
**PRODUCTION, STORAGE, PROCESSING AND
UTILIZATION OF BAMBARA IN GHANA**

**FRI/NRI/DFID PROJECT ON
MARKETING AND PROCESSING OF BAMBARA (W. AFRICA)**

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ABSTRACT

Standardized conventional questionnaires, secondary data sources and informal interviews were used to obtain both qualitative and quantitative information on the production, storage, processing and utilization of bambara groundnuts from the production areas in the Southern and Northern sectors of Ghana. The objective of the study was to investigate the production, storage, processing and utilization practices of bambara producers as well as identify the constraints with these practices, with the main focus on identifying the processing methods in the Northern sector of Ghana. A total of 178 bambara producers, 90 in the Southern sector and 88 in the Northern sector were selected randomly for this study. Generally, bambara was produced on a smaller scale as compared to other legumes. On the whole, an average of about 3 acres of land was cropped for bambara, ranging from 0.25 acre to 25 acres. An overall average of 3.5 maxi bags of bambara was produced in a year; 4.6 and 2.5 maxi bags respectively in the Southern and Northern sectors. Farmers reported of a general decline in bambara production over the previous 3 years. Bambara groundnuts were stored up to 8 months either shelled or unshelled. Traditional pre-storage treatment was the most common practice. Out of a total of 178 producers, 72 practiced traditional pre-treatment, 32 applied agro-chemicals, while as much as 68 did not treat the bambara before storage. More than 70% of the total sample stored their bambara in barns while about 25% stored in baskets or sealed pots. Processing of bambara into flours and pastes was more prevalent in the Northern sector. Only 7% of respondents in the Southern sector as compared to 100% in the Northern sector processed bambara into flours and pastes. The utilization of bambara was much higher in the Northern sector where it forms an important part in the traditional diet. Utilization of bambara in the Southern sector was limited to cooking whole dry nuts into a sauce. Long cooking and processing periods were the most important constraints to bambara utilization identified in this study. These constraints have contributed to the decline in bambara utilization and consequently its production.

INTRODUCTION

A collaborative research project on the production, storage, processing, utilization and marketing of bambara groundnuts led by the Food Research Institute was initiated in 1999, with the Natural Resources Institute Limited in UK. The project is being sponsored by the Department of International Development's (DFID) Crop Post Harvest Research Programme (CPHP) and coordinated by the Food Research Institute of Ghana. The project has a long term goal of developing and effectively promoting strategies which will improve food security of poor households through increased availability and improved quality of cereals and pulse foods and better access to food. The main objectives of the project are to identify traditional processing methods of bambara in Northern Ghana and to adapt these methods, or if necessary to develop alternative technology, so that the cooking process is improved; and to conduct studies to determine the market potential of bambara in Africa and elsewhere so that opportunities which could facilitate an increase in production are identified. This study was conducted to identify the storage, processing and utilization methods available in the production areas, as well as the constraints associated with these methods.

Bambara groundnuts (*Vigna subterranea*) is an important source of protein, and is complementary to staple cereals which are low in certain essential amino acids. It also has significant levels of calcium and phosphorus. It was ranked the second most important grain legume in Ghana after cowpea by Doku and Karikari in 1971. For many years in Ghana, production and utilization was slightly ahead of cowpea (Doku, 1996), but the introduction of high yielding varieties of cowpea and improved methods for controlling cowpea field pests led to the neglect of bambara. It was described as "the neglected crop" or "the forgotten crop" by Marfo (2000). The cooking properties of bambara is an important factor which has led to a decline in its utilization, especially in the urban centres of Ghana. Observations indicate that the water absorption capacity of bambara is very poor as compared to cowpea, and the thick testa could be responsible for this (Plahar *et al.*, 1998). This results in long cooking periods and the effort and time required to cook

and process bambara, in addition to the large quantities of water and especially fuel needed cannot be afforded by many homemakers.

In Ghana bambara is cultivated in the Transition and Savanna zones and plays a very important role in the diet of people in Northern Ghana. Due to the decline in its production and utilization, bambara is now basically a subsistence crop especially in the Northern sector of Ghana and is considered a “women’s crop”. It is not regarded a crop of major importance and as such its production, processing and sale is often relegated to the women. Its cultivation and processing is therefore on a very small scale and commercial cultivation and processing of the groundnut has not been fully exploited in Ghana.

The study on the production, storage, processing and utilization of bambara was carried out in major production areas identified in the Southern and Northern sectors of Ghana. The Dangbe West and North Tongu districts in the Southern Sector and the West Gonja district, Tolon Kumbungu district as well Tamale and surrounding areas, and the Bawku East district in the Northern Sector formed the study areas. The specific objectives of this study were:

- i. to identify the major bambara production areas production systems in Ghana
- ii. to identify the storage and processing methods and facilities used by the producers
- iii. to identify the extent of bambara utilization in the production areas
- iv. to identify the major constraints to bambara processing and utilization; and the coping mechanisms adopted by the processors.

The findings of this study will help to identify the traditional processing methods of bambara especially in the Northern sector, which can be adapted or alternatives developed to improve the cooking quality of bambara.

METHODOLOGY

Selection of Survey Areas

The production areas of bambara in Ghana were identified through information obtained from agricultural officers and traders of the bambara groundnut. The Southern Sector of Ghana, mainly the coastal belt, and the Northern Sector were identified to be the areas where bambara cultivation is most concentrated. The Dangbe West and North Tongu districts in the Southern Sector were selected after confirmation from traders and agricultural extension agents in the Greater Accra and Volta regions. Similarly, the West Gonja district, Tolon Kumbungu district as well Tamale and surrounding villages (Northern region) and the Bawku East district (Upper East region) were selected for the survey in the Northern Sector. Major producing areas surveyed in the Southern Sector are Addokope, Tamatoku, Asigbekope all in the Dangbe West district, as well as Adidome, Mafi Kumasi and Fiakpe in the Adidome district. In the Northern Sector, areas surveyed include Gbulahagu, Damongo, Tamale, Galinga, Yipala, Dakpakora, Achubunyor, Tuunayili, Bawku, Alelo, Worinkambo, Kpinkpayong and Benugu. Information received from extension agents identified the Upper West region also as an important producing area, but this study did not cover that region.

Sampling Methodology

Farmers and processors involved in bambara cultivation and processing were identified with the help of agricultural extension agents, chief farmers, assemblymen and other key informants. Respondents were then randomly selected from the groups for interviewing.

Data Collection

Conventional survey interviews were undertaken in all the survey areas to obtain both quantitative and qualitative data. A structured/semi-structured questionnaire was used to obtain information on the production, storage, processing and utilization of bambara groundnuts in the survey areas. The questionnaire developed was pre-tested, a few changes made and finally administered in the field by the authors and trained field

assistants. Secondary data review technique was applied to obtain documented information on bambara production, storage, processing and utilization.

Data Analysis and Presentation

The coded responses were analyzed using the Microsoft Excel software. Results are presented in simple frequencies, percentages, bar charts and pie charts. Qualitative data was described.

RESULTS AND DISCUSSION

1. BIODATA OF RESPONDENTS

1.1. Gender Distribution of Respondents

A total of 178 cultivators/processors of bambara were interviewed. This was made up of 90 and 88 respondents from the Southern and Northern sectors respectively. Out of the total number interviewed, almost 52% were males while 48% were females (Table 1a). There were more females than males in the Northern sector and vice versa in the South. This may be attributed to the fact that bambara being a subsistence crop in the Northern sector, is considered a “women’s crop”. There are therefore more women than men involved in its cultivation. The men involved cultivate bambara on a more commercial basis. Background information also indicated that more men than women engaged in bambara cultivation in the Southern sector districts because it is labour intensive and is grown on a commercial basis largely. The Southern sector as shown in Table 1.1a had more males than females participating in this study.

1.2. Age Distribution of Respondents

The average ages of respondents in the Southern and Northern sectors were 47.6 and 49.9 years respectively. In both sectors surveyed, the majority of respondents fell within the age group of 31 - 60 (Table 1a). A significant percentage of respondents, 15.5% and 22.7% (19.1% overall) in the Southern and Northern sectors respectively, were at least 61 old. On the whole, only 7.3% of respondents were younger than 31 years. This implies that there are more older than younger people involved in bambara production and processing. This may have an effect on the capacity of production as well as the future of the crop.

1.3. Educational Background of Respondents

The educational status of respondents in both sectors was generally found to be low. As much as 67.4% of the total number of respondents had no formal education (Table 1a). About 40% of respondents in the Southern sector had primary, middle or junior secondary

Table 1a. Distribution of Sex, Age and Educational level of Respondents.

Parameter	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Sex						
Male	52	57.8	40	45.5	92	51.7
Female	38	42.2	48	54.5	86	48.3
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>
Age Distribution (years)						
21 - 30	10	11.1	3	3.4	13	7.3
31 - 40	26	28.9	19	21.6	45	25.3
41 - 50	18	20.0	26	29.6	44	24.7
51 - 60	22	24.5	20	22.7	42	23.6
61 - 70	12	13.3	9	10.2	21	11.8
>70	2	2.2	11	12.5	13	7.3
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>
Educational Status						
No formal education	52	57.8	68	77.3	120	67.4
Prim./Middle/JSS	35	38.9	16	18.2	51	28.6
Secondary/SSS	1	1.1	0	0.0	1	0.6
Post Secondary	2	2.2	4	4.5	6	3.4
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>
Religion						
Christian	63	70.0	32	36.4	95	53.4
Moslem	1	1.1	46	52.3	47	26.4
Traditionalist	26	28.9	10	11.3	36	20.2
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>
Marital Status						
Married	76	84.4	84	95.5	160	89.9
Single	1	1.1	2	2.3	3	1.7
Divorced	0	0.0	1	1.1	1	0.6
Separated	4	4.5	0	0.0	4	2.2
Widowed	9	10.0	1	1.1	10	6.0
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

education, while only 18% of respondents in the Northern sector had attained the same level. Only a few respondents (about 4% overall) had at least secondary school education. Generally, respondents in the Southern sector had a better educational status than those in the North.

1.4 Marital Status and Religion of Respondents

Of the total sample interviewed in both sectors, almost all the respondents were married. More than 84% and 95% of respondents in the Southern and Northern sectors respectively were married (Table 1a). The respondents in the Southern sector were mainly Christians (70%) while those in the Northern sector were Moslems (52.3%). A significant proportion of respondents from the Northern sector were Christians (36.4%) while a few were traditionalists (11.3%). In the Southern sector, there were more traditionalists (28.9%) than Moslems (1.1%).

1.5 Economic Activities

The primary source of income for respondents in both sectors was found to be farming. Almost 90% of the total sample size was involved in farming as their main occupation (Table 1b). Artisanary jobs like carpentry and masonry, trading and fixed salary jobs also served as the main sources of income for some respondents. For respondents with a secondary occupation, trading, artisanary jobs and farming were the sources of supplementary income. As much as 74.4% and 78.4% of respondents from the Southern and Northern sectors respectively, did not have any secondary source of income. These respondents depended solely on farming for their means of income.

Table 1b. Economic Activities of Respondents.

Occupation	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
<i>Main occupation</i>						
Farming	86	95.6	74	84.1	160	89.9
Hunting	0	0.0	1	1.1	1	0.6
Fixed salary jobs	2	2.2	3	3.4	5	2.8
Trading	2	2.2	2	2.3	4	2.2
Artisanary jobs	0	0.0	8	9.1	8	4.5
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>
<i>Secondary occupation</i>						
Farming	2	2.2	7	8.0	9	5.0
Hunting	0	0.0	1	1.1	1	0.6
Fixed salary jobs	1	1.1	0	0.0	1	0.6
Trading	14	15.6	7	8.0	21	11.8
Artisanary jobs	6	6.7	4	4.5	10	5.6
None	67	74.4	69	78.4	136	76.4
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.00</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

2. PRODUCTION OF BAMBARA IN THE SOUTHERN AND NORTHERN SECTORS OF GHANA

2.1. Production Capacity and Trends in Yield

Generally, bambara was cultivated on a smaller scale as compared to other legumes like groundnuts, cowpea and soybean in the all the areas surveyed. Kay (1979) stated that bambara was reported to be the third most important leguminous crop south of the Sahara, being superseded by cowpea and groundnuts. Sole cropping of bambara was not practiced by any of the respondents interviewed. On the whole, an average of about 3 acres of land was cropped for bambara. In both areas, the minimum acreage cultivated for bambara was 0.25 acre while the maximum acreage were 6 and 25 acres for the Southern and Northern sectors respectively. Figures 2.1a and 2.1b show the percentage distribution of land size cropped for bambara in both sectors.

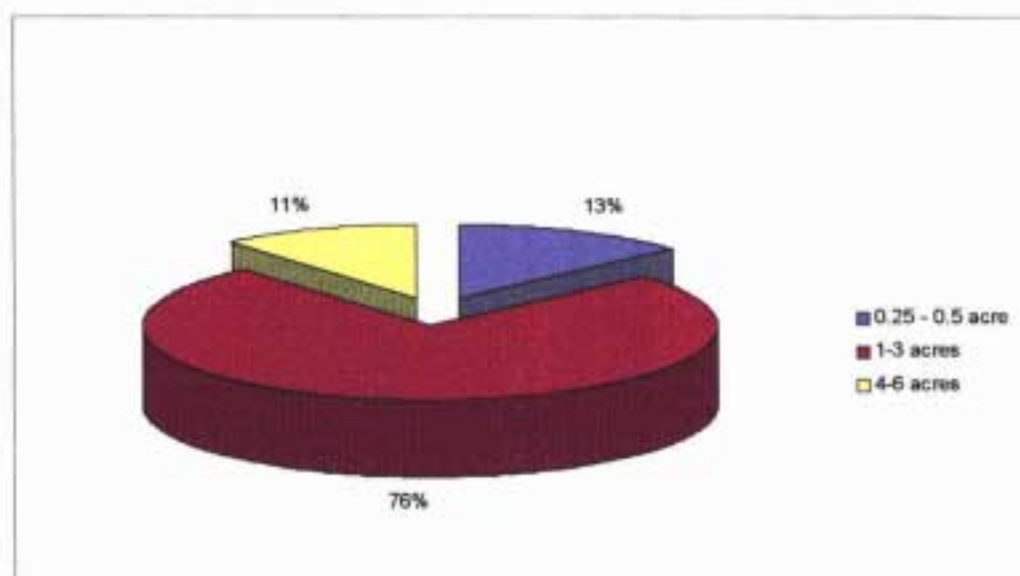


Fig. 2.1a Percent distribution of land size under bambara cultivation by farmers in the Southern sector.

Source: Survey data - 2000

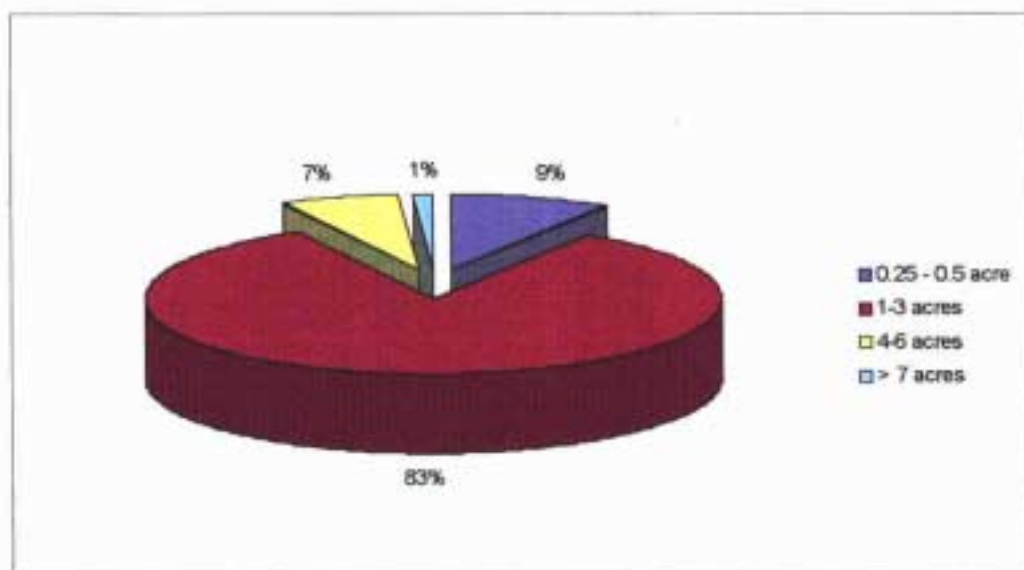


Fig. 2.1b Percent distribution of land size under bambara cultivation by farmers in the Northern sector.

Source: Survey data - 2000

The overall average yield/acre in this study was 3.53 maxi-bags in a year with the respective averages been 4.57 and 2.49 maxi-bags for the Southern and Northern sectors. In the Southern sector, majority of the respondents (76.6%) produced between 4 and 6 maxi-bags/acre (Fig 2.1c), while in the Northern sector, 1-3 maxi-bags/acre was produced by the majority (78.4%). Only a few respondents in both sectors (4.5% each) stated yields above 6 bags/acre. The highest yield reported in the Northern sector was 15 bags/acre while in the Southern sector, the highest was quoted to be 7.5 bags. Better soil types and rainfall pattern in the Southern sector may account for the better yield of bambara generally. Kay (1979) reported that bambara requires an evenly distributed moderate rainfall from sowing till flowering and although adapted to a wide range of soils, bambara groundnut thrives on light sandy, well drained loam. The availability of two cropping seasons in the South as opposed to one in the North may also be a contributory factor. Figure 2.1d shows the total yield/acre of bambara groundnuts for both sectors.

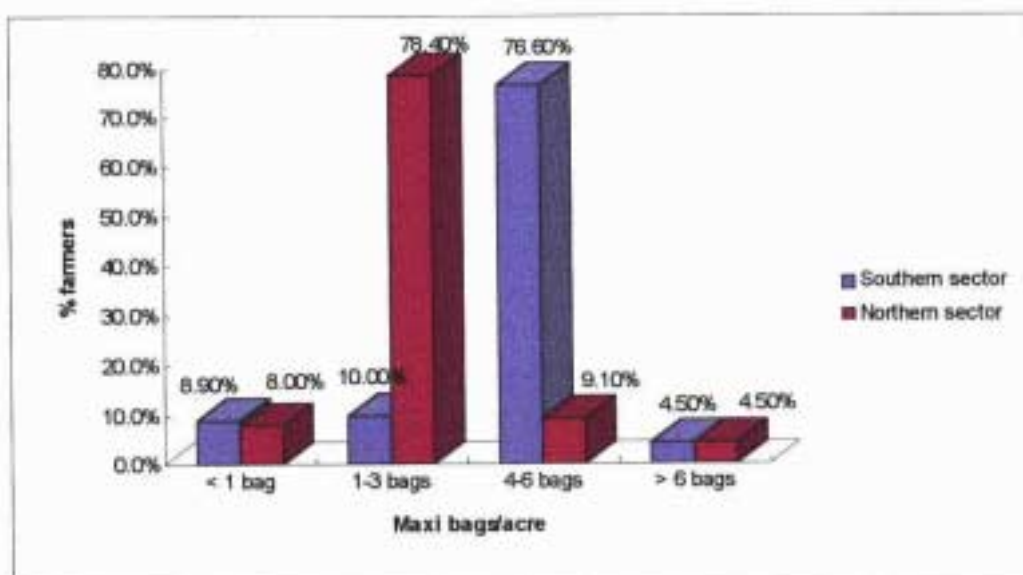


Fig 2.1c Percent distribution of yield/acre of bambara in the Southern and Northern sectors.
Source: Survey data - 2000

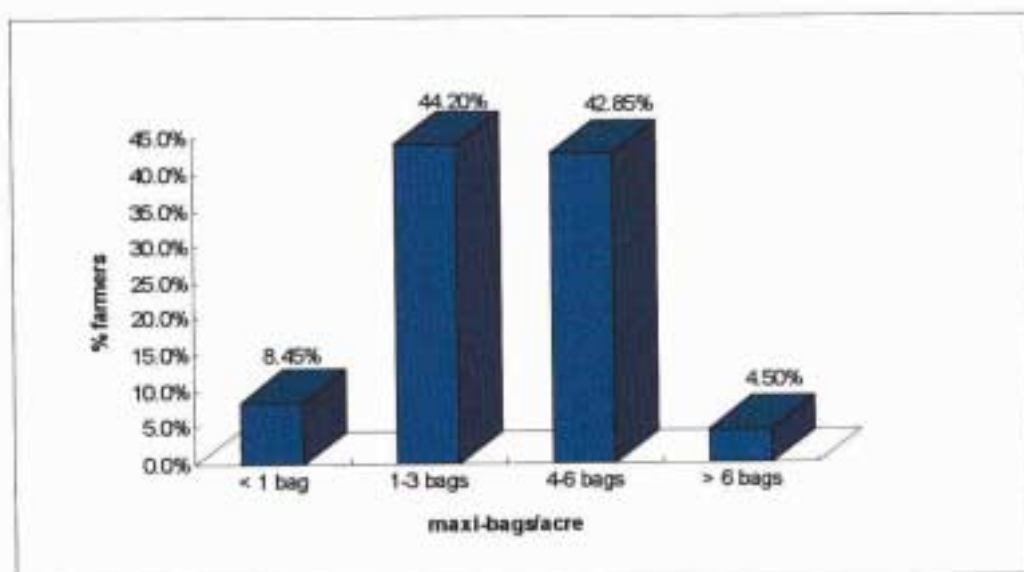


Fig 2.1d Percent distribution of overall yield/acre of bambara groundnuts.
Source: Survey data - 2000

Generally, farmers reported that bambara production had decreased over the last three years. Whereas about 68% of respondents in the Northern sector reported a decrease in their production over the previous three years, almost 65% of respondents in the Southern sector indicated a similar trend (Table 2.1). On the whole, about 26% of respondents however, had an increase in their production over the same period. Reasons given for the increase in production included good climate (especially in the Southern sector), increased capital, acquisition of bigger land (especially in the Northern sector), higher income realized and increased subsistence need for the household. Poor weather, lack of capital and land, poor soils and decreased income were the most important reasons given for a decrease in yield.

2.2 Seasonality of Supply

In the Southern sector, bambara was said to be in high supply between August and September, and also between October and February. The two bumper seasons may be accounted for by the two possible cropping seasons in the Southern sector. Between January and July, bambara is in low supply in the Southern sector. In the Northern sector, bambara supply is high between October and January, peaking in December. From June to August, and sometimes September, bambara is scarce in the Northern sector.

2.3 Income Generation from Bambara

Bambara was produced in the survey areas both for subsistence and income generation (Table 2.3a). For almost 16% of respondents in the Southern sector, bambara was cultivated solely as a subsistence crop while it served as a cash crop for about 31% of the respondents (Table 2.3a). A lower percentage of respondents in the Northern sector (19.3%) cultivated bambara solely to raise income with the majority (60.7%) growing the legume for both reasons of subsistence and cash. It was realized that the overall 25 respondents who stated subsistence as their main reason for cultivating bambara groundnuts were mostly producers who occasionally sold very negligible quantities of the groundnut. These respondents produced on a small scale and therefore occasionally sold few bowls of bambara to food vendors. A few respondents sold large quantities of the

Table 2.3a. Reasons by Respondents for growing Bambara.

Main reason	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Subsistence only	14	15.6	11	12.5	25	14.0
Cash only	28	31.1	17	19.3	45	25.3
Both subsistence & cash	48	53.3	60	68.2	108	60.7
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

legume. This was more prevalent in the Southern sector. In the Northern sector, some families produced bambara solely for household consumption and did not sell any.

On the average, about 30% of bambara produced was kept for household consumption while the rest was sold to raise income for the household. The main reasons for which bambara was cultivated were therefore to supplement both household income and food stock. In the Northern sector districts, almost 38% of bambara produced was depended on to supplement household food stock while in the Southern sector, almost 23% was consumed by household members. The higher consumed proportion in the Northern sector may be accounted for by the fact that the a wide variety of traditional meals is prepared from bambara in the North.

Generally, bambara was produced on a smaller scale as compared to other legumes, especially in the Northern sector. In terms of household income contribution 53% of respondents in the Southern sector indicated that bambara as compared to other legumes contributed higher to household income, while the remaining 43% said other legumes contributed a higher income (Table 2.3b). In the Northern sector, only 28% reported that

Table 2.3b Comparative income generation from Bambara.

Comparative contribution to income	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Higher than other legumes	48	53.3	25	28.4	73	41.0
Higher than other legumes	42	46.7	63	71.6	105	59.0
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

bambara contributed higher to household income while 72% realized more money from other legumes especially groundnut.

On the whole, for respondents who realized a higher income from other legumes, groundnut was the most important legume that contributed more to household income (Fig 2.3). For 94 respondents, a higher income was realized from groundnut, while for 5 and 6 respectively, cowpea and soybean contributed more than bambara in household income.

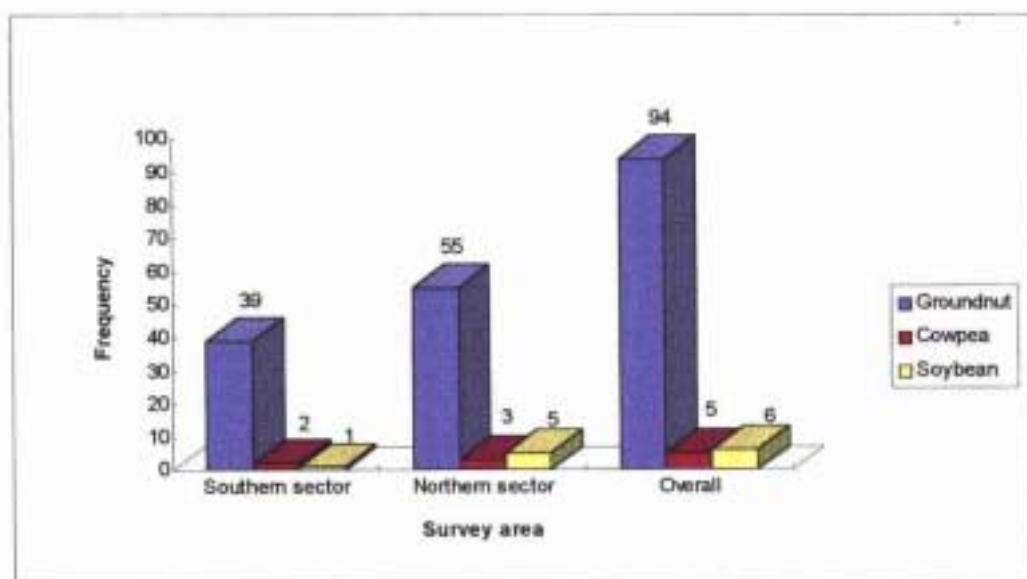


Fig. 2.3 Comparative income generation from other legumes.

Source: Survey data - 2000

2.4 Financing of Bambara Production and Labour Needs

The production of bambara was self-financed by all respondents in this study. Credit facilities were unavailable and loans raised to cultivate bambara and other crops were paid with high interest rates in the Southern sector. In the Northern sector loans were hardly available to produce bambara. Respondents reported that technical advise on bambara cultivation was often not available, although some agricultural extension officers interacted with stated that they did not discriminate against marginal crops like bambara not reported on by MOFA.

The production of bambara was reported to be highly labour intensive especially during harvesting. Labour costs are very high especially for land clearing, weeding and harvesting. Family labour was therefore highly depended on for many activities, sometimes adversely affecting production capacity. This may be a contributory factor to the low production levels in both sectors surveyed.

2.5 Constraints to Bambara Production

Various constraints faced by respondents were reported to have adverse effects on bambara production. In the Southern sector, the four most important constraints stated in order of decreasing importance were poor climate, lack of processing equipment, limited access to land and high cost of labour (Table 2.5). In the Northern sector, high cost of inputs was the most important constraint (27.7%), followed by limited access to land (22.7%) and other problems (18.2%) such as low yield, insect pest infestation, weeds and poor soils. Poor storage facilities was also stated as a constraint by a significant proportion of producers in the Northern sector.

As shown in Table 2.5, poor climate was not stated as a constraint by many respondents in the Northern sector as compared to the Southern sector. This may be due to the fact that the Savanna zone offers a very suitable climate for the production of bambara. Kay (1979) reported that bambara groundnut prefers a sunny hot climate with average day temperatures between 20 - 28°C and can be grown successfully in dry savanna areas with a rainfall of approximately 24 - 30 in. Bambara groundnut is one of the best crops for savanna ochrosols (Kay, 1979).

Table 2.5 Constraints to Bambara Production

Most important constraint	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Climate	33	36.7	8	9.1	41	23.0
Limited access to land	12	13.3	20	22.7	32	18.0
High cost of labour	10	11.1	5	5.7	15	8.4
High cost of inputs	5	5.6	24	27.3	29	16.3
Poor storage	2	2.2	12	13.6	14	7.8
Lack of processing equipment	22	24.5	0	0.0	22	12.4
Others	3	3.3	16	18.2	19	10.7
None	3	3.3	3	3.4	6	3.4
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

3. STORAGE, PROCESSING AND UTILIZATION OF BAMBARA IN THE SOUTHERN AND NORTHERN SECTORS OF GHANA

3.1 Storage of Bambara

3.1.1 Drying, Pre-storage treatment and Packaging of Bambara

Bambara nuts to be stored were left in the fields until very ripe and almost dry before harvesting. After harvesting, the nuts are dried in the pods in the sun over varying periods depending on the moisture content of the nuts at harvesting. In the Southern sector areas surveyed, drying before storage was done over an average period of one month, with respondents stating a range of one week to 2 months. Some producers reported that occasionally, drying could be done for as long as three months depending on factors like the weather and availability of drying space, while some could complete drying the nuts within three days. In the Northern sector, drying was done mostly in two weeks, with drying periods ranging from 1 to 6 weeks. It was revealed in this study that drying in the Northern sector was done on the average over a shorter period as compared to the Southern sector. Storage of bambara on the open compound to ensure continuous exposure to sunlight in the North could account for this. Generally, it was believed by the farmers that the longer the nuts were dried before storage, the lower the rate of insect pest infestation.

As shown in Table 3.1.1, the majority of farmers in the areas surveyed did some form of pre-treatment before storage. In both sectors traditional pre-treatment was more common than agro-chemical. On the whole only 38 farmers applied agro-chemicals to the nuts before storage, while 72 practiced traditional pre-storage treatment. As much as 68 farmers did not do any pre-treatment before storage.

In the Southern sector, the most common traditional treatment practices were mixing shelled nuts with dry warm sand before packaging and packaging unshelled nuts into barns in alternate layers with dry warm sand. The base of the barn is often fumigated to prevent insect and pest infestation from the ground.

Table 3.1.1 Pre-treatment of Bambara before Storage

Pretreatment	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Agro-chemical	24	26.6	14	15.9	38	21.3
Traditional	33	36.7	39	44.3	72	40.5
None	33	36.7	35	39.8	68	38.2
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

In the Northern sector, the shelled nuts were mixed with wood ash, dry warm sand or a combination of these before storage. Some farmers in addition to these traditional treatments, treated the nuts with agro-chemicals, namely phosphine mix, recommended by agricultural extension officers. In the Southern sector areas surveyed, direct contact of the nuts with agro-chemicals was generally believed to be toxic and therefore avoided. Further investigation revealed that most farmers who indicated agro-chemical pre-treatment in the Southern sector (Table 3.1.1), often sprayed the base of the barn with agro-chemicals rather than the bambara.

The bambara nuts were mainly packaged in jute and poly sacks before storage. Shelled nuts could also be kept in baskets or sealed pots in the Northern sector while unshelled nuts could be packed into storage barns in the Southern sector without the use of sacks.

3.1.2 Storage of bambara

The most important storage facility identified in this study was the storage barn. In the Southern sector, the barns were erected from the ground and roofed with thatch while in the Northern sector, barns were erected on poles. More than 70% of respondents interviewed in this study stored their bambara nuts in barns (Table 3.1.2). Bambara stored

in the barns could keep up to 8 months, at which time all the nuts were sold up to re-invest in farms or consumed. About 25% of respondents stored the bambara in baskets or sealed pots kept in their rooms. In the Northern sector, open platforms on which bagged bambara nuts are stored for continuous exposure to sunlight was also practiced by 9% of farmers (Table 3.1.2). The study revealed that both storage barns and platforms were constructed such as to allow sunlight into the stored nuts in the Northern sector.

Generally, bambara could be stored shelled or unshelled in both sectors. Shelling of bambara was done manually in all the areas surveyed in this study. In the Southern sector, shelling was done by beating the dry pods in a bag with sticks, while in the Northern sector, it was done by pounding the pods in a mortar. It was realized that storage of shelled nuts was more common in the Northern sector than in the South where shelling was normally delayed until the bambara was ready for the market or for consumption.

Table 3.1.2 Distribution of Storage structure used by Bambara Producers

Storage facility	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Storage barn	68	75.6	55	62.5	128	69.1
Baskets/Pots	21	23.3	25	28.4	46	25.8
Others	1	1.1	8	9.1	9	5.1
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

3.2 Processing and Utilization of Bambara

3.2.1 Processing of Bambara

The study revealed that processing of bambara groundnuts was more prevalent in the Northern sector than in the South (Table 3.2.1). All respondents in the Northern sector processed bambara into flour and/or paste with only about 7% of respondents in the Southern sector processing bambara into other products. Cooking of whole bambara nuts was identified to be the most common mode of preparation in the South. As shown in Table 3.2.1, bambara was milled into flour by 81.8% of respondents in the Northern sector, with almost 7% of respondents normally processing bambara into a paste and 11% preparing both products. The type of processing done depended mainly on the traditional meal often prepared by the household.

Table 3.2.1 Distribution of Processing methods used by Bambara Producers

Processing Method	Southern Sector		Northern Sector		Overall	
	Freq.	%	Freq.	%	Freq.	%
Mill into flour only	1	1.1	72	81.8	73	41.0
Process into paste only	1	1.1	6	6.8	46	3.9
Both flour and paste	4	4.5	10	11.4	14	7.9
Not applicable	84	93.3	0	0.0	84	47.2
<i>Total</i>	<i>90</i>	<i>100.0</i>	<i>88</i>	<i>100.0</i>	<i>178</i>	<i>100.0</i>

Source: Survey data - 2000

3.2.2. Processing and Preparation Methods

Generally, processing of bambara nuts was reported to be laborious and time consuming. The problem of long processing time was more evident in the Northern sector where processing methods were different from the South.

i. Bambara Flour Preparation:

In this study, the processing of bambara into flour was practiced by only one respondent in the Southern sector (Table 3.2.1) and the processing method was different from what was done in the Northern sector.

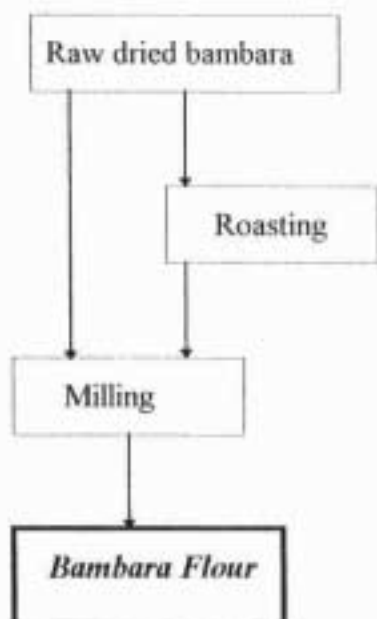
In the Southern sector, the bambara nuts are milled after roasting, or the nuts could be milled raw. In the Northern sector however, four important steps were reported to be followed always in the flour preparation. The nuts are first soaked overnight, and then dehulled the following morning at the mill. The dehulled nuts are winnowed and may be re-dried if wet; after which the nuts are milled into flour. The study revealed that bambara was mainly dehulled before milling into flour in most parts of the Northern sector.

ii. Bambara Paste Preparation:

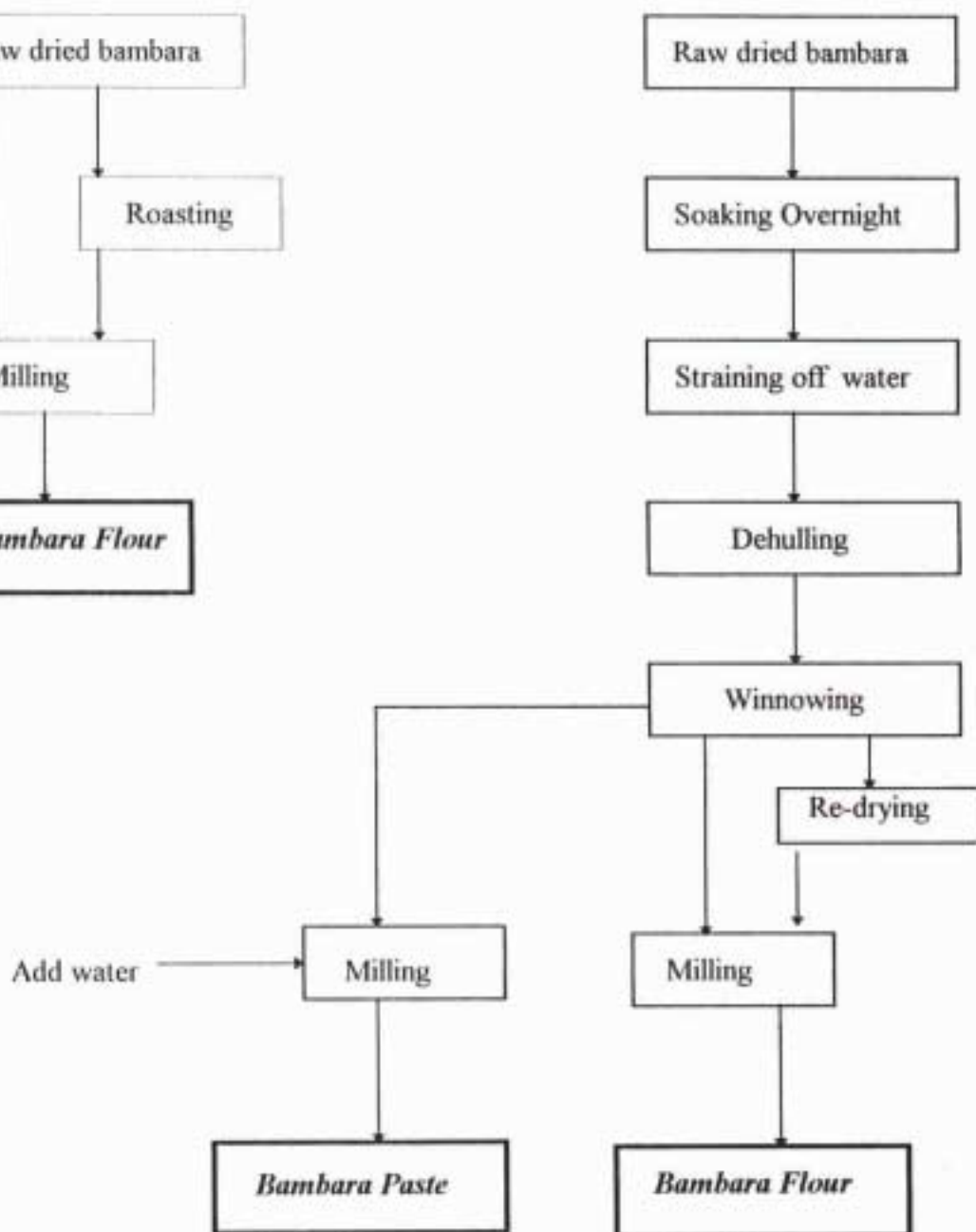
The preparation of bambara paste was also reported to be laborious and went through similar steps as the flour. The main difference is that some water is added to the dehulled nuts before milling. The preparation of bambara paste was on a smaller scale as compared with the flour (Table 3.2.1).

Fig 3.2.2a. Flow Chart for Bambara Flour and Paste Preparation

i. *Southern Sector*



ii. *Northern Sector*



3.2.3 Utilization of Bambara

The utilization base of bambara was found to be much wider in the Northern sector districts surveyed, forming an important part of the diets of the people. It was consumed more often in the Northern sector than in the South (Fig 3.2.3a). Bambara was consumed at least once in a week in the households of almost 66% of respondents in the Northern sector, while in the Southern sector, only 17.7% of respondents indicated that it formed part of the household menu at least once in a week. For as much as 83.3% of respondents in the Southern sector, as compared to 34.1% in the Northern sector, bambara was not consumed often in the households. The higher frequency of intake in the Northern sector can be attributed to the wider variety of traditional meals prepared from bambara, as compared to the South. On the whole, most of the respondents in the survey areas were not eating bambara often, with only an average total of 5% eating bambara on daily basis (Fig 3.2.3b)

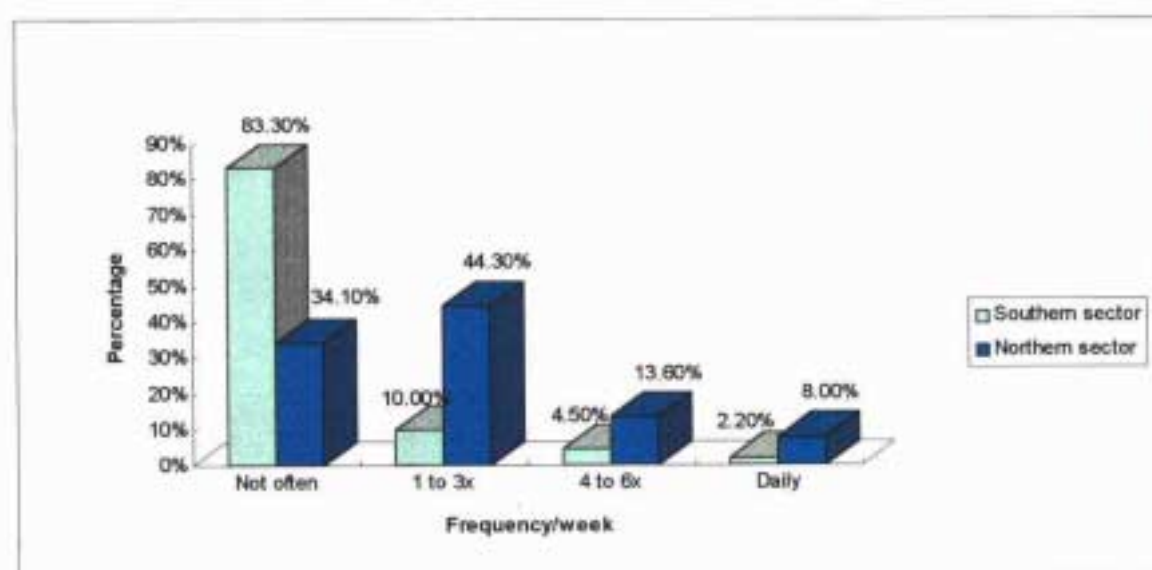


Fig. 3.2.3a Frequency of bambara consumption in the Southern and Northern sectors of Ghana.

Source: Survey data - 2000.

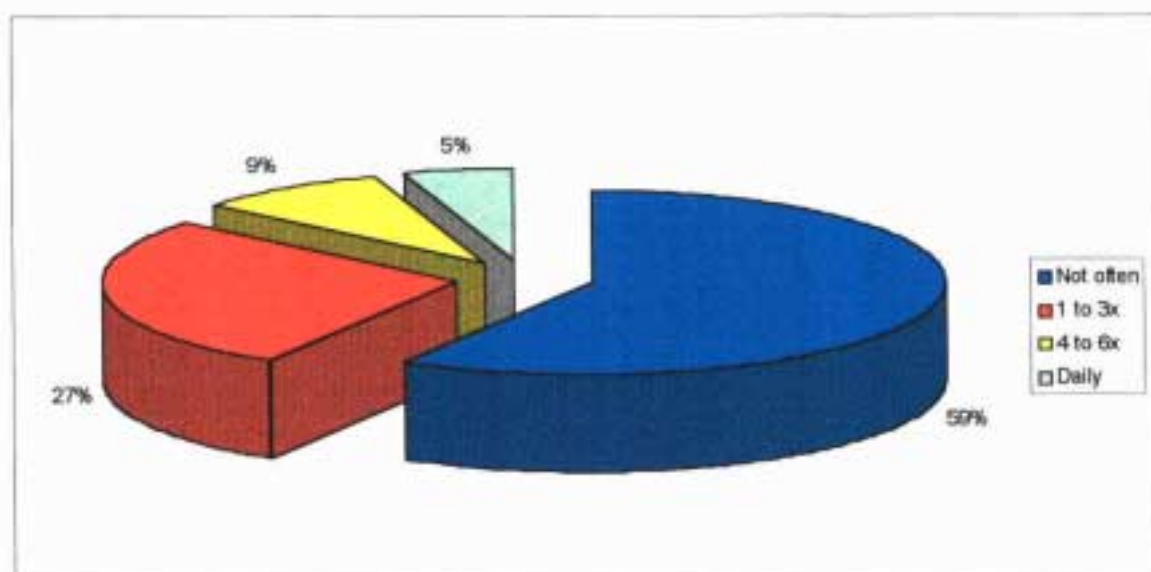


Fig. 3.2.3b Overall frequency of bambara consumption in the survey areas.

Source: Survey data - 2000.

In the Southern sector districts, bambara is mainly eaten as freshly boiled nuts or cooked dried and shelled nuts prepared in sauce. As freshly boiled nuts, newly harvested nuts that had not been dried are boiled in pods, and the cooked nuts are eaten out of the pods. In the North, in addition to these forms of consumption, the most extensive form in which bambara is used is in the form of flours and pastes. The preparation methods of 5 main traditional dishes identified in the Southern and Northern sectors are described below:

a. Southern Sector

i. Boiled fresh bambara in pods:

The young and tender bambara harvested fresh are boiled in the pods for 45 min. to one hour until very soft. Salt may be added to taste. It is served in the pods but the nuts are taken out before eating. This dish is eaten as a snack mainly, but may be serves as a breakfast meal for children.

ii. Bambara sauce (Aboboi):

This is the most important dish prepared from bambara in the Southern sector. It is referred to as "aboboi" by the majority of Southerners and is prepared from the dry shelled bambara nuts. Preparation of this meal takes a much longer time since the nuts are very hard when dry. The bambara is normally soaked overnight, sometimes in warm water. This softens the nuts slightly by morning. The nuts are then boiled over high heat for at least three hours until very soft. Salt is not added at the beginning of cooking because this further prolongs the duration over which the bambara softens. It was envisaged that the addition of small amounts of a traditional rock salt known as "Kamwe" ($\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$) could be added when boiling bambara to hasten its softening. Uzogara *et. al* reported that "Kamwe" is utilized by housewives in West Africa traditionally, to circumvent the long cooking times of beans. This will form the basis for further investigation to develop methods for reducing cooking times of bambara.

When the bambara is well cooked, salt, tomato puree, pepper puree and sugar (optional) are added to the sauce and allowed to simmer for about 30 minutes until the sauce thickens. The sauce is often served with fried ripe plantain as a main meal. It may also be served with "gari". This constitutes a main meal of the day to most people in the area.

b. Northern Sector

i. Boiled fresh bambara in pods:

This meal is prepared similarly as done in the Southern sector. However in the Northern sector, when the bambara is well cooked the nuts are taken out of the pods and melted shea butter often poured on before serving. It is eaten as a snack or complete meal.

ii. Bambara sauce:

This is also prepared with dry bambara as in the Southern sector. The bambara is boiled after washing for long hours (at least 3 hours) until soft. Here again, the women could

make use of "kanwe" to facilitate the softening. Salt is added after the bambara is well cooked. The sauce is normally served alone as a complete meal in the North.

iii. Bambara stew:

This dish is prepared with the bambara sauce. Onions, tomatoes and pepper are stewed in shea butter until well done, after which the sauce is added and allowed to simmer for 15 - 20 minutes. Bambara stew may be served as a side dish with "gari", or as a complete meal.

iv. "Tugbani":

This is a dish prepared with bambara flour. The flour is mixed with water to form a stiff paste, with no salt or seasoning added. The paste is then beaten to incorporate in air, until it becomes lighter. The paste is then moulded and packed in leaves or polyethylene, and steamed for a duration of between 45 minutes and one hour. "Tugbani" is served with stew or pepper sauce and palm oil as complete meal or snack.

v. "Koose":

This snack is prepared from the bambara paste. The paste must be soft enough to drop easily from a ladle. Traditional spices as well as pepper and salt are added to the paste and beaten continuously until light and foamy. The beaten paste should pour easily from a ladle or spoon. Guinea fowl eggs may be added to enrich the dish and help the paste bind more easily. The beaten paste is spooned into hot oil and fried until the crust is dark grey in colour, or until the dropped paste floats easily in the oil. "Koose" is served mainly as a snack and is especially popular on market days when it is fried and sold in the market.

3.2.4 Constraints with Bambara Processing and Utilization

The majority of respondents in the Southern and Northern sector areas surveyed affirmed that bambara was hard to cook. A few respondents however, believed that comparatively bambara varieties available now are easier to cook than in previous years. Generally, it

was evident that respondents were faced with some constraints in the processing and utilization of bambara. The Northern sector respondents reported more constraints than those in the Southern sector with some of these constraints being solved by various means. Constraints and possible solutions stated by the respondents are shown in Table 3.2.4.

Table 3.2.4 Constraints with bambara processing and utilization

Constraint	Solution
<p><i>Southern Sector</i></p> <ul style="list-style-type: none"> • Long drying periods • Long cooking periods 	<ul style="list-style-type: none"> * None * Add "kanwe" * Soak overnight in hot water * Wash with hot water * Cook with high fire intensity * Cook overnight on slow fire
<p><i>Northern Sector</i></p> <ul style="list-style-type: none"> • Long cooking periods • Broken nuts (during shelling) • High milling cost • Long processing time / Laborious processing • Weevil infestation • Long distances to mills • Long drying periods 	<ul style="list-style-type: none"> * Mill into flour * Add "kanwe" * Cook overnight * Cook with high fire intensity * Pound to split before cooking * Soak overnight * None * Pound at home * Some processing steps carried out ahead of time eg. dehull, dry and keep then mill when flour is needed * communal help in processing * Dry, winnow and treat before and during storage * None * None

MAIN FINDINGS AND CONCLUSION

The main findings of the studies on the production, storage, processing and utilization of bambara in the Southern and Northern sectors of Ghana are summarized as follows:

1. The major bambara producing areas in the Southern sector of Ghana identified in this study are the Dangbe East and North Tongu districts of the Greater Accra and Volta regions respectively.
2. In the Northern sector, the Bawku East, Tolon-Kumbungu, West Gongga districts as well as the Upper West region were identified as major producing areas.
3. The primary source of income for respondents in both sectors is farming.
4. Bambara is generally cultivated on a smaller scale as compared to other legumes like groundnuts, cowpea and soybean.
5. Sole cropping of bambara is hardly practiced by farmers who grow bambara.
6. An average of 3 acres of land is cropped by each farmer, with an overall average yield of 3.5 maxi in a year; 4.6 and 2.5 maxi bags respectively in the Southern and Northern sectors.
7. Bambara is produced for both subsistence and cash, with families in the Northern sector depending on bambara as household food stock more than those in the South. On the average, 30% of bambara produced is kept for household consumption.
8. Production of bambara is self financed by the producers, with family labour highly depended on for many activities.
9. The most important constraints to production faced by bambara farmers in the Southern sector are poor climate, lack of processing equipment, limited access to land and high cost of labour, while in the Northern sector high cost of inputs, limited access to land as well as low yield, insect pest infestation, weeds and poor soils are the major constraints.
10. Bambara can be stored shelled or unshelled over an average period of 8 months.
11. Traditional pre-storage treatment is more commonly practiced by farmers in the survey areas than agro-chemical treatment.

12. Generally, processing of bambara is limited to flours and pastes, with the most common traditional bambara meal being boiled whole bambara nut sauce. Processing of bambara was more prevalent in the Northern sector than in the South.
13. Bambara plays a more important role in the diets of households in the Northern sector than in the South.
14. The major constraints to bambara processing and utilization identified in this study are long cooking periods and long processing periods. Long drying periods and weevil infestation were also identified to be significant constraints.

CONCLUSION

Long cooking and processing periods associated with bambara are major constraints which have not been overcome effectively over the years and have contributed to the decline in its utilization and consequently production. It is important that the factors leading to these processing problems be eliminated or solved efficiently to increase the utilization base of bambara.

APPENDIX

QUESTIONNAIRE

PRODUCTION, PROCESSING AND UTILIZATION OF BAMBARA BEANS IN GHANA

A. SOCIO-ECONOMIC BACKGROUND AND GENERAL INFORMATION

- i. Respondent Code Number
- ii. Date of interview
- iii. Name of respondent
- iv. Name of town/village
- v. District Region
- vi. Ecological zone

1. Sex:
 Male = 1 Female = 2

2. Age

3. Educational Level
 No formal education = 1 Primary/JSS/Middle = 2
 Secondary/SSS = 3 Others (specify) = 4

4. Religion
 Christian = 1 Moslem = 2
 Traditionalist = 3 Others (specify) = 4

5. Marital Status
 Married = 1 Single = 2
 Divorced = 3 Separated = 4
 Widowed = 5

6. Main occupation
 Farming = 1 Hunting and gathering = 2
 Fixed salary based job = 3 Trading = 4 Others (specify) = 5

7. Secondary occupation

B. PRODUCTION

8. Production levels of bambara and other cereal legumes grown by the farmer

Type of legume	Acreage under cultivation	Yield/planting season or year	Proportion consumed	Proportion sold

Bambara = 1 Soybean = 3 Other (specify) = 5

Groundnut = 2 Cowpea = 4

9. What are your reasons for growing bambara?
- | | | | |
|-------------|-----|-----------------|-----------|
| Subsistence | = 1 | For both | = 3 |
| For cash | = 2 | Other (specify) | = 4 |
10. Does bambara give you more income than other legumes grown?
- Yes = 1 No = 2
11. If no to question 10, which legume(s) give you a higher income?
- Groundnut = 1 Soybean = 2 Cowpea = 3 Other (specify) = 4
12. In which months of the year is bambara in high supply.....
13. In which months of the year is bambara in low supply.....
14. Has your production of bambara increased or decreased over the past 3 years?
- Increased = 1 Decreased = 2
15. What accounted for the increase in production?
- | | | |
|--------------------------------|--------------------------|-------------------|
| Good weather = 1 | Increased capital = 2 | Higher income = 3 |
| Acquisition of bigger land = 4 | Other (specify) = 5..... | |
| NA = 6 | | |
16. What accounted for the decrease in production?
- | | | |
|------------------|--------------------------------------|--------------------|
| Poor weather = 1 | Lack of capital = 2 | Reduced income = 3 |
| Lack of land = 4 | Other (specify) = 5 NA = 6..... | |
17. What is the first (most important) constraint to bambara production in the area.
- | | | | |
|----------------|-----|------------------------------|-----------|
| Climate | = 1 | Storage | = 5 |
| Access to land | = 2 | Lack of processing equipment | = 6 |
| Labour | = 3 | Other (specify) | = 7 |
| Inputs | = 4 | No constraint | = 8 |
18. What is the second constraint
- Other (specify) = 7
19. What type of land do you use?
- | | | | |
|--------|-----|------------------|-----|
| Family | = 1 | Hired | = 2 |
| Leased | = 3 | Others (specify) | = 4 |
20. Indicate the type of labour and people involved in the various activities.
- | | |
|--|------------------------|
| i. Land clearing | ix. Harvesting |
| ii. Ploughing | x. Shelling |
| iii. Harrowing | xi. Winnowing |
| iv. Ridging | xii. Storage |
| v. Hoeing | xiii. Marketing |
| vi. Planting | |
| vii. Weeding | |
| viii. Application of Agro-chemical | |
| Family = 1 | Combination (tick) = 4 |
| Hired = 2 | Other (specify) = 5 |
| Pooled = 3 | |
21. Is labour readily available? Yes = 1 No = 2
22. How do you finance your farming activities?
- Own resources = 1 Bank loan = 2 Money lenders = 3 Relatives = 4 Combination (tick) = 5

23. What are the terms of payment if money is borrowed?
24. Do you have any problems obtaining agricultural credit? Yes = 1 No = 2
25. Are the following easily accessible? Yes = 1 No = 2
- i. Extension services
 - ii. Irrigation infrastructure
 - iii. Mechanized services
 - iv. Transfer of improved technologies
26. What agricultural inputs do you own
- Cutlass = 1 Hoe = 2 Others (specify) = 3.....

Gender issues and responsibilities related to bambara production in the household.

27. Who takes responsibility for the following : Person responsible Reasons
- i. Preparation of land for bambara cultivation
 - ii. Cultivation of bambara
 - iii. Harvesting of bambara
 - iv. Shelling of bambara
 - v. Storage of bambara
 - vi. Marketing of bambara
- Husband = 1 Wife = 2 Both = 3 Children (male) = 4 Children (female) = 5 Children (both) = 6
Every household member = 7

C. STORAGE, PROCESSING AND UTILIZATION

28. For how long do you dry your bambara after shelling before storage?
29. How do you shell your bambara after harvesting?
- Manually (specify) = 1..... Mechanised = 2
30. How do you package the bambara before storage?.....
31. Do you treat the bambara with agro-chemicals before storage?
- Yes = 1 No = 2
32. If no to 31, do you treat the bambara by any traditional method before storage?
- Yes = 1 No = 2 NA = 3
33. Describe traditional pre storage treatment if applicable
34. Where do you store your bambara?
- Storage barn = 1 Rooms = 2 Other (specify) = 3.....
35. Do you process bambara into other products? Yes = 1 No = 2
36. If yes, how do you go about this?
- Mill into flour =1 Other (specify) =4
Prepare into paste =2 N/A =5
Combination (tick) =3
37. How often is bambara consumed in the household/week?
- Not often = 1 1 - 3x = 2 4 - 6x = 3 daily = 4

38. What traditional meal is bambara used for in the household
 Abobei = 1 Tighani = 2 Others (specify) = 3..... Combination = 4 (tick)
39. In what form is bambara utilised?
 Fresh in pods = 1 Dry & shelled = 2 Others (specify) = 3..... Combination = 4 (tick)
40. What problems do you encounter with bambara processing and utilization.....

41. How do you overcome these problems?.....

42. Is bambara hard to cook?
 Yes = 1 No = 2
43. If yes, how do you overcome this problem?.....
