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Adoption of New Rice for Africa (NERICA) technology in Ogun State, Nigeria

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This study was carried out with the aim to find out the level and socio-economic determinants of the adoption of New Rice for Africa (NERICA) using Ewekoro Local Government Area of Ogun State in Nigeria as a case study. One hundred and sixteen rice farmers were randomly selected in this area, twenty eight of which adopted NERICA rice varieties within 2009/2010 cropping season. Information was gathered through the use of well structured questionnaire and personal interview of the farmers. Descriptive statistics, ordinary least-squares (OLS) regression analysis and T-test statistics were used for the analysis of the data collected. It was discovered through the findings that the rate of adoption was 33.36%, while the socio-economic determinants of the adoption of the technologies include farming experience, age of the farmer, frequency of contact with the officials of Agricultural Development Programme (ADP) in the state and farm size. Moreover, the findings show that the non-adopters of NERICA technological package had higher average output and average yield than the adopters of the technologies. Lastly, the study gave valuable recommendations which could be helpful toward enhancing improved rate of adoption of NERICA rice technologies by the farmers in the study area.

Key words: New Rice for Africa (NERICA), adoption, rice, socio-economic determinants, technologies.

INTRODUCTION

Since the introduction of New Rice for Africa (NERICA) in the mid 1990's, the NERICA has carved a special niche for itself among upland rice farmers in sub-Saharan Africa (SSA). Today, it is a symbol of hope for food security in SSA, the most impoverished region in the world where a staggering one-third of the people are under-nourished and half of the population struggle to survive on US $1 a day or less (Think Quest Team, 2006). The NERICA is a group of rice varieties resulting from the inter-specific crossing between the Asian rice (*Oryza sativa*) and the African rice (*Oryza glaberrima*). They are the output of the hybridization breeding programme started in 1991 by the Africa Rice Centre (WARDA). The NERICA varieties promises to raise significantly the productivity, income and food security of rain fed upland rice farmers in SSA. The NERICA varieties were introduced to rice farmers starting from 1996 in West Africa through participatory varietal selection (PVS) trials (Tiamiyu, 2008). Till date, up to eighteen (18) NERICA varieties have been disseminated in numerous countries across SSA such as Nigeria, Sierra-Leone, Gambia, Ghana, Guinea, Mali, Cote

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d'Ivoire and Togo through informal channels by farmers and by development projects. These rice varieties which are suited to dry lands were distributed and sown on more than 200,000 ha during the last five years in several African countries notably Guinea, Nigeria, Cote d'Ivoire and Uganda, according to African Rice Centre (2008). Though this represents a major advancement, it is still projected to fall short of meeting the growing demands for rice as a food staple.

In order to improve and encourage the increased production of rice in Nigeria, some varieties bred by WARDA for upland ecologies were introduced to farmers through the participatory varietals selection (PVS) trials in 1999 and 2001. The PVS was conducted in nine States which included Ogun State and Federal Capital Territory. The apparent success of these trials led to the release of NERICA varieties. The Federal Government launched the Multinational NERICA Rice Dissemination Project (MNRDP) in 2003. This was aimed at promoting the use of NERICA seed varieties and complementary production technologies packaged with it among farmers (Tiamiyu, 2008). In 2003, MNRDP started the implementation activities for the dissemination of NERICA in six States including Ogun State where the area of this study was located. According to the MNRDP project, the NERICA rice varieties embody improved seed technology and management practices of agrochemicals in terms of biological and chemical technologies. The NERICA varieties cultivated in the study area are NERICA 1 to 8. The production parameters of the adopters of these technologies can be used to solve the problem of low yield, low productivity and rice self-insufficiency in Nigeria.

Statement of problem

The world food problem is a serious issue especially in Africa. Population increase is escalating, and increase in crop production is becoming an uphill task. Recently, in order to resolve the problem, NERICA was developed in West Africa. However, certain problems bother the mind of the researchers. The growth in consumption which has become most substantial in Africa's rapidly growing cities, where rice is increasingly becoming the staple diet of the poor urban households. Rice has therefore become a staple of considerable strategic importance. At present, rice imports are still significant because the region is yet to be self sufficient in rice production. As a result of the increment in the consumption of rice in the country, the imported rice is being used to bridge the gap existing between production of the local rice and the domestic demand of the consumers. The demand-supply gap of rice is becoming a major problem which requires attention in Nigeria's agricultural economy. Moreover, high exchange rate involved in importation of rice is a serious issue that requires quick attention if an economy would achieve any significant development. Hence, the adoption of NERICA rice by the farmers is believed to have potential to lead to an increase in productivity of rice in the country, result in reducing demand-supply gap, increase rice self sufficiency and enhance improved foreign exchange earnings.

Objectives of study

The objective of this study is to determine the socio-economic factors influencing the adoption of the NERICA technology and to examine the level of adoption of NERICA rice by farmers in the study area.

Statement of hypotheses

i) There is no statistically significant difference in the output level of NERICA adopters and non-adopters.
ii) There is no statistically significant difference in the level of yield of NERICA adopters and non-adopters.

LITERATURE REVIEW

Much evidence has been provided attesting the productive performance of the agricultural sector in Africa and factors influencing it, but there is still little evidence on crop-specific and sub-regional productive performance. An assessment of crop-specific efficiency, productivity and adoption analysis should be of more interest to policy makers implementing liberalization policy than overall aggregates. The adoption of the new agricultural technology that led to the green revolution in Asia can also lead to significant increases in agricultural productivity in Africa, and stimulate the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (World Bank, 2008). Mendola (2006) observes that the adoption of the high yielding variety has positive effect on household well-being in Bangladesh. More recently, Kijima et al. (2008) conducted a study on the impact of NERICA in Uganda and found that NERICA adoption reduces poverty without deteriorating the income distribution. A study carried out by De Janvry and Sadoulet (1992) shows a positive impact of adoption of agricultural technologies. In contrast, a study in Bangladesh by Hossain et al. (2003) shows that the adoption of high yielding varieties of rice has a positive effect on the richer households but had negative effects on the poor. In Zimbabwe, Bourdillon et al. (2002) observe that the adoption of high yielding varieties of maize increases the crop incomes of adopters only modestly. These conflicting findings justify the need for further research on this issue. There is suggestion that the promotion of NERICA cultivation can contribute to improving expenditure/income of farmers and

consequently to poverty reduction. This is consistent with the study of Irz et al. (2001), who show that a close relationship exists between farm productivity and household poverty.

In his study, Diagne (2006a) determines the rates of adoption and rates of diffusion of NERICA rice varieties in some West African countries which include Cote d'Ivoire, Guinea and Benin. He also employs econometric analysis to show the socio-economic determinants of adoption of NERICA in Cote d'Ivoire. He shows that the main factors which positively influence the adoption of NERICA include growing rice partially for sale, household size, growing upland rice, past participation in PVS trials and living in a PVS-hosting village. On the other hand, he discovers that age of the farmers and having a secondary occupation had a negative impact on adoption (Diagne, 2006b). In Guinea, Diagne et al. (2007) show that the main socio-economic determinants of adopting NERICA with positive effects were participation in training programme and living in a village where NGO SG2000 has had activities. In Benin, land availability and living in PVS-hosting village were found to have positive effects on adoption. It was also found that varietal attributes such as swelling capacity and short growing cycle were important determinants of adoption of NERICA (Adegbola et al., 2005).

MATERIALS AND METHODS

Study area and sampling technique

This study was conducted in Ewekoro Local Government Area of Ogun State, Nigeria. This is a major rice-producing area in the state, comprising of Wasimi and Arigbajo which serve as major villages in the area. Major crops cultivated include maize, rice, cassava and melon while sugarcane is the major cash crop of the inhabitants of the Local Government Area. Majority of the people living in this locality were involved in farming activities either on a part time or full time basis. One hundred and sixteen small-scale rice farmers were sampled in the study area by using simple random sampling technique.

The data were collected during the 2008/2009 farming year through the use of well structured questionnaire which was administered by personal interview conducted for the selected farmers. Descriptive statistics and multiple regression analysis were used in meeting the objectives of this study. The descriptive statistics entails the frequency tables which show the distribution of the socio-economic characteristics of the farmers such as sex, age, household size, farming experience, educational qualification and proximity to ADP official village of residence. The regression analysis shows the socio-economic factors that determine the level of adoption of NERICA technology. The model of the regression analysis is as follows:

$$Q = a_o + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8$$

Where Q = level of NERICA technology adoption of farmers; the level of adoption was measured using the proportion of utilisation of each component that constitutes the NERICA technological package; these include cultivation of NERICA varieties, appropriate fertilizer application, mechanization and pesticide/herbicide application. The summation of the proportion of utilization of each of these components determines the level of NERICA technology adoption of the farmers. X_1 = sex (dummy: male = 1, female = 0); X_2 = age (years); X_3 = household size; X_4 = farm size (acres); X_5 = proximity to ADP official village of residence (dummy: farmer residing in ADP official resident village = 1; otherwise = 0); X_6 = education (years); X_7 = farming experience (years); X_8 = frequency of ADP contact; a_o = constant; $a_1 – a_8$ = parameters to be estimated.

RESULTS AND DISCUSSION

The result of the descriptive statistics of the sampled rice farmers

From Table 1, it could be observed that over 55% of the farmers were male while less than 45% were female. The average age of the farmers is observed to be 41.42 years, as majority of them (about 69%) falls within ages 30 to 59 years. There is a relatively low level of education among the farmers: the average year of formal education among the sampled paddy farmers was 2.86, as almost 70% of the farmers had no formal education. The average household size is 6.14, and most of the paddy farming households had sizes ranging between 1 and 10. The average year of farming experience was found to be 19.71 years, while the average farm size was 4.41 acres. Most of the farmers (about 80%) cultivate on 5 acres of land or lesser. About two-third of the farmers had no contact with Agricultural Development Project (ADP) officials, while less than 10% had contact with the ADP officials at least once a month. Consequently, this could be the reason for the low adoption level of NERICA by less than 25% of the rice farmers.

The items that are involved in NERICA technology adoption level include cultivation of NERICA seed, fertilizer application, mechanization and herbicide/pesticide application. Moreover, the stages of adoption are itemized to range from 'not aware', 'aware', 'thinking about it', 'interested', 'ready to adopt', to 'adopted'. These are coded from 0 to 5. A farmer that adopts all the four components of the technology mentioned earlier is scored 20 (4 × 5) scores, while a farmer that is not aware of all the four technologies is scored 0 (4 × 0). The adoption level (*x)* of a farmer could be determined using the following formula:

$$x = \frac{a}{20} \times 100$$

a represents the adoption score given to an individual farmer. For this study, any farmer that does not cultivate NERICA seed variety was not considered as an adopter of NERICA technology. The value *x* serves as the regress and for the exogenous variables. To determine the mean adoption level, this study adopts the formula:

Average adoption level = $\sum fx/N$

Where *f* = frequency of each value observed; *N* = number of observations of the variable *x.*

Table 1. Socio-economic characteristics of the selected rice farmers.

Socio-economic characteristics	Frequency	Percentage	Mean
Sex			
Male	64	55.17	
Female	52	44.83	
Total	116	100.00	
Age (years)			
20-29	16	13.79	
30-39	24	20.69	
40-49	30	25.86	
50-59	26	22.41	41.42
60-69	14	12.07	
70 & above	6	5.17	
Total	116	100.00	
Educational qualification			
Non-formal	80	68.97	
Primary	30	25.86	2.86
Secondary	6	5.17	
Total	116	100.00	
Household size			
1-5	48	41.38	
6-10	54	46.55	6.14
11-15	14	12.07	
Total	116	100.00	
Farm size (acres)			
0.01-2.50	62	53.45	
2.51-5.00	30	25.86	
5.01-7.50	4	3.45	4.41
7.51-10.00	6	5.17	
10.01-12.50	10	8.62	
12.51-15.00	4	3.45	
Total	116	100.00	
Farming experience (years)			
1-10	44	37.93	
11-20	28	24.14	
21-30	30	25.86	19.71
31-40	4	3.45	
41-50	6	5.17	
51-60	4	3.45	
Total	116	100.00	
Frequency of ADP contact			
Weekly	4	3.45	
Monthly	6	5.17	
Quarterly	14	12.07	
Yearly	16	13.79	
Not at all	76	65.52	
Total	116	100.00	

Table 1. Contd.

Adopted rice variety		
Local	88	75.86
NERICA	28	24.14
Total	116	100.00

Source: Field survey (2010).

Table 2. Comparison of the output (in bags) and average yield (bags/acre) of paddy farmers based on NERICA rice adoption type.

Farmer category	Average output (bags)/average yield (bags/acre)	Standard deviation	Standard error
Adopter	3.5043	3.3830	0.3606
	8.2045	2.3643	0.2520
Non-adopter	9.6741	9.5578	1.0189
	18.3409	11.7678	1.2545

Source: Field survey (2010).

The average level of adoption in the area of study was observed to be 33.36%.

The result of the regression analysis showing the socio-economic factors influencing the level of adoption of NERICA technology in the study area

$$Q = 71.125^{**} + 2.435X_1 - 1.807X_2^{*} - 0.124X_3 + 1.310X_4^{**} + 2.987X_5 - 0.068X_6 - 0.459X_7^{**} + 5.954X_8^{**}$$

(9.249) (2.447) (1.280) (0.401) (0.364) (3.075) (0.376) (0.117) (1.235)

Where, ** - 1% significance level; * - 5% significance level.

From the regression analysis computed using SPSS 15.0, it was observed that age of the farmers, farm size, farming experience and frequency of ADP contact were the most significant socio-economic variables influencing the level of adoption of the farmers. The younger farmers tend to have higher adoption level than the older farmers; this is in conformity with literatures. Also, farmers with larger farm holdings seem to have higher adoption level than those cultivating on smaller pieces of land. Moreover, rice farmers with fewer years of experience tend to adopt NERICA technologies more than the more experienced farmers in the study area. More importantly, increased contact with the ADP officials has a tendency to improve the level of adoption of the farmers in the area of study.

Comparison of the performance of the adopters and non-adopters of NERICA technologies in the study area

From Table 2, it could be observed that the non-adopters had higher output and yield than the adopters of NERICA technologies. This may not be as a result of lower potential of the technology but rather due to the incidence of pests such as rodents and birds, according to the information obtained through personal interviews with the farmers. It was observed that the pests have preference for NERICA varieties paddy output over the local rice varieties paddy output; hence, the lower output and yield were recorded by the rice farmers in the study area. Moreover, through personal interviews, some of the adopters of the technologies were observed to show possibility of discontinuation of the technologies in the preceding seasons. The mean values of the output and yield of the adopters and non-adopters of NERICA varieties were used to conduct the T-test statistics presented in Table 3. From the result of the T-test conducted, it could be deduced that there is statistically significant difference in the output and yield levels of NERICA adopters and non-adopters in the study area.

CONCLUSION AND RECOMMENDATIONS

The study shows that younger farmers have tendency to adopt improved technologies than the older farmers, and it was discovered that about two-thirds of them were 40 years and above. This is not a good omen for instituting an improved technology if the discoveries in the literatures are anything to go by. Farmers that operate on relatively small scale level are discovered to have lower adoption level, and it is a known fact that the agricultural production in developing economies mainly depends on small production scale. Almost four-fifth of the sampled farmers in the study area operates on less than 5 acres of land, while the average farm size was 4.41 acres. It

Table 3. Test of hypotheses using T-test.

Hypothesis (H_0)	Degree of freedom	Critical value	T-value	Decision
There is no statistically significant difference in the output level of NERICA adopters and non-adopters.	0.05, 43	2.02	5.412	Reject H_0
There is no statistically significant difference in the level of yield of NERICA adopters and non-adopters.	0.05, 43	2.02	7.658	Reject H_0

Source: Data analysis (2010).

was also revealed that those paddy farmers with fewer years of experience tend to adopt NERICA technologies. A little less than 40% of the rice farmers in the study area had farming experience of ten years or less. Contact with the ADP officials serves as an important factor that could enhance higher level of adoption of improved technologies by the farmers in the area of study. However, only about 8% have contact with the ADP officials at least once in a month, and about two-thirds have no contact at all with any ADP or extension agents. Consequently, there appears to be a relatively low level of adoption of NERICA technology among the paddy farmers.

In conclusion, NERICA technological package would only be of great benefit to our agricultural economy, if and only if the technologies are directed towards the right direction, and there is increase in farmers-extension agent ratio. Also, it is not enough to introduce a new technological package but to sustain such package is very essential for a successful agricultural production system. Therefore, this study offers the following recommendations toward helping the agricultural policy makers:

i) Strategies should be developed toward reaching the older farmers on the field, since they form a larger proportion of the farmers remaining in agricultural production. This also applies to the relatively more experienced farmers; extension agents should endeavor to introduce every approach possible with the aim of convincing them to adopt improved technological packages.
ii) Improved agricultural technologies should be made available and affordable to the small scale farmers since they produce the bulk of the agricultural produce in the developing world economies.
iii) Any serious-minded government should consider a significant increase in the number of agricultural extension agents, if there would be a successful and timely dissemination of newly introduced agricultural technological packages. It is only through such attitude would there be an initiation of a move toward economic development. Also, NGOs with agricultural-related functions should consider the enhancement of information dissemination and extension services as part of their obligations, as this would help to bridge the gaps between already existing farmers and government-employed extension workers.
iv) The agricultural researchers, especially those involved in the development of NERICA rice varieties, should look into developing varieties that would pass the test of pest attacks especially rodents which form an obstacle against increased productivity of the varieties in the study area.

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