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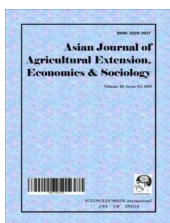
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Processing and Conservation of Oil Bean (*Pentaclethra macrophylla*) in Enugu State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study ascertained practices of processors in processing and conservation of oil bean (*Pentaclethra macrophylla*) in Enugu State, Nigeria. Seventy two respondents purposively selected from three agricultural zones, three blocks and nine circles constituted the sample for the study. Data collected during field work through structured interview schedule were presented in percentage, chart and mean score. Findings of the study reveal that middle aged and married people with relatively large house hold size and long years of experience in processing were involved in processing of oil bean in the area. They got oil bean they processed from people's farm land and sourced information on/about processing the oil bean from friends and relatives. Boiling, de-hulling, washing, sieving, slicing, wrapping were activities the respondents undertook in processing of oil bean. However, there were variations in sequence or order of these activities among them. Little or nothing was done by the processors towards the conservation of the crop while poor storage and processing facilities and lack of knowledge on modern preservation techniques were major constraints to processing of oil bean in the area. It was therefore recommended that government and non-governmental organisations should assist the processors by providing processing and storage facilities for oil bean while research institute should conserve

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and generate improved species of the crop to arouse interest of the farmers and processors on the crop. These actions will help to boost output, yield and retain the crop in the universe.

Keywords: Processing; conservation; oil bean; Enugu State; Nigeria.

1. INTRODUCTION

Agriculture was the key to development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that nurtured the development of civilization [1]. Recently, the services sector has overtaken agriculture as the economic sector employing most people worldwide [2]. This may be due to climate change, increase in population and consequently pressure over land and losses of some plants and animal species due to poor/lack of conservation /domestication practices. The African oil bean tree (*Pentaclethra macrophylla*) as one of the ancient and poorly domesticated crop is the sole member of the genus occurring naturally in the humid lowlands of West Africa. It is a leguminous tree that belongs to the family Leguminosae, sub-family Mimosoideae and recognized by peasant farmers in the Southeast of Nigeria for its soil improvement properties [2]. *Pentaclethra macrophylla* has been cultivated in Nigeria since 1937 and for many years in other West African countries where it's seed is relished as a food [3]. It is popular in Nigeria where it is known by several names such as Apará in Yoruba, Ukana in Efik, and, the most prominent, Ugba/Ukpaka in Igbo. Ugba is an essential food item for various traditional ceremonies, and in instances it may be used as meat substitute in certain soups/gravy particularly for the rural poor [4]. African oil bean seeds contain up to 44 percent protein, with all twenty essential amino acids. The seeds also contain essential fatty acids within the seed oil, as well as many minerals, particularly magnesium, iron, manganese, copper, phosphorus and calcium, and trace amounts of vitamins [5].

With the diverse native uses of this specie, and the present research effort on it, its utilization could be further enhanced for agro forestry development in the humid tropics [3]. The usage of the crop is very diverse especially in Southeast Nigeria. It is planted or retained along the edges of home gardens and farms mainly for its seed from which edible oil can be extracted. They are also fermented to yield a snack or condiment called "ugba" which has meaty taste and very popular in South-Eastern Nigeria [6].

The empty dry pods are used as fuel for cooking. Farmers protect this specie on farms because its open crown does not severely affect crop growth and because some trees are leafless during the growing season. The leaves also contribute to soil fertility [7]. *Pentaclethra macrophylla* wood, called 'mubala' or 'ovala', is suitable as fuel wood and for charcoal making [8]. The wood is hard and difficult to work, but suitable for poles, railway sleepers and general carpentry [9]. Traditionally, pestles and mortars are made from it. Ash from its wood or pods is used as a mordant in the dyeing industry [10]. It is also used in Africa in traditional human and veterinary medicine [3]. The ripe fruits are applied externally to heal wounds. Extracts of the leaf, stem bark, seed and fruit pulp have anti-inflammatory and anthelmintic activities. They are used for treating gonorrhea and convulsions and also used as analgesic. The root bark is used as a laxative, as an enema against dysentery and as a liniment against itch [11].

The nutritional and economic importance of African oil bean seed cannot be over emphasized. Irrespective of these factors, population of *P. macrophylla* has declined strongly in some areas. In Nigeria, the crop is now largely confined to the South-eastern region. Regeneration rate seems inadequate and the crop equally faces decline [12]. This is perhaps attributed to lack of knowledge on importance, preservation, storage and utilization techniques associated with the crop [13].

Factors that limit domestication by local farmers are the tendency of the species to disperse its seeds by explosive shattering of the pods which makes it difficult for farmers to gather the seeds, and the tall height attained at peak productive capacity [14] which makes harvest difficult. This can cause accidents through breaking of the branches and falling of the tree during heavy wind. Little or no research has been carried out to generate desirable oil bean species with moderate height and other better features.

Normally, oil bean seeds undergo fermentation process before consumption. The traditional fermentation methods widely practiced in Africa and other developing countries usually involve a

spontaneous development of different lactic acid producing bacteria [15]. These processing methods have almost always led to the problem of inconsistent product quality and other attendant problems. Also, the problem of occurrence and growth of pathogens in most of these fermented food products cannot be ruled out as the general hygienic conditions of the processors, the equipment used, water and other raw materials cannot be said to be free of potential pathogens [15].

Consequently, there seems to be lack or little information on how oil bean seeds are being exploited, processed and conserved locally thereby stifling initiatives on evaluation of the suitability of methods used in undertaking these tasks and invention of new and better methods. These aforementioned gaps and other challenges facing the crop will likely affect the distribution of the crop in the universe and may lead to extinction of the crop in near future thereby deemphasizing biodiversity conservation and food security.

With these facts above, it is imperative to assess activities of processors in domestication/conservation and processing of oil bean (*P. macrophylla*) in Enugu State, Nigeria. Specifically, the study sought to describe socio-economic characteristics, processing and conservation methods of oil bean processors in the State; identify their sources of information as well as constraints they face in processing oil bean.

2. METHODOLOGY

2.1 Study Area

The study was carried out in Enugu State. Enugu state is one of the South-eastern states that make up the thirty six states in Nigeria. The state is located between Latitudes 5°55' and 7°10' North and Longitudes 6°50' and 7°55' East. The state is bounded in the North by Kogi and Benue states, in the East by Ebonyi and Abia states, at the South by Abia and Imo states and in the West by Anambra state. Her land mass is 8,022.95 km² while the population is 3,257,298 [16]. The major occupation of people in the state is farming. Major crops cultivated include cassava, yam, cocoyam, vegetables, oil palm, etc, while poultry, goat and sheep are livestock commonly reared in the area. Enugu state consists of 17 local government areas (LGAs) and is divided into six agricultural zones. They

include: Awgu, Agbani, Enugu, Nsukka, Enugu Ezike and Udi agricultural zones.

2.2 Population and Sample

Processors of oil bean in the state constituted the population for the study. Three agricultural zones (Awgu, Udi and Nsukka) were purposively selected for the study. A block was purposively selected from each of the zones while three circles were purposively selected from each of the blocks giving a total of 3 blocks and 9 circles for the study. The purposive selection targets areas where the processors of oil bean seeds concentrate. Eight processors of oil bean seed were purposively selected from each circle giving a total of seventy two (72) respondents for the study.

2.3 Data Collection and Analysis

Data were gathered from the respondents through the use of structured interview schedule. This was administered by the researcher and research assistants. It contained information related to specific objectives of the study. Information on the characteristics of the respondents was achieved by collecting data on the following variables: age, marital status, educational level attained, household size and years of experience in processing of oil bean. Respondents were requested to indicate their sources of oil bean seed processed and sources of information on processing of oil bean from the list of possible sources provided while provisions were made for them to list their other sources that were not in the list. They were also asked to describe step by step methods they used in processing oil bean as well as stating their activities in conserving the seed.

In ascertaining the constraints they face in processing oil bean, a four point Likert-type scale of "to no extent, little extent, large extent and very large extent" with nominal values of "1, 2, 3 and 4", respectively, was used in collecting the data. The mean was 2.5. Variables with mean scores equal or greater than 2.5 were regarded as major constraints while variables with mean scores less than 2.5 were regarded as minor constraints. Some of the constraints in the list were poor storage facilities, lack of knowledge on modern preservation technique, lack of finance, lack of knowledge on modern processing technique e.t.c. Data collected were presented in percentage, chart and mean score. These analyses were executed with Statistical Product and Service Solution (SPSS) version 16.0.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Respondents

3.1.1 Age

Greater proportion (38.9%) of the respondents were within the age range of 41 to 50 years (Table 1). The mean age of the respondents was 47.3 years, showing that the respondents were middle aged and were in their active years.

3.1.2 Marital status

Table 1 also shows that greater proportion (59.7%) of the respondents were married, while 37.5% were widows. This may mean that processing of oil bean in Enugu state is dominated by married people.

3.1.3 Household size

Table 1 further reveals that majority (86.1%) of the respondents had household size of 6 to 10 persons, while their mean household size was 7 persons. An implication of this is that they have large household size. Hence, the respondents may engage household labour in processing of oil bean which may make oil bean processing cost cheaper, processing activities easier, interesting and encouraging in the study area.

3.1.4 Educational qualification

Majority (61.1%) of the respondents had secondary school education while 23.6% had primary school education as their highest educational qualification. Virtually, all the respondents had formal education which can expose them to useful activities in processing, agriculture and world.

3.1.5 Years of experience in oil bean processing

Table 1 further reveals that majority (76.4%) of the respondents had between 1 to 10 years of experience in processing of oil bean while their mean years of experience in processing of this crop was about 16 years. This means that majority of the respondents had long years of experience in processing and are likely to know the intricacies of the tasks which invariably make their processing activities easier.

3.1.6 Sources of oil bean seed processed

Table 2 reveal that the respondents sourced oil bean seed they processed from people's farm

(79.2%), forests (73.9%) and buying from markets (54.2%). Truly, oil bean seeds are common in primary and secondary forests. An implication of this is that the respondents may not get good quality seeds since they mainly pick and buy whatever they see around. Research institutes and Agricultural Development Programme (ADP) could serve as good and formal sources of this seed if they can generate and propagate the seed.

3.1.7 Respondent's sources of information on processing of oil bean seed

Fig. 1 shows that greater proportion (66.7%) of the respondents got information on oil bean processing from friends and relatives while 50.0% got from their childhood knowledge. The result shows that respondents sourced information on processing of oil bean from informal sources which poses doubts on the reliability of these information generated through these sources.

3.1.8 Methods of processing oil bean

Table 3 reveals that half (50%) of the respondents processed their seeds by boiling for about 7 to 10 hours, dehull, slice, boil again for about 1 to 2 hours wash with salt water, sieve and wrap. About 18% revealed that they boil, dehull, wash, slice, wash again, boil again, soak, sieve and wrap while 13.9% indicated that they boil, dehull, slice, boil, soak, sieve and wrap. Also, 6.9% indicated that they boil, dehull, boil, soak overnight, sieve, wash and wrap, 5.6% revealed that they boil, dehull, wash, boil, wash, sieve and wrap while the remaining 4.2% asserted that they boil, dehull, slice, wash and wrap. The findings show that all the processors (respondents) dehull oil bean after first boiling, most of them boiled oil bean twice while all of them washed it in the course of processing it. Thus, the difference in the processing steps lies mainly on the sequence of the activities like boiling, dehulling, washing, sieving, slicing and wrapping. In conformity, [17] reported that oil bean processors boil, dehull, wash and then cut oil bean seeds into slices (about 4 cm × 0.2 cm) and boiled for further 30 minutes during processing. The product is drained and rewashed. The slices are wrapped in dry-heat blanched banana leaves and left to ferment in room temperature (29 to 32°C) for 3 days.

Table 1. Distribution of respondents according to their socio-economic characteristics

Socio-economic characteristics	Frequency	Percentage	Mean
Age			
20-30	3	4.2	47.3
31-40	15	20.8	
41-50	28	38.9	
51-60	24	33.3	
61-70	2	2.8	
Marital status			
Single	2	2.8	7
Married	43	59.7	
Widowed	27	37.5	
Household size			
1-5	8	11.1	7
6-10	62	86.1	
11-15	2	2.8	
Educational qualification			
No formal education	6	8.3	15.56
Primary school level	17	23.6	
Secondary school level	44	61.1	
Tertiary education	5	6.9	
Years of experience of oil bean processing			
1-10	55	76.4	15.56
11-20	12	16.7	
21-30	5	6.9	

Source: Field work, 2013

Table 2. Distribution of respondents on sources of oil bean seed processed

*Sources	Frequency	Percentage (%)
Markets	39	54.2
Producers	2	2.8
Farms	21	29.2
Friends and relatives	9	12.5
Gathering from people's farmland	57	79.2
Gathering from forests	53	73.6
Gathering from anywhere the seed is seen	17	23.6
Buying from children	5	6.9

*Multiple responses Source: Field work, 2013

3.1.9 Conservation/domestication methods embarked upon by processors of oil bean seed

About twenty four percent of the respondents did nothing towards conservation of oil bean, 20.8% conserved it by disallowing cutting down of the tree, 19.4% conserved the tree by maintaining or protecting oil bean crop found around the farm while about 17% conserved it by discouraging others from cutting down the tree. It is a fact that biodiversity conservation is a crucial aspect of multi-functionality in agriculture [18] but this

finding suggests that little or no effort has been made in the area towards conserving the crop. This may lead to extinction of this crop in the near future. [19] has stated that some efforts of farmers towards domestication/conservation of the African oil bean tree include: Restricting the harvest of oil bean tree by trespassers, prohibition of setting of fire in forests, seizure of products from offenders and punishment of forest offenders through payment of fines. All these strategies were not used to domesticate/ conserve African oil bean tree by these respondents.

3.1.10 Constraints to processing of oil bean

Major constraints to processing of oil bean as shown in Table 5 were poor storage facility (M=3.9), poor processing facility (M= 3.6), lack of knowledge on modern preservation technique (M=3.6), lack /poor finance (M= 3.4), lack of knowledge on modern processing technique (M=3.4), gender stereotypic nature of the work (M=3.1), lack of labor and laborious nature of processing (M= 2.9 each). When these aforementioned constraints exist, processors are constrained from adding value to the crop by way of processing. Adding value to agricultural produce will safeguard food wastage and provide surplus food for people and power the industrial revolution of the Government [19].

Table 5 also shows that dirtiness of the job (M=2.4), crop not meeting customer's taste (M=1.9), lack of water (M=1.7) and scarcity of the seeds (M= 1.8) were minor constraints to processing of oil bean seed. Implication of this finding is that processors lack facilities and knowledge/information on modern processing and preservation techniques which may make processing and preservation of this product labourious with low quality output that can be sold at cheaper rate possibly without gain. In line with this, [20] asserted that constraints associated with oil bean production include unavailability or insufficient hybrid seeds or varieties and oil bean production is essentially affected by lack of processing facilities, low prices, poor production inputs and low technology utilization.

Table 3. Distribution of respondents on methods they use in processing oil bean seed

Method	Percentage (%)
Boil, dehull, slice, wash and wrap	4.2
Boil for 7 to 10 hours, dehull, slice, boil again for about 1 to 2 hours wash with salt water, sieve and wrap	50.0
Boil, dehull, slice, wash, boil, wash, sieve and wrap	5.6
Boil, dehull, boil, slice, soak overnight, sieve, wash and wrap	6.9
Boil, dehull, wash, slice, wash, boil, soak, sieve and wrap	18.1
Boil, dehull, slice, boil, soak, sieve and wrap	13.9

Source: Field work, 2013

Table 4. Distribution of respondents on methods they used in conserving oil bean

*Methods	Percentage (%)
Planting more oil bean	2.8
Maintaining/protecting oil bean crop found around	19.4
Disallowing cutting down of trees	20.8
Discourage others from cutting down the tree	16.7
Encourage people to plant/maintain the crop	13.9
Replace old plants with new ones	2.8
None	23.6

*Multiple responses. Source: Field work, 2013

Table 5. Mean scores of respondents based on constraints to processing of oil bean

Constraints	Mean (M)	S.D
Scarcity of seeds	1.8	0.9
Gender stereotypic nature of the task	3.1	1.0
Poor storage facilities	3.9	0.3
Lack/scarcity of water	1.7	0.8
Lack/insufficient labor	2.9	0.8
Poor processing facilities	3.6	0.7
Lack /poor finance	3.4	0.7
Lack of knowledge on modern processing	3.4	0.6
Lack of knowledge on modern preservation	3.6	0.6
Laborious/drudgery in processing	2.9	0.7
Dirtiness of the job	2.4	0.7
Crop may not meet customer's taste	1.9	0.8

Source: Field work, 2013

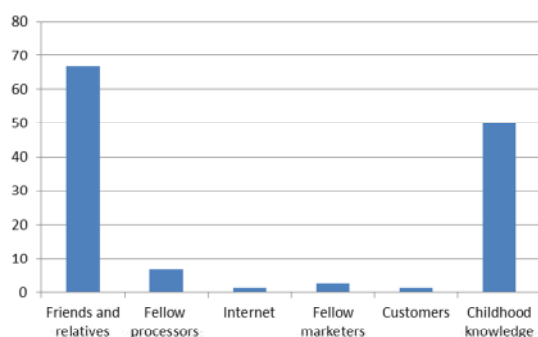


Fig. 1. Respondents' sources of information on oil bean processing

Source: Field survey, 2013

4. CONCLUSION

Middle- aged people that were married with relatively large household size and long years of experience in processing activities were involved in processing and marketing of oil bean in the area. They sourced oil bean they processed from forests and information on how to process it from friends/relatives. Activities involved in processing of oil bean were boiling, dehulling, washing, sieving, slicing and wrapping. The crop may go extinct since little or no activity has been undertaken by the respondents towards domestication and conservation of the crop. Poor processing and storage facilities were challenges that hindered processing of oil bean seed in the area.

5. RECOMMENDATIONS

1. Research institutes such as International Institute for tropical Agriculture (IITA) and National Crops Research Institute ((NCRI) should conserve the seed and generate improved species of oil bean. Agricultural extension personnel should create awareness on importance of domestication and conservation of the seed. They should also encourage the processors, farmers and the masses to embark on the activities while transferring improved species and technologies on the seed from research to the aforementioned bodies and other stakeholders.
2. Government and non-governmental organizations should provide adequate processing and storage facilities for oil bean. Processors should also form cooperative groups in order to assess this assistance from government and non-

governmental organizations easily. They should also embark on self-help development project by pooling their resources together towards provision of facilities that will help them in their processing activities. Provision and utilization of such infrastructure will enhance the quality of their output, increase productivity and income from oil bean.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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