

SOCIO-ECONOMIC CONTRIBUTION OF AFRICAN BREADFRUIT (*Treculia africana* Decne) TOWARD SUSTAINABLE LIVELIHOOD IN EASTERN, NIGERIA

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ABSTRACT

*Home gardens provide perspective for conservation of plant genetic resources while contributing to improving livelihoods. The Non-Timber Forest Products (NTFPs) the conserve are gathered for household consumption and commercial uses; they have formed an inherent part of rural economy for millennia and equally serve as safety net during periods of adverse environmental changes such as famine due to crop failure. Accordingly, the study was carried out to examine the level of income generation, processing, distribution of sales as well as the importance of *Treculia africana* to food security in Southeastern, Nigeria in 2015. The study was conducted in Okigwe agricultural zone, Imo State, Nigeria. A multi-stage sampling technique was employed for this study. Data collected was analysed using descriptive statistic. The results revealed that majority of the respondents were female (53.70%) and were married (84.40%). The source of the product was mainly from the home gardens (76.70%) and the reason for harvesting was for income generation and subsistence use (household consumption) (77.78%). The product was best harvested during rainy season (68.00%) when fruits are most abundant (48.90%). Majority of respondents (57.80%) sold *Treculia africana* kernel in cigarette cup ranging from ₦110–₦160 while the weekly income was between ₦2500–₦4500. The major problem affecting price rate of *Treculia* fruits and kernels was labour (25.20%), transportation (16.90%) and local tax (22.20%). It is therefore, recommended that appropriate conservation measures be put in place using sustainable policy framework that would enhance its in situ and ex situ conservation and equally ensure its protracted use in order to increase its abundance and availability.*

Keywords: Income, dietary, culinary values, African breadfruit, ukwa, sustainable Livelihood.

INTRODUCTION

The contributions of forest based resources especially *Treculia africana* popularly known as “Ukwa” to the livelihood of rural

populace in Igbo Land South Eastern, Nigeria is enormous. This Non-Timber Forest Products (NTFPs) which are commonly found in home gardens in eastern,

Nigeria have formed an inherent part of the people's daily life for millennia. Generally, home garden provides perspective for conservation of plant genetic resources while contributing to improving livelihoods (Gbedomon *et al.*, 2015).

Accordingly, NTFPs generally serves as supplementary and alternative sources of food and income and are especially crucial in years of crop failure usually as a result of changing climate (Udeagha, 2015; Shackleton, 2014). As Chamber and Conway (1991) have defined, livelihood as ways by which people satisfies their needs or gains a living. On the other hand, in Nigeria there are several indigenous woody plants with edible fruits and vegetables of high nutritive value, which are eaten by many Nigerians in which *Treculia africana* is one of them and had played an important role sustaining the food security of the people over time. But today, these indigenous fruit producing trees serve as means of income generation to urban dwellers as well (Kola-Oladiji *et al.*, 2006). However, *Treculia africana* Decne (African

breadfruit) is a multipurpose tree crop of South east Nigeria. It is a leguminous and medicinal plant belonging to the order *Urticales* and family *Moraceae*. *Treculia africana* is a widely grown nutritional fruit tree used as a vegetable in humid South Eastern ecological zone of Nigeria and it is widely distributed in tropical Africa (Meregini, 2005; Metuno *et al.*, 2007; Agbogidi and Onomeregbor, 2008). The edible seeds are a valuable food stuff among the Igbos in particular (Okonkwo and Ubani, 2007). The seeds are potential sources of protein that help meet inadequate consumption of protein food; especially in rural parts of Nigeria. The spongy pulp (deseeded flesh) is used as fodder (Ogunleye and Parakoyi, 1992) while the seed hulls are used in several feed stuffs for livestock (Ademosun and Imevbore, 1988). The seeds are ground into powder and have been found to have bread making properties (Giami and Amasisi, 2005) and could be used for pastries (Keay, 1989), weaning foods, breakfasts cereals (Okafor, 1990; Appiah *et al.*, 2011),

alcohol (Okafor, 1990), wood production (Agbogidi and Onomeregor, 2008; WAC, 2004; Orwa et al., 2009, Jean, 2015), beverages (Sunday et al., 2009; Orwa et al., 2009, Nwabueze and Uchendu, 2011) and the tree has medicinal and environmental value (Oorts et al., 2003; Nuga and Ofodile, 2010; Orwa et al., 2009, Irvine, 1981, PARDI, 2011). *Treculia africana* (Ukwa), contribute immensely to the economy of the rural people. Its benefits are numerous, however, in Imo State; it is generously and graciously served as special delicacies in homes, eateries, restaurants, festivals and ceremonies.

However, *Treculia africana* is currently included in the list of endangered species of Southern Nigeria (Meregini, 2005) and this is quite worrisome (Nuga and Ofodile, 2010).

As a matter of fact, the species is urgently in need of priority conservation measures (Nuga and Ofodile, 2010).

The seed/kernels provide an important food source which is consumed as main dish especially in Southern Nigeria (Okafor,

1990). Baiyeri and Mbah, (2006) stated that in these areas, the seeds are variously cooked as porridge or roasted and eaten with palm kernel (*Elaeis guineensis*) and coconut (*Cocos nucifera*) as roadside snack. The seed which is highly nutritious constitute a cheap source of vitamins, minerals, proteins, carbohydrates and fats (Osuji and Owel, 2010). It is recommended for diabetic patients because of its low carbohydrate content as reported by Irvine (1981).

Many studies have focused on *Treculia africana*, investigating the potential of its extracts in medicine, nutrition and proximate analysis (Appiah et al., 2011; Nuga and Ofodile, 2010; Osabor et al., 2009; Onyekwelu and Fayosa, 2007; Oorts et al., 2003; WAC, 2004; Irvine, 1981) but very few studies had examine its contribution toward alleviating poverty in rural communities. This paper therefore, examines and highlights the potentials of *Treculia africana* contribution toward rural households' sustainable livelihood.

MATERIALS AND METHODS

Study Areas

The study was conducted in three Local Government Areas (LGAs) under the Okigwe Agricultural Zone of Imo State, Nigeria. Imo State is situated in South Eastern geopolitical zone of Nigeria. It lies within latitude $5^{\circ}10'N$ and $7^{\circ}15'N$, and longitude $6^{\circ}30'E$ and $7^{\circ}28'E$ with an area of $5,289.4\text{km}^2$ with a population of 4.7million people (NPC, 2009). The population density is over 500 persons per square kilometer (NPC, 2009). It is bordered by Abia State on the East, by the River Niger and Delta State on the West by Anambra State to the North and Rivers State to South. The State is rich in natural resources including crude oil, natural gas, lead, zinc and economically exploitable tree crops like the Iroko, mahogany, obeche, bamboo, rubber tree and oil palm trees among others. The state falls within the tropical rainforest zone; the rainy season begins in April and probably ends in October. The annual rainfall varies from

1,500 mm to 3500 mm in most part of the State (Korieocha *et al.*, 2011). In average annual temperature above $24^{\circ}C$ creates an annual relative humidity of 75% and with humidity reaching 90% in the rainy season (John *et al.*, 2014; Korieocha *et al.*, 2011; Ezebuio *et al.*, 2010). The dry season experiences two months of harmattan from late December to late February. The hottest periods are between January and March with raining starting by March or early April recently due to changing climate these weather patterns are highly irregular. Furthermore, owing to ecological disturbance, the areas original covered by forest and are currently made up of secondary re-growth of various stages of degradation (Dike, 2005; Udeagha *et al.*, 2016).The major livelihood activities of the people in the area are mainly agriculture and the soil is moderately deep and consists of imperfectly drained sandy clay loam (Okigbo, 1987; Ezebuio *et al.*, 2010; Korieocha *et al.*, 2011).

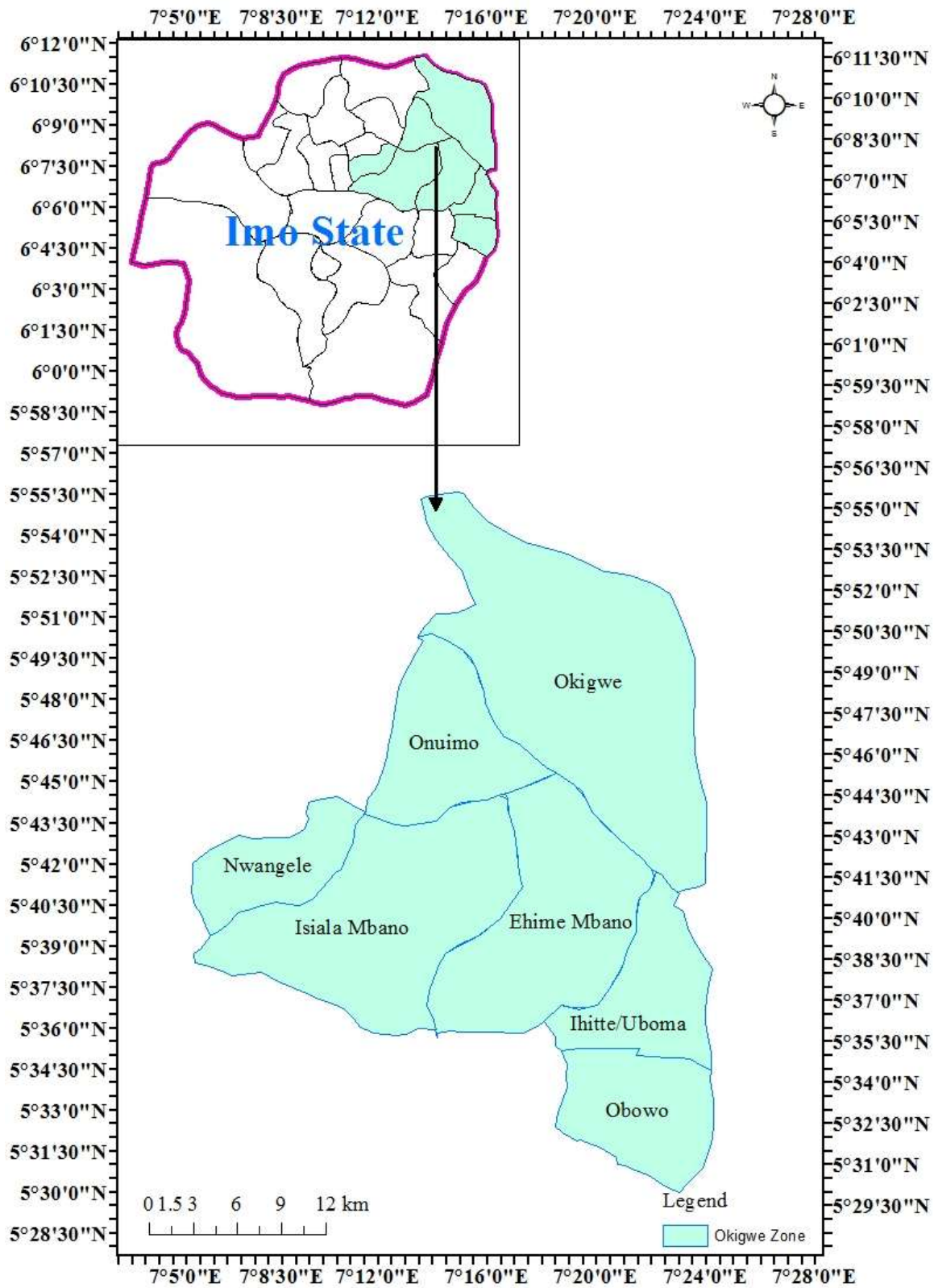


Figure 1: Map of Imo State showing Okigwe Agricultural Zone

Sampling Techniques and Data Analysis

Multistage random sampling technique was employed for this study. In the first stage, out of the three Agricultural Zones in Imo State; Okigwe Agricultural Zone was purposively selected based on the increasing evidence of traditional agroforestry systems (on-farm conservation) which is refer to home garden agroforestry system practice in this zone. The home garden allows local farmers and households to keep some key versatile plant/tree species especially, *Treculia africana* among others in farms near their houses.

In the second stage, three Local Government Areas (Onuimo, Ehime Mbano and Okigwe) out of seven (7) Local government Areas was purposively selected identified as having high concentration of home gardens. Furthermore, three villages were randomly selected from each of the Local Government areas given a total of nine villages.

In the third stage, 10 sample households were selected from each of villages using lottery methods. This approach was chosen in order to ensure comparison, variations, representativeness of sample households and villages. The numbers were drawn from the lottery without replacement until a sample size of 10 households was reached in each village. The household's involvement in collection, processing, consumption and marketing of *Treculia africana* was used as a yardstick in the selection. The sampling technique used in this study conforms to that of Udeagha (2015) and Angelsen *et al.* (2011).

In all, a total sample size of 90 households was selected and used for administering the semi-structured questionnaire for the study. Data collected was analysed using descriptive statistics such as frequency, means, percentages and charts.

RESULTS AND DISCUSSION

Households Characteristics based on their Socio-economic

Table 1 showed that 53.33% of the respondents were female while 46.67%

were male. This implies that female partake more in the sale and distribution of *Treculia africana* in the study areas which agreed with the findings of Ijeomah (2006) that women in Imo State are more involved in the collection and processing of home garden based NTFPs than men. Okafor (1990) stated that women are mostly involved in the extraction, processing and sales of these forest resources as a means of occupation mostly in rural areas. Also majority (86.67%) of the respondents was married, 11.11% was single while; 2.20% were widowed. Accordingly, Grinstein-Weiss and Sherraden (2006), Wilmoth and Koso (2002) and Lupton and Smith (2002) noted that marriage has a number of important features that enhance wealth accumulation. More so, Anyanwu (2013) stated that the total product of a married couple is larger than the sum of the outputs of each produced separately. On the other hand, 16.67% of the respondents were between the ages brackets of 0 – 25 years, 34.44%

were from 26–35years, 30.00% were between the age brackets 36–45 years, while 18.89% were between 49-55 years. This indicates that the respondents were in their middle age hence may be energetic to have involved in sales, processing and preservation of breadfruit which according to Etoamaihe and Ndubueze, (2010) were labourious and time consuming in nature. However, the educational level of respondents show that (22.22%) had no formal education while about 7.78% had primary education, and a greater percentage (44.44%), had secondary education while 25.56% had tertiary level of education. Generally, 77.78% of the respondents had one form of education or the other. Perhaps the high level of educational qualification enable the respondents to embrace African breadfruit as a valuable nutritive food which means the higher the level of education the more the respondent attach importance in the consumption of *Treculia Africana* kernel and the more they are informed about its

nutritional values. This assertion conforms to the postulation of Fadairo *et al.* (2015) that the basic objective of any form of educational level be it primary, secondary and post-secondary(Tertiary) is to impart knowledge which would influence changes in attitude, skills or knowledge and equally reduces poverty(Anyanwu , 2013; 2014). However, majority (47.78%) of the respondents engaged in farming as their primary occupation while 17.78% were civil servants, 228.89% engaged in trading as their primary occupation while 5.55% of the respondents involved in other form of job to earn more income. The majority (90.00 %) of the respondent were born and still reside in the area while 10.00% are migrates from neighboring communities, local government areas and other State who came in search of greener pasture. According to Shomkegh *et al.* (2016),

Msalilwa *et al.* (2013) and Ermias *et al.* (2014), how long a person lived in an area aid the individual to accumulate experience and knowledge about the importance uses and participation in gathering and processing of NTFPs of that particular locality.

Also, the result indicates that 70.00% of the respondent had a household size of 1-5, 28.89% had household size of 6 -10. This implies that larger percentage of the sample size had household size of 1-5 persons meaning that there was ready source of family labour to help with productive processes. In line with this findings Anyanwu (2013) noted that following micro-economic arguments, in Nigeria, children are considered as an essential part of the household's work force to generate household income, and as insurance against old age .

Table 1: Distribution of Households Based on their Socio-economic Characteristics

Variables	Frequency	Percentages (%)
Gender		
Female	48.00	53.33
Male	42.00	46.67
Marital Status		
Married	78.00	86.67
Single	10.00	11.11
Widow/widower	2.00	2.22
Age		
0-25	15.00	16.67
26-35	31.00	34.44
36-48	27.00	30.00
49-above	17.00	18.89
Educational status		
No formal	20.00	22.22
Primary	7.00	7.78
Secondary	40.00	44.44
Tertiary	23.00	25.56
Major occupation		
Farming	43.00	47.78
Civil servants	16.00	17.78
Trading	26.00	28.89
Other	5.00	5.55
Residence		
Born where respondents resides	81.00	90.00
Migrated	9.00	10.00
Household size		
1-5	63.00	70.00
6-10	26.00	28.89
11 and above	1.00	1.11
Total	90.00	100.00

N=90

Respondents Characteristics according to their source of products and Reasons for Harvesting

Table 2 shows that 76.67% of the respondents source the product from the market/home garden. 18.89% collected from the wild. 4.44% sourced for it from

other means. However, 15.56% of the respondent in the sample harvest for marketing purpose and 6.66% for home consumption while 77.78% for both. This implies that majority of the respondents purchased from the market while more

respondents harvested these products for both marketing and home consumption. This finding corroborates with Baiyeri and Mbah, (2006) who noted that African

breadfruit is an important natural resource for the rural poor households, contributing significantly to their income and dietary needs.

Table 2: Distribution Respondents according to their source of products and reason for Harvesting

Variable	Frequency	Percentage (%) n=90
Source of Product		
Market/Home garden	69.00	76.67
Collect from wild	17.00	18.89
Other	4.00	4.44
Reason for harvest		
Marketing	14.00	15.56
Home consumption	6.00	6.66
Both	70.00	77.78

Harvesting Season and Marketing

Periods *Treculia africana*

Table 3 indicated that most respondent (68.90%) harvested better in the rainy season because produce are in abundance and available during rainy season than dry season. Thus, it also help in seed processing because availability of rainy

water is very important since most rural community lack access to clean water. Also majority of the respondents (72.22%) agreed that the marketing of *Treculia* seeds/kernel are better during non-market days since it is in constant demand and rarely available most times.

Table 3: Harvesting Season and marketing periods of *Treculia africana*

Variable	Frequency	Percentage (%)
Best Harvesting season		
Rainy season	62.00	68.90
Dry season	15.00	16.70
Both	13.00	14.40
Marketing periods		
Market days	25.00	27.78
Non-market days	65.00	72.22

Market Price of a cup of processed Seeds of *Treculia africana* in the Study Area

Figure 1 shows that 17.80% respondents sold a cigarette cup of *Treculia africana* at the rate of ₦50–₦100, 57.80% sold at the rate of ₦110–₦160 per cup, 11.10% sold

at the rate of ₦160–₦200 per cup while 13.3% of the respondents did not sell this product. This assertion is in line with postulation of Kola-Oladiji *et al.* (2006) which stated that engaging in the trade on the seed of *Treculia africana* is a very high profitable venture that generates huge income among Igbo traders in Ibadan.

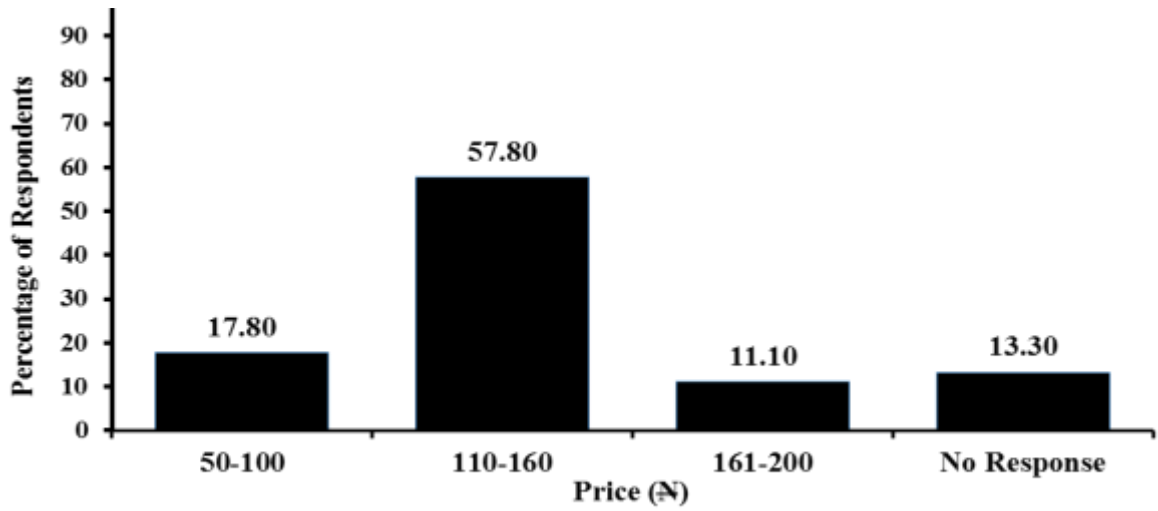


Fig 2 :Market Price of a cup of Processed Seeds of T.africana in the Study Area

Respondents Estimation of weekly Income from Sales of *Treculia africana* in the Study area

The figure 2 shows that 13.30% of respondents earn between ₦500–₦2000 weekly, 65.60% earned ₦2500–₦4500 weekly, and 10.00% earned ₦5000 and above while 11.10% of the respondents consumed the product. This implies that majority of the respondents in Okigwe

Agricultural Zone earned about ₦2500 – ₦4500 weekly which was an indicator of profit though in a small scale. This finding agreed with Baiyeri and Mbah (2006) and Kola-Oladiji *et al.* (2006) that *Treculia africana* (African bread fruit) is an important natural resource for the rural poor households, contributing significantly to their income and dietary needs.

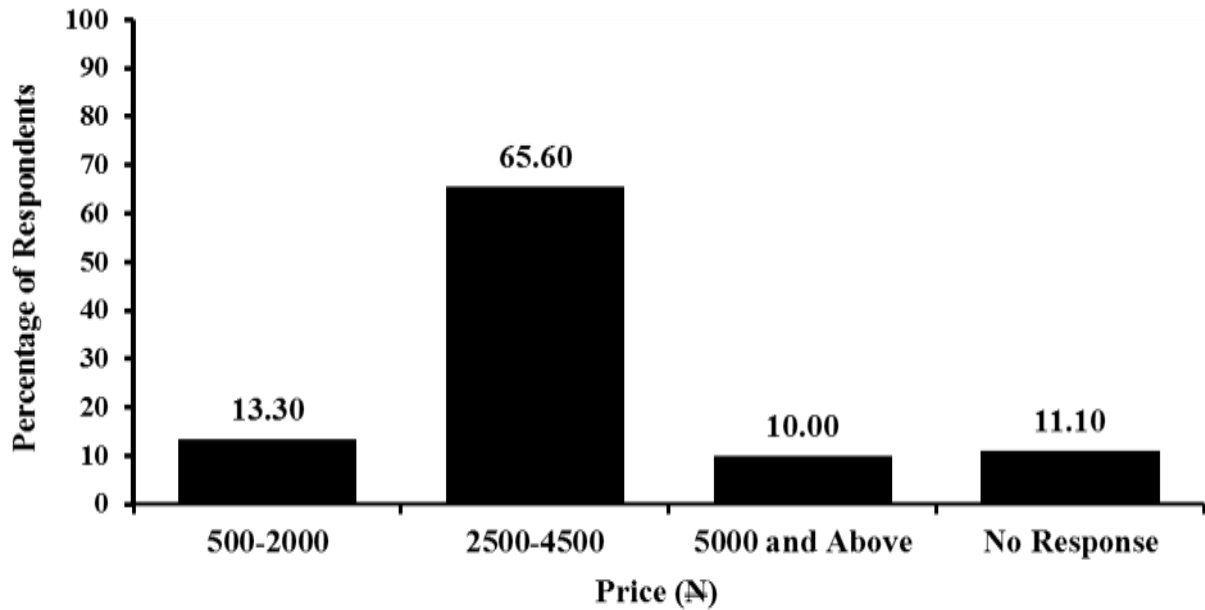


Fig 3: Estimated weekly Income from Sales of T.africana in the Study Area

Factors that affect market price of *Treculia africana* in the study area

The result on challenges observed by the respondents revealed that 16.70% of the respondents in breadfruit marketing reported on difficulties in transportation. 22.20% payment of local tax, 25.60% cost

of labour while 35.60% of the respondents affirmed that all the factors as the major challenges determining the price of breadfruits in the study area. Thus, this implies that these challenges strongly influence the price of *Treculia africana* in the market.

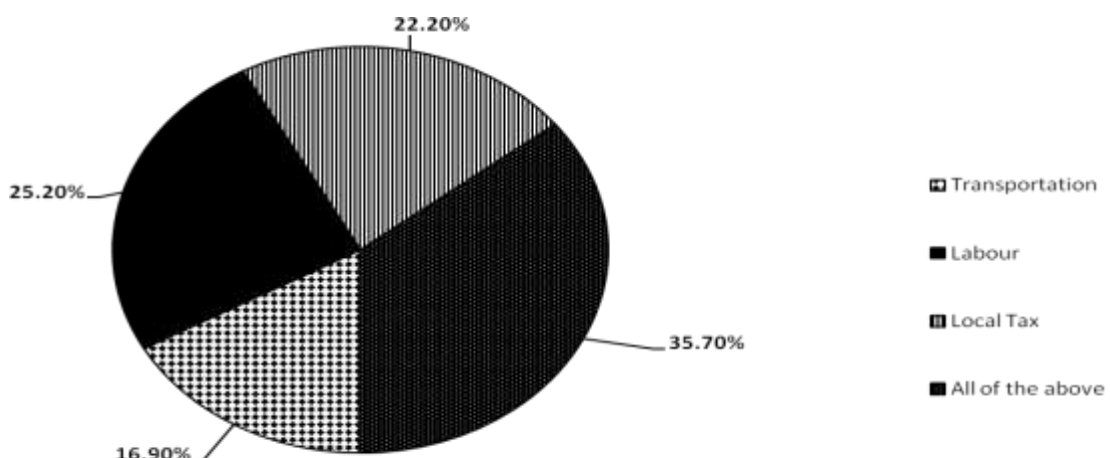


Fig 3: Identified factors which affect market price of *T. africana* in the study area

CONCLUSION AND

RECOMMENDATION

Treculia africana disproportionately contributed to the income, dietary and culinary value of both rural and urban households in Eastern, Nigeria. The kernels/seeds are highly sorted after because of its high nutritive value and are currently becoming less abundance due to increasing land use changes. This study demonstrated how profitable and the contribution *Treculia africana* makes toward sustaining the livelihoods of the rural households in south eastern Nigeria.

Additionally, the study highlighted some of the challenges faced in the marketing of *Treculia africana* kernels. It is therefore, recommended that appropriate conservation approaches be put in place using sustainable policy frameworks that would enhance *in situ* and *ex situ*

conservation of *Treculia africana* both in the home gardens and in the wild hence increasing its abundance and availability.

These policy actions should also encourage interventions toward improving *Treculia* kernel processing methods as this would further increase its market value and equally make the processing less labourious.

Further researches should be commission to investigate the possibilities in improving the current variety of *Treculia africana* in order to come with early maturing varieties that have all year around fruiting ability and resistance to sudden environmental changes. Overall, this would guarantee its abundance and availability and equally increase its contribution toward sustaining the livelihood of the rural households who depends on *Treculia* kernels both for their food and non- food needs.

REFERENCES

- Ademosun, A. A. and Imevbore, E. A. (1988). An evaluation of the nutritive value of the African giant land snail, *Archachatina marginata* in relation to some popular protein source. *Journal of animal Production Resources*, 8:76-87
- Agbogidi, O. M. and Onomeregbor, V. A. (2008). Morphological Changes in the Seedlings of *Treculia africana* Grown in Crude Oil impacted Soils. *In: Climate Change and*

- Sustainable Renewable Natural Resources Management (ed) Popoola, L. Proceeding of 32nd annual conference of the Forestry Association of Nigeria, Held in Umuahia, Abia – State, Nigeria. 20th – 24th Oct; 2008, 170 – 182p.*
- Angelsen, A., Larsen, H. O., Lund, J. F., Smith-Hall, C and Wunder, S. (2011). *Measuring Livelihood and Environmental dependence: Method for research and fieldwork*. London: Earthscan, 1-264p.
- Anyanwu , J.C (2014). Determining the correlates of poverty for inclusive growth in Africa. *European Economics Letters*, 3(1): 13-17
- Anyanwu, J.C. (2013). Marital Status Household size and Poverty in Nigeria: Evidence from the 2009/2010 Survey Data. Working Paper Series N^o 180 African Development Bank, Tunis Tunisia. 1-28p
- Appiah, F., Oduro, I and Ellis, W.O. (2011). Pasting Properties of *Treculia africana* seed flour in Ghana and production of a Breakfast meal. *Agriculture and Biology Journal of North America*, 2(2):325-329.
- Baiyeri, K. P and Mbah, B. N., (2006). Effects of Soilless and Soil-based Nursery Media on Seed Emergence, Growth Response to Water Street of African breadfruit (*Treculia africana*). *African Journal of Biotechnology*, 5(15): 1405-1410.
- Chambers, R. and Conway, G. R. (1991). "Sustainable Rural Livelihood: Practical concepts for the 21st century. IDS Discussion paper. 296. IDS. Brighton. 1-33p
- Dike, M. C. (2005). Assessing the ecology status of woody plant species at eroded site of Abia and Imo State, Nigeria. *Global Journal of Environmental Science*, 4(1) :77-85
- Ermias, M., Ewmetu, Z and Teketay, D. (2014). Non-Timber Forest Products and Household Incomes in Bonga Forest Area, South Western Ethiopia. *Journal of Forestry Research*, 25(1): 215-223.
- Etoamaihe, U. J. and Ndubueze, K. C. (2010). Developing of motorized African breadfruit dehuller. *J. Eng. Appl. Sci.* 5:312-315.
- Ezebuio, N.C., Ironkwe, A.G., Ugboaja, C.I and Okoro, B.O (2010). Adoption of Improved Cassava Varieties by Women in Umuahia Agricultural zone of Abia, Nigeria. *Nigerian Journal of Rural Sociology*, 10(1): 17-23.
- Fadairo, O.S., Olutegbe, N.S and Tijani, A.M (2015). Attitude of crop farmers towards e-wallet platform of the growth enhancement support scheme for input delivery in Oke-Ogun area Oyo State. *Journal of Agricultural Informatics*, 6(2): 62-77. Doi:10.17700/jai.2015.62.184.
- Gbedomon, R.C.,Fandohan, A.B., Salako, V.K., Idohu, A.F.R, Gele Kalai, R.L and Assogbajo, A.E (2015). Factors affecting home gardens ownership, diversity and structure: A case study from Benin. *Journal of Ethnobiology and Ethnomedicine*, 11:56 Doi 10.1186/s 13002-015-0041-3. Assessed 4th February, 2016

- Giambi S. Y and Amasisi T. (2005). Performance of African Breadfruit (*Treculia africana* Decne) Seed Flour in Bread Making. *Plant Foods Human Nutrition*, 58 (3): 1-8.
- Grinstein-Weiss, M. and Sherraden, M. (2006), Saving Performance in Individual Development Accounts: Does Marital Status Matter? *Journal of Marriage and Family*, 68: 192-204.
- Ijeomah, H. M. (2006). Forest Resources Depletion and the Role of Rural women in selected communities of Ideato South Local Government Area, Imo State. *Pat*, 2(2): 104–117.
- Irvine, J. I. (1981). Comparative study of the Chemical Composition and Mineral Element Contented of *Treculia africana* Seeds and Seed Oils, *Journal of Food Engineering*, 40:241 – 244.
- Jean, D. B. (2015). *Treculia africana*-The Potentials of a Multipurpose Indigenous Tree Species in Africa. <http://www.nutrecul-agroforestry.com>.
- John, C., George, U and Chukwuemeka, O. S. (2014). Time Series Analysis and Forecasting of Monthly Maximum Temperatures in SouthEastern Nigeria. *International Journal of Innovative Research and Development*, 3: 165-171.
- Keay, R. W.L. J. (1989). Trees of Nigeria: a Revised Version of Nigeria Trees. Vols. 1 and 2. Stanfield DP, Clarendon Press, Oxford.
- Kola-Oladiji, K.I., Adesope, A.A and Adio, A.F (2006). Profitability of marketing African bread fruit (*Treculia africana*) in Ibadan metropolis. *Journal of Agricultural, Forestry and the Social Science*, 4(1):44-50.
- Korieocha, D.S., Ogbonna, M.C., Korieocha, J.N and Nwokocha, C.C. (2011). Effect of Fluazifopbutyl and Atrazine/Metolachlor (Tankmixed) for Weed Control in Sweet potato (*Ipomoea batatas*) in South Eastern, Nigeria. *Journal of Agriculture and Social Research*, 11: 72-80.
- Lupton, J. and Smith, J. P. (2003). Marriage, assets and savings. In S. Grossbard-Shecht (Ed.), *Marriage and the economy: Theory and evidence from advanced industrial societies*. New York: Cambridge University Press.129-152p
- Meregini, A.O.A. (2005). Some Endangered Plants Producing Edible Fruits and Seeds in Southern Nigeria. *Fruits*, 60:211-220.
- Metuno, R. Ngandeu, F. Tchinda A.T. Ngameni, B. Kapche, G. D. Ejemgou, P.C Ndadjuji, B.T. Bezabih, M. and Abegaz, B.M. (2007). Chemical constituents of *Treculia acuminata*. Biall., *Treculia africana* Decne (Moraceae). *Biochemical Systematics and Ecology* 36: 148-152
- Msalilwa, U., Augustino, S. and Gillah, P. R. (2013). Community Perception on Climate Change and Usage Patterns of Non-Timber Forest Products by Communities around Kilolo Districts, Tanzania. *Ethiopian Journal of Environmental Studies and Management*, 6 (5): 507-516.

- National Population Commission (NPC) (2007). Federal Republic of Nigeria Government Extraordinary Official Gazette 94(24) and Statutory Instrument No. 23 of 2007.
- Nuga, O.O and Ofodile, E.A.U. (2010). Potential of *Treculia africana* Decne: An Endangered species of Southern Nigeria. *Journal of Agricultural and Social Research*, 10(2):91-99.
- Nwabueze T.U. and Uchendu, C.B. (2011). African Breadfruit (*Treculia africana*) Seed as Adjunct in Ethanol Production. *European Journal of Food Research and Review*, 1(1): 15-22.
- Ogunleye, A. J. and Parakoyi D. B. (1992). Chemical Composition of the Pulp and Seedling of *Treculia africana* clinical trial of the extracted from pulp in the treatment of worms. *Nig. J. Pure and Appl. Sci.*7:179-181.
- Okafor, J. C. (1980). Edible Indigenous Woody Plants in the Rural Economy of the Nigerian Forest Zone. *Forest Ecology and Management*, 3:45-55.
- Okafor, J. C. (1990). Indigenous Trees of the Nigerian Rainforest. A Paper Presented in a Symposium on the Potentials for Domestication and Rebuilding of Forest Resources. Yaounde, Cameroon, 34 – 38p.
- Okigbo, B. N. (1987) Cropping system and related research in Africa Occasional Publication Series O.T.I. Addis Ababa, Association for the advancement of Agricultural Science in Africa (AASA).
- Okonkwo, E. U. and Ubani, O. N., (2007). Indigenous Technologies for the De-hulling, storage and Utilization of breadfruit seeds *Artocarpus altilis* (Park) Fosb. (*Treculia africana* Decne) family: Moraceae in Anambra State. *J. Res. Agric.* 4(1): 27 – 30.
- Onyekwelu, J.C. and Fayose, O.J. (2007). Effect of Storage Methods on the Germination and Proximate Composition of *Treculia africana* Seeds. Paper Presented at the Conference on International Agricultural Research for Development. Tropentas, Germany.
- Oorts, K., Vanlauwe, B and Merckx, R. (2003). Cation exchange capacities of soil organic matter fractions in a Ferric Lixisol with different organic matter inputs. *Agriculture, Ecosystems and Environment*, 100:161, 100:161-171.
- Orwa, C. Mutua, A. Kindi, R. Jamnadass, R. and Anthony, S. (2009). Agroforestry Database: a tree reference and selection guide version 4.0 (<http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>)
- Osabor, V.N., Ogar, D.A, Okafor, P.C and Egbung, G.E (2009). Profile of the Africana Bread Fruit (*Treculia africana*). *Pakistan Journal of Nutrition*, 8(7):1005-1008.
- Osuji, J. O. and Owel, S. D. (2010). Mitotic index studies on *Treculia africana* Decne in Nigeria. *AJAE*, 1(1) 25-26.
- PARDI (Pacific Agribusiness Research for Development Initiative) (2011). Developing commercial breadfruit production in the South Pacific

- Islands
LivalToralivai@kokosiga.com.
- Shackleton, S. (2014). Impacts of Climate Change on Food Availability: Non-Timber Forest Products. Bill Freedman (Eds.) *Global Environmental Change*. Springer science +Business media, Dordrecht, 2014, 695-700p.
- Shomkegh, A.S., Mbakwe, R and Udeagha, A.U. (2016). Uses and Relative Abundance of Non-Timber Forest Plants in Farmlands of Selected Tiv Communities in Benue State, Nigeria. *Journal of Agriculture and Ecology Research International*, 8(2):1-12. Article Number 26117
- Sunday, Y. G. Mathew, N. A. Monday, O.A. and Juliet, N.E. (2009). Composition, Functional and Storage properties of flour of raw and heat processed African breadfruit (*Treculia africana*) seed. *Plt. Hum. Nutr.* 53: 357-368.
- Udeagha, A.U. (2015). Impact of Climate change on the contributions of *Irvingia* fruits and kernels to Rural Household Economy in Cross River State. Unpublished M.Sc. Dissertation, University of Uyo, Uyo, Akwa Ibom State, Nigeria. 1-175p.
- Udeagha, A.U., Shomkegh, S.A and Daniel, S.K. (2016). An Assessment of Leaf Chlorophyll Concentration of Afforestation Tree Species in South Eastern, Nigeria. *Journal of Forest and Environmental Science*, 32(2):205-211.
- Waite, L. J. and Gallagher, M. (2000). *The Case for Marriage*, New York: Doubleday.
- Wilmoth, J. and Koso, G. (2002). Does marital history matter? Marital status and wealth outcomes among preretirement adults. *Journal of Marriage and the Family*, 64, 254-268.
- World Agroforestry Centre (WAC). (2004). *Treculia africana*. In: Agroforestry databas <http://www.worldagroforestry.org/sea/products/afdbases/af/asp/speciesinfo.asp?spID=1651> Assessed on 2/12/2010.