

DETERMINANTS OF ADOPTION OF IMPROVED RICE VARIETIES IN SELECTED LOCAL GOVERNMENT AREAS IN NASARAWA STATE, NIGERIA

¹Adenuga A. H., ¹Omotesho O. A. ²Ojehomon V. E. T., and ³Diagne, A.,

*¹Department of Agricultural Economics and Farm Management,
University of Ilorin, Ilorin, Kwara State, Nigeria*

*²National Cereals Research Institute (NCRI) Badeggi,
P. M. B. 8, Bida, Niger State, Nigeria*

*³Leader, Impact Assessment and Policy Unit, Africa Rice Centre,
Cotonou, Benin Republic*

Corresponding Author: adenugahenry@gmail.com

+234803040468

ABSTRACT

Adoption of improved technology is a key factor in raising crop productivity. This study was therefore carried out to determine the major factors influencing the intensity of adoption of improved rice varieties in selected Local Government Areas in Nasarawa State, Nigeria. Using a well structured questionnaire, a two stage random sampling technique was employed to collect data from 120 rice farming households. Descriptive statistics and the Tobit regression model were the major analytical tools employed for the study. The estimated results showed that the major factors influencing the intensity of adoption of improved rice varieties in the study area include non-farm income which was significant 10% level of significance, gender of the household head and farm size which were significant at 5% level of significance and access to credit as well as years of experience in rice farming which were significant at 1% level of significance. The study therefore recommend that to increase rice production in Nigeria through adoption of improved rice varieties, credit should be made available to the local rice

farmers and dissemination of research outputs should be targeted at the women rice farmers and not just men. Also, Given that high cost of complementary chemical fertilizer was identified as the most important constraints to adoption of improved rice varieties, the government alongside providing improved rice varieties should also ensure that the complimentary inputs are provided to the farmers at subsidized rates.

Keywords: Adoption; Tobit Model, Improved Rice Varieties, Nasarawa State.

INTRODUCTION

Rice is a very important food crop globally. It is an ancient crop consumed as healthy and staple food by more than half of the world population (Daramola, 2005). It ranks third after wheat and maize in terms of worldwide production (Imolehin and Wada, 2000). Rice serves as an important staple food in the diet of the estimated 160 million Nigerians. Though there has been a steady increase in rice production in Nigeria, the production increase has, however, not been enough to

meet the consumption demand of the rapidly growing population (Singh et al., 1997). In recent years, rice production in the country has been expanding at the rate of 6% per annum with 70% of the production increase due mainly to land expansion and only 30% being attributed to an increase in productivity (AfricaRice (WARDA), 2007; Fagade, 2000; Falusi, 1997; Okoruwa et al., 2007). The country is the second largest importer of rice in the world contributing largely to the country's food import bill which had reached N638.4 billion annually (about \$4.2 billion). N1 billion (\$6.4 million) is spent daily on rice importation (Uzundu, 2011). Importation of rice rose from 7,000 tonnes in the 1960s to 657,000 tonnes in the 1990s (IRRI, 1991; 1995). Currently, total demand for rice in Nigeria is put at about 5 million metric tons a year out of which about 2 million metric tons are imported. Rice production in Nigeria is dominated by small holder farmers who use traditional manual methods that are characterised with problems of low productivity and consequently poor livelihood (Uzundu, 2011). More than 80% of the inhabitants in rice producing areas depend on it for their survival as a result of the activities that take place along the distribution chains from cultivation to consumption (Ogundele and Okoruwa, 2006). Productivity increase in the last four decades is centered on increasing the number of new released varieties and a positive and increasing trend in the rate of adoption of modern varieties (Simtowe et al., 2010).

Seed is the key input in agriculture and to a great extent the yield and quality of the crop depend on the quality of the seed planted (Awotide et al., 2012). Improved rice varieties enables farmers to crop several times within three planting period because of a relatively short growing period, the genetic potential of these seeds also ensures bumper harvests, disease and pest resistance, and drought tolerance; the improved varieties can compete

favorably with weeds (AfricaRice, 2008). It is assumed that notable improvements can take place in Nigerian agriculture, if the available technologies are accepted and adopted by the farmers (Ibrahim et al., 2012). This is because it is no longer possible to meet the needs of increasing numbers of people by expanding the area under cultivation or relying on irrigation (Datt and Ravallion, 1996). According to Diagne et al., (2009), Productivity increase in agriculture has the capability of reducing poverty through increase in farmers' income and reduction in food prices. New agricultural technologies and improved practices play a key role in increasing agricultural output and raising the standard of living of the farming population. Successful, adoption of improved agricultural technologies could stimulate overall economic growth and improve farmers' welfare through inter sectoral linkages while conserving natural resources (Sanchez et al., 2009).

Low rates of adoption of improved agricultural production technologies have been identified as one of the major reasons for low agricultural productivity in Nigeria. Given that product of agricultural research have no value if they are not put to use by the end users, identification of the factors determining adoption of improved technologies is very vital. This will help in raising the productivity of the farmers, and thereby improve their livelihood through increased income. There have been few studies conducted to determine the rate of adoption of improved agricultural technologies in Nigeria (Dontsop et al., 2011; Diagne, 2009). In view of the above, this study was carried out to:

- i. describe the socioeconomic characteristics of the rice farming households in the study area;
- ii. analyse the factors influencing the intensity of adoption of the improved

- iii. rice varieties and assess the constraints to adoption of improved rice varieties in the study area.

METHODOLOGY

Study Area

The study was carried out in Nasarawa State, Nigeria. The state is located within 8°32' and 8.53°North and 8°18' and 8.3°East in North Central, Nigeria (Wikipedia, 2013). Nasarawa State is bounded in the north by Kaduna State, in the west by the Abuja Federal Capital Territory, in the south by Kogi and Benue States and in the east by Taraba and Plateau States. The state has a land area of 12,000 square kilometers with a population of 1,863,275 (NPC, 2006). The state is divided into thirteen (13) Local Government Areas (LGAs). Agriculture is the dominant occupation of the inhabitants of Nasarawa state. Some of the major agricultural products in the state include , rice, maize, sorghum, millet groundnut cowpea, soya beans, sesame, melon, yam, cassava, sweet potato, mango, cashew, sugar-cane, oil palm, cattle, sheep, goats, poultry, pigs and fisheries. The state and Benue state forms one of the major rice hub in Nigeria (Nasarawa state Government, 2008).

Sampling Technique

A two stage random sampling technique was used to select 120 rice farming households from two Local Government Areas (Obi and Lafia) in the state. These two Local Government Areas were selected because they are the main rice hub in the state where rice is produced. A list of all the villages in the two Local Government Areas was then constructed. From each of the Local Government areas, 6 villages were randomly selected to make up a total of 12 villages. In all, ten rice farming households were then randomly selected from each of the selected villages to make a total of 120 households.

Method of Data Collection

Primary data was collected using a well structured questionnaire. Questions relating to the socio-economic and demographic characteristics of the rice farming households, varieties of rice cultivated and land area devoted to the cultivation of the rice crop were asked.

Method of Data Analysis

Various analytical tools and procedures were employed for this study. Descriptive statistics such as percentages, frequencies and means was employed to explain the socio-economic characteristics of the respondents and the constraints to adoption of improved rice varieties in the study area while Tobit regression model was used to identify the determinants of adoption.

Tobit Regression Model

In technology adoption studies, limited dependent variable models such as Logit, Probit and Tobit models are usually employed to obtain information from the non-normal distribution of such data. Logit and Probit models are appropriate when dealing with a discrete dependent variable, usually taking two values, 0 or 1. These models are useful if we are only concerned with the question of whether to adopt or not, but are not appropriate when we want to measure the intensity of adoption of a technology. The Tobit model which better handles censored dependent variables (continuous between some lower and possibly upper bound) (Pindyck and Rubinfeld, 1998; Shakya and Flinn, 1985) is superior to the Logit and Probit in this respect.

For this study, the Tobit regression model was used to establish the relationship between the extent of adoption of improved rice varieties as a production technology and the various factors affecting it. The application of Tobit analysis is preferred because it employs both data at the limit as well as those above the

limit.

According to McDonald and Moffit (1980), the Tobit model is specified as follows:

$$Y_i = X_i\beta \text{ if } i^* = X_i\beta + U_i > T$$

$$\text{or } Y_i = 0 \text{ if } i^* = X_i\beta + U_i < T$$

Where Y_i is the probability of adoption and intensity of use of improved rice varieties; i^* is non-observable latent variable; β is $k \times 1$ vector of parameters to be estimated; u_i is an independently normally distributed error term with zero mean and constant variance σ^2 and T is a non-observable threshold level. The above equation is a simultaneous and stochastic decision model. If non-observed latent variable i^* is greater than T , the observed qualitative variable Y_i that indexes the adoption becomes a continuous function of explanatory variables and zero otherwise (i.e. non-adoption of improved rice varieties). Using the stata statistical package, 11.0, the maximum likelihood approach was used to estimate the coefficients in the equation.

The proportion of rice farm planted with improved rice varieties specified as a function of socio-economic and institutional factors is as follows

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu_i$$

Where:

- X_1 = Nonfarm income in naira
- X_2 = Age of Household Head in years
- X_3 = Gender of Household Head (dummy; Male=1, Female=0)
- X_4 = Educational level of Household Head in years
- X_5 = Area of farm land available to the household in hectares
- X_6 = Household size
- X_7 = Access to Agricultural Extension service (No of visits)
- X_8 = Access to credit (dummy; Yes=1,

No=0)

X_9 = Experience in rice farming in years

X_{10} = Membership of Association

μ_i = Error term

It is hypothesised that income would have a positive relationship with adoption. This is because farmers with off-farm income are believed to be more financially buoyant to access improved technology than farmers without. The age of the household head is hypothesised to have a negative relationship with adoption (Hassan et al., 1998; Itana, 1985). For the gender of the household head, it is hypothesised that male headed households are more likely to adopt improved technology compared to female headed households (Doss and Morris, 2001). Educational level of the household head is expected to have a positive relationship with adoption of improved rice varieties (Ojehomon et al., 2012; Weir and Knight, 2000). Farm size is expected to influence the adoption of improved technology and the expected sign on the coefficient of farm size is indeterminate. This is because series of studies have shown that the farm size could positively or negatively influence adoption (Idrisa et al., 2012; Shiyani et al., 2002). Household size is hypothesised to have a positive and significant effect on adoption of improved rice varieties (Itana, 1985; Idrisa, Ogunbameru and Madukwe, 2012). Extension contact is expected to have a positive and significant relationship with the 2 adoption of improved rice varieties. (Lawal and Oluyole, 2008; Ojehomon et al., 2012). Access to credit is also expected to influence the likelihood of adoption of improved rice varieties positively (Ouma et al., 2006). Farming experience is expected to have a positive and significant relationship with the adoption of improved rice varieties (Idrisa, Ogunbameru and Madukwe, 2012). Membership of association is also expected to influence adoption of improved technology. It is hypothesized to have a positive

relationship. Bandiera and Rasul (2002) looked at social networks and technology adoption in Northern Mozambique and found that the probability of adoption is higher amongst farmers who reported discussing agriculture with others.

RESULTS AND DISCUSSION

Table 1 gives a summary of the socioeconomic characteristics of the respondents

As shown in Table 1, majority of the

Table 1: Socio-economic characteristics of respondents

Characteristics	Frequency	Percentage (%)
Gender		
Male	87	72.5
Female	33	27.5
Total	120	100
Age (Years)		
21-30	5	4.2
31-40	19	15.8
41-50	39	32.5
51-60	44	36.7
>60	13	10.8
Total	120	100
Marital Status		
Married	92	76.7
Single	5	4.1
Widow/Widower	9	7.5
Divorced/separated	14	11.7
Total	120	100
Educational Status		
No Formal Education	25	20.8
Quranic Education	31	25.8
Primary Education	45	37.5
Secondary Education	15	12.5
Tertiary Education	4	3.3
Total	120	100
Household size		
1-5	25	20.8
6-10	66	55.0
11-15	20	16.7
>15	9	7.5
Total	120	100
Access to Credit		
Yes	42	35.0
No	78	65.0
Total	120	100
Off-Farm Income		
Yes	29	24.2
No	91	75.8
Land Ownership		
Patrimony	98	81.7
Purchased	8	6.7
Rent	14	4.2

Source: Field Survey, 2013

respondents in the study area are males (72.5 %) showing large gender disparity in rice farming in the study area. The low participation of women may be due to the traditional gender roles. Majority of the farmers are in the age range of 41 -50 years and the average age was 49.06 years. About 60% of the respondents were above 47 years. This is an indication that rice farmers in the study area are getting old. Most of the respondents are married and as much as 20.8% have no formal education. The low level of formal education might contribute to the low level of adoption of improved technologies. The mean household size was found to be 9 persons per household and it ranged from 3 to 23 members. This large household size may be due to the practice of polygamy in the study area. Only 35% of the respondents had access to credit. Farming is still the main source of livelihood in the study area as only 24% of the respondents have other source of income. Virtually all the farmers cultivated other crops such as yam, maize, guinea corn, melon etc alongside rice. Majority of the farmers (81.7%) inherited their farm land. The area of land under rice cultivation in the study area ranged from 0.5 to 6 hectares and the average land size is 2.1 hectares.

Determinants of Adoption of Improved Rice Varieties

Rate of adoption can be measured in two ways: (1) in terms of number of farmers who adopt the technology or, (2) in terms of area

under the improved technology. Both measures are accurate (Morris et al., 1999). Given that the objective of this study is to measure the intensity of adoption, we adopted the second approach.

The major improved rice varieties cultivated in the study area is Cipi Variety. It was difficult to get specific names for the different varieties since the various villages have different names for the same varieties. However, farmers in the study area frequently mix varieties in their fields and often cultivate more than one variety, including local varieties, at the same time.

Table 2 presents the maximum likelihood estimates of the tobit regression equation for improved variety adoption decision model. Access to non-farm income, Gender, farm size, access to credit and years of experience in rice farming were the significant determinants of adoption of improved rice varieties in the study area. The significance of non-farm income implies that farmers with other sources of income are more likely to adopt improved rice varieties compared to farmers without. The result showed that if non-farm income increases by 1 unit, the probability of adopting improved rice variety would increase by 2 percent. This may be in view of the fact that such farmers are likely to have more money to purchase the needed improved rice varieties at the right time.

The result also shows that the male rice

Table 2: Tobit model estimate for the intensity of adoption of improved rice varieties

Parameter	Estimated Coefficients	std error	t-statistic.
Constant	0.03980	0.2440	0.16
Non-Farm Income	0.0205	0.0105	1.96*
Age	0.0001	0.005	0.20
Gender	0.1973	0.0977	2.02**
Educational Status	0.0313	0.0121	2.59
Farm size	0.1385	0.0634	2.18**
Household Size	-0.0075	0.0188	-0.40
Extension Visits	0.0258	0.0988	0.26
Access to credit	0.5314	0.1227	4.33***
Years of Experience	0.0193	0.0067	2.90***
Membership of Association	-0.1169	0.1217	-0.96
Sigma	0.3422	0.0259	0.2911

Dependent variable: Proportion of rice farm under improved variety

* Significant at 10%,** Significant at 5%, *** Significant at 1%.

Log of likelihood function = -55.23

Left-censored observations = 23

Uncensored observations = 97

farmers are more likely to adopt improved rice varieties than their female counterparts. This may be as a result of the fact that most training related to adoption of improved technology is often targeted at the males. So they seem to know better. Access to credit has a positive influence on the number of hectares of land planted to improved variety of rice. Each additional unit of credit access increases the probability of adoption by 53 percent. Farm size has a positive and significant influence on the adoption and use of improved rice varieties with each additional hectare of land increasing the probability of adoption by 13.9 percent. This may be due to the fact that farmers with larger farm size are more likely to have more incentives to adopt new technologies and are more able to bear risks associated with early adoption of improved technology. This result is in line with that of Abdelmagid and Hassan 1996. Farming experience is shown to have a positive impact on adoption of improved rice varieties in the

study area. This may be due to the fact that farmers with more experience are likely to know the performance of the seed varieties better hence would more easily adopt improved rice varieties.

Constraints to Adoption of Improved Rice Varieties

Some of the major constraints to the adoption of improved rice varieties in the study area include lack of awareness on the available improved seeds (19.8%), high cost of complementary chemical fertilizer (41.5%), unavailability of cash to purchase seed (26.7%), unavailability of improved seeds (4.8%) and low sales price for the outputs (11.9%).

CONCLUSION AND RECOMMENDATION

The result of the study has shown that access to credit, farm size, non-farm income, years of experience in rice farming and gender of the

rice farmer are the major determinants of adoption of improved rice varieties in the study area. The study therefore recommend that to increase rice production in Nigeria through adoption of improved rice varieties, credit should be made available to the local rice farmers and dissemination of research outputs should be targeted at the women rice farmers and not just the men. Also, the results of the study suggests that creating more opportunities for non-farm employment and income will lead to an improvement in the financial ability of the smallholder rice farmers to acquire external inputs at the right time. Given that high cost of complementary chemical fertilizer was identified as the most important constraints to adoption of improved rice varieties, the government alongside providing improved varieties should also ensure that the complimentary inputs are provided to the farmers at subsidized rates.

ACKNOWLEDGEMENT

The Authors are grateful to Africa Rice Centre Cotonou, Benin Republic for funding this research and to the National Cereals Research Institute, Badeggi, Nigeria for providing the technical support.

REFERENCES

Abdelmagid, S.A. and F.K. Hassan (1996). Factors affecting the adoption of wheat production technology in the Sudan. *Journal of International Agriculture* 35(4): 325–337).

African Rice Centre (WARDA) (2007). African Rice Trends: Overview of Recent Development in the Sub-Saharan Africa Rice Sector. Africa Rice Center Brief. Cotonou, Benin, WARDA. 8pp.

Africa Rice Center (WARDA)/FAO/SAA. (2008). NERICA: the New Rice for Africa – a Compendium. EA Somado, RG Guei and SO Keya (eds.). Cotonou, Benin: Africa Rice Center (WARDA); Rome, Italy: FAO; Tokyo, Japan:

Sasakawa Africa Association. 210 pp. Retrieved from <http://www.africarice.org/publications/nerica-comp/NERICA%20Compendium.pdf>

Awotide B. A., Diagne a. and Omonona B. T. (2012, October), Impact of Improved Agricultural Technology Adoption on Sustainable Rice Productivity and Rural Farmers' Welfare in Nigeria: A Local Average Treatment Effect (LATE) Technique. Paper Presented at the African Economic Conference, Kigali, Rwanda 23pp.

Daramola, B. (2005, November). Government policies and competitiveness of Nigerian rice economy. Paper presented at the Workshop on Rice Policy & Food Security in Sub-Saharan Africa, Republic of Benin. Retrieved from <http://www.nerica.org/workshop/RicePolicy/Biyi/Biyi.D.Nigeria.Paper.pdf>

Datt, G., and M. Ravallion (1996). How important to India's poor is the sectoral composition of growth? *World Bank Economic Review* 10(1), 1-26.

Diagne, A.; S. A. Adekambi; F. P. Simtowe And G. Biaou, (2009, August). The impact of agricultural technology adoption on poverty: The case of NERICA rice varieties in Benin. A shorter version of the paper is being presented as contributed paper at the 27th Conference of the International Association of Agricultural Economists. Beijing, China

Dontsop-Nguezet, P.M, A. Diagne, V.O.Okoruwa and V.E.T. Ojehomon (2011). Impact of improved rice technology adoption (NERICA varieties) on income and poverty among Rice Farming Households in Nigeria: A Local Average Treatment Effect (LATE) Approach. *Quarterly Journal of International Agriculture* 50(3), 267-291.

Doss, C.R. and M. Morris (2001). How does gender affect the adoption of agricultural innovations? The case of improved

- maize technology in Ghana. *Agricultural Economics*, 25(1): 27-39
- Fagade, S.O. (2000). Yield gaps and productivity decline in rice production in Nigeria. Paper Presented at the Expert Consultation on Yield Gap and Production Decline in Rice, FAO, Rome, Italy. 15 pp
- Falusi, A.O. (1997). Agricultural Development and Food Production in Nigeria: Problems and Prospects. In: B., Shaid, N.O., Adedipe, M. Aliyu and Jir, M. (eds.) *Integrated Agricultural Production in Nigeria: Strategies and Mechanism* (NARP Monograph No. 5. pp. 151-170).
- Hassan, R.M., Kiarie, N., Mugo, N., Robin, O. & Laboso, A. (1998). Adoption and performance of maize in Kenya. In: Hassan, R.M. (ed.) *Maize Technology Development and Transfer: A GIS Approach to Research Planning in Kenya*. CAB international, London.
- Ibrahim, A. A., Mustapha, S.B. and Nuhu, S. H. (2012). Effects of adoption of rice production technologies on farmers income in Borno State, Nigeria, *Journal of Agriculture and Veterinary Science*, 1(4), 19-22
- Idrisa, Y.L. , Ogunbameru, B.O. and Madukwe, M.C.(2012). Logit and Tobit analyses of the determinants of likelihood of adoption and extent of adoption of improved soybean seed in Borno State, Nigeria. *Greener Journal of Agricultural Sciences*: 2 (2), 37-45,
- Imolehin E. D. and Wada A. C. (2000). Meeting the rice production and consumption demands Nigeria with improved technologies, FAO Corporate Document Repository, International Rice Commission Newsletter. Retrieved from <http://www.fao.org/DOCREP/X7164T/X7164T00.HTM>
- IRRI. 1991. *World Rice Statistics*, p. 34-42.
- IRRI. 1995. *World Rice Statistics*, p. 34-42.
- Itana A. (1985). An analysis of factors affecting the adoption and diffusion patterns of package of agricultural technologies in subsistence agriculture. Unpublished MSc. Thesis, Addis Ababa University
- Lawal, J.O. and Oluyole, K.A. (2008). Factors influencing the adoption of research results and agricultural technologies among cocoa farming households in Oyo state, Nigeria. *International Journal of Sustainable Crop Production*, 3(5): 10-12.
- McDonald, J.F., & Moffitt, R.A. (1980). The uses of tobit analysis. *Review of Economics and Statistics*, 62, 318–321.
- Morris, M.L., J. Risopoulos, and D. Beck. 1999. Genetic change in farmer-recycled maize seed: A review of the evidence. CIMMYT Economics Program Working Paper 99-07. Mexico, D.F.: CIMMYT.
- Ogundele, O.O. and Okoruwa, V.O. (2006). Technical efficiency differentials in rice Production technologies in Nigeria. AERC Research Paper, 154, African Economic Research Consortium, Nairobi, Kenya. Retrieved from <http://www.aercafrica.org/documents/rp154.pdf>
- Ojehomon V. E. T., Adewumi M. O., Omotesho O. A., Ayinde K., Diagne A. (2012). Adoption and Economics of New Rice for Africa (NERICA) Among Rice Farmers in Ekiti State, Nigeria. *Journal of American Science*, 8(2): 423-429
- Okoruwa V. O.; M. A. Y, Rahji and O., Ajani, (2007). Rice and Maize Stratification Project in Nigeria. Draft Report
- Ouma, J.O., De Groot, H. and Owuor, G. (2006, August). Determinants of improved maize seed and fertilizer use in Kenya: Policy implication. Paper presented at the International Association of Agricultural Economists' Conference, Gold Cost, Australia.
- Pindyck, R.S. and D.L. Rubinfeld (1998).

- Econometric models and economic forecasts. Irwin/McGraw-Hill, USA.
- Shakya, P.B., and J.C. Flinn. 1985. Adoption of modern varieties and fertilizer use on rice in the Eastern Tarai of Nepal. *Journal of Agricultural Economics* 36(3).
- Simtowe F., Kassie M., Asfaw S., Shiferaw B, Monyo E., Siambi M. (2012, August). Welfare Effects of Agricultural Technology adoption: the case of improved groundnut varieties in rural Malawi. Paper presented at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil. Retrieved from <http://ageconsearch.umn.edu/bitstream/126761/2/Simtowe2.pdf>
- Sanchez, P. A., G. L. Denning, and G. Nziguheba (2009). The African Green Revolution Moves Forward. *Food Security* 1:37-44.
- Shiyani, R.L., Joshi,P.K., Asokam,M. and Bantilan, M.C.S. (2002). Adoption of improved Chickpea Varieties: Krishak Bharati Cooperative (KRIBHCO) Experience in tribal region of Gujarat, India. *Agricultural Economics*, 27: 33-39.
- Singh, B.N., Fagade, S., Ukwungwu, M.N., William, C., Jagtap, S.S., Oladimeji, O., Effisue, A. and Okhidievbie, O. (1997). Rice growing environments and biophysical constraints in different Agroecological zones of Nigeria. *Met. J.*, 2(1): 35-44.
- Uzondu J. (2011). Much ado about rice production. *Nigerian Newsworld* Retrieved 12th January, 2013 from www.nigeriannewsworld.com/content/much-ado-about-rice-production
- Weir, S., Knight, J., (2000). Adoption and Diffusion of Agricultural Innovations in Ethiopia: The Role of Education. CSAE Working Paper WPS2000-5, Center for the Study of African Economies. Oxford University, UK.
- W i k i p e d i a (2 0 1 3) , http://en.wikipedia.org/wiki/Nasarawa_State retrieved 31st January, 2013