 5% level of significance was rejected while its alternative was accepted. This implies that the socio-economic characteristics of the respondents do have significant effect on the level of adoption of improved rice production technologies. The result of factor analysis identified such constraints as: human/technology attributes, technical constraint, financial constraints, and poor institutional support as major constraints to adoption of improved rice production technologies in the State. Necessary recommendations such as designing farm-level technologies that reflect the socio-economic attributes, active participation of youths in agricultural empowerment interventions and complementing agricultural innovations with proper institutional framework for credit mobilization were made.
Keywords: Adoption, Rice Technologies, Farmers, Ebonyi State, Nigeria

INTRODUCTION

Rice (*Oryza sativa*) is perhaps the world's most important food crop being the staple food of over 50 percent of the world population, particularly of India, China and a number of other countries in Africa and Asia (FAO, 2006). It is one of the major cereals, and has assumed cash crop status in Nigeria, especially in the producing areas, where it provides employment and income for more than 80% of the inhabitants as a result of the activities that take place along the production and distribution chains from cultivation to consumption (Imolehin, 1991). Due to its increasing contribution to per capita calorie to Nigerians, the demand force has been increasing at a much faster rate than in any other African countries since 1970's (WARDA, 2001). Rice has become part of everyday diet of many in Nigeria. Both rice production and its consumption (demand) is growing faster than for any other major staples because consumption is broadening across all socio-economic classes.

In the past, Philippines and Indonesia were the principal rice importers in the world. However, this has recently changed and Africa has become the highest importer of rice on the planet today, with Nigeria being at the fore-front (Boris, 2004). This results due to large gab existing between demand and supply and inability of local production to meet the need of teeming population. With the expansion of the cultivated land area of rice, there has been a steady increase in rice production and consumption in Nigeria. The production increase has however not been enough to meet the consumption demand of the rapidly growing urban population (Singh, *et. al,* 2007). This situation led to shortage of rice in the 1990's which contrasted with Nigeria's self sufficiency in rice production during 1960's.

According to FAO (2006), the Nigerian rice production currently estimated at 3 million tonnes of rice per year as against the annual domestic demand of about 500 million tones. The per capital consumption which went up from about 5kg during the 1970's to about 30kg at present continues to increase. This demand supply gap is being met through rice import which now represents over 25% of all agricultural import and more than

40% of domestic consumption during the last years (WARDA, 1986). Nigeria's import bill for rice increased from US 100,000 in 1970 to US$800 million in 2005. This forced the government to take several steps to redress the trend, including planning a total ban on the importation of rice and implementing certain initiatives towards increasing domestic production. This is because the country has abundant potential for rice production both for dry land, rainfed and swamp low lands cultivations. Nigeria has a potential land area for rice production of about 4.6 billion hectares. But, only 1.7 million hectares of 35% of the Nigerian total land mass is grown with rice (Imolehin and Wada 2000).

The limited capacity of the Nigerian rice sector to meet the domestic demand has been attributed to several factors; notable among them is the declining productivity due to low adoption of improved production practices. This has caused a wide gap to exist between potential and actual yield per hectare. Reports by Oyekanni, Okeleye and Okomji (2008), Nwite, Igwe and Wakatsuki, (2008) from research stations (based on their on-station and on-farm trials) showed that adoption of technologies and improved management practices should lead to substantial yield increase in rice production. This invariably underscores the significant role that technology adoption stands to play in attaining the much needed growth in the Nigerian rice sub-sector.

Availability of a sustainable agricultural technology for Nigerian resource-poor rice farmers is important due to the country's effort at achieving food security. Since there is often time lag between technology development and adoption, experimenting farmers' adoption behaviour is very important in assessing acceptability of a technology because such farmers provide insights about potential adoption of a new technology.

The State Agricultural Development Project (ADP) is an intervention initiated by the World Bank to assist farmers adopt improved agricultural production technologies as a means of achieving high productivity among the farmers. However, it seems that rice farmers in Ebonyi State have not been able to achieve desirable increase in yield due to consistent use of traditional technologies in neglect of improved production practices disseminated by Ebonyi State Agricultural Development Programme (ADP). There are some expected benefit/impact that ADP is expected to have conferred on the rice farmers in terms of dissemination of skills and knowledge of improved rice production practices through extension field agents. Therefore, the extent of adoption of improved package of practices by rice farmers in Ebonyi State needs to be investigated.

However, contemporary observations show that while some use improved practices, a reasonable number still rely on traditional methods thereby subjecting majority of them to unbearable low yield. Reasons adduced for this include: lack of knowledge of improved practices as well as scarcity and cost of the necessary rice supporting inputs. The situation on ground creates doubts on the determinants of rice farmers' adoption of improved rice production technologies in Ebonyi State, hence the need for an empirical study on the subject matter.

OBJECTIVES OF THE STUDY

The main objective of this study is to investigate the determinants of adoption of improved rice production technologies in Ebonyi State of Nigeria. The specific objectives include to:

i) assess rice farmers knowledge of improved rice production technologies;
ii) ascertain the effects of socio-economic characteristics of rice farmers' on their level of adoption of improved rice production technologies; and
iii) identify constraints limiting adoption of improved rice production technologies in the study area.

HYPOTHESIS

Ho_1: There is no significant relationship between the socio-economic characteristics of rice farmers and the adoption of improved rice production technologies in the study area.

METHODOLOGY

The study was conducted in Ebonyi State of Nigeria, which lies approximately on latitude 7°3' N and longitudes 5°4' E and 6°45' E and in the Eastern part of Nigeria. A multi-stage sampling technique was used to draw samples for the study. Firstly, 2 (two) Local Government Areas were randomly selected from each of the 3 (three) agricultural zones of the State. Secondly, random selection of 4 (four) autonomous communities from each local government area was made. Thirdly, 10 (ten) rice farmers were systematically selected from each autonomous community. This gave a total of 80 (eighty) rice farmers in each agricultural zone and 240 (two hundred and forty) rice farmers as the total sample size for the study. A well-structured questionnaire and interview schedule were used to collect primary data for the study. Both descriptive and inferential statistics were employed in data analysis. Objective one was analyzed using percentage distribution tables. Ordinary least square multiple regression analysis was employed to analyze objective two while factor analysis of Statistical Package for Social Sciences research was used in the analysis of objective three. The null hypothesis was tested using F-test at 5% level of significance.

RESULTS AND DISCUSSION

Rice Farmers' Knowledge of Improved Rice Production Technologies

Awareness promotes demand and demand is a force for rapid adoption and spread of agricultural innovations. In order to determine the level of awareness, 14 (fourteen) rice production technologies were considered and rice farmers level of awareness was tested. The result of level of awareness of IRPTs in the study area was shown in Table 1.

Table 1: Percentage Distribution of the Level of Awareness of Improved Rice Production Technologies by Rice Farmers in the Study Area.

	Improved technologies	Knowledgeable Yes (%)	Not knowledgeable No (%)
I	Use of improved varieties	220 (91.67)	20 (8.33)
Ii	Use of agrochemicals	210 (87.50)	30 (12.50)
Iii	Zero tillage	205 (85.42)	35 (14.58)
Iv	Fertilizer application	200 (83.33)	40 (16. 67)
V	Proper spacing	85 (77.08)	55 (22.9)
Vi	Improved nursery	160 (66.67)	80 (33.33)
Vii	Timely transplanting	155 (64.58)	85 (35.42)
viii	Line planting	140 (58.33)	100 (41.67)
vix	Urea deep placement	129 (53.75)	11 (46. 25)
x	Planting depth	115 (47.92)	125 (52.08)
xi	Optimum seed rate	109 (45.42)	131 (54.58)
xii	Fertilizer inculcation	87 (36.25)	153 (63.75)
xiii	Improved processing	52 (21.67)	188 (78.33)
xiv	Use of modern rice milling	39 (16.25)	201 (83.75)

Source: Field Survey, 2013.

N.B Values in parenthesis represent the percentage values while those outside represent the frequencies

The result of percentage distribution of rice farmers' knowledge of improved rice production technologies revealed that majority (91.67 %)of the rice farmers are knowledgeable on availability and use of improved rice varieties; also, 87.50% were aware of use of agrochemicals in rice production while the knowledge of zero tillage was known by 85.42%. Similarly, the use of fertilizer in rice cultivation was known by 83.33% while proper spacing during transplanting was known by 77.08%. Further analysis indicates that improved nursery, timely transplanting, line planting and urea deep placement was known by 66.67%, 64.58, 58.33% and 53.75% respectively. Most of the farmers (83.75%)were not aware of use of modern rice milling, 78.33% were not aware of improved processing techniques while fertilizer inculcation, optimum seed rate and planting depth were not known by 63.75%, 54.58% and 52.08% respectively. This result implies that while majority of the farmers were abreast of recommended production practices at field level, they seem to lack relevant information down the production value chain i.e, improved processing and modern rice milling.

Effects of Socio-economic Characteristics of Rice Farmers on their Level of Adoption of Improved Rice Production Technologies in Ebonyi State.

Ordinary least square multiple regression analysis was used to determine the effects of socio-economic characteristics of rice farmers on their level of adoption of improved rice production technologies. The result obtained is shown in Table 2.

Table 2: Summary of Multiple Regression Result

Variables	Variable name	Regression coefficient	Standard error	T- value	Level of significance
B_0	Constant	2.131	0.278	7.677	*
X_1	Gender	0.007	0.006	1.127	NS
X_2	Age	- 0.014	0.008	-1.799	NS
X_3	Marital Status Household size	-0.005	0.005	-0.901	*
X_4	Educational Status	0.468	0.037	12.799	*
X_5	Farm size Farming	1.047	0.000	-2.349	**
X_6	Experience	0.016	0.007	2.209	**
X_7	Annual Income	0.101	0.082	1.229	*
X_8	Membership of cooperative society	0.510	0.060	8.465	*
X_9	Contact with Extension Agents	0.002	0.005	0.471	*
X_{10}		0.456	0.956	0.869	*

Source: Data Analysis, 2013.
NS = Not Statistically Significant
* = Significant at 1%
** = Significant at 5%
F-ratio = 83.877**,** R^2 = 0.766**,** Adj R^2 = 0.757
Standard Error of Estimates = 0.375
Durbin-Watson Constant = 2.278

The result of multiple regression analysis indicates an R^2 of 0.766 or 76.6 percent. This shows that about 76.6 percent of the variation in level of adoption of improved rice production technologies in Ebonyi State was influenced by the socio-economic characteristics of the rural farmers. The close relation of R^2 to adjusted R^2 is an indication that the explanatory power of the independent variables cannot be exaggerated. The overall effect of the independent variables on the dependent variable was indicated by F-statistics which was significant at 1 percent level. The high value of Durbin Watson constant of 2.278 indicates the absence of autocorrelation; which is an evidence to show that the models are well-specified. The low value of standard error of the estimates indicates that the result is statistically reliable. Thus, the a priori, statistical and econometric criteria were met. From the result of the analysis, all the socio-economic variables examined were positively signed except age and marital status. Only gender (X_1) and age (X_2) were not statistically significant.

This result affirms the findings of similar agricultural innovation adoption studies previously carried out in some other parts of the country and Africa in general. In a study on adoption of savannah rice production technology, Fashola *et al*., (2007) found that membership of association, level of education, were important contributors to adoption decision of a farmer. However, similar study by Omonona *et al*., (2005) on adoption of improved cassava varieties in Edo State, Nigeria showed that sex, age, access to extension agents, access to inputs and crop yield were significant variables which positively influenced adoption of improved cassava varieties. It is then suffice to say that extension contact and basic attribute of improved varieties are significant motivating factors for adoption of improved varieties among crop farmers in Nigeria. The studies of Ajala (1992) and Ikani *et al*., (1998) showed that farmers' age, farming experience and organizational participation significantly influenced adoption. The difference might be the type of technologies studied among other factors. Similary, Feder *et al*., (1985) asserted that there is positive and significant coefficient of farm size in relation to adoption of innovations. Abebaw and Abelay (2001) reported similar findings. They asserted that coefficient of years of experience was negative and significantly influenced by farmers' decision to adopt improved technology in Tanzania. The result of null hypothesis tested at 5% level of probability indicates F-cal (83.87) and F-tab (1.94). Since F-cal was greater than F-tab, the null hypothesis was rejected .This implies that the socio-economic characteristics of the rice farmers significantly influenced their level of adoption of Improved Rice Production Technologies in the study area.

The final regression equation is estimated below:

$Y = 2.131 + 0.007X_1 - 0.014X_2 - 0.005X_3 + 0.468X_4 + 1.047X_5 + 0.061X_6 + 0.101X_7 + 0.510X_8 + 0.002X_9 + 0.456X_{10}$

(0.278) $(0.006)^{NS}$ $(0.008)^{NS}$ (0.005)* (0.038)* (0.00)** (0.007)** (0.082)* (0.60)* (0.005)* (0.956)*

Constraints Limiting the Adoption of Improved Rice Production Technologies in the Study Area

Factor analysis was used to identify constraints militating against adoption of improved rice production technologies. From the data obtained from field survey, four (4) major constraints were extracted based on the responses of the respondents. Only variables with constraint loading of 0.30 and above at 10% overlapping variance (Ashley, *et al.*, 2006, Madukwe, 2004) were used in naming the factors. Variables that loaded in more than one constraint such as $V0_1$ (Scarcity of improved seeds) and $V0_{13}$ (Lack of interest among the youths) and those lower than 0.3 were not considered. The next step as reported by Kessler (2006) was giving each constraint a denomination that best describes or characterizes the set of variables contained in it. In this regards, the variables were grouped into four (4) major constraints as constraint I (Human/Technology Attributes), constraint II (Technical constraint), Constraint III (Financial constraint) and Constraint IV (Poor institutional support).

Table 3: Varimax Rotated Factor Matrix on Constraints to Adoption of Improved Rice Production Technologies in Ebonyi State.

Variables Code	Variables Names	Constraint I Human/Technology Attributes	Constraint II Technical Constraint	Constraint III Financial Constraint	Constraint IV Poor Institutional Support
$V0_1$	Scarify of improved seeds	**-0.010**	**-0.147**	**0.121**	**0.0007**
$V0_2$	Old Age of farmers	**0.472**	-0.319	-0.034	0.006
$V0_3$	Low level of education	**0.909**	-0.397	0.165	0.047
$V0_4$	Poor Attitude to Risk	**0.359**	0.112	-0.312	0.064
$V0_5$	Lack of farming Experience	**0.760**	-0.206	0.001	0.128
$V0_6$	Inadequate finance	0.114	0.013	**0.917**	0.051
$V0_7$	Inefficient Extension service delivery	-0.249	0.279	0.021	**0.435**
$V0_8$	Poor government support	-0.603	0.055	-0.261	**0.401**
$V0_9$	Low level of knowledge and Awareness	-0.379	**0.671**	0.013	-0.129
$V0_{10}$	Poor marketing of products	-0.025	0.004	0.012	**1.535**
$V0_{11}$	Tediousness of the technology	**0.360**	-0.446	-0.035	-0.034
$V0_{12}$	High cost/scarcity of labour	0.044	0.112	**0.817**	0.015
$V0_{13}$	Lack of interest among youths	**0.471**	-0.055	0.001	**0.563**
$V0_{14}$	Lack of adequate knowledge of improved practices	0.196	**0.401**	-0.347	-0.251
$V0_{15}$	High cost of Agrochemicals	0.114	0.213	**0.327**	0.061
$V0_{16}$	Lack/high cost of fertilizers	-0.167	0.111	**0.423**	-0.029
$V0_{17}$	High cost of farm tools	-0.488	0.038	**0.591**	0.051

Source: Data Analysis.

Result shows that in constraint I, $V0_2$- Old age of farmers (0.472), $V0_3$-Low level of education (0.909), $V0_4$- Poor attitude to risk (0.359), $V0_5$-Lack of farming experience (0.760) and V011-tediousness of the technology (0.360) loaded high and therefore were classified as human/technology attributes., Negatu and Parih (1999) confirmed significant role played by the attributes of the technology as well as institutional circumstances surrounding such technology adoption.

Constraint II was considered and named technical constraint due to the factors that loaded high under it. These are: $V0_9$- low level of knowledge and awareness (0.671), $V0_{14}$- Lack of adequate knowledge of improved practices (0.401). The complexity of improved technology could be a serious constraint militating adoption as implied by this study. Williams *et al.* (1984) opined that if the recommended practice was relatively easy to follow and visible, it was likely to be more accepted than one that had to undergo a lot of complex processes.

Constraint III was critically examined and named financial constraint due to the high loading variables under it. These are: $V0_6$ Inadequate finance (0.917), $V0_{12}$ High cost and scarcity of labour (0.817), $V0_{15}$-High cost of agrochemicals (0.327), $V0_{16}$ Lack/High cost of fertilizers (0.423) and $V0_{17}$ – High cost of farm tools (0.591). This agrees with Obinne (1994) and Arokoyo (1996) who identified low income level of farmers and higher cost of inputs as constraints to technology adoption, especially among low income farmers. Similarly,

Baker (2005) and Hebinck and Richards (2007) asserted that the most successful programmes of agricultural change are those that tie adoption to credit programmes. Nwike and Chidebelu (1991) identified lack of funds as an important constraint to continuous adoption of innovation especially in the case of fertilizer acquisition.

Finally, factor IV was named poor institutional support due to the variables which loaded high under it. These are: $V0_7$-Inefficient extension service delivery (0.435), $V0_8$ -Poor government support (0.401) and $V0_{10}$-Poor marketing of products (1.535). Institutional factors deal with the extent or degree to which institutions impact on technology adoption by smallholders (Meinzen-Dick *et al*; 2004). Udoh (2001) and Eshiett (2007) maintained that contact with extension agents, especially with respect to interpersonal contacts, relive favourably to the adoption of new farm practices and concomitant improved agricultural production. In a related study, Bello (2007) further asserted that farmers could reject many apparently attractive and supposedly appropriate technologies either through non adoption or discontinuation of earlier adopted technologies because they were not really appropriate or that the method of technology transfer was not appropriate.

CONCLUSION

The findings of this study reveals that rice farmers in Ebonyi State are aware of field level improved rice production technologies disseminated by the ADP and their potential benefit in boosting their productivity. However, the level of adoption of these technologies was significantly influenced by the socio-economic characteristics of the farmers. The major socio economic determinants of adoption of improved rice production technologies in Ebonyi State of Nigeria were identified to include gender, age, household size, education e.t.c The constraints to the adoption of improved rice production technologies in the State are broadly classified into human and technology attributes, technical constraint, financial constraint, and poor institutional support.

RECOMMENDATIONS

It is, therefore, recommended that farm-level technologies should be designed to reflect the socio economic attributes of the potential recipients based on established baseline studies of the farmers' communities. Such technologies should be simple and as much as possible fit into the prevailing farming system of the potential users. Active Participation of youth in agricultural empowerment interventions should also be encouraged due to their relative high propensity to adopt innovations compared to their adult contemporaries. Such agricultural innovations should be complemented with proper institutional framework for easy mobilization of credit by the farmers. There is also burning need to restructure the current extension system in the State for better results at grassroots level.

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