Adoption and Economics of New Rice for Africa (NERICA) Among Rice Farmers in Ekiti State, Nigeria.

V.E.T. Ojehomon[1], M. O. Adewumi[2], O.A. Omotesho[2], K. Ayinde[3], A. Diagne[4]

[1.] National Cereals Research Institute, Badeggi, Niger State, Nigeria.
[2.] University of Ilorin, P.M.B. 1515, Ilorin, Kwara State, Nigeria.
[3.] Ladoke Akintola University of Technology, P.M.B.4000, Ogbomoso, Oyo State, Nigeria.
[4.] Africa Rice Centre, 01 BP 21031, Cotonu, Benin Republic.
bayoayinde@yahoo.com/kayinde@lautech.edu.ng

Abstract : Using cross sectional data collected from randomly selected three hundred and fifteen (315) rice farmers from twenty one (21) locations in Ekiti State of Nigeria, this study examined the exposure, potential population adoption rate, determinants of adoption and the returns to farmers' labour and management in Economics of New Rice for Africa (NERICA) production. The data were analyzed using descriptive tools, average treatment effect estimation model and farm budget technique. Education, family size, contact with extension agents and residence in a Participatory Varietal Selection (PVS) hosting village activities were found to be significant variables that determined farmers' exposure to NERICA. The observed sample adoption rate was 40% while the average treatment effect was 71%. Residence in a PVS hosting village was the significant factor determining adoption of NERICA in the study area. NERICA attracted a higher average return per hectare than other varieties. The study suggests that stake holders in Nigeria agriculture need to scale up the activities of PVS as a means of disseminating NERICA to other parts of the country using extension agents. The findings of this study may be applicable to other similar states and countries.

[V.E.T. Ojehomon, M. O. Adewumi, O.A. Omotesho, K. Ayinde, A. Diagne. Adoption and Economics of New Rice for Africa (NERICA) Among Rice Farmers in Ekiti State, Nigeria. Journal of American Science 2012;8(2):423-429]. (ISSN: 1545-1003). http://www.americanscience.org. 60

Keywords: NERICA; Average Treatment Effect (ATE); exposure; adoption.

1. Introduction

Rice is a major commodity in world trade; it feeds at least half of the world's population (Hawksworth, 1985). In recognition of its importance, the United Nations (UN) declared the year 2004 as the international year of rice at the 57th session of her General Assembly. In Sub-Saharan Africa, West Africa is the leading producer and consumer of rice (WARDA, 1996). It accounts for 64.2% and 61.9% of total rice production and consumption in Sub-Saharan Africa respectively.

Nigeria is both the highest producer and consumer of rice in the West Africa sub-region with figures slightly above 50% (WARDA, 1996). Due to rapid population growth, urban residents' exposure to dietary patterns of foreign cultures, urban lifestyles with preference for foods which require less time to prepare and rising household income of the urban population, the demand for rice in Nigeria keeps on increasing. (Ojehomon et.al., 2004). The annual rice consumption in 1960 was 3 kilograms per capital; it increased to 18 kilograms in 1980. It averaged 22 kilograms in the 1995/1999 (Moses and Adebayo, 2007). The rate of increase in consumption between 1995 and 1999 was more and it doubled the population growth rate of 3.5% per annum. Between 1961 and 2002, rice production increased at an average rate of 11.8 per cent per annum. Yield, however, grew at a lower rate of 3.19 percent. In 2005, the average Nigerian consumed 24-28 kg of rice per year. This represents about 9 percent of total calorie intake.

National rice production between 2002 and 2004 was 3.065 million metric tons while demand was about 5.0 million metric tonnes. In spite of the increase in production of about 1.8 percent, the demand for rice outstripped supply (Ojehomon et.al. 2004; Bello, 2004). Consequently, the country has been importing to bridge the demand – supply gap.

Nigerian foreign reserve has been depleted due to massive importation of rice for local consumption. Rice importation rose from 7.4 tons to 53.6 tons in two decades. In 1999 the rice import bill was US$259 million, this increased to US$655 million in 2001 and to US$756 million in 2002(FAO, 2002). This was a huge drain in the Nigerian foreign reserve. Nigeria has the potential of 5 million ha of land that spread across all the ecologies suitable for rice cultivation (FAO, 2002). Yet Nigeria still imports rice. The major reason for the importation was due to low productivity. In order to reverse this trend, the government started to focus on rice production through promotion of adoption of improved rice technologies to increase rice productivity and to enhance farmers' income.

The breeding effort in Africa Rice Centre (West African Rice Development Association (WARDA)) developed the New Rice for Africa (NERICA) to boost rice production in Africa (Osiname, 2002). NERICA cultivars whose inter-specificity crosses between Oryza sativa and O. glaberrima were introduced to Nigerian farmers through the Participatory Varietal Selection (PVS) methods with a view of increasing rice production. Despite the much-acclaimed superiority of NERICA in the PVS trials over other rice varieties, information was lacking on its performance at the farm level in Ekiti State as at the time this project was embarked on. An evaluation of NERICA on rice farmers in Ekiti State, Nigeria was therefore conducted.

NERICA is said to be suitable for the low-input conditions of rainfed rice farming under poor management condition. It is believed to combine the ruggedness of local African rice species with the high productivity traits of the Asian rice that was the pillar of the Green Revolution (Guy, 2001). Many donors have pumped large sums of money to advance NERICA through the African Rice Initiative (ARI). However, the question is whether the money being spent on NERICA said to be the hope of rainfall upland rice farmers in sub-Sahara Africa (WARDA, 2008) worth all the efforts.

To further shed light on the performance of NERICA on farmer's environment, this study estimated the exposure rate and potential population adoption rate of NERICA by the rice farmers. The study also examined the costs and returns to NERICA and Non-NERICA farmers in the study area. The modern evaluation theory exposed in average treatment effect (ATE) estimation literature by Wooldridge (2002) and Diagne (2006) was employed in the determination of exposure rate and potential population adoption rate. The ATE method was employed because NERICA was a newly released variety and its diffusion was not widely spread in the population. Thus, if the classical probit or logit model was used to examine the adoption rates the result will suffer from non-exposure bias and give biased and inconsistent estimates of population adoption rates. The non-exposure bias occurs because farmers who have not been exposed to NERICA can not adopt it even if they might have done so they had known about it. The non exposure bias occurs because of incomplete diffusion of technology in the population (Diagne, 2006). Therefore, the population adoption rate is under estimated.

The study further examined the costs and returns to NERICA and Non-NERICA farmers in the study area.

This study provides empirical information on evaluation of NERICA as well as a guide to all stakeholders on future design of policies on rice production.

2. Material and Methods

2.1 Study Area

NERICA was introduced to rice farmers in Ogun, Ondo, Ekiti, Nassarawa, Kaduna and Taraba states of Nigeria in year 2000. Preliminary investigations revealed that NERICA project has taken off in Ekiti State. Ekiti State is therefore selected to be used as a case study for this project. The state was formed in 1996 from the former old Ondo State. The state lies between Latitude 7^0 25'N and 80^0 5'N and Longitude 4^0 45'E and 5^0 46'E of the equator. The climate is tropical rain forest with distinct wet and dry season. The raining (wet) season starts from middle March and ends in early November. The dry season is from November to early March. The mean annual rainfall ranges between 1,000 mm to 1,500 with high humidity of about 75%. The mean annual temperature is about 27^0C, which ranges from 21^0C – 28^0C. The population is about 1.6 million according to the 1991 census.

The state is made up of Ado-Editi, Ekiti East, Ekiti Southwest, Ekiti West, Efon Alaaye, Emure, Gbonyin, Ido-Osi, Ijero, Ikare, Ikole, Ilejemeje, Irepodun/Ifelodun, Ise-Orun, Moba and Oye Local Government Areas. The total land mass is 580,460km^2 and a population density of 280 people per square kilometre. Rice is a major food crop in the State (Ekiti State, 2003).

The target population for this study is the small scale farmers in the State. Primary data was collected in 2009 through a survey with the aid of structured questionnaire administered by trained enumerators.

Prior to the official release of NERICA in 2003, its diffusion in the study area was through the Participatory Variety Selection (PVS), Community Based System (CBSS) training and farm trials carried out in Epe, Oye, Igbole, Agbado, Iworoko, Eringiyan and Oke Ado located in seven Local Government Areas of Ekiti State. All these seven villages were therefore used for this study.

A three stage sampling technique was employed to obtain the data used in the study. In the first stage, the seven villages where PVS trials were conducted were chosen through purposive sampling. These villages are called the PVS villages or PVS hosting villages. In the second stage, two non PVS villages within a fifteen – kilometer radius were randomly selected. Fifteen farmers were randomly chosen from each of the selected 21 villages in the third stage making a total sample size of 315 rice farmers. The survey was restricted to rice farmers only.

2.2 Analytical Techniques

2.2.1 Adoption

The average treatment effect (ATE) estimation method was employed to determine the adoption rate and the factors influencing the adoption of NERICA in the area. Following Rosenbaum and Rubin (1983), the propensity score is the conditional probability of receiving a treatment given pre-treatment characteristics. The propensity score model is defined as:

$P(x) \equiv \Pr\{D = 1 \mid x\} = E\{D|x\}$ .... (1)

Where D = {0, 1} is the indicator of exposure to treatment and x is the multidimensional vector of pre-treatment characteristics. The pretreatment characteristics employed are gender, age, education, family size, PVS village, contact with extension agents and secondary occupation. The ATE probit parametric model of adoption and the linear model for determinants of adoption are represented by:

$Y = E(y \mid x, w) = \alpha w + \delta w(x - \bar{X})$ .... (2)

Where Y = Status of adoption of NERICA varieties in 2006; y = outcome of exposure to treatment; w = a binary indicator variable for NERICA exposure (w =1 indicates exposure and w = 0 otherwise.; x = a vector of explanatory variables; $\bar{X}$ = vector of sample means of x; α and δ = are the parameters to be estimated, the coefficient α is the average treatment effect (ATE). It is the estimate of the true population adoption and δ = parameter vector which measures the respective partial effects of the covariates on the adoption of NERICA varieties cultivated holding exposure constant.

$ATE_1 = E(y_1 - y_o \mid w=1) = E(y_1 \mid w=1)$........................ (3)

Where

ATE_1 = average treatment effect on the treated; y_1, y_o = outcome of exposure to treatment. w = treatment variable status; (w =1) = Exposure to treatment.

$ATE_0 = E(y_1 - y_o \mid w=0) = E(y_1 \mid w=0)$ ....(4)

Where

ATE_0 = average treatment effect on the untreated and (w=0) = non exposure to treatment

Once a consistent estimate of ATE, ATE_1 and the probability of exposure P (w = 1) is obtained, the expected "non exposure" bias (NEB) can be calculated thus:

$NEB = P(w=1) x ATE_1 ATE$..................................... (5)

Or

NEB=JEA–ATE .... (6)

Where ATE, ATE_1 and P (w=1) are as defined in equation 2, 3 and 4 above respectively;

JEA is the joint exposure and adoption parameter and is consistently estimated by the sample average of observed adoption outcome value thus;

$$JEA = \frac{1}{n}\sum_{i=1}^{n} y_i \quad \text{...................................... (7)}$$

The population selection bias (PSB) is given as:

$PSB = ATE_1 - ATE$.. (8)

Since two NERICA varieties (NERICA1 and NERICA 2) have been officially released in Nigeria. NERICA adoption is defined as the use of at least one NERICA variety in the specified cropping season. The average adoption impact on the exposed subpopulation is given by the conditional expected value as:

$ATE = E\,y_1 = P(w=1)(E(y_1 \mid w=1)) + P(w=0)(E(y_1 \mid w=0)) = P(w=1)[ATE1 + (1 - p(w=1))](E(y_1 \mid w=0)$... (9)

Where P (w =1) = probability of exposure.

Variables included in the ATE model are: Adoption status(Y) which is the adoption of a technology, and is defined to mean its *use* at the individual farmer level or at the aggregate population level. It is 1 = if adopted and 0 otherwise ; X_1 = the gender of farmers (1 = male and 0 = female); X_2 = the age of farmers (years); X_3 = Education of farmers(1 = formal education and 0 = non formal education) ; X_4 = the family size which is the number of people living under the same roof; X_5 = the PVS village where leaving in (PVS hosting village = 1 and 0 otherwise); X_6 = contact with extension agent where (extension contact = 1 and 0 otherwise); X_7 = Secondary occupation of the rice farmers (where yes= 1 and 0 otherwise); X_8 = Land area cropped to upland rice in hectares; X_9 = the adoption status of farmers in year 2005 (adopted = 1 and 0 otherwise); X_{10} = amount of loan received in Naira; X_{11} = the security of tenure where (secured = 1 and 0 otherwise); and w = the exposure variable status (w) which is the extent of knowledge of the technology in the population. The exposure variable only indicates whether the farmer has been exposed to the technology or not. It does not necessarily imply its use. The apriori expectation is positive for gender, age, education, PVS hosting village, contact with extension agents, secondary occupation, land area cropped to upland rice, adoption status of farmers in year 2005, amount of loan received in Naira, family size and security of tenure.

2.2.1 Farm Budget

To determine the structure of costs and returns to NERICA and non NERICA production in the study area, farm budget analysis was employed. GM is the gross margin defined as:

GM = TVO – TVC .... (10)

Where TVO is the gross income from sales of rice output added to quantity of output used as gifts, home consumption and other uses valued at market price in naira; TVC is the total variable cost of production, defined as expenses (direct and imputed) on seeds, hired labour, fertilizer, herbicide and transportation but excluding unpaid family labour.

The farm budget focuses on the returns to the farmer's labour and management (RLM) expressed in naira per hectare; and is defined as:

RLM = GM - (IC + IL + DC + IF) ……………. (11)

Where IC = Imputed interest on capital, which represents the interest paid on informal loans; IL = Imputed rent on land, this represents the amount that the farmers paid for land or would have paid for land if they did not own it; DC = Depreciation charges which was determined by using the straight line method without salvage value at the end of useful life for items such as cutlasses, hoes, sickles and jute bags; IF = Imputed cost of family labour unpaid family labour (in man-day's) employed by each farmer. Family labour is assumed to have opportunity cost equal to the prevailing wage rate in the study area and RLM = Returns to farmer's labour and management.

3. Results

Table 1 presents the variables that determine exposure to NERICA and their marginal effects.

Table 1: Determinant of Exposure and their Determinants

Variable	Coefficient	Marginal Effect
Gender	-0.28(-1.63)	0.11(-1.65)
Age	0.01(0.50)	0.002(0.50)
Education	-0.12(-2.18) **	-0.05(-2.18) **
Family size	-0.09(-3.25) *	-0.04(-3.25) ***
PVS village	0.82 (4.71) *	0.31(5.17)***
Extension agents	1.10(6.53) *	0.40(7.16)***
Secondary occupation	-0.16(-0.91)	-0.06(-0.09)
Constant term	0.25(0.45)	

Sample size (N) = 315 Log likelihood = -178

Robust Z statistics in parenthesis

*** Significant at 1% ; ** Significant at 5%

Table 2 reveals the ATE Parametric (Probit) Estimation of Population Adoption Rates.

Table 2: ATE Parametric (Probit) Estimation of Population Adoption Rates

Variable	Estimate	Std. Error	Z	P>|z|
ATE	0.71	0.038	18.55	0.000
ATE_1	0.73	0.031	23.56	0.000
ATE_0	0.70	0.057	12.26	0.000
JEA	0.40	0.017	23.56	0.000
NEB	-0.32	0.026	-12.26	0.000
PSB	0.014	0.021	0.68	0.499
Observed				
Ne/N	0.55	0.028	19.43	0.000
Na/N	0.40	0.028	14.37	0.000
Na/Ne	0.73	0.051	14.37	0.000

Table 3 shows the variables that determine the adoption of NERICA among the farmers.

Table 3: Determinants of NERICA adoption among the rice farmers.

Variable	ATE Model
Gender	-0.01(-0.05)
Age	0.02(1.13)
Education	0.08(0.93)
Family Size	-0.04(-1.09)
PVS village	0.97(3.94) ***
Extension	-0.49(-1.67)
Secondary Occupation	0.16(0.67)
Farm size	-0.08(-0.64)
Adoption 2005	0.32(1.05)
Credit	-8.852E-07(-0.21)
Security of tenure	0.29(1.13)
Constant	0.39(0.42)

Robust Z statistics in parenthesis

*** Significant at 1%

In Table 4 the cost and returns to NERICA and NON-NERICA rice production (N/ha) is summarized.

Table 4: Costs and returns to NERICA and NON-NERICA rice production (N/ha)

Variable	NERICA	NON- NERICA
RLM	61,362.06	39,568.76
RRI	1.50	1.30
a. Gross Revenue	184, 800.00	141,600.00
Less		
b. TVC	60,462.24	56,543.47
Seed	8,400.00	9,120.00
Fertilizer	2,357.42	1,814.00
Herbicide	1,250.00	5,058.96
Hired labour	46,169.98	38,696.30
Transport cost /others	2,285.00	1,854.21
Equal		
c. Gross Margin	124,337.76	85,056.53
Less		
d. Imputed interest on capital	3,005.50	3,834.73
Less		
e. Imputed rent value of land	2,289.26	3,392.00
Less		
f. Depreciation on farm tools	1,000.00	675.00
Less		
g. Imputed cost of family labour	56,680.94	37,586.04
Equals		

4. Discussions

Result revealed that the significant factors determining exposure to NERICA are education, family size, contact with extension agents and living in a PVS village (Table 1). Extension contact has a positive influence on rice farmers' exposure to NERICA. Agricultural Development Projects (ADP) which is the extension unit of the State Ministry of Agriculture is the formal channel of contact with the farmers in Nigeria and it is also the formal channel of diffusion of agricultural technology. It is the organ responsible for contacting and organizing the farmers for the PVS activities.

Living in a PVS village is also a factor having positive influence on exposure to NERICA with a marginal contribution of 0.31. Farmers living in these villages have 31% more chance of being exposed to NERICA compared to those who do not. Living in a PVS village plays a significant role in facilitating exposure to NERICA.

The other significant determinants of exposure with significant marginal contributions to the probability of NERICA exposure are education (-0.05) and family size (-0.04). The coefficients of these two variables are negative but significant. This means that farmers with informal education and farmers with small family size seek to be exposed to NERICA. The farmers with small family size require more hired labour which will increase cost of production particularly for weed operation which is problem in upland rice farming. NERICA is expected to suppress weed growth and expected to reduce labour on weeding operation therefore farmers with small family size will be interested in a rice variety that will reduce labour requirement.

The reason why there was inverse relationship between education and exposure may be because the requirement for exposure to NERICA was not complex; all it entailed was to visit the PVS sites. The PVS sites were established in strategic locations that were visible and accessible to farmers and non farmers.

Result further revealed that out of a total of 315 rice farmers sampled, 172 were exposed to NERICA (Ne) and 125 adopted (Na) it. This implies that 55% of the rice farmers were exposed and the observed adoption rate among the exposed sub group is 73% (Table 2).

Furthermore from Table 2, it could be observed that the ATE which is the potential population adoption rate was estimated to be 71%. This means that the NERICA adoption rate could have been 71% if the entire population were exposed to the NERICA in 2006 or before. The ATE which reveals the demand for the technology by the target population is the relevant quantity for making projection of adoption rate into the future and for extrapolation of adoption rates in the population at large (Diagne, 2006). The adoption rate among the presently NERICA exposed subpopulation (ATE_1) was 73%. This implies that NERICA was well accepted among those farmers who have first hand information about the quality of the rice.

The population adoption gap or non exposure bias (NEB) was 32%. This is attributable to incomplete diffusion of the NERICA in the population. As the exposure of the population to NERICA increases, this bias diminishes. Other things being equal, the ex-ante or ex-post adoption impact of a technology dissemination project is precisely measured by the resulting reduction in the adoption gap created by the non-exposure bias. The coefficients of ATE, ATE_1, ATE_0, JEA and NEB are all significant ($P < 0.05$). The population selection bias (PSB) although positive was not significant. Table 3 shows the summary of the determinants of NERICA adoption in the study area.

From Table 3, it is observed that the PVS village is the only significant variable determining the adoption of NERICA. This implies that the factor that is driving the adoption of NERICA among the farmers in the study area is PVS activities.

The ATE model further revealed that only the marginal contribution of PVS hosting village status is statistically significant. By implication, residences in a PVS-hosting village enhance the adoption of NERICA by 28% and may encourage the adoption of the NERICA even without participation in PVS trials. This could happen through social learning, learning from neighbours or verbal communication about a technology's qualities.

In the cost and return analysis, it is observed that rice farmers in the area cropped upland rice solely. Average farm size of these small rice farm holders was 1.26 ha for NERICA and 1.10 ha for non NERICA. NERICA farmers spent 49.83 man-days more than non NERICA farmers on per hectare of farmland. NERICA farmers used 25% percent more labour input than non NERICA farmers. This difference is due to the labour used by NERICA farmers for bird scaring. The NERICA farmers spent more labour input on bird scaring because it matures earlier than other rice varieties. At the time when NERICA mature on the field, there no other rice varieties that are available as food for the birds, so the birds concentrate on NERICA fields and the farmers have to employ more labour per unit area to scare the birds. Birds are generally seen as a serious problem in the study area hence other non-NERICA farmers usually plant their rice almost the same time so as to minimize the birds' damage to any particular rice field.

Table 4 presents the costs and returns structure to NERICA and non-NERICA production in the area. The costs and returns are expressed in Naira^{-1}. Average variable costs dominated the production cost of a typical rice farmer in the area. It is N60, 462.24 ha^{-1} and N56, 543.47 ha^{-1} for non-NERICA farmers.

A large proportion of the variable costs were spent on labour. NERICA and non NERICA farmers spent 83 percent and 75 percent of cost on labour. This is so because all farm operations were done manually. NERICA with an average RLM of N61, 362.06ha^{-1} could be said to have financial advantage in form of higher profitability than the non-NERICA varieties with a RLM of N39, 568.76^{-1}**.** The rates of return were 1.50, 1.38, for NERICA and non NERICA respectively. This revealed that for every naira spent on production, NERICA farmers got a return of 50 kobo while non NERICA farmers received 38 kobo. This shows that on the average the investment in NERICA rice production in the area is more profitable than the other non-NERICA varieties grown in the area.

Conclusion:

The study shows that there is an indication of a high future adoption of NERICA in Ekiti State in Nigeria. Efforts at increasing NERICA production in Nigeria through PVS must be scaled up and extended to other States in the country. More research need to go into solving the menace of birds attack on NERICA as this will go along way in reducing the cost of production. This study may have relevance to other countries with similar situation.

Acknowledgement:

The authors are grateful to WINROCK for providing the fund for this project.

Corresponding Author:
Dr. Kayode Ayinde
Department of Pure and Applied Mathematics,
Ladoke Akintola University of Technology,
P.M.B.4000, Ogbomoso, Oyo State, Nigeria.
E-mail: bayoayinde@yahoo.com
kayinde@lautech.edu.ng

References

1. Bello, A. (2004): "Rice Policy and Cognate Economic Issues", in Abo, M. E. and A.S. Abdullahi[eds] *The Nigeria Rice* Memorabillia Project Synergy Limited, Abuja, Nigeria xxxvi 1145 pages. Pg. 7.
2. Diagne, A. (2006): Taking a New Look at Emperical Models of Adoption: Average Treatment Effect Estimation of Adoption Rates and their Determination. Paper presented at the 26 conference of the International Association of Agricultural Economics August 12 – 18, at Gold Coast, Austria.
3. Dimara, E. and Skuras D. (2003): Adoption of Agricultural Innovations as a Two Stage Partial Observability Process. *Agricultural Economics* 28: 187 –196.
4. Ekiti State (2003): Online Nigeria. www.Onlinenigeria.com. Posted 30 January, 2003.
5. FAO (2002): www.fao.org.
6. Guy, M. (2001): NERICA-New Rice: Transforming agriculture for West Africa. AgriForum AgriForum, Quarterly Newsletter of the Association for Strengthening Agricultural Research in Eastern and Central Africa www.scienceinafrica.co.za/nerica.
7. Hawksworth, D.L.(1985): Foreword. In S.H.Ou. Ed. *Rice Diseases* CMI Slough, UK, CAB pp. 380

Moses, J. and Adebayo, E.F. (2007): Efficiency of Factors of Determining Rainfed Rice Production in Ganye Local Government Area, Adamawa State. J. of Sustainable Development in Agriculture and Environment. Vol.3: 20-30.

8. Ojehomon, V.E.T., Momoh, S., Ogunremi, L.T., Tiamiyu, S.A., Wayas, J.W. and Ogundele,O.O.(2004): Rice Policy and Cognate Economic Issues. The Nigeria Rice Memorabilia Project Synergy Limited, Abuja, Nigeria xxxvi 1145 pages. Pg. 7.
9. Osiname, A. (2002): Review of Current Status, Policy and Prospects of Rice Production in Nigeria . A Presentation at Rice Stakeholders Workshop Nigerian Institute of Social and Economic Research (NISER) Oyo Road, Ibadan 19-20 November. Papers 3, 135 – 146.
10. Rosenbaum, P. R. and Rubind, D. B. (1983). The Central Role of the Propensity score in Observational Studies for Casual Effects. *Biometrika*, 70(1): 41 – 55
11. WARDA (1996). *Rice trends in sub-Saharan Africa, Second Edition*. WARDA, Bouaké.
12. WARDA (2008). NERICA Adoption and impact: Summary of findings from four Countries *Research and Development brief.*

1/18/2012