EFFECT OF THE ADOPTION OF IMPROVED RICE VARIETIES ON THE PRODUCTIVITY OF SMALL-SCALE FARMS IN BADEGGI, NIGER STATE, NIGERIA

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ABSTRACT

The paper examines the effects of the adoption of improved rice varieties on the output of small-scale farms in Badeggi, Niger State, Nigeria.. A multi-stage sampling technique was used in selecting study areas. Four villages each were selected purposely from the two district areas in Badeggi and twenty farmers each were randomly selected from eight villages giving a total of 160 farmers. Data were collected using structured questionnaire and analyzed with the use of simple descriptive statistics and multiple regression. The results from the study revealed that the use of improved rice variety was significant at 1% and 5% level of significance and had a positive effect on farmers output. The study also revealed that about 82% of the farmers used the improved variety and also about 44.64% of the farmer's source of awareness was through listening to radios. It is concluded that the use of improved rice variety is an important innovation in boosting the output of rice farmers. It is recommended that farmers be advised to join cooperative societies to benefit from the opportunities it avails the farmers.

INTRODUCTION

Rice production started in Nigeria in 1500BC with the low yielding' indigenous red grain species, *Oryza Glaberrima Stend* (Hardcastle, 1959). The high yielding white grain *Oryza Sativa* was introduced in about 1890 and by 1960 it accounted for more than 60 percent of rice grown in the country. In the 1960's Nigeria was almost 99 percent self sufficient in rice production consumed' by her citizens. Over the following two decades, 1970's and 1980's self-sufficiency in rice production declined to 38 percent leading to demand outstripping supply.

To supplement the 62 percent deficit, the Federal Government of Nigeria resorted to massive importation of rice. Since 1980, Nigeria has become the largest rice producing country in West Africa and the third largest in Africa after Egypt and Madagascar (WARDA 1996). In 1983,alone more than 544,000 tonnes of rice were imported into the country (Appendix 1).By 1985 there was a ban on rice imports.

By 1990 the country was producing 3.4 million tonnes of rice from about 1.2 million hectares (Imolehin, 1991). This healthy production trend would have been sustained, but for the unsteady Government policy on rice imports. Indeed increased production over the last two decades could be attributed, to the ban imposed on rice import and if this import restriction has been maintained, Nigerian rice farmers would have risen to the challenge of meeting the domestic demand for the commodity. As the Government removed the rice import restriction in 1991, foreign rice flowed back to Nigerian markets by 1992. Restriction on rice import was reintroduced later in 1997 and local production increased in response to the attractive prices offered (WARDA 1996). However, with the coming in of a democratic Government in 1999, ban on rice importation was initiated. Several production constraints have been identified as factors militating against the self-sufficiency in rice production in the country. These include:

i. Limited adoption of improved practices

ii. Inadequate credit/inputs
iii. Lack of appropriate implements
iv. Disease and pest attacks
v. Nutritional disorders / iron toxicity
vi. Soil and water management
vii. Marketing
viii. Inconsistency in Government policy (NCRI, 1997).

Active and systematic rice research started in Nigeria in 1953, with the establishment of the Federal rice research station at Badeggi in Niger state, now the headquarters of the National Cereals Research Institute. The focus for rice research at the station was development of varieties with improved grain quality, uniform shape and size appropriate for minimal breakage during milling. These aims were achieved through introduction and adaptation (Imolehin, 1991a). From 1954 to 1970, 13 (thirteen) improved varieties were released to farmers, from 1971 to 1984, 16 (sixteen) improved varieties were released to farmers, from 1985 to 1989, 14 (fourteen) improved varieties were released to farmers (Ayotade, 1991) and from 1990 to 2000, 8 (eight) improved verities were released to farmers .A total of 51 rice varieties have been released from 1954 to date to serve the different ecologies and other specific needs in Nigeria. The area under study supports rice production as a lowland rainfed area and also as one under irrigation.

The need to improve on the yield of rice farmers, the desire to develop varieties that are resistant to blast reaction and highly adaptable to the ecology of the area under study brought about the release of FARO 44(Federal agric research *oryzea*) variety. The rice variety FARO 44, goes by a cultivar name SIPI 1692033. It is adaptable to shallow swamp ecologies with a maturity period of 150 days. The plant grows to a height of about 95cm and has a yield of 4.0-6.0 tonnes/ha. It s grain shape is long and was released in the year 1992 with a high resistance to blast of rice. However, inspite of the existence of this innovation, farmers still adhere to traditional farming practices and slow rates of its adoption. These have brought about repeated causes of reduction in rice yield/output. In the light of these problems in the study area, the study specifically seeks to:

i. determine the socio-economic characteristics of farmers
ii. examine the effect of the adoption of the improved rice variety on the output of small-scale farmers in the study area.

Rice forms an important component of Nigeria's diet. The average Nigerian now consumes 21 kg of rice per year representing a percent of total calorie intake and 23 percent of total cereal consumption (FAO, 2004). Since the mid 1980's, rice consumption has increased on an average at an annual rate of 11 percent of which only 3 percent can be explained by population growth (FAO,2004). The remainder represent a shift in diet towards rice at the expense of coarse grain (Millet and Sorghum) and wheat.

An estimated 21 million tonnes of rice are consumed annually in Nigeria (FAO,2004).

The increase in rice production is attributed entirely to expanded area under rice cultivation, which at present is reported to be 19 million hectares. Government policies have also contributed to the expansion in rice production through programmes of input subsidies and ban on rice import since 1985. Despite the ban, an estimated 0.4 million tonnes of rice continue to enter Nigeria each year (IRRI, 1995).

METHODOLOGY

The study area, of this research is Badeggi Local Government Area in Niger State, Nigeria. The Local Government consists of two district areas, Badeggi district Area with eight villages and Katearegi District Area with 7 villages. Badeggi Local Government has a land mass area of about 1,260sqkm and it has a population of about 113,000 people. The inhabitants are mainly Nupes with a large number of Gwaris, Pangus and Kamukus who have migrated into the area due to the fertility of the land. The area is characterized by annual rainfall ranges from. 1,300 - 1500mm with mean annual

rainfall of 1400mm. (NGSG.2003; NSADP1997). Sampling procedures involved a multi-stage sampling technique in which firstly, four Villages were purposely selected from each of the two district areas in Badeggi Local Government Area. These were selected due to the high prevalence of rice production in the area. This now gave a total of 8 (eight) villages which include Katearegi, Bisenti, Kambari, Zazungi, Badeggi, Essa, Cheche and Kasanagi. Secondly a total number of 20 (twenty) farmers from each of the eight Villages were randomly selected giving a total of 160 farmers.

Data were collected through the means of structured questionnaire. Data collected were analyzed with the use of simple descriptive statistics, which includes percentages and means. Other tools used include the use of multiple regression analysis.

Objective one, the socioeconomic characteristics of respondents was analyzed with the use of simple descriptive statistics while objective two, examining the effect of the adoption of improved rice variety on farmers output was analyzed with the use of multiple regression analysis (ordinary least square estimates).

Hypothesis

The expectation is that under normal circumstances a unit increase in any input should have positive and significant effect on output. Hence, the adoption of improved rice variety with all the improvement on its characteristics should increase rice yield. Based on this it is hypothesized that, the use of improved rice variety has no significant effect on the farmers' output.

THEORETICAL FRAMEWORK

Production function stipulates the technical relationships between inputs and output in any production process (Olayide and Heady 1982; Chambers 1988; Yilmaz and Ozkan,2004). It can be expressed in implicit form as:

$Y_i = F(X_i)$ ---------- EQN 1

Where;

Y_i and X_i, denotes outputs and inputs respectively and I is the i^{th} output and input.

Most of the empirical studies carried out on adoption of new technology focused on the measurement of adoption rate. Studies in this category include Phillip et al (2000) and Lopez-Pereira et al (1991). In this and related studies, adoption rates were computed within the broader objective of assessing the economic impact of the technology in question. Imoh and Essien (2005), Yakubu, I (2005) and Ibrahim,*et al* (2006), used multiple regression analysis to estimate factors affecting adoption of new technology. For this study multiple regression analysis was used to capture the effect of the adoption of improved rice variety on farmers' output. The estimates of the multiple regression analysis was used to determine the effect of the adoption of the individual independent variables on farmers' output.

The model was expressed in its implicit form as;

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8$ and u).

Where:

Y_1= Adoption index(1 if adopted;0 otherwise)

X_1 = Capital items in ₦ (rent on land, depreciation on fixed cost items, etc)

X_2 = Farm size allocated to improved rice seed cultivation (Ha)

X_3 = Labour in mandays

X_4 = Inputs Used in ₦ (chemicals, fertilizers, herbicides, etc)

X_5 = Yieid of improved rice in (kg)

X_6= Farming experience (number of years spent in rice farming)

X_7= Membership of cooperative society(1 for member ; 0 otherwise)

X_8= Contact with extension staff(1 if contacted; 0 otherwise)

u = Error term

Four functional forms were tried, and were expressed in the explicit form as;

Linear:

$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + u$ ----------EQN 1

Cobb-douglas

$\ln Y = \ln bo + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x_6 + b_7 \ln x_7 + b_8 \ln x_8 + u$------EQN 2

Semi-log:

$Y = \ln bo + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x_6 + b_7 \ln x_7 + b_8 \ln x_8 + u$ ----------EQN 3

Exponential:

$\ln Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + u$ ----------EQN 4

Where:

bo = constant.

b_1-b_8 = estimated regression coefficients.

u = error term.

x_1-x_8 = Independent variables

The functional form producing the best fit was chosen as the lead equation based on the following criteria:

The number of estimators that are statistically significant, value of F-statistics, magnitude of coefficient of multiple determination R^2 (explanatory power of the model) and the statistical significance of the magnitudes of the coefficients and the signs on the estimated parameters.The Cobb Douglas production function was chosen based on the above specified criteria.

RESULTS AND DISCUSSION

Socio-Economic profile of respondents

Analysis of the socio-economic attributes of the respondents in table 1 shows that 53.2% fell within the age bracket of 40- 49 years. The study also revealed that 98.2% and 83.3% of the respondents (both those using improved rice varieties and those not using) were mainly males while the remaining 1.8% and 16.7% were females. The respondents were all married with an average household size of ten people. The study also revealed that 71.43% and 54.17% had Arabic School Education for both categories of respondents.

Table 1: Socio-economic characteristics of the respondents

	Farmers using improved rice varieties		Farmers not using improved rice varieties	
Characteristics variables	Frequency	percentage	Frequency	percentage
1. AGE IN YEARS				
< 29	5	4.46	5	20.83
30-49	20	17.86	2	8.33
40-49	55	49.11	1	4.17
50-59	17	15.18	3	12.50
>60	15	13.39	13	54.17
2. GENDER				
Male	110	98.2	20	83.3
Female	2	1.8	4	16.7
3. NUMBER OF CHILDREN				
<5				
6-10	98	87.5	15	62.5
11-20	12	10.7	4	16.6
>21	2	1.78	5	20.8
4. EDUCATIONAL LEVEL				
No formal	6	5.35	11	45.83
Education	80	71.43	-	-
Arabic School	26	23.21	-	-
Primary School	-	-		
Tertiary School				
5. MARITAL STATUS				
Married	112	100	24	100
Single	-	-	-	-
Total	112	100	24	100

Source: Field Survey, 2005

Source of awareness of the improved rice varieties

Table 2 revealed that 44.64% of the farmers got to know about the improved rice varieties through listening to radio. This is as a result of various radio programmes being featured by extension agents (from the ADP) usually in various local languages about new innovations / practices relating to agriculture. About 40.18% of the farmers were informed of new improved varieties through direct contact with the extension agents. The study further revealed that 112 farmers i.e. (82%) used improved rice varieties while 24 farmers (18%) still continued with the use of local varieties.

Table 2: Source of Awareness of Improved Rice Varieties.

Means of Awareness	Frequency	Percentage
Through friends	17	15.18
Through the radio	50	44.64
Through the extension agents	45	40.18
Through television		
Directly from research Institutions		
Total	112	100

Source: Field survey data 2005.

Regression Estimates of the effect of adoption of improved rice varieties on farmers' output

Table 3 presents the estimates of the coefficients of the parameters of the production function. A high R^2 value of 0.642 implies that about 64.2% of the variation in rice production is explained by the variables included in the model.

The elasticity of output with respect to amount of capital invested (X_1) is 0.781. It is positive and statistically significant at 5% level. This implies that an increase in capital would increase the level of farmers output in rice production. It can be deduced from this that capital invested into rice production is a significant and positive determinant of agricultural output.

The estimated coefficient of farm size allocated to improved rice variety (X_2) as depicted by its small t-ratio of 0.53 indicates that farm size was insignificant at 5% level, though positive. It can be implied that an increase in farm size would increase the farmers output in rice production. Labour (X_3)

and input used (X_4) were all positive and significant at 5% levels depicted by their high t-ratios, there various magnitudes at 0.042 and 0.168, indicates that rice production is inelastic to changes in the level of the variables. It further reveals that a 1 % increase in labour used and a 1 % increase in input used will cause an increase of 0.042% and 0.168% in rice production respectively.

The 0.011 elasticity of farm size indicates that a 1 % increase in farmland used would cause an increase of 0.011 percent in rice production. The production elasticity with respect to yield from use of improved rice variety (X_5) is positive and significant at 5% level and is in conformity with apriori expectation that the use of improved rice variety would increase crop yields. This is : agreement with similar studies carried out by Yakubu, (2005) and Ibrahim et al, (2006). The 0.153% elasticity of yield from adoption of improved rice variety indicates that a 1 % increase in the use of improved rice variety would cause an increase of 0.153 percent in rice production. This would further translate to increased income for the farmer, output for the farmer, rice for consumption and even as reserve seedlings which will further enhance continuity of production with the use of improved rice variety. The farmers in the study area are displaying rational economic behaviour on the premise of potential economic returns in the adoption of improved rice variety. This is inline with adoption behaviour theory by Rogers, (1995). Years of farming experience (x_6) was also found to be positive and statistically significant at 5% level. Membership of cooperative society (X_7) was found to be nega ive and not significant. This is not surprising, however, as a number of the farmers did not belong to any membership society. Studies from Oboh *et al.* (2006) revealed that membership of cooperative societies was a positive indication of farmers' likelihood to adopt new varieties because cooperative societies provide learning opportunities for members to exchange farm innovation, ideas and share other vital farming experiences. Contact with extension staff (X_8) was found to be positive and insignificant. There is however, a significant relationship between adoption of improved rice variety and output from rice production at 0.001 and 0.005 levels of significance respectively. This means that we accept the alternative hypothesis which states that the use of improved rice variety has a positive and significant effect on farmers' output.

Table 3: Estimates of Cobb-Douglas Production Function For Adoption Of Improved Rice Variety

Variables	Regression Coefficient
Constant term	1.188 (3.22)**
Capital items (X_1) ln N	0.781 (2.11)**
Size of farmland (X_2) ln ha's	0.111 (0.53)
Labour in (X_3) Mandays	0.042 (3.22)**
Inputs used in N (x_4)	0.168 (1.35)**
Rice yield in kg (X_5)	0.153 (3.11)**
Farming Experience (X_6)	1.080 (2.12)**
Membership of cooperative society (X_7)	- 0.142 (0.33)
Contact with extension staff (X_8)	0.081 (0.45)
R^2	0.642
F-value	1.997

Note: ***, ** and * implies statistical significance at 1%, 5% and 10% levels, respectively.

Source: Field survey data 2005.

CONCLUSION

The study revealed hat the adoption of improved rice variety Faro 44 is moderately high with about 82% using the variety. Capital used, labour and inputs were significant to farmers output from the use of this variety. Membership of cooperative society was not significant, years of farming experience and information from radios, friends and extension agents about the improved rice variety were responsible for its adoption by the farm s. This translated to the positive and significant outcome of the farmers yield. The significa t relationship between farmers' adoption of this variety and farmers output reveals that the farmers in the study area were responsive to the adoption of this innovation. It is however, recommended that farmers be encouraged to join cooperative societies to benefit from the opportunities provided by being members of the society.

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APPENDIX 1 : RICE IMPORTS IN NIGERIA, 1980 - 1997

Years	Imports '000tonnes	Amount (Million $)	(Million N)
1980	450.00	245.00	134.75
1981	657.00	407.5	248.78
1982	539.00	290.1	194.37
1983	544.00	237.8	171.22
1984	365.00	165.0	127.05
1985	356.00	94.6	84.19
1986	320.00	80.0	140.00
1987	100.00	92.0	369.84
1988	200.00	55.0	249.70
1989	300.00	80.0	588.80
1990	220.00	60.0	482.40
1991	210.00	60.0	904.60
1992	270.00	78.0	1340.40
1993	380.00	99.0	2183.94
1994	411.26	109.0	2398.34
1995	374.35	10.24	226.00
1996	5,266.64	232.43	3015.00
1997	6,900.54	647.55	4285.00

Source: IRRI (1991); Anonymous (1998); CBN (1997).