



# **An Assessment of the Adoption of Improved Rice Processing Technologies: A Case of Rice Farmers in the Federal Capital Territory, Abuja, Nigeria**

**S. O. Adejoh<sup>1\*</sup>, N. Madugu<sup>1</sup> and U. M. Shaibu<sup>1</sup>**

<sup>1</sup>*Department of Agricultural Economics and Extension, Kogi State University, Anyigba, Nigeria.*

## **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors SOA and NM designed the study, wrote the protocol and wrote the first draft of the manuscript. Author UMS performed the statistical analysis and managed the analyses of the study. Author NM managed the literature searches. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/ARJA/2017/34333

### Editor(s):

(1) Ali Musa Bozdogan, Department of Agriculture Machinery, Faculty of Agriculture, University of Cukurova, Turkey.

### Reviewers:

(1) Edward Tsinigo, Ghana.  
(2) Barry Silamana, Institute of Environment and Agricultural Research (INERA), Burkina Faso.  
(3) Musa M. A. Dube, University of Swaziland, Swaziland.

Complete Peer review History: <http://www.sciencedomain.org/review-history/20260>

**Original Research Article**

**Received 24<sup>th</sup> May 2017**  
**Accepted 14<sup>th</sup> June 2017**  
**Published 28<sup>th</sup> July 2017**

## **ABSTRACT**

**Aim:** To ascertain the adoption of improved rice processing technologies among rice farmers in the Federal Capital Territory, Abuja, Nigeria.

**Study Design:** Survey research.

**Place and Duration of Study:** Federal Capital Territory, Abuja, Nigeria, between June and August, 2016.

**Methodology:** A simple random sampling technique was used to select 240 rice farmers from four of the six agricultural zones as delineated by the FCT Agricultural Development Project (FCT-ADP) for the study. Descriptive statistics, sigma scoring method and binary logistic model were used to analyse primary data obtained through questionnaire administration.

**Results:** Results from the findings showed that 72.5% of the farmers were male with an average age of 43 years. Rice farmers in the area had a mean farming experience of 9 years and operated on an average farm size of 4 hectares with average annual income from processing activities of

\*Corresponding author: E-mail: [adejohonalo@gmail.com](mailto:adejohonalo@gmail.com);

158, 244. The results further indicated a generally low level of adoption with respect to improved paddy steaming (sigma score = 5.1) and improved drying (sigma score = 4.1). The marginal effect of access to credit, awareness, and years of processing experience directly influenced the probability of adoption of improved rice processing technologies among rice farmers in the area at 5%, while household size decreased adoption at 1%.

**Conclusion:** There was low adoption of processing technologies among rice farmers due to high purchase costs and other constraining socioeconomic variables. The study therefore recommends the establishment of effective linkage system and collaboration of the major stakeholders towards appropriate technology development and dissemination.

*Keywords: Adoption; awareness; credit; logit; processing; technologies.*

## 1. INTRODUCTION

Rice (*Oryza sativa*) is increasingly becoming an important staple crop in Nigeria; a rich and cheap source of carbohydrate to both man and animals. Rice has served as a major staple cushioning the effect of under-nutrition and severe hunger in Nigeria and many other developing countries of the world. Domestic rice which is normally poorly-milled and non-polished have great color variation and might contain different varieties in the same bag [1].

The main actors in the rice value chain in Nigeria are farmers, paddy traders, millers, rice traders and retailers. The main value adding activities include: production, harvesting, storage and paddy aggregation at traders' level, parboiling, milling, wholesaling, and retailing. Value addition in rice processing is enhanced by regular adoption of appropriate processing technologies by the stakeholders. In some countries processing consists mainly of removing the husks and sometimes polishing the grains to get it white. In most other countries, especially Asian countries and West Africa it is usual to parboil before milling [2].

Prior to the advent of modern facilities, several traditional methods have been used to process rice. These methods include: pounding in mortar with pestle; beating with clubs on the floor; rubbing on the floor; beating gently with clubs in jute bags and threading under the feet of man or hooves of animals [3]. These crude means are deficient due to the fact that lots of damages are done to the rice, which leads to product and labour wastages. Apart from that, these methods are not hygienic [4]. The author further noted that the available modern rice processing technologies in Nigeria include: paddy cleaner which separates all the impurities like straw, dust, sand, and stones, from paddy, where a blower is attached to the machine for proper cleaning; and paddy.

Rice Polishing Machine (RPM) also known as the Rice Polisher is one of the newly developed rice processing machines used in the industry. This machine was designed to make the milled rice more attractive in appearance and also to improve the packing properties as well as to remove the final traces of dust, bran, and flour from rice surface. Another rice processing machine is the: rice grader- after the first or second polishing, the polished rice will be separated into different qualities of rice according to their size through the elevator. Broken rice and different sizes of rice will be separated through different sieves. These machines help improve the quality and marketability of the rice product and they are available in different capacities (small, medium and large scale).

Rogers and Shoemaker [5] defined innovation as new ideas, methods, practices or techniques which provide the means of achieving sustained increase in farm productivity and income. Technology adoption is the choice to acquire and use a new invention or innovation.

The adoption of improved rice production and processing technologies leads to increased productivity, product quality and thus, higher income to farmers. This could in turn lower the market prices of the product; generate greater efficiency and national economic growth. As pointed out by Okwoche, et al. [6], the contribution of any new technology to economic growth can only be realized when and if the new technology is widely diffused and adopted. Adoption itself usually results from a series of individual decisions to begin using the new technology, decisions which often stem from awareness and comparison of the uncertain benefits of the new invention with the uncertain costs of adopting it. An understanding of the factors affecting the adoption of these technologies is thus apt.

For Nigeria to be self-sufficient in the rice commodity, particular attention has to be put on the postharvest handling and processing practices of rice [7]. This is paramount to the production of clean, edible, high-quality milled rice from the paddy. Thus, a clear and deep understanding of the postharvest technology adoption issues required to produce quality table rice is of crucial importance if rice processors are to meet market-competitive standards of quality. According to [8], non adoption and adherence to recommended practices such as in planting improved variety, pest and disease management, improved handling and processing techniques, storage and marketing practices of agricultural produce, are some of the militating factors to agricultural production in Nigeria.

Transformation of traditional farming system for increased food production and product quality entails adoption of improved practices. The adoption of improved rice processing techniques is imperative towards obtaining quality rice that would meet demand and stimulate increased cultivations. Poor or non adoption of rice processing techniques by farmers invariably means poor quality rice product with corresponding low consumer appeal. Thus, the need for regular studies on the state of technology adoptions should not be far-fetch. In addition, most previous studies in the area is seen to have failed to focus much on the post harvest value chain, while dissipating so much on the cultivated area expansion and yield increase. Understandably, there is a need to explore and provide relevant data on the factors that influence the adoptions of post harvest processing technologies in the given context. This is the thrust of the present study.

## 2. MATERIALS AND METHODS

The study was carried out in the Federal Capital Territory (FCT) Abuja which is centrally located within Nigeria between Latitude 8°25'-9°25'N and longitude 6°45' -7°45'E. The territory covers an area of 8,000 square kilometers, and bordered by four States namely: Niger to the north and across the west, Nassarawa across the east and the south east, Kogi to the south west and Kaduna to the north east [9]. The FCT is made up of six Area Councils namely, Kuje, Municipal, Gwagwalada, Abaji, Bwari and Kwali. Major occupations of people in the area include civil service, farming, trading among others. Crops such as rice, maize, yam, cassava, sorghum and millet are grown in large quantities.

A three staged sampling technique was used to select the respondents. Based on the concentration profile of rice production activities in the FCT as reported by Madugu [10], four of the six agricultural zones as delineated by the FCT Agricultural Development Project (FCT-ADP) were purposely selected. From each of the four FCT –ADP zones, six major rice production cells were randomly selected. From each cell, 10 rice farmers who were also involved in processing activities were randomly selected for the study, giving a total of 240 respondents.

Descriptive and inferential statistics was used to analyse primary data obtained through structured questionnaire. The level of adoption of rice processing technologies was obtained using sigma scoring method. The following steps were used as adopted by [11].

First obtain the percentage of processors who used the technology:

$$\left\{ \frac{\text{(Number of processors using the technology)}}{\text{Total number of respondents}} \times 100 \right\} = A\%$$

This is followed by dividing the percentage (A %) by two and minus the answer from 100.

$$100 - (A \% / 2) = B\%$$

Check B% on the statistical table of normal deviates to get the sigma distance (X). Next increase the value of the sigma distance using a constant figure of 2 and multiplying the result by the same constant.

$$(X + 2) \times 2 = Y$$

Since sigma method assigns weight in reverse direction on a 10 point scale, the actual sigma score would be 10 minus the answer (Y).

$$10 - Y = Z$$

**Decision rule:** Any mean score (Z) less than 5 was considered as low level of adoption of rice processing technology.

Binary logit regression analysis was used to analyze the effect of selected socioeconomic variables on the adoption of improved rice processing technologies. The logit was modeled as specified:

$$\text{Ln}y = \text{Ln} (p/1 - p)$$

$$\ln(p/1 - p) = f(\beta_i X_i) + e_i$$

Where;

- Y = adoption (1= adopter, 0 = otherwise)
- P = Probability of farmer adopting the technology
- 1 - p= probability of farmer not adopting the technology
- Ln = Natural logarithm function.
- $\beta_i$  = vector of logistic regression coefficients.

$X_i$  = vector of independent variables given as follows:

- $X_1$  = sex (male=1, female=0)
- $X_2$  = Age of the farmer (in years).
- $X_3$  = Household size (number of persons).
- $X_4$  = Level of education (years spent schooling).
- $X_5$  = Experience in rice processing (years)
- $X_6$  = Extension contact (yes = 1, 0 otherwise)
- $X_7$  = Access to credit (yes=1, 0 otherwise)
- $X_8$  = awareness (Yes = 1, 0 otherwise).
- $X_9$  = quantity of rice processed (kg).

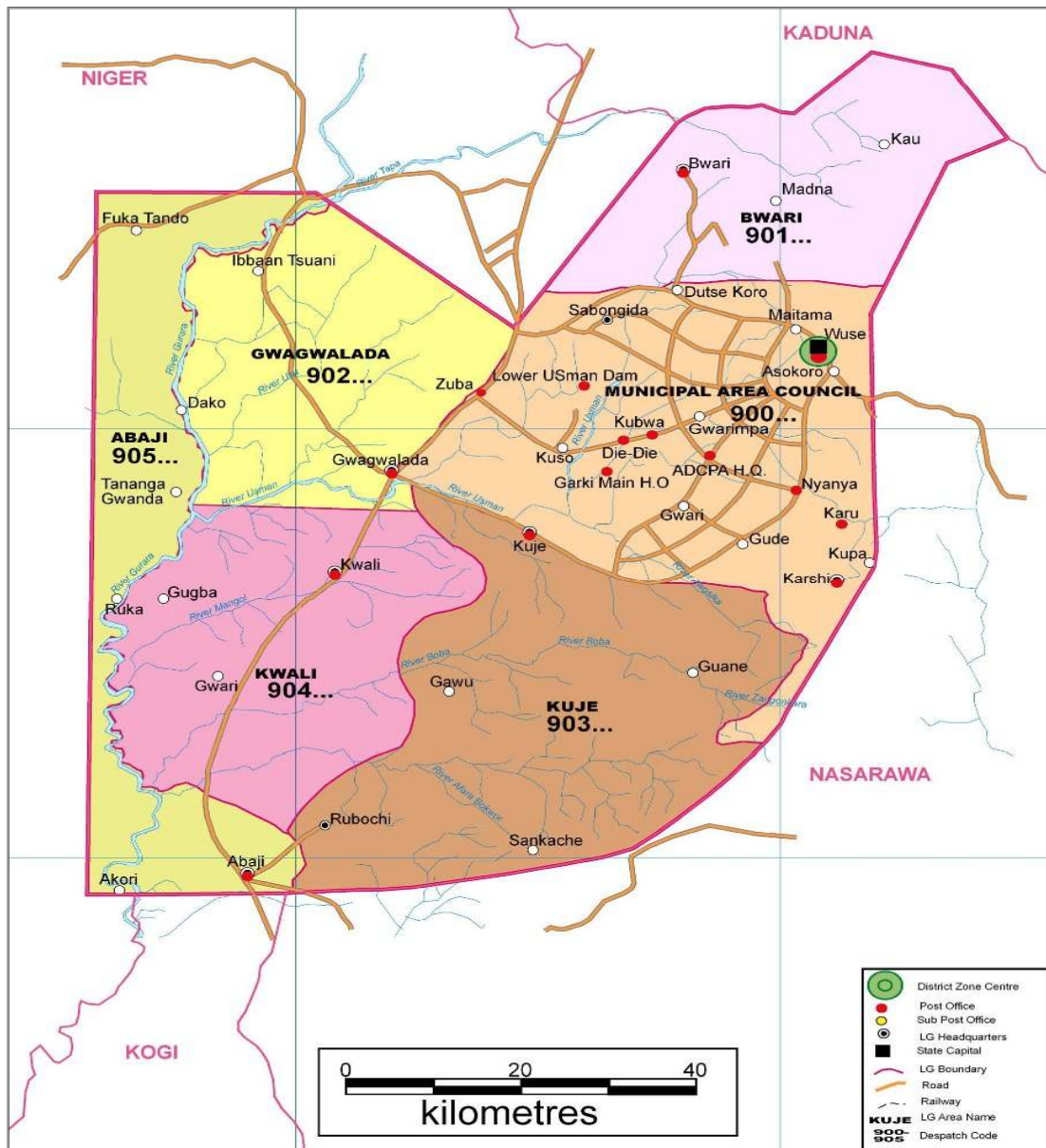


Fig. 1. Map of the Federal Capital Territory Abuja

### 3. RESULTS AND DISCUSSION

#### 3.1 Description of Socioeconomic Variables

Relevant socioeconomic variables of rice farmers in the area were described in Table 1. The involvement of more males than females could be attributed to the tedious nature of the various activities before rice is fit for consumption. The result further underscores

gender role pattern of people where males played dual roles of household and farm family heads. A mean age of 43 years is an indication that most rice farmers in the area are still in their productive age. This age is necessary sequel to the energy requirement in rice farming. This finding agrees with [12], who reported that Nigeria farmers are within the age bracket of 40-60 years. The high involvement of married (85.4%) people in rice farming and processing could be an added advantage in rice

**Table 1. Distribution of respondents according to socioeconomic characteristics**

Socioeconomic characteristics	Frequency	Percentage	Mean
<b>Sex</b>			
Male	174	72.5	
Female	66	27.5	
Total	240	100	
<b>Age (years)</b>			
18 – 33	50	20.8	
34 – 49	119	49.6	
50 – 65	69	28.8	
66 – 81	02	.0.8	
Total	240	100	43 years
<b>Marital status</b>			
Single	15	6.3	
Married	205	85.4	
Divorced	04	1.7	
Widowed	06	2.5	
Widower	10	4.2	
Total	240	100	
<b>Family size (number)</b>			
1 – 5	101	42.1	
6 – 10	110	45.8	
11 – 15	20	8.4	
16 – 20	07	2.9	
21 – 25	02	0.8	
Total	240	100	6 members
<b>Education status (years)</b>			
No formal education (0 years)	55	22.9	
Primary Education (1 – 6 years)	46	19.2	
Secondary Education (7 – 12 years)	79	32.9	
Tertiary Education (13 – 18 years)	60	25.0	
Total	240	100	
<b>Farming experience (years)</b>			
1 – 10	164	68.3	
11 – 20	68	28.3	
21 – 30	06	2.6	
31 – 40	02	0.8	
Total	240	100	9 years
<b>Annual income from rice processing</b>			
10,000 – 100,000	99	41.3	
101,000 – 200,000	74	30.8	
201,000 – 300,000	60	25.0	
Above 300, 000	07	2.9	
Total	240	100	₦158, 244

Source: Field survey, 2016

processing. This is evident as members of the family could serve as source of labour for various activities involved in rice processing. Marriage is also reported to directly influence the adoption of agricultural technologies [13]. The average household size of 6 persons is slightly less than the national average of 7 persons. The implication of relatively large household size is that in most cases, labour is readily available for farm activities. Most (57.9%) of the respondents had post primary education and about 23% of the farmers had no formal education. Education is expected to directly influenced adoption of innovation. The findings indicated an average processing experience of 9 years among the respondents. Experience in agricultural activities is very important as it influence the adoption of farming technologies such as the improved rice processing technologies. This position was anchored by Idrisa [14], when they reported that experience depicts a good signal for adoption since experience helps to convince the farmer of the importance of innovation. The average income in this study is an indication that rice processing in the area is still at the subsistence level.

### **3.2 Level of Adoption of Improved Rice Processing Technologies**

The level of adoption of improved rice processing technologies among the respondents is presented in Table 2.

The result in Table 2 shows a generally low level of adoption of improved rice processing technologies among rice farmers in the area. However, a high level of adoption was recorded for rice dehuskers/dehullers (sigma score = 6.0) and improved paddy steaming (sigma score = 5.1). This result could be attributed to the high level of awareness on these technologies. Invariably, awareness precedes adoption of a particular technology. Awareness of agricultural technology is very important since it stimulate farmers' interest in new ideas and practice. This finding anchors the report of Abubakar, [15] who said that creating awareness on new research findings and technologies in agriculture to rural farmers remain a promising strategy for increasing agricultural production. Supportively, Agbamu [16] reported that adequate information is one of the major prerequisite for widespread acceptance of agricultural innovations. This finding agrees with Agwu [17] who also reported high adoption level for improved technologies in Abia State as a result of farmers' awareness that

the technologies increase yields and minimize loses.

### **3.3 Effect of Selected Socioeconomic Variables on the Adoption of Improved Rice Processing Technologies**

Estimates of the binary logistic regression analysis on the effect of selected socioeconomic variables on the adoption of improved rice processing technologies are presented in Table 3.

The model's log likelihood ratio of 251.876 and  $\chi^2$  value of 65.674 indicate that all variables included in the model significantly influence the probability of adopting improved rice processing technologies by rice farmers in the area at 1%.

#### **3.3.1 Household size (number)**

The marginal effect (-0.094) of household size was negatively signed and significant at 1 percent. The inverse relationship implies that the likelihood to adopt improved rice processing technologies among rice farmers in the area decrease with an increase in the number of family members. The decrease is by 9.4%. Increased household size implies more mouth to be fed. Consequently, capital resource which could have been used to adopt improved rice processing technologies would be channeled to provision of basic family needs. This finding agrees with Lawal, [18] who identified household size as an important variable in the adoption of improved maize seed variety. Arene and Tee [19] reported a positive and significant relationship between family size and adoption. The finding is however in contrast with Sani et al. [20] and Ofuoku et al. [21] who observed a significant positive relationship between household size and adoption level.

#### **3.3.2 Access to credit (dummy)**

The marginal effect (0.681) of rice farmers' access to credit was positively signed and significant at 1 percent. This result implies that the likelihood to adopt improved rice processing technologies increased among farmers who had access to credit facilities. The increase is by 68%. Credit is essential for the purchase and maintenance of rice processing equipment. It also helps in expanding the scale of production which could lead to economies of scale. This finding underscores the role of credit in the

adoption of agricultural innovations. Farmers may be willing to adopt new technologies; they are however constrained with the financial involvement to adopt such innovation. This finding agrees with Adah [22] who reported a positive relationship between credit availability and adoption of improved oil palm processing technologies in Kogi state, Nigeria.

**3.3.3 Awareness (dummy)**

The coefficient of awareness (2.379) was positively related to the adoption of improved rice processing technologies at 1 percent. By implication, the likelihood to adopt improved rice processing technologies by rice farmers is more among farmers who are aware of the technology than those who are not. The finding agrees with Agwu [17] who reported a positive relationship between awareness and the adoption of improved production technologies by small scale farmers. According to Agbarevo and Obinne [23] the awareness stage involves the farmer learning of the existence of an innovation. At this stage, the farmer has little knowledge about it and may

have heard about the innovation from other family members, friends, neighbours, the mass media, change agents, sales promoters or local cooperative organizations. At this stage, the farmer might want to go on and find out more about the innovation which could possibly leads to its adoption.

**3.3.4 Processing experience (years)**

The marginal effect (0.042) of processing experience was positively signed and significant at 5 percent. This implies that the likelihood to adopt rice processing technologies increases with an increase in the number of years spent in rice processing. The increment is about 4.2%. This finding agrees with Otunaiya and Akinleye [24] who reported that experience of farmers positively influence the adoption of improved maize technologies. However, Adah [22] reported an inverse relationship between processing experience and adoption of improved oil palm processing technologies in Kogi state, Nigeria.

**Table 2. Adoption score for improved rice processing technologies N = 240**

Improved rice processing technologies	Frequency	Percentage	Sigma score
<b>Paddy cleaning</b>			
Mechanical rice threshing/winnowing	8	3.3	1.7
Wet cleaning	70	29.2	3.9
<b>Parboiling</b>			
Improved paddy steaming	160	66.7	5.1
Improved drying	80	33.3	4.1
<b>Milling</b>			
Dehuskers/Dehullers	240	100	6.0
Destoner/Grader	None	-	-

Source: Computed from field survey, 2016

**Table 3. Estimates of the binary logistic regression showing the effects of selected socioeconomic variables on the adoption of improved rice processing technologies**

Variable	Marginal effect	S.E	t-value
Sex (dummy)	-0.214	0.379	0.320
Age (years)	0.011	0.021	0.264
Household size (number)	-0.094	0.055	2.923 <sup>***</sup>
Education (years)	0.006	0.026	0.051
Extension contact (dummy)	0.507	0.519	0.954
Access to credit (dummy)	0.681	0.371	3.372 <sup>***</sup>
Awareness (dummy)	2.379	0.402	34.950 <sup>***</sup>
Processing experience (years)	0.042	0.032	1.721 <sup>**</sup>
Quantity of rice processed (kg)	0.024	0.153	0.025
Constant	-2.874	1.074	7.158

Source: Computed from field survey data, 2016.

Log-likelihood= 251.876, LR  $\chi^2 = 65.674$ , Prob> $\chi^2 = 0.000$ ; Pseudo  $R^2 = 0.239$   
<sup>\*\*\*</sup> and <sup>\*\*</sup> = significant at 1% and 5% respectively

#### 4. CONCLUSION

This study assessed the adoption of improved rice processing technologies among rice farmers in the Federal Capital Territory, Abuja. The otherwise low adoption is due to high purchase costs and other constraining socioeconomic variables of the respondents. It can thus be inferred that the adoption potentials of the respondents can generally be enhanced if those constraints are accordingly addressed by the various stakeholders.

Based on the findings, the following recommendations are made:

1. Awareness play significant role in the adoption of improved rice processing technologies as evident in this study. It is therefore recommended that the extension agency should intensify awareness campaigns and sanitization of farmers and processors on pertinent processing technologies. To create further awareness and stimulate interest, there should be regular information dissemination in various languages on radio, television, bulletins and leaflets.
2. It was found in this study that access to credit facilities is also a determinant for adoption of improved rice processing technologies. It is therefore recommended that credit facilities should be provided by the government, Non Governmental Organization and other relevant agencies at liberal terms so as to increase the scope of rice processing and improve the living standard of rice farmers. Also, rice processors can group themselves or be grouped into cooperatives so that they can pool their resources and attract government attention.
3. The establishment of effective linkage system and collaboration of the major stakeholders towards appropriate technology development and dissemination. These include the Federal Ministry of Agriculture, the various Agric Research Institutes, the Extension Agencies and the Donor Agencies.
4. The government should effectively ban the importation of processed rice into the country, to stimulate domestic rice production and hence, adoption of modern/improved processing technologies towards meeting the domestic demand.

5. The relevant agencies and establishments should encourage regular adoption studies and gap analysis. This will avail information on the existing adoption realities and areas for intervention towards improved technology adoption by rice farmers in the FCT Abuja.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. USAID Nigeria, Overview of Nigerian Rice, MARKETS –Investment Opportunities; 2009.
2. Poritosh R, Takahiro O, Hiroshi O, Nobutaka N, Takeo S. Processing conditions, rice properties, health and environment. *Int. J. Environ. Res. Public Health*. 2011;8:1957-1976.
3. Rahaman MA, Miah MAK, Ahmed A. Status of rice processing technology in Bangladesh. *Agric. Mech. Asia Afr. Latin Am*. 1996;27:46-50.
4. Mutalubi AA. Development of a rice polishing machine. *AU J. T*. 2007;11(2): 105-112.
5. Rogers EM, Shoemaker FF. *Communication of innovations (a cross-cultural approach)*. New York: Collier Macmillan Publishers; 1997.
6. Okwoche VA, Obinne CPO, Onugba JA. Adoption of herbicides and fertilizers among rural farmers of Zone B area of Kogi State Agricultural Development Project, Kogi State, Nigeria. *Asian Journal of Agricultural Sciences*. 2011;3(5):389-392.
7. Ogunbiyi MO. Assessment of postharvest handling and quality control practices of rice in north Central Nigeria: A case study of Lafia, Nasarawa State. *Journal of Developments in Sustainable Agriculture*. 2011;6:143-163.
8. Omoti U. Oil palm in Africa: Evolution during the last decade, trends and new challenges. Invited paper, XIV International Conference: Palm oil: The alternative in oils and fats in Latin America, Cartagena Colombia, 23 -26 September; 2003.
9. Dawan PD. Brief history of the Creation of Federal Capital Territory (FCT). In: *Geography of Abuja Federal Capital Territory*, P.D. Dawan, (Ed.).



- Famous/Asanlu Publishers, Minna, Niger State, Nigeria. 2003;1-8.
10. Madugu NY, Shaibu A, Yahaya I, Franca I, Isa B. Baseline survey of rice production in the Federal Capital Territory Communities. First schedule report, FCTA – ARDS Rice Value Chain Transformation Committee; 2012.
  11. Adejoh SO, Edoke MH, Shaibu UM. Assessing the availability, accessibility and use of media channels for sourcing agricultural information by urban and rural farmers in Kogi State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*. 2016;14(2):1-8. Available:[www.sciencedomain.org](http://www.sciencedomain.org)
  12. Onoh PA, Peter-Onoh CA. Adoption of improved oil palm production technology among farmers in Aboh Mbaise Local Government Area of Imo State. *International Journal of Agriculture and Rural Development*. 2012;15(2):966-971.
  13. Mohammad BT, Achem BA, Abdulquadi AF. Factors influencing adoption of agricultural processing technologies developed by National Centre for Agricultural Mechanization (NCAM) in Ifelodun Local Government Area, Ilorin Kwara State. *International Journal of Science and Research (IJSR)*. 2014;3(4): 413-417.
  14. Idrisa YI, Ogunbameru BO, Madukwe MC. 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*. 2012;2: 37-45.
  15. Abubakar BZ, Anyo AK, Buhari U. The roles of mass media in disseminating agricultural information to farmers in Birnin Kebbi Local Government area of Kebbi State. A case study of state Fadama II Development Project. *Journal of Agricultural Extension*. 2009;13(2):95-110.
  16. Agbamu JU. Development communication in rural development communication. *Asian Institute for Development Communication* Kuala Lumpur, Malaysia. 2006;11(1):35-49.
  17. Agwu AE. Adoption of improved oil palm production and processing technologies in Arochuku Local Government Area of Abia State, Nigeria. *Agro-science: Journal of Agriculture, Food, Environment and Extension*. 2006;5(1):25-35.
  18. Lawal BO, Saka JO, Oyegbami A, Akintayo IO. Adoption and performance assessment of improved maize varieties among smallholder farmers in south western Nigeria. *Journal of Agril. Food Inform*. 2004;6(1):35-47.
  19. Arene CJ, Tee DM. Agricultural Insurance in Humid Nigeria: An analysis of the performance of the livestock subsector. *Revista di Agricultura Tropicale e subtropicale*. 2005;90(2):165-176.
  20. Sani A, Abubakar BZ, Yakubu DH, Atala TK, Abubakar L. Socio-economic factors influencing adoption of dual-purpose cowpea production technologies in Bichi Local Government Area of Kano State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*. 2014; 3(4):257-274.
  21. Ofuoku AU, Egho EO, Enujoke EC. Integrated pest management adoption among farmers in Central Agro-ecological Zone of Delta State, Nigeria. *Advances in Biological Research*. 2009;3(1-2):29-33.
  22. Adah OC. Adoption analysis of improved oil palm fruit processing technologies in Kogi State, Nigeria. PhD Thesis, Kogi State University, Anyigba, Nigeria.
  23. Agbarevo MNB, Obinne CPO. Elements of rural sociology and agricultural extension. Tee Publishers, Uwani Enugu, Enugu. State. 2010;110-124.
  24. Otunaiya AO, Akinleye SO. Adoption of improved maize production technologies in Yewa North LGA of Ogun state, Nigeria. *Proceedings of 10<sup>th</sup> Annual National conference of Nigeria Association of Agricultural Economists (NAAE) held at university of Abuja, 7<sup>th</sup> – 10<sup>th</sup> October*. 2008;395-403.

© 2017 Adejoh et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://sciencedomain.org/review-history/20260>