



## **Farmers' Improved Breadfruit Awareness and Adoption Status in Southeast Nigeria**

**D. O. Enibe<sup>1\*</sup>**

<sup>1</sup>*Department of Agricultural Economics and Extension, Chukwuemeka Odumegwu Ojukwu University (COOU), Igbariam, Anambra State, Nigeria.*

### **Author's contribution**

*The sole author designed, analysed, interpreted and prepared the manuscript.*

### **Article Information**

DOI: 10.9734/AJAEES/2019/v29i430094

#### Editor(s):

(1) Dr. N. Karunakaran, Vice-Principal, Department of Economics, EK Nayanar Memorial Govt. College, Elerithattu, Kasaragod, Kerala, India.

#### Reviewers:

(1) Popoola Jacob Olagbenro, Covenant University, Nigeria.  
(2) M. B. Bashir, College of Agriculture, P.M.B 1025, Jalingo, Taraba State, Nigeria.  
Complete Peer review History: <http://www.sdiarticle3.com/review-history/47120>

**Original Research Article**

**Received 11 November 2018**

**Accepted 05 February 2019**

**Published 16 February 2019**

### **ABSTRACT**

This study analysed improved breadfruit (*Treculia africana*) awareness and adoption situation in Southeast Nigeria. It examined farmers' budding breadfruit awareness and adoption status and their willingness to adopt the innovation. The study also identified the reasons why farmers do not adopt the crop's new varieties. Two hundred and sixty respondents (260) spread in thirteen (13) communities of Anambra and Enugu States were randomly selected and interviewed using survey questionnaire. Data collected were verified in an in-depth interview (II) and two Focus group discussions (FGD). Data collected were analysed using descriptive statistics. The results show that: adoption status (20.47%) of its improved varieties was low while majority of the farmers were willing to adopt (88%). The study also found the major reasons why the farmers have not adopted the crop's improved varieties. The result concludes that farmers are greatly in need of improved breadfruit varieties and that the crop requires favourable policy interventions. The paper recommends policy interventions for the crop's conservation, awareness creation and provision of its improved varieties to farmers at affordable prices.

**Keywords:** *Improved breadfruit; awareness; adoption; policy interventions; Nigeria.*

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

## 1. INTRODUCTION

Some African countries have started production of non-traditional agricultural products in efforts to find new agricultural market and diversify their export products and income sources [1]. It is argued that agriculture have the potential to drive economic growth of the countries with increasing productivities of the farmers and linking them to the markets. Some of the ways to penetrate the market is through increased production and marketing of underutilized crop species. Such underutilized crop species may not have been known outside their native lands, suggesting that their native countries may have comparative market advantages in their large scale production, processing and marketing. There is the need to understand the market potentials of such crop species and the reasons why farmers do not invest in the commercial production of their new varieties.

Breadfruit (*Treculia africana*) is a leguminous food crop that needs national and international conservation attention. This is in consideration of five major reasons. First, it is a nutritious and underutilized crop species which contains 10% oil, 18% protein, 50% carbohydrate and with several important vitamins and mineral elements [2]. Second, it has been identified and accepted staple food crop in Nigeria and among African consumers in various parts of the world [3]. Third, studies have shown that breadfruit have important socio- cultural values in Southeast Nigeria [4]. Fourth, the crop has been identified to have great value addition potentials and can be used for production of different products such as weaning food, bread, biscuit and cake [5,6,7,8]. Finally, it offers attractive market niche opportunity due to people's resent awareness of its nutritional values, increasing demand and potentials. In support of these, [9] reported that breadfruit rings to the mind when considering all food crops in Nigeria with market potentials. The high price and demand for breadfruit in rural and urban populations have been emphasized [10,11,12,13]. From the above it is clear that when the crop is mass produced through its traditional and improved varieties, fully utilized and marketed; may increase farmers' income and livelihoods and contribute to the producing country's gross domestic product (GDP), agricultural export base and offer international agricultural market penetration opportunity. In addition, increased production of this crop may also help in reducing the number of people

(about 842 million) reported to be either hungry or food insecure in the world [14].

According to [15] the first law of demand states that "The higher the price of a commodity, the lower the quantity demanded and the lower the price, the higher the quantity demanded, *ceteris paribus*" Similarly, [15] added that the law of supply states that "The higher the price of a commodity, the higher the quantity supplied or vice versa". In consideration of the afore-stated laws, the market situation of breadfruit is paradoxical. This is in the sense that the crop's high and increasing demand does not seem to be leading to an increase in its cultivation as the law of supply indicates. Various reasons were attributed to be the cause and some of them are conflicting and require further investigation. For example, [1] reported that farmers' lack of information on crop's innovations' and cost are some of the reasons why farmers do not exploit their market opportunities. On breadfruit, [16] *inter alia* attributed the reason to long gestation period of the traditional varieties. But there is evidence that improved breadfruit varieties exist which have short gestation periods of 3-4 years than that of the traditional varieties with a gestation period of about 10 years [17,13].

Instead of reports on breadfruit increasing supply due to its high price and increasing demand, authors have enlisted it to be an endangered species [18,13,16]. Based on the foregoing, it becomes clear that there are still information and market research gaps on breadfruit which require investigation. This raises the following research questions: Are farmers aware of the existence of improved breadfruit saplings? To what extent have farmers adopted improved breadfruit? Are farmers willing to adopt breadfruit technologies? Why do some farmers not adopt improved breadfruit? The broad objective of the study was to analyse improved breadfruit awareness and adoption situation in Southeast Nigeria. The specific objectives were to: Examine Farmers' awareness status on improved breadfruit existence. Access improved breadfruit adoption status. Examine farmer's willingness to adopt new breadfruit (NBF) and identify the reasons why some farmers adopt new breadfruit while others in the same community do not adopt.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was conducted in Anambra and Enugu states of Southeast Nigeria political Zone. The

zone is located within latitude  $4^{\circ}47^1$  N and  $7^{\circ}7^1$  N and longitude  $7^{\circ}54^1$  E and  $8^{\circ}27^1$  E. Southeast Nigeria is in the tropical rain forest region of Nigeria. It is made up of five states: Abia, Anambra, Enugu, Ebonyi and Imo states. Anambra and Enugu States were purposively selected for the study because breadfruit is one of their major home garden tree crops.

Anambra State situated between latitude  $5^{\circ}38^1$  N to  $6^{\circ}47^1$  N and longitude  $6^{\circ}36^1$  to  $7^{\circ}21^1$ . It shares boundary with Enugu State in the east, River Niger and Delta State in the west, Kogi State in the North and Imo State in the South. Anambra State has 21 Local Government Areas (LGA) and four agricultural zones. Enugu State lies between latitudes  $5^{\circ}56^1$  North and  $7^{\circ}06^1$  North and longitude  $6^{\circ}53^1$  and  $7^{\circ}55^1$  East. Enugu State is bounded in the east by Ebonyi State, in the West by Anambra State, in the North by Benue and Kogi States and in the South by Abia and Imo States [19]. The State has 17 LGAs. Thirteen communities spread in ten LGAs of the states were used for the study. The communities and the LGAs are listed in Table 1. The LGAs and the communities were purposively selected because Agricultural Development Programme (ADP) staffs that assisted in the research considered them suitable. In addition, Igbariam which is one of the study communities was purposively selected because it contains farmers from different parts of Anambra and from other states of the Southeast Nigerian region. This is because it contains the remains of the farm settlement established in the 1960s by the Eastern Nigerian regional government.

## **2.2 Data Collection**

A questionnaire was designed, pre-tested and used for data collection. The questionnaire contains questions on farmers': improved breadfruit awareness and adoption status, willingness to adopt new breadfruit and reasons why they did not adopt the new breadfruit saplings. For the aforesaid reasons, the questionnaire used the following five point Likert type scales (1 – 5): 1 (Not important), 2 (of some important), 3 (important), 4 (very important), 5 (extremely important). The Likert type scales were expressed in percentage. This was helpful in understanding the levels of importance which the farmers (respondents) attached to each of the reasons they gave. Twenty (20) respondents selected purposively from two communities were used for the pre-test. Experience gained from the pre-test helped in the modifications of some of the questions in the real questionnaire and

added value to the study's validity and reliability. The questionnaire were used to collect information on farmers' improved breadfruit awareness and adoption status, farmers' willingness to adopt improved breadfruit technologies and on the reasons why they did not adopt the crop's improved varieties. In addition, two focus group discussions and an in-depth interview were respectively conducted for accessing initial information used in the development of the questionnaire and in verifying the price of the improved breadfruit and those of other improved crop's planting materials. Accessed with the questionnaire were whether farmers were aware of the existence of improved breadfruit or not, those respondents who were aware of the new breadfruit existence were requested to reveal whether they had adopted it or not. The respondents who had not adopted it were requested to reveal whether they were willing to adopt the crop's improved varieties or not.

The survey questionnaire was used to collect information on farmer's new breadfruit awareness and adoption status, farmers' willingness to adopt improved breadfruit and on the reasons why farmers do not adopt budded breadfruit saplings. In this study, improved breadfruit (IBF), new breadfruit (NBF) and budded breadfruit (BBF) were used interchangeably and they mean improved breadfruit saplings that were scientifically developed. An in-depth interview was used to verify NBF and other improved crops' price issues raised by the respondents during the questionnaire survey.

## **2.3 Sampling Method**

In sample selection for the survey a well designed questionnaire involved multi- stage purposive sampling techniques were adopted in the selection of respondents for the study. Three stages were involved. In the first stage, five (5) local government area (LGAs) were selected from both Anambra and Enugu States. In the second stage, one (1) community was selected from each of the LGAs except Nsukka where two (2) communities were selected and Anambra LGA were three (3) communities were selected. The LGAs and the communities were purposively selected because of their prominence in the production and marketing of improved breadfruit among the communities. Two communities were selected from Nsukka LGA because of the aforementioned reason. In addition, Nsukka LGA is a model one which may be a good

representative of the other LGAs and because it has one of the biggest breadfruit markets in the selected LGAs of Enugu State. The following communities presented in Table 1 were purposively sampled from Enugu State: Udi, Obinofia Ndiuno, Nguru, Edem Ani, Umuozzi and Orba. For four major reasons three communities were selected from Anambra East LGA. First, the LGA contains important agricultural communities. Second, Igbariam farm settlement of the 1960s which was established by the Eastern Nigerian government is in the LGA and improved breadfruit trees were found to have been adopted by farmers in the farm settlement. Third, two of the important agricultural product markets named Eke Otuocho and Oye-farm are in the LGA. Fourth, there is the need to study one of the many riverside communities of the LGA communities for better understanding of their breadfruit production condition. The same purposive sampling process was used in the selection of the following Anambra State communities shown in Table 1: Amawbia, Umunachi, Oko, Ukpor, Igbariam, Nando and Aguleri. In third stage, 20 farmers selected through a simple random sampling process from each of the 13 communities drawn from the 10 LGAs of the two states were interviewed using the trained enumerators and the questionnaire. This totalled 260 respondents for the questionnaire survey. Two key informant interviews (KIIs) and two focus group discussions (FGDs) were conducted to collect group information from farmers on the objectives of the study. From the respondents, an in-depth interview (II) was conducted for more detailed

information on the price of improved breadfruit and on the price of other improved crops' planting materials.

## 2.4 Data Analysis

The data collected were interpreted and summarised relative to the objectives. Objectives 1 to 3 were analysed using basic descriptive statistics such as percentages, Figures and a Table.

## 3. RESULTS AND DISCUSSION

### 3.1 Farmers' Awareness Status on New Breadfruit

Table 2 shows that a larger proportion (54%) of the respondents indicated that were not aware of the existence of improved breadfruit. The result further revealed that a significant proportion of the farmers 46% were aware of the existence of the breadfruit innovation.

The implication is that lack of farmers' awareness was a significant contributory reason for low adoption of new breadfruit and non-exploitation of the market opportunities in breadfruit subsector. The result is consistent with the findings of many authors who reported that awareness of an innovation tends to increase adoption [20,21,22,23,24]. In particular, the result on awareness is in support of [16] who recommended that a yearly trade fair should be organized for awareness creation of the potential of breadfruit cultivation.

**Table 1. Distribution of the communities used for the survey questionnaire**

State/ LGA	Community	No. of farmers
<b>Anambra State</b>		
Awka South	Amawbia	20
Dunukofia	Umunachi	20
Orumba	Oko	20
Nnewi North	Ukpor	20
Anambra East	Igbariam	20
Anambra East	Nando	20
Anambra East	Aguleri	20
<b>Enugu State</b>		
Udi	Udi	20
Ezeagu	Obinofia Niuno	20
Igboeze North	Umuozzi	20
Udenu	Orba	20
Nsukka	Nguru	20
Nsukka	Edem-Ani	20
<b>Total</b>		<b>260</b>

Source, Field Survey, 2014

### 3.2 New Breadfruit Adoption Status

Fig. 1 shows that ,majority( 79.53%) of the respondents had not adopted improved breadfruit saplings indicating that there was low adoption 20.47% of the technology in the study area. The implication is that overwhelming majority of the farmers in the study area had not adopted the new breadfruit, confirming that market opportunities in the crop's innovation have not been exploited.

This result is in agreement with established literature on adoption studies which reported that many of the effective innovations have not earned success in solving the problems for which they were constructed due to non-adoption or low adoption irrespective of their advantageous characteristics over the older ones [20,25,26,27,28]. Hence, [29] reported that inadequate access to production resources is an aspect of rural poverty. It further, reveals that farmers' income and livelihoods can be enhanced with their access to breadfruit technologies. The result is also in line with [30] who suggested that policies aimed at improving agricultural labour productivity should focus more on access of improved planting materials to rural dwellers at affordable rates. The result indicates that breadfruit requires serious policy decisions and to help achieve its increased production and utilization for food security and market development.

### 3.3 Farmers' Willingness to Adopt New Breadfruit (NBF)

Fig. 2 reveals that, Majority (88%) of the respondents were willing to adopt new breadfruit. The implication of the results is that an

overwhelming majority of the farmers were willing to adopt new breadfruit. The result, however, reveals that a very few proportion of the farmers 12% were not willing to adopt budded breadfruit suggesting that there could be other reasons for low adoption of breadfruit innovation which need identification. This result is contrary with the study conducted in Sweden where subsidy and incentives were recommended to encourage farmers' willingness to establish energy crops [31,32]. The reason for this may be because those energy crops might not be multipurpose crops unlike breadfruit which is one of the most important multipurpose tree crops in the traditional agroforestry systems of South-eastern Nigeria.

### 3.4 Reasons why Some Farmers Adopt New Breadfruit While Others in the Same Community do not Adopt

From the Table 2 revealed some of the major reasons why some farmers do not adopt bread fruit were: Lack of access to NBF planting material in (83.64%) of the respondents, Lack of space for planting in HMG or near home (62.13%), High cost of new breadfruit saplings (57.21%), and lack of awareness of new BF existence (54.33). The result revealed that lack of access to new breadfruit was ranked highest and of extreme importance among the reasons. The result shows that lack of farmers' access to new breadfruit planting materials is the most important reason.

An in-depth interview (II) at Oko reveals that breadfruit, coconut and citrus planting materials were each sold at N500.00 by official crop providers (II: OK/22/03/13). This reveals that the price is high and can be higher when resold by

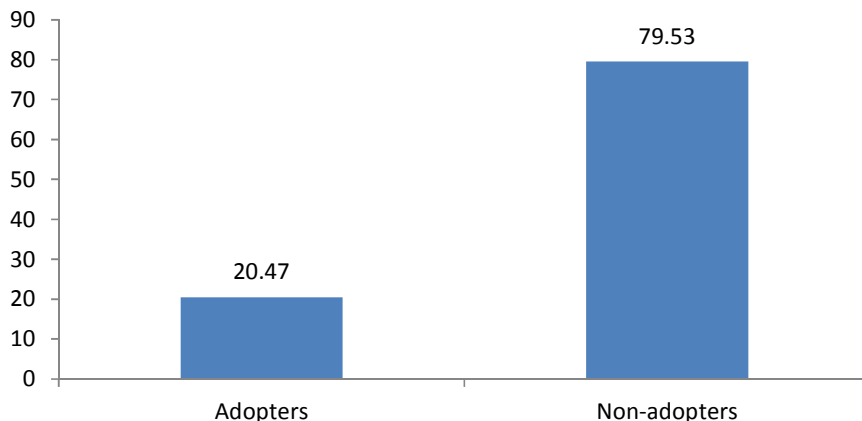
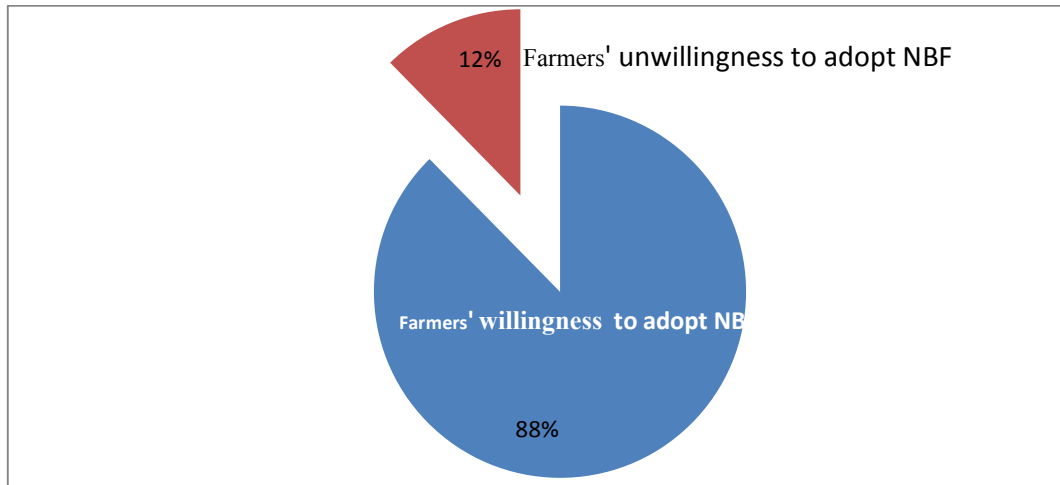


Fig. 1. New breadfruit adoption status of the study area



**Fig. 2. Farmers' willingness and unwillingness to adopt NBF**

**Table 2. Reasons why some farmers did not adopt new breadfruit (NBF) in Southeast Nigeria**

Reasons for not adopting NBF (2-5)	Total Re(n)	Not IMP (1)	of some IMP (2)	IMP (3)	Very IMP (4)	Extremely IMP (5)	Total % of IMP levels (2-5)
Lack of access to NBF Planting material	208	16.35	7.69	9.13	21.15	45.67	83.64
High cost of NBF	201	42.79	17.41	15.92	15.92	7.96	57.21
Lack of Awareness of NBF Existence	208	45.67	6.73	12.02	18.75	16.83	54.33
Drudgeries in BF depulping	200	66.00	11.50	12.50	7.50	2.50	34
No space for planting in HMG	206	37.86	12.62	11.65	0.19	27.67	62.13
Poor performance of NBF	194	89.18	6.70	3.61	0.00	0.52	10.83
Poor market of NBF	194	89.69	8.25	2.06	0.00	0.00	10.31
Preference for TBTs (traditional BF trees)	193	84.46	6.74	4.66	2.07	2.07	15.54
Do not like BF consumption	141	97.87	2.13	0.00	0.00	0.00	2.13
Preference for other tree crops	191	65.45	17.28	13.61	2.09	1.57	34.55
Belief against TBF planting	149	91.95	6.04	1.34	0.00	0.67	8.05
Reluctance/ Procrastination	188	70.21	11.70	12.77	3.19	2.13	29.72

Source: Field Survey, 2014. Key: 1, 2, 3, 4, 5 are 5 point Likert type scales in percentage, IMP = Important, Re = Responses, BF = breadfruit, HMG = Home Garden

private crop providers. In evidence, a farmer in a focus group discussion (FGD) at Ibagwaka reported: “We have the land for increased planting of new breadfruit. If it is supplied to us, we are going to buy as long as the price is affordable” (FGD: IB/14/02/13). The implication is that the major reasons why some farmers adopted NBF while others in the same community do not adopt were respectively: lack of access of new breadfruit planting material,

lack of space for planting in HMG or near home, lack of awareness and high cost of new breadfruit planting materials.

This result is in agreement with the findings of many researchers such as [25,26,28,29] who found that unavailability of planting materials hinders adoption of crop innovations. The result on awareness has been discussed in section 3.1. With respect to high cost of planting materials,

the result supports the finding of [33] which revealed that adoption potential may be increased by reducing establishment costs. For access to planting materials which is found to be the most important, the result agreed with [28] who suggested that policies aimed at improving agricultural labour productivity should focus more on access of improved planting materials to rural dwellers at affordable rates. This might be the reason why [30] reported that inadequate access to production resources is an aspect of rural poverty.

#### 4. CONCLUSIONS AND RECOMMENDATIONS

The study reveals that: there is low adoption of improved breadfruit in the study area, majority of the respondents were willing to adopt improved breadfruit varieties, the major reasons for poor adoption of breadfruit improved varieties were: lack of access to its planting material, high cost and lack of awareness of the crop's technologies existence.

Adequate policy decisions should be taken on the crop by Nigerian policy makers for exploitation of its' comparative production, processing, and marketing advantages.

Awareness creation should be made by agricultural development agencies on the crop and its technologies made available to farmers and investors at affordable costs.

#### COMPETING INTERESTS

Author has declared that no competing interests exist.

#### REFERENCES

1. Markelova H, Mwangi E. Collective action for smallholder market access: Evidence and implications for Africa. Review of Policy Research. 2010;27(5):621-640.
2. Omobuwajo TO, Akande EA, Sanni LA. Selected physical, mechanical and aerodynamic properties of African breadfruit (*Treculia africana*) seeds. Journal of Food Engineering. 1999b;40: 241-244.
3. Nwabueze ITU, Iwe MO, Akobundu ENT. Physical characteristics and acceptability of extruded african breadfruit-based snacks. Journal of Food Quality. 2008;31:142-155.
4. Enibe DO. Analysis of the factors constraining an increase in breadfruit planting in Rural Communities of Southeast Nigeria. Proceeding of the 14<sup>th</sup> Students International Summit held at Kasetsart University, Kamphaeng Seen Campus, Thailand. Published by the Centre for International Programs (CIP), Tokyo University of Agriculture, Japan; 2014.  
Available:<http://www.nodai.ac.jp/cip/iss/14thiss/proceedings/index.html>
5. Nwabueze TU. Water/oil absorption and solubility indices of extruded African breadfruit (*Treculia africana*) blends. Journal of Food Technology. 2006;4(1):64-69.
6. Runsewe-Abiodun OAO, Olanrewaju DM, Akesode FA. Efficacy of the African breadfruit (*Treculia africana*) in the nutritional rehabilitation of children with protein-energy malnutrition. Nigerian Journal of Pediatrics. 2001;28(4):128-134.
7. Okeke EC, Eneobong HN, Uzuegbunam AO, Ozioko AO, Kuhnlein H. Igbo traditional food system: Documentation, uses and research needs. Pakistan Journal of Nutrition. 2008;7:365-376.
8. Enibe SO. Design, construction and testing of African breadfruit depulping machine. Journal of Institute of Agricultural Engineers, Summer. 2001;6-21.
9. Nzekwe U, Amujiri AN. Effects of storage duration and methods on the shelf –life of the seed of African breadfruit, *Treculia africana* Decne, Moraceae. Inter. Jour. of Scientific Research. 2013;1(3):15-21.
10. Enibe DO. *Treculia africana* consumer acceptability test in South Eastern Nigeria. Discovery and Innovation, African Science Publishers. 2007a;19:S271-273.
11. Enibe DO. *Treculia africana* consumer acceptability and utilization for food security and industrial development in South Eastern Nigeria. In: 41<sup>st</sup> Annual Conference Proceeding of the Agricultural Society of Nigeria, Ahamadu Bello University, Zaria, Nigeria. Agricultural Society of Nigeria (A S N). 2007b;455-458.
12. Okeke EC, Eneobong HN, Uzuegbunam AO, Ozioko AO, Kuhnlein H. Igbo traditional food system: Documentation, uses and research needs. Pakistan Journal of Nutrition. 2008;7:365-376.
13. Nzekwe U, Ojeifor IM, Nworie HE. Assessment of the gestation period and economic yield of African breadfruit,

- Treculia africana*, Var. *africana* Decne, Moraceae. Journal of Tropical Agriculture. 2010a;9:18-23.
14. Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), and World Food Programme (WFP). The State of Food Insecurity in the World: The Multiple Dimensions of Food Security. Rome, FAO; 2013.
  15. Anyaele JU. Comprehensive economics for senior secondary schools. A. Johnson Publishers LTD; Ikate, Surulere, Lagos.
  16. Nuga OO, Ofodile EAU. Potentials of *Treculia africana* Decne - An endangered species of Southern Nigeria. Journal of Agriculture and Social Research (JASR). 2010;10:91-98.
  17. Okafor JC. Promising trees for agroforestry in Southern Nigeria, Tokyo, Japan, United Nations University Publication; 1990.
  18. Baiyeri KP, Mbah BN. Surface sterilization and duration of seed storage influenced, emergence and seedling quality of African breadfruit (*Treculia africana* Decne). African Journal of Biotechnology. 2006a;5(15):1393-1396.
  19. Eze CO, Chah JM, Uddin IO, Anugwa IJ. Bio-security measures employed by poultry farmers in Enugu State Nigeria. Journal of Agricultural Extension. 2017;21(3):89-95.
  20. Barlow C. The market for new tree crop technology: A Sumatran case. Journal of Agricultural Economics. 1997;48:193-210.
  21. Ramji NP, Khem SR, Gopal TB. Adoption of agroforestry in the hills of Nepal: A logistic regression analysis. Agricultural Systems. 2002;72:177-196.
  22. Subedi M, Hocking TJ, Fullen MA, McCrear AR, Milne E, Bo-zhi WU, Mitchell DJ. An awareness-adoption matrix for strategic decision making in agricultural development projects: A case study in Yunnan Province, China. Agricultural Sciences in China. 2009;8(9):1112-1119.
  23. Chapman LJ, Astrid NC, Be-Tzion K. Evaluation of a 3 year intervention to increase adoption of safer nursery crop production practices. Applied Ergonomics. 2010;41:18-26.
  24. Chang H, Chen Y. Are participators in the retirement program likely to grow energy crops? Applied Energy. 2011;88:3183-3188.
  25. Ramji PN, Thapa GB. Impact of agroforestry intervention on soil fertility and farm income under the subsistence farming system of the middle hills, Nepal. Agriculture, Ecosystem and Environment. 2001;84:157-167.
  26. Michele M, David PJ, Amir GA. The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: Where are we on the learning curve? Agricultural Systems. 2003;75:215-234.
  27. Llewellyn RS. Information quality and effectiveness for more rapid adoption decision by farmers. Field Crop Research. 2007;104:148-156.
  28. Chibwana C, Fisher M, Shively G. Cropland allocation effects of agricultural input subsidies in Malawi. World Development. 2011;40(1):124-133.
  29. Ugwu DS. Crop production in the compound farming system of South Eastern Nigeria. Journal of Agriculture and Social Research (JASR). 2006;6:1-10.
  30. O'Gorman M, Pandey M. Cross-country disparity in agricultural productivity: Quantifying the role of modern seed adoption. Journal of Development Studies. 2010;46(10):1767-1785.
  31. Borejesson P. Environmental effects of energy crop cultivation in Sweden-II: Economic evaluation. Biomass and Bioenergy. 1999;16:155-170.
  32. Ericsson K, Roseenqvist H, Nilsson JL. Energy crop production costs in the EU. Biomass and Bioenergy. 2009;33:1577-1586.
  33. Franzel S. Socioeconomic factors affecting the adoption potential of improved tree fallows in Africa. Agroforestry Systems. 1999;47:305-321.

© 2019 Enibe; 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://www.sdiarticle3.com/review-history/47120>