



## Farmers' indigenous knowledge of breadfruits' nutritional, medicinal and fodder values in Southeast Nigeria

Enibe, David Okechukwu,

Department of Agricultural Economics and Extension, Chukwuemeka Odumegwu

Ojukwu University Igbariam, Anambra State, Nigeria.

Corresponding Author: Enibe, David Okechukwu, Department of Agricultural Economics and Extension, Chukwuemeka Odumegwu

E-mail: [enibedav@yahoo.com](mailto:enibedav@yahoo.com)

### Abstract

This study investigated farmers' indigenous knowledge gap of Traditional breadfruit (*Treculia africana*) nutritional, medicinal and utilization values in Southeast Nigeria. Data for the study were collected via a structured questionnaire administered to 260 farmers from 13 communities in Anambra and Enugu States of Southeast Nigeria. Data collected were analysed using descriptive statistics such as percentage, mean and standard deviation. The result *inter alia* reveals that: majority of the farmers (89.2%) have indigenous knowledge of breadfruit seeds as very good nutritional and medicinal food item, farmers use the seeds' after cook residues as beverage drinks. The general tendency is a greater use of the seeds as against other body parts of the tree. The factors limiting farmers' consumption of breadfruit in the study area include lack of finance (55.1%) and its processing drudgeries (10.2%). The study concludes that while some breadfruit body parts are used as food, feeds and medicine, its other parts are highly underutilized and under researched. The paper recommends policy intervention for the crop's increased research and production for food security and development of different important industrial sectors such as beverage drinks, animal feeds and pharmaceutical industries.

**Key words: Breadfruit, indigenous knowledge, food, industries, policy.**

### INTRODUCTION

Many crop species and tree species are through indigenous knowledge known and used inside their native lands. Nigerian crops and diets have been studies in different perspective such as in medicine, public health and biology (Petrikova *et al*, 2023). In different parts of the world, people are noted to access different values from tree species and such values include food, medicine, snacks and symbols of love (Enibe, 2020). There are little sociological research on what Nigerian diets includes, how diets differ in population groups and sub groups and on how crop's values and uses change or evolve over time among consumers (Petrikova, et al, 2023).

Hunger, poverty and malnutrition problems in vulnerable countries is revealed to be attracting the attention of international institutions and humanitarian agencies (Chiaka *et al*, 2022). Such agencies include the United Nations World Food Programme (WFP) and Food and Agricultural Organization (FAO). This is why the United Nations Organization (UNO) is reported to have made it a crucial target issue in her sustainable development goals (SDGs) to be realized by 2030. According to Chiaka *et al*, (2023), reports gotten so far from various countries is not encouraging, suggesting that the hunger, poverty and malnutrition problems may not be solved in those vulnerable countries as targeted. There is, therefore every need to increase efforts for addressing the problems which were reported to worsen in developing countries due to the increased unemployment situations, low calorie consumption, lack of attention to food diversity and climate change problems (Chiaka *et al*, 2022). Africa's efforts to address the problems are reported to be suboptimal and inadequate irrespective her 2003 signing of the Maputo Declaration on Agriculture and Security and adequate (52%) available arable land (Chiaka *et al*, 2022). In consideration of the above, there is the need to research further on multipurpose and nutritious food crops and tree species to finding out how they can be used to improve calorie consumption and decrease malnutrition.

This is important because consumption of staple foods in middle-low income countries favours high energy, high-fat and high-sugar processed foods (Petrikova, 2023). Such food items in the study area include yam, cassava, rice and maize. This suggests that more nutritious food items are neglected and underutilized and that there is the need to change consumption pattern and move towards increased consumption of more meat or animal products and nutritious food crops that are available in different agricultural areas and lands. But there is the need to understand: how such traditional food crops or animals species are used, why some of them are underutilized even in their native lands where the people may have adequate indigenous knowledge of their socio-economic, nutritional and medicinal values. How their values can be added may be known through the ways farmers or native people use them.

This idea is striking for Nigeria as Africa's most populous country because she is noted to: rank 98<sup>th</sup> out of 107 countries of the world 2020 Global Hunger index, second rank among countries with stunted children and her high estimated number of people (41% - 87 million) who live below international poverty line (Chiaka *et al*, 2022). In addition, consumption research in Nigeria is found to be inadequate and they concentrated on purchasing power, nutrient deficiency, overweight or obesity and household diversity (Chiaka *et al*, 2022). Ammann *et al* (2023) reported that current food system is not sustainable and contributes to climate crisis.

In the study area, Enibe (2018) argued that the uses and potential values of breadfruit positions it a good crop species for farmers to use in building resilience and adaptation to climate stress. African Breadfruit referred is further revealed to be the crop that is first remembered when considering all the food crops of nutritional importance with market potentials, cultural values (Enibe, 2019). The crop has nostalgia connections and this may be why it is demanded by African consumers in different parts of the world as noted by Enibe (2019). The Breadfruit referred here is *Treculia africana* which is a native of South-eastern Nigeria that can be found as forest trees in some tropical African countries such as Cameroun, Ghana and Sudan. It is a member of the plant classification family Moraceae and of genus *Treculia* (Enibe, 2018). It is one of the important tree crops in traditional agroforestry systems of Southeast Nigeria where it is integrated into a mixed cropping system with other tree crops such as oil palm, pear and coconuts and also with food crops such as

yam, coco-yam, plantain and bananas. The seed is an important traditional staple food of South Eastern Nigeria where it is popularly called "Ukwa" (Enibe, 2018).

Series of studies have been conducted on breadfruit. Such studies reveals that the seed contains 12% oil; 18% protein and 50% carbohydrate and several important vitamins and minerals such as potassium (K), magnesium (Mg) and zinc (Zn) (Osabor et al, 2009; Omobuwajo, 1999a; Lawal, 1986). It is reported that little or no research has been conducted on the crop's sociology of production (Enibe, 2018) and production process is known to end at the consumers' level. Studies also reveals that breadfruit can be used to produce several by-products (Enibe, 2019).

The problem is that the aspects of the breadfruit tree parts that are used and those underutilized have not been clearly distinguished. The result may give insight to researchers and industrial operators on the potentials areas of research and value addition to the crop. The other problem is that farmers in the study area have not been adequately segregated in various ways as they relate with breadfruit and such areas include indigenous knowledge of the crop, season and off season consumption of the crop and on other ways they differ on the crop's utilizations. Understanding of these issues may provide information on the other areas of the crop needing further research and on factors contributing to its limited production, consumption and utilization.

In consideration of above, the following pertinent research questions are raised: How do consumers differ in their breadfruit season and off season consumption? Why do consumers not increase breadfruit consumption in the study area? Do farmers differ in their minds while consuming breadfruit as nutritious and medicinal food? Are there differences among farmers in their utilization of breadfruit tree parts as medicine and fodder? Stratify farmers according to their use breadfruit body parts as medicine and fodder. The broad objective of the study is to examine farmers' indigenous knowledge of breadfruit use values in Southeast Nigeria. The specific objectives are to: Assess farmers' differences in their breadfruit season and off season consumption. Identify the reasons for low breadfruit consumption in the study area. Understand farmers' indigenous knowledge of breadfruit as a nutritious and medicinal food item. Assess farmers' indigenous knowledge of breadfruit body part's herbal uses. Identify the parts of breadfruit trees that are still under researched and underutilized. Stratify farmers according to their use of breadfruit in ruminant animal's feeding.

## **MATERIALS AND METHODS**

### **2.1 Study Area**

The study was done in Anambra and Enugu states of Southeast Nigerian political Zone. The zone is located within latitude 4°47' N and 7°71' N and longitude 7°54' E and 8°27' E. Southeast Nigeria is in the tropical rain forest region of Nigeria. It comprises these 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 and farm field food security tree crops. Anambra State situates between latitude 5°38' N to 6°47' N and longitude 6°36' to 7°21'. 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 is sub divided into four agricultural zones and 21 Local Government Areas (LGA). Enugu State situates between latitudes 5°56' North and 7°06' North and

longitude 6°53'1" and 7°55'1" East. The 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 subdivided into 17 LGAs. Thirteen communities selected from ten LGAs of the two states were utilized for the study. The town communities and the LGAs are presented in Table 1. The LGAs and the communities were purposively selected because Agricultural Development Programme (ADP) staffs who assisted the researcher considered them suitable. In addition, Igbariam which is one of the study communities was purposively selected because it contains farmers from different areas of Anambra and from other states of Southeast Nigerian. This is because it contains the remains of the farm settlement established in the 1960s by the Eastern Nigerian regional government headed by Michael I. Okpala.

## **2.2 Data Collection**

A pre-tested questionnaire was used for the study's data collection. The questionnaire *inter alia* contained questions on farmers': season and off season consumption of breadfruit, weekly, fortnightly and monthly consumption of breadfruit, reasons why farmers do not consume more breadfruit, farmers' mind on breadfruit consumption, kind of drink farmers serve while consuming breadfruit and medicinal uses of the different body parts of breadfruit. The questionnaire was also used to access farmers' ownership of ruminant animals and their utilization of the crop for feeding of their ruminant animals.

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 research questionnaire and this added value to the study's validity and reliability. The questionnaire were used to collect information on: the frequency of breadfruit consumption during its season and off season, why farmers do not consume more breadfruit as they do to other food items, farmers' mind while consuming breadfruit, kind of drink served during consumption of the crop, medicinal uses of the crop ruminant ownership of the farmers and their fodder uses of breadfruit parts.

## **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 the two study states (Anambra and Enugu States). In the second stage, one (1) town community was selected from each of the LGAs except Nsukka and Anambra LGAs where two (2) and three (3) town communities were respectively selected. The LGAs and the communities were purposively selected because of their prominence in the production and marketing of breadfruit seeds in assembly markets of the communities. Two communities were selected from Nsukka LGA because of the aforesaid reason. Moreover, Nsukka LGA is a model one which may be a better representative of the other LGAs in the state and because it has one of the biggest breadfruit seeds markets in the LGAs selected from Enugu State. The following communities listed 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 town and village communities. Second, Igbariam farm settlement of the 1960s set up by the Eastern Nigerian government is in the LGA and improved breadfruit trees were found to have been adopted in the

farms of the settlers. Third, two of the important agricultural products' markets respectively called Eke Otuocha and Oye-farm are some of the LGA's notable land marks. Fourth, there is the need to study one of the many riverside town communities of the LGA for better understanding of their breadfruit production and marketing situation. The same purposive sampling process was adopted in the selection of the Anambra State communities alphabetically listed in Table 1: Amawbia, Umunachi, Oko, Ukpok, Igbariam, Nando and Aguleri. In third stage, 20 farmers selected via a simple random sampling process from each of the 13 communities drawn from the 10 LGAs of the two states were interviewed using the pretested questionnaire and trained enumerators. This gave a grand total of 260 respondents for the survey.

**2.4 Data Analysis**

The data collected were interpreted and summarized as they affect the objectives of the objectives. Objectives 1 to 4 were analyzed using basic descriptive statistics such as frequency distribution, percentages, mean, standard deviation, and Tables.

**3. RESULT AND DISCUSSION**

**3.1 Breadfruit Consumption:**

Table 2 shows that 29.8% of the respondents consume breadfruit once a month in its fruiting seasons while 41.7% do not consume it out of season. Table 2 also shows that in season, 26.3% consume the seed once a week while 21.9 consume it twice a week. Also, out of season consumption of breadfruit is 2.9% a week and twice a week, 5.9% every two weeks, 7.2% twice a month, 39.1% once a month. Another striking result of the study is that while none of the farmers are none breadfruit consumers during its fruiting season, large proportion of them do not consume the crop during its off seasons. The result suggests that breadfruit consumption in the study area is irregular and varies from one household to another in its seasons and off seasons. An in-depth interviewee reported that the seeds are available in the markets during the off seasons, but sold at very high prices which poor people cannot afford to spend just to feed his or her family in a meal.

The result suggests that: all farmers consume breadfruit during its fruiting season, its consumption is respectively limited to once a month (29.88%), once a week (26.29%) and twice a week (21.91%) and that consumption of the crop tends to increase from zero during the seasons to a large proportion (41.70%) during its off seasons. The result implies that seasonality and high price of the seeds are the significant factors affecting increased consumption of the crop. The result is in agreement with Uluocha *et al* (2016) who reported that the crop's seed is in constant demand, but scarce most times. The result further agrees with Enibe (2017) who found that the seed is sold in assembly markets at an average price of N438.00 per Kg and N1, 500.00 Per Kg during its high price seasons such as December and January months. The result supports Ohajianya and Osuafor 2017 who concluded that household demand for breadfruit's diverse usages constitute useful grounds for the crop's planting expansion.

**Table 2: Frequency of breadfruit consumption in and out of season (n=251; 235)**

Variable	Frequency	% of total	Mean	SD
----------	-----------	------------	------	----

On season Breadfruit consumption			41.83	28.44
Once per week	66	26.29		
Twice per week		55	21.91	
Once per Fortnight		31	12.35	
Twice a Month		24	9.56	
Once a Month		75	29.88	
Non Breadfruit consumer		0	0	
Total		251	100	
Out of Season Breadfruit Consumption			39.17	432.47
Once per week		72.98		
Twice per week		72.98		
Once per Fortnight	14	5.96		
Twice a Month		177.23		
Once a Month	92	39.15		
Non Breadfruit consumer	98	41.70		
Total	235	100		

**Source: Field Survey, 2014.**

### **3.2. Reasons for not consuming more breadfruit**

Table 3 shows that majority(55.1%) of the respondents were limited from consuming more breadfruit by finance, a significant proportion of the respondents(28.9%) could not consume more of it because they preferred to generate income with it while 10.2 % of them were limited from consuming more of it due to the drudgeries involved in its processing. The result suggests that the three major factors which limits majority of the respondents from consuming more breadfruit were respectively: lack of finance, desire to use it for income generation and the drudgeries in its processing. The implication of the result is that: breadfruit is an important food security and income generating crop whose consumption is mostly limited by lack of finance, farmers receive its high price signal which should have induced them for increased planting of the trees, processing technologies on the crop will add values that will increase its production, consumption and utilization potentials.

The result supports reports of researchers on the crop who found that breadfruit has: wide acceptance as a staple food crop in Nigeria and overseas (Omobuwajo, 1999b; Nwabueze et al 2008; become a very high income earner (Nuga and Ofodile, 2010),emerged to be a cash crop,and is the most costly foodseed item sold in South Eastern Nigeria (Enibe, 2007). The result is in agreement with Enibe (2019) who in a study of farmers' improved breadfruit awareness and adoption status recommended that adequate policy decisions should be taken for exploitation of its comparative production, processing and marketing advantages.The result supports Ohajianya and Osuafor 2017 who concluded that household demand for breadfruit's diverse usages constitute useful grounds for the crop's planting expansion. The result also agrees with Enibe (2019) who recommended that awareness creation should be made by agricultural development agencies on breadfruit and its technologies made available to farmers and investors at affordable costs.In addition, Chukwuone and Okeke (2012) reported that increasing demand for Breadfruit has made it the highest income earner to rural dwellers when compared to other non-wood forest products (NWFPs) of savannah and rain forest regions of Southern Nigeria.

**Table 3: Reasons for not consuming more breadfruit (n=176)**

Variable	Frequency	% of total	Mean	SD
Reasons For not consuming more BF	25	14.36	4.40	
Lack of Finance	97	55.11		
Prefer to Sell it to get money			51	28.98
Drudgeries in its processing			18	10.23
Long cook time of breadfruit			5	2.84
Hate of breadfruit taste			1	0.57
Preference for other food items	4		2.27	
Total	176	100		

**Source: Field Survey, 2014.**

### 3.3. Farmers' mind on breadfruit consumption, meal serving combination and medicinal uses:

Table 4 shows that 52.2% of the respondents were served breadfruit meal with drinking water while 47.8% were served the meal along with its residues as beverage drink. Table 4 also shows that 89.2% of the respondents have nutrition and medicinal food in their mind when consuming breadfruit meal. On the other hand, Table 4 shows that 70.5% of the respondents do not traditionally use breadfruit or its body parts as medicine. The result suggests that: farmers in the study area have indigenous knowledge of breadfruit as nutritional and medicinal food item, a significant proportion of the farmers consume breadfruit residues as beverage drink indicating that it has the potential to be used for production of beverage drinks which can be widely accepted by consumers in the study area and beyond.

The result also suggests that aspects of breadfruit body parts are most likely to be medicinally underutilized and that lack of adequate knowledge of the medicinal values of breadfruit could be a significant factor influencing planting more of the crop's trees. Hence standard deviation (73.54) and mean (127) in Table 4 suggests that there is a significant difference between the number of the respondents that uses the crop medicinally and those that were not using it. This implies that many inhabitants of the study area were yet to have adequate medicinal knowledge of the crop.

This result is in agreement with the finding of Runsewe et al (2001) who in their study of the efficacy of *Treculia africana* in the nutritional rehabilitation of children with protein-energy malnutrition reported that the crop among others are still neglected due to inadequate knowledge of their nutritional values. Also, the result agreed with the work of Ite (2005) who reported that the decision of households to have trees in their homestead farms was influenced by knowledge of the economic and environmental values of the trees. The result also suggests that breadfruit could be good raw material in pharmaceutical and brew or beverage industries for production of drugs and beverage drinks of acceptable standard. This is mainly because the crop has been severally reported to contain important vitamins and mineral elements and because farmers have indigenous knowledge of its high nutrients composition and hence have been employing it as beverage drink in the crop's meals.

The result is in conformity with existing literature on the crop because several researchers reported that breadfruit contains many important vitamins and mineral elements. In support of high nutrient

composition of breadfruit Nuga and Ofordile (2010) reported that, “The seeds have an excellent polyvalent dietetic value whose biological value exceeds even that of soybeans”. Indeed, *Treculia africana* is reported a rich source of oil (12%), protein(18%), and carbohydrate(50%) in addition to very many other minerals and vitamins (Omobuwajo et al 1999a; Lawal, 1986). *Treculia africana* oil is found to be of comparable quality to that of groundnut, sunflower or palm kernel (Ibironke and Ajayi, 2008).Agbogidi et al (2011) reported that “Proximate analysis shows that the seeds of *Treculiaafricana* contain protein, fat, iron, ash, calcium, phosphorus, carbon, hydrogen, magnesium, iron, sulphur, crude fibre, carbohydrate, and other minerals including zinc, lead, copper, phytate, oxatate and tannin”.

**Table 4: Farmers’ mind on breadfruit consumption, meal serving combination and medicinal uses(n=245; 249; 254)**

Variable	Frequency	% of total	Mean	SD
<b>Breadfruit serving meal Drink</b>			81.67	90.94
Poor Man’s food	6		2.41	
Breadfruit and drinking water	128		52.24	
Breadfruit meal, its residues and water	117		47.76	
Total	245	100		
<b>Farmer’s Mind on breadfruit consumption</b>			62.25	106.56
Nutritional and medicinal food			222	89.16
One of those food items	145	62		
Food taken when other foods items such as				
Rice, beans and cassava are not available	7		2.81	
Total			249	100
<b>Breadfruit medicinal uses</b>	127		73.54	
Yes			75	29.53
No	179	70.47		
Total			254	100

**Source: Field Survey,2014.**

### **3.4. Farmers ruminant animals’ ownership and fodder uses of breadfruit body parts**

Table 5 shows that 61.5% of the respondents were owners of ruminant animals while 38.5% of them were not owners. Also, Table 5 shows that 79% of the ruminants’ owners feed their animals mainly with breadfruit leaves and pulps (44.9%). The result suggests that majority of the ruminants’ owners in the study area (79%) use breadfruit leaves and pulps in feeding their ruminant animals. The result also reveals that ownership of ruminant animals could be one of the factors encouraging rather than discouraging planting more of the breadfruit trees in both home gardens and in farm fields. The result further reveals that there is no significant difference between the uses of any of those breadfruit body parts by farmers in feeding their ruminant animals. The implication of the result is that while breadfruit leaves and pulps appears to be the most important breadfruit body parts which famers feed to their ruminant animals any of the pulps, leaves and seeds are good fodder and could beharnessed as feed supplement for the ruminant animals or employed as raw materials in ruminant animals’ feed industries.



The result of a negligible proportion of the farmers (1.87%) feeding their farm animals with breadfruit seeds is understandable because studies reveals that it is the seeds of the crop that are used by consumers for food and snacks. This is unlike *Artocarpus atilis* whose pulp are also consumed fresh by man just as the ruminant animals do to the pulps of *Treculia africana*.The result about farmers combined use of breadfruits’ seeds, leaves and pulps is also understandable because observation reveals that farmers collect the leaves and immature breadfruit heads which contain both immature seeds and pulps and feed their ruminants after breaking the heads. The result is in conformity with Anele et al (2009) who in their study reported that “*Treculia africana* could be harnessed as feed supplements for ruminant animals”

**Table5: Ruminants ownership and fodder uses of breadfruits’ body parts (n=244; 167; 107)**

Variable	Frequency	% of total	Mean	SD
<b>Ruminant ownership</b>	122	39.60		
Yes			15061.48	
No	94	38.52		
<b>Total</b>	244	100		
<b>Breadfruit uses as fodder</b>	83.5	68.59		
Yes	13279.04			
No			3520.96	
<b>Total</b>	167	100		
<b>Parts of breadfruit tree used as fodder</b>	17.83	18.08		
Seeds			21.87	
Leaves			23	21.50
Pulp			9	8.41
Leaves and Pulp			48	44.86
Seeds, leaves and pulp	25		23.36	
<b>Total</b>			107	100

**Source: Field Survey,2014.**

### **Summary and Conclusion**

The study found that: farmers in the study had indigenous knowledge of breadfruit as a nutritive and medicinal crop,breadfruit is a costly food item preferred in the study area than other crops such as rice, beans and maize, breadfruit consumption is limited by lack of finance, farmers desire to generate income from the seeds and there are drudgeries in its processing; breadfruit has numerous potentials and could be raw material in different industries such as food, feed, beverage drinks and pharmaceutical industries.

The study concluded that breadfruit is an important, but underutilized food, medicinal and industrial crop whose increased production is desirable for food security and development of various industries.

### **Recommendation**

Based on findings of the study the researcher recommends that:

1. Increased breadfruit research and planting by farmers should be encouraged by industries, governments, non-governmental organizations and international agencies in agriculture.
2. Food, feeds, snacks, beverages, and pharmaceuticals industries should innovate and produce new products with breadfruit body parts.
3. Proximate analysis of other body parts of breadfruit trees for determination of their in-depth medicinal properties should be done by various industries and researchers.

### **References**

- Agbogidi, O. M., Edema, N. E., and Agboje, I. (2011). Evaluation of African breadfruit (*Treculia africana*) for bioremediation in soils impacted with crude oil. *International Journal of Science and Nature*, **2**, 461 – 466.
- Ammann, J., Arbenz, A., Mack, G., Nemecek, T. and Benni, N. E. (2023). A review on policy instruments for sustainable food consumption. *Science Direct*, **36**, 338-353.
- Anele, U. Y., Arigbede, O. M., Sudekum, K. H., Oni, A. O., Jolaosho, A. O., Olanite, J. A., Adeosun, A. I., Dele, P. A., Ike, K. A., Akinola, O.B. (2009). Seasonal chemical composition, invitro fermentation and in sacco dry mater degradation of four indigenous multipurpose tree species in Nigeria. *Animal feeds and Technology*, **154**, 1-2, 47-57.
- Chiaka, J. C., Changing food consumption pattern and land requirements for food in the six geopolitical zones in Nigeria. *Foods*, **11**, 150. <https://doi.org/10.3390/foods11020150>.
- Chukwuone, N. A., and Okeke C. A. (2012). Can non – wood forest products be used in promoting household food security? Evidence from savannah and rain forest regions of Southern Nigeria. *Forest Policy and Economics*, **25**, 1 – 9.
- Enibe, D. O. (2007a). *Treculia africana* Consumer acceptability test in south easter nigeria. discovery and innovation. *African Science*, **19**, 271 - 273.
- Enibe, D. O. 2018. Analysis of the Social Barriers Constraining Increased Breadfruit Tree Cultivation in Southeast Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*. **28**(3): 1-9.
- Enibe, D. O. 2019. Farmers’ Improved breadfruit awareness and adoption status in Southeast Nigeria. *Asian Journal of Agricultural Extension, Economics, and Sociology* **29** (4):1- 8.
- Enibe, D. O. 2020. Analysis of the social and cultural values constraining increased African Star Apple production in Anambra state of Nigeria. *Advances in Social Sciences Research Journal* **7**(5):134-144.

- Ite, U. E. (2005). Tree integration in homestead farms in Southeast Nigeria: Propositions and evidence. *The Geographical Journal*, **171**, 3, 209-222.
- Lawal R. O., and Bassir O. (1986). Effects of stepwise dietary processing on the nutritional values of the seeds of *Treculia africana*. *Food Chemistry*, **19**, 245-254.
- Nuga, O. O. and Ofodile, E. A. U. 2010. Potentials of *Treculia africana* DECNE - An endangered species of Southern Nigeria. *Journal of Agriculture and Social Research (JASR)*10: 91 – 98.
- Nwabueze, I. T. U., Iwe, M. O. And Akobundu, E. N. T. (2008). Physical characteristics and acceptability of extruded african breadfruit-based snacks. *Journal of Food Quality*, **31**, 142-155.
- Ohajianya Donatus O.1. and O. O. Osuafor 2017. Economics of household demand for African breadfruit (*Treculia africana*) in Owerri Agricultural Zone of Im State, Nigeria. *International Journal of Environment, Agriculture and Biotechnology (IJEAB)* 2 (6): 2456-1878.
- Omobuwajo, T. O., Ikegwuoha H. C., Koya O. A., Ige M. T. (1999a). Design, construction and testing of a dehuller for african breadfruit (*Treculia Africana*) seeds. *Journal of Food Engineering*, **42**, 173-176.
- Omobuwajo, T. O., Akande E. A., Sanni L. A. (1999b). Selected physical, mechanical and aerodynamic properties of African breadfruit (*Treculia africana*) seeds. *Journal of Food Engineering*, **40**, 241-244.
- Osabor, V. N., Ogar, D. A., Okafor, P. C. And Egbung, G. E. (2009). Profile of the African breadfruit (*Treculia africana*). *Pakistan Journal of Nutrition.*, **8**, 7, 1005-1008.
- Petrikova, I; Bhattacharjee, R. and Fraser, P. D. (2023). The Nigerian diet and its evolution: Review of the existing literature and household survey data. *Foods*, **12**, 443.
- Runsewe-Abiodun, I., Olowu, A. O., Olanrewaju, D. M., and Akesode, F. A. (2001). Efficacy of the african breadfruit (*Treculia africana*) in the nutritional rehabilitation of children with protein-energy malnutrition. *Nigerian Journal of Pediatrics.*, **28**, 4, 128-134.
- Uluocha, O. B, Udeagha, A. U., Udofia, S. I and C. I. Duruigbo 2016. Socio-economic contribution of African breadfruit (*Treculia africana decne*) toward sustainable livelihood in Eastern, Nigeria. *Journal of Research in Forestry, Wildlife & Environment*8 (2): 40-57.