PROCESSING AND STORAGE OF BAMBARA GROUNDNUT IN NORTH EASTERN NIGERIA

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Abstract
A survey of the bambara groundnut scale of production, processing and storage methods as well as the uses of the crop in North Eastern Nigeria, was carried out. The crop was found to be of economic importance to the communities that produce it, but the scale of production remained low, and the processing and storage methods are still traditional. The pods, which normally develop underground, are harvested by manually pulling up the plant with attendant losses. Sun drying of pods is mainly practiced and shelling is accomplished by either pouring into a jute or hessian bag and beating the pods with stick, pounding using pestle and mortar or cracking with stone on a slab. In some instances, manual treading of the pods on a flat surface is used to achieve shelling. The pods or seeds are stored in pots, bags, and drums or in local granaries. No commercial production and industrial utilization of the crop was found taking place in the study area.Pie-chat, fig; 1, showing the gender of farmers in Bambara groundnut production in the study area, showing 60o representing 17% of men involved in the production of the crop. 280o representing 63% of the farmers in the study area are women.The Bar-chat (fig;3) shows the percentages of methods of storage used in the study area (20% pot/bag/drum, 7% Rhombus, 17% Granary/pot, 30% pot/bag, 10% Bag/drum, 13% Granary and 3% pot/drum). The study suggests that bambara groundnut harvesting equipment, mechanical sheller and solar drying system should be introduced into the region while the present facilities used in storing the product should be modified to enhance their efficiency.

Keywords: ***Bambara groundnut, processing, storage, shelling, rhumbu, North Eastern Nigeria***

Introduction

The rate at which the World's population is presently increasing in relation to agricultural growth indicates that not only should the production of main crops be increased, but that other crops hitherto neglected should be given attention. Among the later group of crops is the bambara groundnut (Vigna subterranean (L) Verdc.), which flourished in Africa before the introduction of the peanut (Arachishypogaea) (Goli et al. 1991).

Bambara groundnut is a popular crop in Sub-Saharan Africa. It is highly nutritious and so plays an important role in the people's diet. The seed contains about 63% carbohydrate, 19% protein and 6.5% oil (Goli, 1997). There is a wide diversity of plant and seed characteristics and growth

Table 1: Distribution of cultivars of bambara groundnut by country

Country	Cultivars
Malawi	Zambian and Barotseland cultivars
Congo (D.R)	Kahembabrune
Upper Volta	Souma niaga
Basaga	NantaSemberwa, Kibuzo and Kikol
Niger	TV_{12}, TV_{21}, TV_{37}, TV_{83}

Source: Stanton (1966)

Nigeria has been noted as one of the centers of bambara groundnut origin (Hepper, 1970) with the crop considered to have originated within the area between Jos and Yola of North Eastern Nigeria. Presently the crop is grown throughout the country, with the exception of riverine and swampy areas. Wide range of differences exist in the seed coat colour, seed sizes, pigmentation around the eye, pod shape, growth habitat and other characteristics of the crop across the country. There appears to be little or no significant research effort directed towards the improvement of bambara groundnut post harvest handling and processing operations even in the main production center of North Eastern Nigeria. The rigours involved in the harvesting and processing of the crop has made farmers to show little interest in its commercial production. Even though changes in attitude are now taking place, the effect on production level has not been significant. Simple statistic (pie-chat and bar-chat) were used to analyse the methods
of storage, method of processing and farmers gender.

In this paper, the findings of a survey work carried out on bambara groundnut with the aim of identifying the varieties available, the scale of production, and processing and storage technologies in North Eastern Nigeria are been presented

- **Objective of the study**

Identifying the varieties available, the scale of production, processing and storage technologies used in North Eastern Nigeria.

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.Materials and methods

The study was carried out in the six North Eastern States of Nigeria, namely Taraba, Adamawa, Borno, Gombe and Bauchi States. At least five Local Government Areas in each of the state were visited.

Two questionnaire types were designed, one for the Ministry of Agriculture and the other for local farmers. The questionnaire for the ministry was directed to Agricultural officers and the ADP extension officers. It sought information on the scale of production, varieties cultivated, primary and secondary processing practices, storage techniques and uses of bambara groundnut in the areas under their supervision. The questionnaire directed to the farmers sought information on the variety cultivated, area of land put under cultivation, yield obtained per hectare, methods of primary and secondary processing, storage techniques and uses of the crop by the farmers.

The farms were visited and area put under the cultivation of the crop measured. Samples of bambara groundnut cultivated in the various areas visited were collected. A total of 130 questionnaires were distributed and the responses of both the agricultural officers, extension officers and farmers were obtained.

Results and discussion

The responses to the questions in the questionnaires were analyzed and the results are presented as follows:

Bambara Groundnut Production

Bambara groundnut production in the North Eastern region of Nigeria is based mainly on smallholdings. It is only in Yobe State that production could be said to be in the medium scale because it is used, like other principal crops, as a main source of food in the localities of Fika, Potiskum and Nangere. It is mostly intercropped with major crops such as cowpea, peanut, maize, millet, cassava or yam. The crop is mostly grown by women and cultivation, as sole crop is not common.

It was difficult to obtain accurate production figures for bambara groundnut in the area of study because farmers harvest a great part of the crop for consumption at the immature stage. Farmers expressed different opinions on

whether the total production is increasing. However, most farmers stated that production was decreasing due to the problems of drought, diseases and pest attack.

Method of Planting.Bambara groundnut is planted in rows. Some farmers preferred planting it in scattered patterns, but do not broadcast. An average of 20 plants per square metre was obtained in Adamawa State. Planting density varied from area to area, as do the soil preparation techniques and the tools that farmers use. One grain is planted per hole.

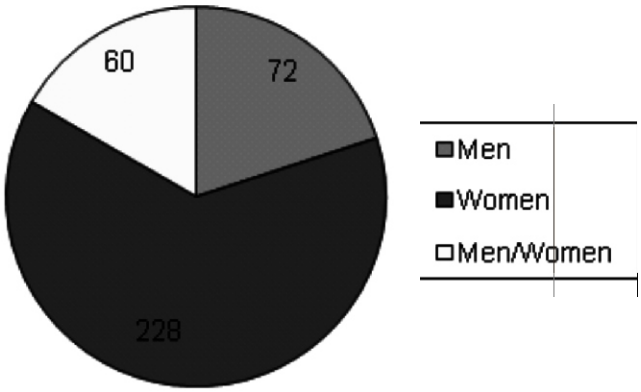
Farm Size.The crop is generally cultivated by women on small farms. Production is primarily on subsistence level. It is cultivated in mixed/intercropping systems. Cultivation as sole crop is not common. Statistics on production does not seem to exist in the region of the study prior to this investigation. This made it difficult to obtain production figures and total area under cultivation for the region. Table 2 however, shows individual farm sizes found under bambara groundnut cultivation. The estimates were made based on the entire farm size belonging to a farmer on which bambara groundnut was mixed or intercropped.

Table 2: Farm size, processing and storage methods and uses of bambara groundnut in the producing areas of North Eastern Nigeria

Locality	Farmer	Farm size (ha)	Method of processing	method of storage	Uses
Mayo Belwa	Women	0.33	Mortar and pestle	Pots/bags/drums	Food
Yola	Women	0.33	Mortar and pestle	Pots/bags/drums	Food
Gombi	Women	0.33	Mortar and pestle	Pots/bags/drums	Food
Hong	Women	0.5	Mortar and pestle	Pots/bags/drums	Food
Maiha	Men/ Women	0.5	Mortar and pestle	Rhumbu	Food
Mubi	Women	0.33	Crushing with stone	Granary/pots	Food
Gella	Women	0.33	Beating with sticks	Granary/pots	Food
Michika	Women	0.33	Mortar and pestle	Granary/pots	Food
Madagali	Women	0.33	Mortar and pestle	Granary/pots	Food
G/Dorawa	Women	0.33	Mortar and pestle	Pots/bags	Food
Zing	Women	0.33	Mortar and pestle	Pots/bags	Food
Yorro	Women	0.33	Mortar and pestle	Pots/bags	Food
A/Kola	Women	0.33	Beating with sticks	Pots/bags	Food
Jalingo	Women	0.33	Mortar and pestle	Granary/pots	Food
Lankoviri	Women	0.25	Mortar and pestle	Pots/bags	Food
Konduga	Men/ Women	0.25	Mortar and pestle	Bags/drums	Food
Bama	Men/ Women	0.25	Mortar and pestle	Bags/pots	Food
Gwoza	Women	0.33	Mortar and pestle	Rhumbu	Food
Geidam	Men/ Women	0.33	Mortar and pestle	Pots/bags	Food
Fika	Men	0.33	Mortar and pestle	Granary	Food
Potiskum	Men	1	Mortar and pestle	Granary	Food
Nangere	Men	1	Mortar and pestle	Granary	Food
Ningi	Men	1	Mortar and pestle	Granary	Food
Ganjuwa	Men/ Women	0.5	Mortar and pestle	Pots/bags	Food
Alkaleri	Men	0.5	Mortar and pestle	Drum/bags/pots	Food
Toro	Women	0.33	Mortar and pestle	drums/pots/bags	Food
Azare	Men	1	Mortar and pestle	Drums/bags	Food
Akko	Women	0.33	Mortar and pestle	Pots/bags	Food/medicine
Billiri	Women	0.33	Mortar and pestle	Pots/Drums	Food/medicine
Gombe	Women	0.33	Mortar and pestle	drums/bags	Food/medicine

Source; Field survey

Fig; 1.



Fig; 2.

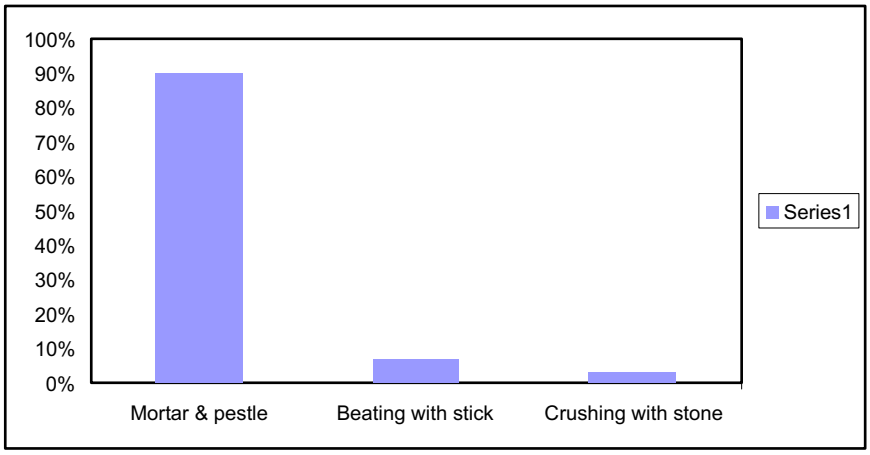
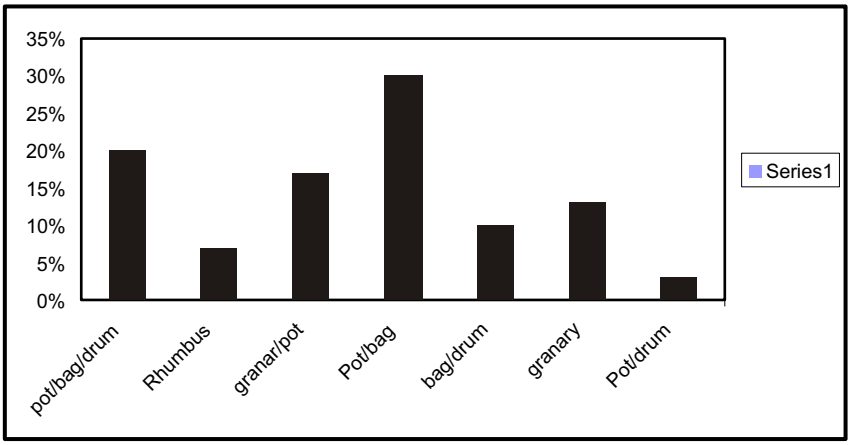


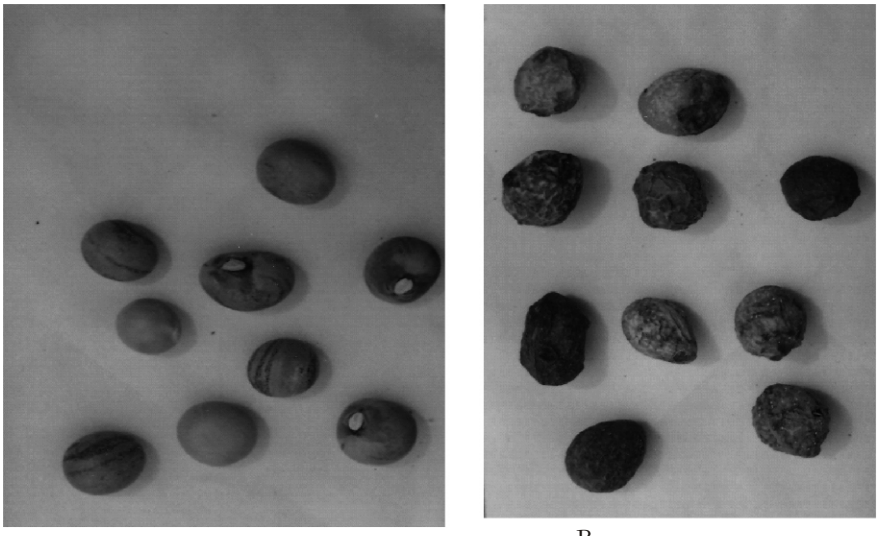
Fig. 3.



Pie-chat, fig; 1, showing the gender of farmers in Bambara groundnut production in the study area, showing 60o representing 17% of men involved in the production of the crop. 280o representing 63% of the farmers in the study area are women. The highest percentage of women is attributed to the fact that culturally and traditionally the crop which requires less rigours of production attracts the involvement of women in the study area. Crops that requires where the suitability of land allows for the production of the crop both men and women get themselves in the production. This accounts for the 72o representing 20% of the gender population involved in the production. The investigation also revealed that 90% (fig;2) of the farmers use mortar and pestle to process the crop, 7% uses beating with stick and only 3% uses stone to crush the product. The Bar-chat (fig;3) shows the percentages of methods of storage used in the study area (20% pot/bag/drum, 7% Rhombus, 17% Granary/pot, 30% pot/bag, 10% Bag/drum, 13% Granary and 3% pot/drum).

Varieties

The varietal names of the bambara groundnut cultivars found in North Eastern Nigeria seem yet to be established. Farmers distinguish different seed – lots by their appearance. Almost all the farmers cultivated traditional landraces that have been selected and maintained by the local community over a long period. A number of these landraces were maintained as uniform lines with such distinct characteristics as seed colour. Others however show characteristics that indicate mixtures. Farmers are not in possession of modern and improved varieties suitable for specific climatic conditions. Much of the variation found in local landraces is in seed colour, eye pattern and seed size. However, the dominant landrace found throughout the region was the one with cream coloured seed shown in Figure1. The different colours produced in different localities of the study area and their characteristic differences with local names and extent of production are shown on Table 3.



A: PodsSeeds B:

Figure 4: Bambara groundnuts pods and seeds

Table 3: Varieties, characteristic differences and production extents of bambara groundnut in the various localities of North Eastern Nigeria.

S/no.	Variety	Varietal characteristics	Locality	Production extent	Local name
1.	White	Creamy white, medium seed size, round shape, eye like butterfly, no eye pattern	All localities	Medium scale	Sola
2.	White	Cream white, large seed size, round shape, eye like butterfly, no testa pattern	All localities	Medium scale	Sola
3.	White	Creamy white, medium seed size, round shape, rhomboid sporting on every side, eye as two thin lines on both sides of hilum	All localities	Medium scale	Sola
4.	White	Creamy white, large seed size, round shape, marbled testa, eye as two thin lines on both sides of hilum	Almost all localities	Low scale	Sola
5.	White	Creamy white, large seed size, oval shape, stripes on testa, from end to end (cylindrically) no testa pattern.	Potiskum, Fika, Nangere, Azare	Low scale	Sola
6.	Brown	Reddish brown, large seed size, oval shape, no eye pattern, no testa pattern.	Akko, Azare, Bama, Fika, Potiskum	Low scale	Sola
7.	Brown	Light reddish brown, round shape, no eye pattern, no testa pattern.	Azare, Fika, Potiskum	Low scale	Joll
8.	Brown	Dark brown, large seed size, round shape, marbled and striped testa, eye like butterfly/thick lines on both side of hilum	damaturu, Fika, Potiskum	Low scale	Bidi
9.	Brown	Reddish brown, large seed size, oval shape, holstaintesta pattern, no eye pattern.	Azare, Fika, Madagali, Potiskum	Low scale	Gadu
10.	Brown	Light brown, medium seed size, round shape, eye as thick circle around hilum, darker testa.	Fika, Potiskum	Low scale	Jalli
11.	Brown	Light brown, medium seed size, round shape, eye as thick circle around hilum, darker testa	Akko, Alkaleri, Azare, Potiskum, Fika	Low scale	Roko-Roko
12.	White	Creamy white, medium seed size, round shape, no eye pattern, all testa patterns.	Fika, Madagali , Potiskum	Medium scale	Sola
13.	Black	Shiny black, medium seed size, round shape, no eye pattern, no testa pattern.	Akko, Fika, Ningi, Madagali, Potiskum	Low scale	Danda
14.	Black	Reddish black, medium seed size, oval and round shapes, no eye pattern, no testa pattern	Potiskum, Fika	Low scale	Duna

Harvesting

The plant is pulled or lifted by hand. The pods, which are produced underground, are attached to the root of the plant, like peanut. The pods are detached from the roots and collected manually. In some communities, the hoe is used to dig up the pods, while in others the animal drawn cultivator is employed. The problems identified with the harvesting methods are the high rate of losses and the great rigour involved.

Yield

Accurate yield figures could not be obtained because a large proportion of the crop is consumed at the immature stage. However, farmers were of the opinion that bambara groundnut yield in the region was decreasing due to the attack of pests and diseases. It was noted that no improved variety has been introduced into the area. Inspite of this, a pool of the harvest of the crop in the region still yields a large output.

Shelling

The shelling methods involve the use of traditional technologies. These vary from locality to locality and depend on the quantity of the crop produced. Sun drying of the pods is mainly practiced and because the drying process lacks control, sometimes the over drying of pods occur and lead to poor shelling output. Most communities use mortar and pestle to crush the dry pods. In some communities, the pods are poured into jute or hessian bags and beaten with sticks on flat surfaces, while in others they are poured on the ground and trodden with feet to have them shelled. This method is used when the quantity of bambara groundnut is small. Other methods include the use of stone to crack the pods on a flat surface and the beating of a jute or hessian bag containing the pods against the wall of a building. The mortar and pestle method of shelling has the advantage of being fast, but there is also the disadvantage of more damages to the seeds. The method of beating with sticks also has the same advantage and disadvantage.

Cracking with stones has the advantage of less seed damage, but the disadvantage of being slow and tiresome. Figure 5 shows the mortar and pestle as well as the feet treading methods of shelling bambara groundnut.

Figure 5: Some bambara groundnut shelling methods

Winnowing

Winnowing of the hull from the seed-hull mixture is carried out after the shelling operation to obtain clean seeds. The method of winnowing is similar to that employed in the handling of guna seed, cowpea and other main crops cultivated in the area. This involves the dropping of seed-hull mixture of the shelled material from a height, against the prevailing wind. The lighter chaff is blown off by wind, while the heavier seeds are collected in a container placed on the ground below the height. This operation is illustrated in Figure 6.

Figure 6: Winnowing of shelled bambara groundnut by tossing against prevailing wind

A: Local granary

B: Storage in pot

Figure 7: Some of the bambara groundnut storage methods

Storage

Bambara groundnut is stored in both shelled and unshelled conditions. When stored in unshelled condition pots are used. This method is employed when the quantity stored is small. When the produce is in large quantity, bambara groundnut is stored in granaries. The product could also be treated with agro chemicals and then stored in bags, drums and some other available containers. Some of these storage structures are shown in Figure 7. Storage of the crop in pots and local granaries made of grass materials was found to be inappropriate as the product, which is highly susceptible to insect attack, was found to be readily infested in these structures.

Uses

The producing communities use bamabara groundnut in many ways. Each community has its own way of preparing bambara groundnut for use. Where it is used for food, the seeds are ground into flour and used to prepare soup, porridge and various fried or steamed food such as 'akara', 'moi-moi' and 'okpa'. The fresh pods are also boiled with salt and pepper and eaten as snack. Dry seeds are equally roasted with salt and eaten as snack. Some communities believe that the black coloured variety has spiritual healing effect. They use the variety

for medicinal purposes. Because bambara groundnut ranks higher in market value than other legumes like cowpea and peanuts, it is used during ceremonies as gifts in some communities.

Conclusions

Bambara groundnut is an important food crop in North Eastern Nigeria. It is a low-cost and dependable crop that grows in harsh environments where many other crops could fail. The crop is mostly grown by women on a small scale. It is mainly intercropped with cowpea, peanut, millet, sorghum or maize. Processing and storage methods involve the use of traditional technologies. No commercial production and no industrial use of the crop take place. Harvesting and shelling of pods are labour intensive. The existing cultivars are landraces with differences that are only distinguished by their appearance. Cultivation as sole crop is not common. Production and yield figures are yet to be concretely established because of consumption at immature stage and the effect of pests and diseases.

Recommendations

The following recommendations would contribute to the improvement of the processing and storage practices of bambara groundnut by farmers in North Eastern Nigeria and encourage the large scale production of this important crop.

- A mechanical harvester for bambara groundnut should be developed and introduced into North Eastern Nigeria. This will eliminate the rigours of the present harvesting methods and reduce the magnitude of losses.
- A bambara groundnut sheller should be developed for use in the region. This will relief the processors of the tedium of the present methods, reduce seed damage and check the attack of mould, afflatoxin and other microorganisms.
- Appropriate technology storage facilities should be developed for the crop and the proper treatment and environment needed for its storage should be determined.
- Research efforts should be geared toward the breeding of pest and disease resistant as well as high yielding varieties.
- Solar drying facilities should be introduced to replace the present sun drying method.

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