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DEVELOPMENT ASPECTS OF THE CASSAVA-PROCESSING INDUSTRY IN LIBERIA

Mission report *

Prepared for the Government of Liberia
by the United Nations Industrial Development Organization

Based on the work of Oladipo Onayemi,
cassava-processing specialist and UNIDO consultant

* This document has not been edited.

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S U M M A R Y

A fact-finding mission was carried out in Liberia for 3 weeks (July 21 - August 15, 1989) in order to evaluate the state of cassava processing industry and determine the prospect for cassava. During the period, data were collected from growers, consumer, government officials and from published information. In order to verify some of the date collected, field visits to production centers and research institutions were undertaken.

The technological needs, and the market potential for cassava products were determined as well as target beneficiaries at potential project sites. Although more detailed analysis is required, what is presented below is a synopsis of the major findings on which possible action could be based.

1. The contribution of cassava products to national diet and economic activity in Liberia will continue to increase as the supply of rice fall short of the demand even with the importation of rice. The artificial constraints on rice marketing through subsidy has been a limiting factor to the full utilisation and contribution of cassava to the food basket.

   As a subsistence crop, producers of cassava, often small holders, do not enjoy the same institutional support and facilities as accorded farmers of cocoa, rubber and coffee.

2. Adequate raw material base for establishing cassava processing factories is available in some counties especially in Nimba, Bong and Grand Bassa, but infrastructural problems - notably lack of good road network and transport, electricity and portable water supply- limit the contribution of cassava from these areas to the national food basket and as sources of raw material for feed formulation or industrial uses.

3. It is proposed that, given the present level of output, a multi-product based factory (or factories) will be recommended for Tappitta in Nimba county and probably, also serve Bong county farmers. This factory could process cassava tubers into food, feed and industrial raw material.

4. UNIDO will construct, supply processing equipment and hand this to selected community leaders and train operators for providing cassava products with appropriate institutional and technical advisory services. The factory will be operated as an independent private enterprise perhaps with credit from Agricultural Credit and Cooperative Bank.

It is suggested that at the end of two years, the project should be sold to the communities/associations willing to buy shares in the venture. The modalities for making the

operation a community based private business should be worked out as is consistent with the enterprise promotion scheme of the government.

5. The project, when established, will serve as an important linkage with CARI and the Ministry of Agriculture.

Moldaco, the firs indigenous privately owned food-processing factory in Liberia is located in Monrovia. It is presently not in production due to financial and management problems. UNIDO could consider appropriate assistance, within its mandate and through government collaboration, to bring back the factory to life. Such a factory as Moldaco has the basic equipment that needs few supplementary capital equipment to make it operational.

6. By-products from the industry will be disposed of as animal feed to be sold to recover some cost.

1. INTRODUCTION

Liberia is gifted with adequate land area, (24,155.00 acres, 19.775.00 (ha), suitable climate and soil for agriculture and has considerable potential for industrial growth. The estimated population (1984) is 2.3 million people and the land suitable for agriculture is estimated at 11,820.00 (4,783.314 (ha).

The land actually in cultivation for food and export crops is estimated at 1,250.00 acre (517,990 (ha). Therefore the land suitable for agriculture but not cultivated is about 10,540.000 acre or 4,165,324 (ha).

The Agricultural sector contributes 35% to the Gross Domestic Product and employs more than 70% of the population thus making agriculture the largest sector in the economy of Liberia. The agricultural sector is composed of traditional (85%) and monetary sub-sector (15%). Farming in the traditional sub-sector is mainly a subsistence farming operation involving the growing of rice, cassava, vegetables and other various crops. (Fig.1). Some agricultural activities in coffee, cocoa, oil palm and rubber production are also carried out in relatively smaller acreage by the farmers.

In line with the Government of Liberia's Economic Recovery Programme, attention is being paid to the optimum utilisation of available agricultural raw materials for production of food products in demand. In this context the utilisation of the country's cassava potential will play an important role.

Specifically, the objectives of this mission were to review the production, utilisation (including processing) and marketing of cassava in Liberia. Such a review is to be made in view of the need to develop or improve the cassava industry for food or for industrial purposes to assist the government in the Economic Recovery Programme.

2. SOURCES AND QUALITY OF DATA

Initial briefings were held in Monrovia with officials of the Ministries of Agriculture, Commerce Industry, Finance, Rural Development and Health. Data were collected on the production and marketing of cassava from the statistics obtained from the Ministry of Agriculture. The expert undertook a 6-day field tour to the major cassava producing areas to assess the size and growth characteristics of the production areas, market for cassava, potential project sites and target beneficiaries and then the only private industrialist processing cassava in Liberia: whose factory is in Monrovia.

Discussions were also held with some growers, market sellers, consumers and traditional processors to determine the pattern of seasonal influences on the growers' activities, demand for cassava tuber or products and assess the problems and prospects for industrial processing of cassava in Liberia. The information gathered together, with literature review of cassava situations in other countries, which the author is familiar with, has enabled broad recommendations to be made on the market potential for cassava products and technologies needed for feasible and economically viable cassava industry in Liberia.

Report Plans

The findings and recommendations are presented in separate section including annexes.

Annex 1 reproduces the terms of reference as contained in the Job Description.

Annex 2 is a list of the contracts made during the visits to the various counties.

Annex 3 is a flow diagram for artisinal processing cassava products.

Annex 4 is a diagram of cassava processing equipment in Liberia.

3. CASSAVA PRODUCTION IN LIBERIA

Cassava Varieties and Cassava Products

In Liberia there are two types of cassava:

(a) Local cassava

(b) Improved cassava varieties: (cassava I,II,III)

These are cultivated as an intercrop with rice or a variety of the maize under the farming system. The two types are sweet cassava i.e. those with low level of cyanide, less than 100 ppr/f.

The local cassava is basically the sweet cassava variety which is predominantly cultivated and there are two cultivars: the white cultivar and red cultivar. The local varieties yield low output of cassava tubers 3-5 tons/acre. The white cultivar is reported to be high in moisture, easy to grate and are used in making foofoo. While the red type has more solid matter and is favoured for the production of farina or gari.

The improved cassava varieties are the caricass I,II, III which have recently been introduced. They are high-yielding in terms of tuber weight, both under the traditional and improved

farm management conditions in comparison with the local varieties.

The caricass I,II,III cultivar are reported to be resistant to mosaic virus and mealy bug. In the production of cassava food products, the improved varieties are favoured for cooking to prepare dumboy, foofoo and dippa. Acceptable gari or farina have been prepared from the improved cassava. Differences have been reported in the level of the cyanide present in the 3 caricass type of cassava but these levels of HCN are generally lower than the HCN level found in the sweet local cassava type.

Variable yields of gari have also been reported in the caricass varieties of cassava, but since all the cassava are produced as subsistence crop, no quantitative data is available to determine which is of the cassava types should be used for a particular product. In addition to the tubers, the use of cassava leaves is quite popular in dietary preparations, and the caricass varieties are rated better for cassava leave output.

Output

Cassava is the second main food crop produced in Liberia. The output of cassava has shown a consistent positive trend in the past 4 - 5 years. Production in 1987 is 340.000 which showed increase of 21.5% from the 1986 cropping which reflected

8.6% cassava over the 1985 output. Table 1 shows the size of rice, cassava acreage production in Liberia.

Table 1:

Statistics of agricultural situation on two main food crops in Liberia 1985 - 1987

ITEM	1985	1986	1987
Agricultural household	176,400	178,600	179,600
Agricultural population	984,000	107,200	1,111,900
Working on farm population	657,000	760,400	776,000
Agricultural household size	5.6	6.2	6.2
Household reportedly growing rice	149,200	152,800	154,000
Household reportedly growing cassava	101,000	100,000	100,000
Acres under rice	569,000	576,000	582,000
Acres under cassava	1,131,000	118,500	115,000

Source: Ministry of Agriculture Production Statistics

Distribution of Output

Most agricultural households in Liberia normally grow cassava as an intercrop with rice and/or other crops. The proportion of households -which is estimated at 56-60 percent of the farming population- that is producing cassava varies from county to county and in some cases especially in Monrovia, home gardening is quite common. It is difficult to estimate how much cassava is produced and the types of cassava cultivated. All that is known is that in general, the sweet red cassava and the improved caricass I,II,III types are widely grown and almost every farmer (rural and urban) is a producer of cassava, (The estimates of production of cassava from different counties is presented in Table 2.) and on an output basis, Nimba and Bong counties are the main producers of cassava.

Role of Cassava in the Agricultural system and Nutrition in Liberia

Cassava production has shown a modest increase as the rate of growth of population and in response to domestic demand. Due to the economic difficulties in recent years, the cultivation of cassava has been intensified by many farmers.

Cassava is generally described as a subsistence crop and it is grown mainly for domestic consumption. Although rice is the preferred staple, cassava cultivation has shown a steady growth or served as an insurance against shortage or failure of rice supply. Since almost every household farmer grows cassava, there appears to be more cassava available than is required for immediately, every farmer is a net seller of cassava and buyer of rice.

With the raw material varieties of cassava introduced into Liberia by CARI, (Central Agricultural Research Institute, Souakoko in Bong county), the potential yield of cassava has improved under traditional farming management. Yield of improved cassava varieties (caricass I,II,III) is of the order of 8m tons/ha compared with the 4 -5m tons/ha of the local cassava varieties. Generally, subsistence farmers and producers of cassava do not benefit from government credit facilities, mechanical inputs, fertilizers or chemicals for weed control, advisory services or availability of new planting material. With these limitations, the potential yield -12m tons/ha- could not be achieved with the improved varieties. With the present improved varieties (caricass I,II,III), some farmers are able to obtain a yield of 7 - 8 tons/ha under the traditional farming practices. Cassava harvesting is done on an 'as required' basis

and many cassava farms are unharvested or abandoned because there is no great demand for the raw tubers for the harvested crops. The contribution of cassava tubers to the farmer's income and natural economy will improve if demand for the tuber is created through improvement or scale up of existing processing outlets. Even with the present yield of improved cassava, some tubers remain unharvested and because there is market for fresh cassava, the harvesting is usually done on an 'as required basis.

CASSAVA ACREAGE, YIELD PER ACRE AND PRODUCTION BY COUNTRY - 1987

TABLE 2

County	Acres	Per cent of total	Farms	Acres per farm	Yield per Acre	Prod. Million lb
Grand Bassa	9,800	8.5	11,000	1.0	17,800	76.4
Bomi	5,100	4.4	4,200	1.3	15,500	28.0
Bong	13,900	12.1	19,100	0.8	16,000	83.4
Cape Mount	8,200	7.4	5,400	1.7	18,000	65.6
Grand Gedeh	10,300	9.5	8,500	1.4	18,000	87.2
Grand Kru	4,400	5.8	4,900	1.1	18,000	36.1
Lofa	10,400	9.1	7,900	1.4	16,000	62.4
Maryland	6,200	5.4	7,000	1.1	15,400	33.5
Margibi	6,900	6.0	7,000	1.1	17,100	49.0
Montserrado	5,400	4.7	5,000	1.2	17,200	36.9
Nimba	26,600	23.1	24,400	1.2	18,000	212.6
Rivercess	2,400	2.1	2,500	1.1	15,000	12.0
Sinoe	4,900	4.2	5,500	1.0	17,500	36.0
Liberia	115,000	100.0	112,400	1.0	17,133	820.0

4. MARKETING OF CASSAVA

Introduction:

Data on the volume of cassava production household consumption, price paid for raw or processed products and the demand for cassava by other users are derived from publications obtained from the F.A.O. and the Ministry of Agriculture Household consumption survey reports. The activities of the growers, market sellers and consumers in relation to the seasonal influences on food habits and nutritional preferences must be considered when interpreting the date. The population of Liberia is currently estimated at 2.million based on a growth rate of 3.5 - 4.0 percent. The largest concentration of the population is in Montserrado county in which Monrovia is situated which accounts for 50 percent of the country's population.

For the purpose of food crop marketing, the most important factors to consider are the size, growth rate and geographical distribution of the population and its characteristics. At present 61 percent of the people in Liberia live in the rural areas while 39 percent live in the urban areas of which 49-50

percent of the entire population live in Monrovia. It is projected that by 1994, the ratio of the people living in the urban and rural areas will be 50:50. Thus a rural to urban migration is predicted and the implications for increased demand for processed foods is apparent.

The rural population currently has an average income of $195 per capita/per annum while those in the urban areas average $1,380 per capita/annum. The average income for the country is put at $600 per capita.

The demand for food-stuffs by the rural and urban population does not show a clear correlation with the pattern of income. Studies on household food consumption in Liberia show that many urban households spend some effort growing food crops particularly cassava in home gardens and outlying farms, (both rural and urban farmers).

Thirty-six percent of the households grow, harvest and store the foods that they consume. The remaining, who are non-farmers, buy in supplies of food and the great majority, (rural non-farmers, and urban) buy from Liberia's traditional markets.

A discussion on the demand situation for cassava will be incomplete without reference to the effect and association between rice and cassava in the dietary pattern in Liberia. Convenience of preparation of rice dishes, and availability of cheap imported rice as well as historical factors have given rice a place of pride on the dietary list.

Rice is undoubtedly the staple of Liberian diet followed by cassava. The average, per capita consumption of rice is 218.41b. a person while roots is 72.1 lb/person.

Cassava accounts for 90 percent of the food supplied from the roots. The contribution of cassava to economy and national diet is usually under-estimated because of the preference and food habit associated with rice. Domestic rice production does not meet the demand for rice, consequently rice is imported and subsidized. But short fall in rice supply still occurs and because of the price subsidy given to imported rice, local rice production has been depressed. If rice were to be sold at its real market value which is estimated at $50/100 lb a bag rather than the government's fixed price of $23 per 100 lb a gab, more people would shift to increase their consumption of cassava products. This shift has already started to take place and

there is a high demand for cassava products especially in Monrovia where gari currently sells for $35/100lb per bag. The trend is for a high demand (4% per annum) for cassava products which is bound to increase to match the rate of growth of population.

On the basis of household expenditure patterns, it is concluded that as income rises, rice tends to be purchased in lesser quantities in relation to other commodities. Spending for cassava products was more stable over income levels than for rice. There is a lot of variation among urban areas in terms of expenditure for other food items. The obvious conclusion is that, regardless of income level, demand for cassava products will continue to increase. Processed cassava faces a much stronger demand at all income levels than does raw cassava or other tubers (potatoes, eddoes).

Cassava is a traditional staple to be relied upon in terms of rice scarcity. Both urban and rural populations know the value of cassava and how to prepare products of cassava. Cassava is consumed at the household level in several forms:

(i) as a vegetable

(ii) pounded to make dumboy - a meal for lunch

(iii) in form of dippa

(iv) roasted as snacks

(v) processed into farina or gari

The leaves are also cooked as vegetables in stews or sauces.

The consumption and preferences of foods made from cassava tubers varies from county to county among both the rural and urban population and people of different ethnic origins.

Although cassava is grown as a subsistence crop, its importance as a cash earner is often not recognised because many households grow cassava for sale and family consumption and do not have a guaranteed market price, being a subsistence crop, like rice. Indeed many cassava growers are not sellers of cassava and buyers of rice. Data derived from the production and consumption survey of cassava showed that, off farm consumption i.e. per capita consumption by the population in the rural area is 47 lb, urban 53 lb, national 61 lb, (this estimates are approximately close to the fact that 85 - 90% of the root crops to the national dietary plate is derived from cassava.

Fresh cassava roots are bulky and quite perishable with short shelf-life. The growers, especially those in the inland counties, encounter a lot of difficulties marketing their

produce. The present poor road conditions in many counties mean that high transportation costs are incurred by the growers in conveying cassava from the farm-gate to the market. This high transportation cost is a limitation and disincentive to growers who also incur substantial losses of the crop due to mechanical injury during transportation f the tubers from the farm to the marketing centers.

The demand for cassava is estimated to be 26,000 metric tons, sixty-nine percent of it is attributed to urban areas, 36 percent to Monrovia i.e. 18,000 and 9,000 tons respectively. The demand is for increased root production, for processed cassava products like gari, farina, foofoo and dippa which are highly valued by the urban consumer than the fresh tubers. It is not likely that present acreage will be increased to meet this demand profile.

TABLE 3.

DEMAND FOR CASSAVA IN MONROVIA

	Product	Tuber Equivalent
Form	Tons	Tons
Tuber	3,000	3,000
Processed	1,700	6,000
Total	4,700	9,000

Estimate Based on household consumption survey

projections till 1992

Growth in Demand

There is at present no great demand for cassava tubers because production increase from improved varieties is meeting the population growth and there appears to be more cassava output than could be harvested especially with the high-yielding varieties. Indeed, this observation was confirmed during the visits to some farms in Bong, Bomi and Nimba counties. In reality this apparent over-production of cassava is deceptive as there is no industrial processing to take care of the unharvested tubers. The present policy of subsiding the price of imported rice is a disincentive for increased production of rice. Processed cassava products like gari, fufu will be in demand as especially among urban consumers who consider the price of rice as "too high" and use cassava as a reserve crop to bridge seasonal declines in the supply of rice. In order to improve the situation, there has to be a major agricultural policy reform as far as rice subsidy is concerned as well as other food crops.

Although rice is grown by almost 90 percent of the farming population, import of rice make up for the shortfall in demand, and cassava production and processing will assume a greater

importance in the very near future under the government programme of food self-sufficiency which is designed to reduce rice importation on a long term basis.

It is expected that it will take up to 10 years to supply all the rice requirement from domestic production, in that case additional 350,000 tons of cassava roots will be required to provide processed cassava products that would meet the shortfall in rice production.

In order to achieve greater contribution of cassava to meet the dietary intake in Liberia, the level of production has to be maintained and cultivation has to increase at an annual rate of 3.8 - 4.9 percent, to match with the rate of growth in population (3-4%). This will generate an additional annual production of about 50,000 tons of cassava roots.

The implications of this increase will be a shift in the consumption pattern in favour of cassava products and its nutritional implications. Cassava is primarily a dietary source of calories which is very low in protein

(a) An increase in the dietary intake of cassava will lead to protein deficiency and cassava toxicity diseases. Improved processing techniques can reduce these effects.
Industrially processed cassava products with proper quality control standards will ensure that safe cassava products are available to the population.

(b) There has to be an organised market to dispose of roots harvested. This involves reducing bottlenecks in transportation be developing good network of roads or finding an alternative outlet for the utilisation of cassava either for animal feed or processed into forms that can be accepted in other markets in the West African region. Unofficial and unrecorded trading in gari to some West African countries has been reported. If this aspect is exploited, cassava products can contribute to the foreign exchange inflow to the economy of Liberia.

4b. MARKETING OF CASSAVA IN LIBERIA

Because of transportation problems, mainly attributable to high cost of transporting the bulky tuber and poor network of Liberian roads, Monrovia and other urban towns do not have an adequate supply of cassava roots from the major production sites. Cassava roots that are produced in Bong, Nimba county hardly reached Monrovia because of high transportation costs which may vary from $2 - $5 per 100 lb bag depending on the distance from Monrovia/urban centers. In fact most growers in Cape Mount, Bomi, Grand Bassa counties send to Monrovia. By processing the tubers, the bulk is reduced as well as transportation cost and shelf life is better.

The supply and price of cassava roots and cassava products is highly affected by the availability of rice. The supply of cassava seems to be evenly distribute throughout the years but during the period of the preparation of land for rice cultivation and harvesting of rice, there is a shift in the labour supply required for harvesting cassava. The period of high demand for cassava is during the wet season (April - October) when there is a shortfall in the supply of rice, (both imported and country rice).

The price paid for cassava and cassava products varies widely from county to county depending on:

a) availability of rice
b) the transportation costs and the preference of the people in the area of a particular product of cassava

However, no generalized statements can ba mad for the price of cassava because this depends on the preferences of the consumers, the distance to the market, and the period of the year. During the visit to Monrovia in Liberia, the following price structure.

	Cassava	Farina
	110 lb/bag	110lb/bag
Average price (Nov-March)	$ 6 - 8	$18 - 15
Average price (April-Oct.)	$10 -15	$30 - 38

Price trends similar to the above has been reported in the past. The wholesale price of cassava tubers and cassava products are $7.0 and $30.00 per 100lb/bag in Monrovia, these costs represent for cassava tubers (on a 100lb/bag) farm gate rice $3.3, transport cost $1.7, wholesale margin $2.80 while the corresponding values for 100lb/bag farina is $20, $20, $2.0, $8.0 respectively.

From this data the wholesale margin for farina is about four times higher than for cassava thus suggesting that higher returns accrue to processors of cassava products for domestic or export market selling the raw tubers to the urban areas. The main conclusion is the increase value added to the cassava as a result of processing it into food products.

Potential for Utilisation of Cassava for Animal Feed

With the expected output of cassava resulting from improved varieties and increased production over domestic needs, there is the potential for non-food use of cassava in Liberia. Table 3 shows the quantity and amount of animal feed imported into Liberia for the period 1983 - 1987.

Table 3

AMOUNT AND VALUE OF ANIMAL FEED

IMPORTED ITEMS INTO LIBERIA (1,2)

Item	Quality (tons)	Value ($)
	1,000	1,000
1983	6,753	2,264
1984	7,019	2,017
1985	6,079	2,017
1986	5,781	1,829
1987	6,323	1,698

Source: 1. Ministry of Planning and Economic Affairs, Buereau of Statistics 1989.

2. The feed include chicken and animal feed prepared that were imported and does not include maize (corn) unmilled or other ingredients from sheet or rice.

Fish is the main source of animal protein in Liberia, but intensive poultry farming is likely to gain more prominence especially in the government's Green Revolution programme. Virtually all the feed that is used for poultry feeding is imported. The possibility of using cassava in the form of cassava chips and pellet has been suggested as part of the industrial project for the Mano River Union Industrial Project. For broilers, substitution up to 15 percent of the total feed content can be made by cassava. Cassava is widely used in the EEC and some West African countries as a substitute for cereal by-product. Cassava, however, would be in competition with local cereal especially rice bran but it could replace up to 10 percent of the total feed requirement if it is well prepared.

It would appear economical to use chips/pellets especially in those counties where cassava production is very high i.e. Nimba county or where feed milling is in operation. This new outlet would require little extra investment for the plant that would make cassava food products. However, standards of the quality for the chip and feed should not be compromised as it will affect the performance of the livestock.

B.2 OTHER INDUSTRIAL APPLICATIONS OF PROCESSED CASSAVA PRODUCTS IN LIBERIA

In order to utilize cassava beyond food uses, cassava can be processed into starch which can be sold directly for industrial application or as intermediate raw material which can be further processed into modified dextrins and sweeteners.

Cassava starch could find applications as:

- thickener in food preparations
- sweetener in soft drink
- adhesive in paper and board industries
- in textile industries for sizing or finishing threads
- in breweries as a fermentable starch

The possibility of converting starch into industrial material are there, but at the present stage of industrial development, there is need to examine a number of infrastructrual problems of this propositions as well as the quality aspects and processing conditions of the chips which will serve as the raw material.

Composite flour technology has been developed in may countries to prepare bread in which cassava flour has replace up to 15 percent in wheat bread formula. Liberia could take advantage of this current state of development and utilize cassava flour as a part-substitute for wheat flour, thus saving some money on wheat importation.

At the moment, there are no food processing industries in Monrovia that could use cassava products on a larger scale and there is little possibility for marketing these products in Liberia. The export potential of cassava starch should not be overlooked as well as the internal market for the local textile industries.

Export Market for Cassava

Given the stagnant world market demand for cassava products as animal feed, there is the possibility that processed cassava food products - gari, farina - could yield a high return in the West African sub-region. There is an unrecorded, unofficial export trade between Liberia and some West African countries.

Moldaco in fact exported gari and farina to the U.S. market with favourable returns.

It is apparent that some opportunities exist and will increase for regional trading in cassava products within the ECOWAS region.

The Liberian processor may take advantage of the CODEX standard for gari in processing cassava for export purpose. This standard deals with the quality aspects, and level of residual HCN in the gari. Considerations will have to be given to shipping costs for cassava chips and pellets and the requirements to quality for the European market in cassava as animal feed.

SCOPE FOR NEW TRADING VENTURE IN LIBERIA

TO SUPPLY CASSAVA PRODUCTS 1989 6 1990

Domestic Market	Tons per annum
For human consumption	
farina	600
flour	500
For animal consumption	
Chip/flour	500

Export Market	
Ivory Coast	
gari	250
flour	500
Cameroon	
gari	500
flour	500
Total tonnage	3,350

These projections call for an animal output of about 25,000 tons of fresh cassava beyond the present level of production in order to meet the estimated export requirement.

5. CASSAVA PROCESSING

There is extensive information on the processing of cassava into food or industrial raw material and animal feed. However in many countries where cassava is widely used as food, the terminology by which the cassava products are called or described differs. In this section, the definition of the cassava products and how they are produced in Liberia will be presented. (see annex III). The technological processes by which they are produced will then be described. As mentioned earlier, cassava is a subsistence crop, and different communities have evolved methods to prepare cassava products suitable to their culinary taste.

Historically, the processing methods were designed to remove the cyanogenetic glucoside and make the cassava safe for consumption. In the course of using varying degrees of heat treatment, different products as we know them today emerged. Historical background, taste of the product, convenience of preparing the dishes, cultural preference and price have dictated which products become a dietary staple in a community. Available data do not permit a firm judgement to be made about the exact quantities of the different varieties of the cassava-based products in the markets in each county. During the visits to

the processing sites an indication of the quantities were obtained based on the household consumption patterns, food habits and preferences. This information were used in making the recommendations.

1. Along the coastal counties, gari and farina are widely produced and are popular. In Monrovia, fufu is popular especially among the settlers from Nigeria and Ghana. Dumboi is a highly relished lunch meal in Monrovia, although other cassava products are marketed in equal amount for the urban consumers. In Lofa county, there is no strong preference for cassava products, however rice is the main diet. In Nimba, Bong and Rivercess counties all the cassava products, described below, are highly consumed in equal proportions.

1. <u>Gari</u>

Cassava roots are washed, peeled, grated into a coarse wet mass and allowed to ferment. The slurry is placed in a woven sack, and tied at the end. Excess liquid is squeezed out by placing logs or stones on top of the sack. The semi-dry mass or cake is sieved to remove the lumps and fibers.

The sieved cake is then garified in a heated pan with frequent turning. Where process of gelatinisation and drying occur. The dried material may be further sieved to different grades of fires for differentials. The coarse particles are sometimes milled and sieved prior to marketing. The preparation of gari is almost identical in many West African countries except that in some areas, a dash of palm oil is added during the drying stage to give the product a yellow colour which some consumers prefer.

2. Farina

This is similar to gari except that in general some Liberians and immigrants from Ghana and Nigeria, who are resident in Liberia, prefer farina which is popular in counties along the coast. But Gari is the favorite of non-Liberians living in Cape Mount and Grand Bassa counties.

3. Dippa

Cassava roots are washed, peeled and cut into smaller sizes (chips) or slices. They are then sun-dried on raised

platforms, or mats or concrete slab until crisp forms are obtained. The dried chips can be stored or marketed as such. But prior to re-constitution in cooking, the chips are pounded in a mortar or milled to fine flour. This product is popular in some states in Nigeria where it is called "Lafun" and in Ghana where it is called "Kokonte".

4. Fufu

Fresh cassava roots are peeled, washed and soaked for 1 - 3 days. The softened tubers are pounded and rolled into balls. Consumers purchase the cassava ball, add water and sieve the fiber and cook it. Another variation of the processing which is almost exclusively carried out at the domestic level is to grate the peeled fresh cassava to a fine slurry, add water and allow the suspension to settle. The starch is then separated by decanting the fibrous lighter layer. The starch is allowed to settle and then formed into palm-sized balls. The product is marketed in this form. Yet another variation of processing this method is to soak the peeled roots for 2 days, mash it and wrap it

in leaves and cook. The leaves are then removed as the paste is pounded. This method is popular in the Bassa county and the same technique is used in the Bassa province in Cameroon. The major difference in the preparation of fufu by different groups or communities lies in the way of separating the starch and the period of fermentation.

The fufu as understood and generally prepared in Liberia, and Nigeria is starch slurry which is later cooked but in Ghana the term is used to describe a mixture of cooked cassava and plantain (unripe) which is pounded to a plastic dough like mass in a wooden mortar with a pestle.

5. **Dumboy or 'G - B'**

This is basically a method of food preparation by which cooked cassava is pounded to form a dough-like mass. The product is highly popular in Monrovia and Nimba counties especially as lunch.

Peeled cassava tubers are cut into pieces, boiled in salted water, and pounded in a mortar with a pestle into a smooth consistency.

Types of Processing

Three types of cassava-processing operations can be discerned in Liberia. Two are traditional processing methods which are practiced widely. They use simple equipment and vary in the among of cassava utilized, amount produced, quality of product in terms of appearance, colour, taste and extent of labour input.

Home Processing

This represents the major form of processing cassava by the farmers and the many households. The among of product is very small, labour input is high and the technology is simple. Equipment used are mainly knives and hope-type utensils. The main feature of this processing technique is that cassava products are for the immediate needs of the family. Occasionally, some home-processors make fufu, dippa and gari for sale to their neighbours for cash to enable them purchase other food items or necessities of life.

Artisinal Processing

This is the processing technique employed for the production of gari and sun-dried chips for fufu or dippa which gets into commerce in the urban areas and for export. Production level is beyond the immediate family needs and traders, mainly middle-men, go to the rural areas to purchase cassava and process it to gari and fufu for export to other centers.

The processing technique is simple, but labour intensive and the output is smaller compared to the industrial output. Farmers' associations, groups of people and large household prepare cassava products by this technique to earn cash income.

Industrial Processing

The only indigenous private food processing industry in Monrovia is Moldaco, located at Slipway area. The company started making a number of food products: cassava chips, plantain chips, fufu, farina, gari, palm-butter, dippa. The company has, since 1984, no longer been in production due to technical and financial problems. However, the equipment is still at the site and some little activity in terms of production of fufu and palm butter is going on.

The rated capacity of the plant was 1.5 tons/h of gari and it has a strong potential for export.

The proprietor of the company ran into management and financial difficulties soon after starting production.

The equipment needs a few adjustments or relocation in order to be able to operate at full capacity.

The factory has all the basic equipment necessary for a wide range of products but it has to be refurbished with new additions like packaging to make it fully operational.

Gari production line was completely assembled. Cassava tubers are purchased locally in the market place, and brought daily into the factory. There was vary limited storage space, and so they were immediately hand peeled. After washing, they were grated in a drum grater and the pulp was placed in a large stainless steel drum. This was a purpose built machine used for fermenting and pressing the pulp. The casing of the drum was about 2 M long by 2 M by 1 M diameter and was perforated to permit the juice to escape. The juice is pressed down by means of a hand operated capstan. Water drained out of the mash was collected by a centritupe drum which is electrically operated. The drum is capable of holding to 10kg batch of cassava mash. The garifier is of the horizontal drum type, oil fired with an insulating cover, central stirrer and drying section.

Gari produced by Modalco is packaged in small plastic bags for export or sale at the supermarkets in Monrovia. The price of the gari from Modalco was higher than the locally available gari in the outlying villages and could not compete in price and quality with the gari processed by the artisinal method. Modalco gari is too fine grained whereas consumers prefer coarse grained gari. The other products were of comparable prices to the locally produced items.

The industry stopped production of gari since 1984 so it was not possible to obtain production cost, profit. The President of the Company, Mr. J. Davis, cited 'lack of working capital' as one of the main factors responsible for his failure. These factors seem to be unrelated to the factors of industrial processing that would assure his profitability. It may be desirable to re-activate this company with the framework of UNIDO assistance to private industrialists.

Level of Cassava Processing in the Counties

Much of the cassava produced in Liberia came from five major counties which have different degrees of processing. Five counties were visited and the farmers, market sellers and

processors were interviewed. The main findings are described below:

1. **Nimba county**

This is a major source of cassava processed and unprocessed. Both home type processing and artisinal processing of cassava take place here. Dippa and GB or Dumboy are quite popular here and except for the poor network of roads, most farmers cultivate cassava for domestic consumption and marketing or sale. Consumers from the neighbouring

countries - Guinea and Côte d'Ivoire - come to buy cassava products and tubers in this country.

The main farming areas are: Zoe-Geh, Gbeh-Gay, Sacepah-Mah, Yarwein Men sonoh and Tappita-District. Based on the yield of cassava and the need for social and industrial development outside Monrovia, an industry for processing cassava products could be located in Tappita district which is also close to Bong county, another major cassava producing area.

3. Margibi County

Artisinal processing takes place in this county organised on a co-operative basis. Gari is the major cassava product of this area and is transported to Monrovia markets and for export. Traditional or artisinal technology of gari process is employed and on the average it takes a family about a week to produce a bag of gari (100 lb).

4. Bomi County

The processing of gari, fufu, and dippa is quite common here by individual or group of families using fairly simple equipment. The county's production is also sold in Monrovia and for export.

In order to reduce the labour input in preparation of gari, Mr. James Woods of Monrovia Vocational Training Centre has developed a cassava grater which is installed in Kpagbola village in Bomi County. The diesel powered grater is capable of grating 3 bags of gari in less than 3 minutes.

Other equipment for cassava processing include screw process, roasting pan, baskets, buckets, wooden boxes, sieves and knives all of which can be produced locally. (see annex 3). The roasting is done in big pans which is placed on a mud support and dried by wood as is done traditionally. It is claimed that four bags of gari can be produced in one hour i.e. up to 40 bags per day. Heat is supplied by firewood.

5. Cape Mount County

Artisinal processing takes place here like in most counties in the coastal region and it is organised on a family or multiple family basis. The major product is gari, which is destined for at the local market in Monrovia or for export to other West African countries.

Current Situation on Processing of Cassava

1) The main features of the home and artisinal processing of cassava into food products are:

a) The high labour input for peeling, washing and grating the tubers. These operations are mainly carried out by women.

b) The low output of the food products in the case of farina or gari, it takes about 5 days to produce a bag of gari.

c) Non-uniform quality of the product; sieving, is unusually necessary to obtain product of uniform consistency. Processed gari are often milled in order to obtain uniform grained product.

d) Besides gari, no large-scale production of fufu, farina or dippa takes place.

Since the cassava roots have to be supplied as and when required (fresh roots) there is the need to purchase and store cassava to be able to maintain a continuous operation for at least a 15-day working period at a time current cassava processing in Liberia does not store cassava tuber for any considerable length of time. This situation may be due to the bulky nature of the tubers and more importantly to the physiological deterioration suffered by cassava tubers and fungal attack if the tubers are not used within 4 days may be

necessary to exploit some alternative means of supplying cassava on a continuous basis or as a semi-processed form for the industry.

One approach may be to store fresh cassava roots in moist saw dust or damp pits after harvesting or using dry cassava-chips in order to maintain a semi-continuous operation. For these alternatives empirical tests are necessary to determine the most suitable choice for Liberia or any given situation in a country.

In order to keep the cassava processing at an industrial level, factors such as contract growing, harvesting delivery on a regular basis of the fresh cassava roots have to be considered. If the use of cassava-chips is to be adopted, size and standards of quality, moisture content, microbial quality, conditions of drying the chips have to be spelt out.

Above all, additional costs and labour inputs for grating, pressing and garifier have to be evaluated and the extra cost of industrial processing cassava products compared with

artisinally processed products evaluated for marketing purposes.

Industrial processing of cassava involves the need for packaging materials like cardboard and films. The extra cost due to the procurement of these inputs do not pose a serious disadvantage over there artisinal processing technique because of the greater returns to the farmers and the increase in employment that it would generate.

In spite of the present state of industrial development in Liberia, it is suggested that one or two decentralised multi-product industrial units for processing cassava be established in one or two major producing areas. The immediate advantages are:

(1) To ensure that the cassava tubers are harvested when mature and do tie up the land when left in the ground due to lack of demand for the raw tubers.

(2) To ensure that cassava products are available in the market and fluctuations in prices will be minimized even during scarcity of rice.

(3) To ensure that the range of cassava products, food, feed and industrial raw material will be available for domestic and export markets.

(4) To provide employment for the rural population and ready market and income to the cassava growers who are currently faced with the uncertainty in stagnant cassava market.

5. TECHNICAL, ECONOMIC AND INFRASTRUCTURAL PROBLEMS ASSOCIATED WITH THE PRODUCTION, MARKETING AND PROCESSING OF CASSAVA IN LIBERIA

Cassava cultivation in Liberia is quite widespread in all the 13 counties. The local varieties have low-yield about 2 - 3 tons/acre while the improved varieties yield up to 8 tons/acre under traditional management practices though it is possible to obtain a yield of up to 12 tons/acre with good management practice. Output of the improved cassava varieties, (Caricass I,II,III) are adequate in the short run to meet the domestic requirements for consumption, internal trade and processing.

Because most households grow cassava every one is a net seller of cassava roots and production, short fall is not envisaged, rather a steady growth 4.5% production of cassava is expected. Cassava is consumed in various forms and as a source of income when transformed into different products like fufu, gari, dippa. The prospects look good for a higher return on investment when cassava is processed into food products especially for export in the West African sub-region or for feed.

Although the varieties differ in the levels o sweetness due to the varying proportions of HCN, they are all used for fufu and gari production. However further studies are needed to determine the product yield from the new cassava varieties and the flour.

Problem of Production, Marketing and Processing

1. The high labour requirement for land preparation, weeding and harvesting and lack of inputs to control pests (mosaic virus and black spider mites) limits the optimum production potential of the caricass I,II,III, varieties.

b) The marketing of fresh cassava roots is a major difficulty to the growers. In the major farming areas, head transport is used to convey the tubers to the nearest collection point. The roads are not well developed and producers occasionally do not get their tubers transported to urban centers at a high price. There is no organised marketing of cassava roots or products. consequently, some farms are not harvested and those which are harvested for sale often get spoilt due to fungal attack, or enzymatic activities.

There is a substantial internal trade for the processed cassava products within the subsistence economy and these are prospects for inter-state trade in gari, farina within the sub-region. The high cost of transportation and lack of institutional support (financial and technical) appear as the major obstacles to the production section.

Processing cassava into different products would create a stronger demand at all levels for both rural and urban agricultural growers but the state of industrial development is a cause of concern for this optimism.

Besides, the value added to the commodity and higher profit that will result from the processing activity, there is the provision of employment, to the rural population. In many counties where there are adequate supplies of cassava, there are no good roads, portable water and electricity.

In setting up processing factories in those areas of Liberia with good supply of cassava tubers, additional expenditure may incurred in procuring:

- water, supplying electricity, means of transportation, and opening up good roads. This extra costs may reduce the overall profit form the industrial processing of cassava.

- supply spare parts for the machinery the factory may be another constraint.

- the educational curriculum in many Liberian colleges do no offer courses in food technology. This may present a manpower problem in the immediate future for increased utilisation of many food crops and reduce the dependence of the country on imported foods.

As noted in the section under processing, in order to develop cassava into a viable industrial activity consideration will have to be given to the provisioning of the tubers or intermediate form such as chips (semi-dried forms) in order to make the operation a continuous one. Current processing operations (hope-types, artisinal, industrial) use fresh cassava tubers which are harvest as required. Intermediate forms of cassava, e.g. chips, might be an alternative raw material for the fufu or dippa which will make the operation run for a few days. Further studies may be required to elucidate how to ensure continuous processing operation for an industrial concern.

In spite of these limitations, it is recommended that one or two processing units for processing cassava be installed in Liberia than a large processing unit in order to economize resources, save on the cost of transportation and provide substitutes for high dependence on rice consumption and importation.

Cassava peel is reported to be high in HCN and two possibilities are available for the disposal of the waste or by-products. The peel could be dried as feed for livestock or sold to livestock farmers in the area. A detailed economic analysis of these propositions could be needed in order to make proper judgement.

From the standpoint of industrial utilisation of cassava, the problem of providing cassava on a regular basis to serve industrial need deserves some comment. As noted earlier, cassava tuber is a subsistence crop produced by small-holder farmers who cultivate small acreage and often harvest them in response to domestic need or market demand.

In the production of gari, fufu, dippa and dumboy, fresh tubers have always been utilised and since cassava is not cultivated on a plantation basis, processors or industrial users

have to rely on the farmers to bring their commodity to a central collection point. Perhaps this aspect constitute to the high price of collection and transporting the tubers to be 'factory' (central villages).

In order to ensure that the factory/industry works for a reasonable length of time without interruption, methods of harvesting the tubers at the right time of maturity and delivery it to a central location deserves a close study.

It will be desirable to have an agronomist within the factory whose duty will be to ensure the cultivation of the right variety of cassava cuttings, maintaining adequate cultural practices and harvesting at the right time for delivery to the collection point or factory. This is where fresh tubers are required. The tubers are, nevertheless, bulky and have to be transported to the factory.

There are some products like fufu and dippa for which semi-dry forms i.e. cassava chips could be convenient raw materials.

Producers in the locality may have to be trained as to the best methods of preparing cassava chips which will be acceptable to the factory based on specified quality characteristics.

Cassava chip production technology is relatively simple, but for food purposes, stringent quality criteria may be specified.

In all the visits throughout Liberia, the processing of cassava, even in Modalco, is highly unorganised to take care of a) raw material acquisition b) processing operation and finished product inspection and packaging.

An industrial operation that will utilise cassava for multi-products will have the following basic components of department organisation. The number of staff depends on the scale of operation.

MANAGING DIRECTOR

|

| | |

Raw material procurement and quality control dept.

processing section

Quality control and marketing section

| | |

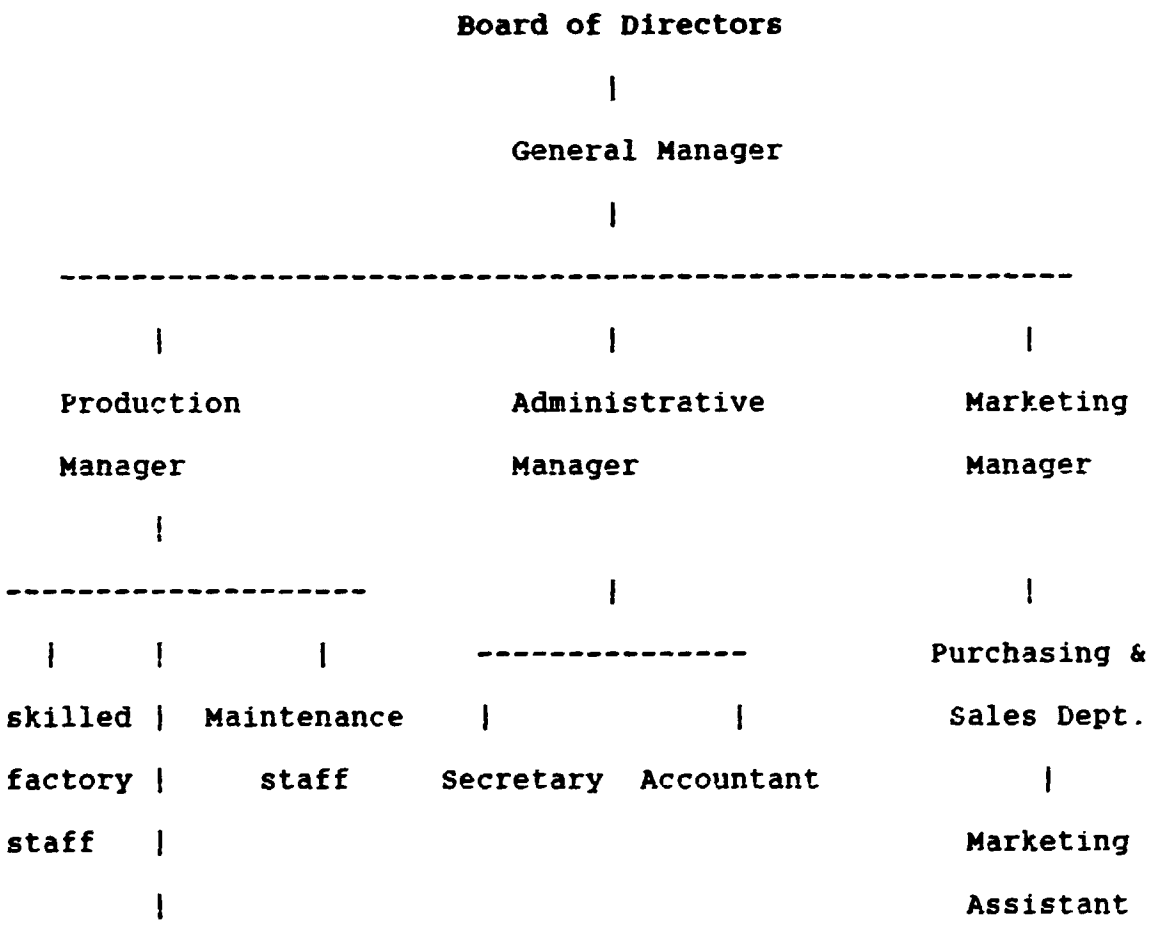
| | |

Agronomists (5)
Chemists (1)
Foreman (1)
Drivers (1)

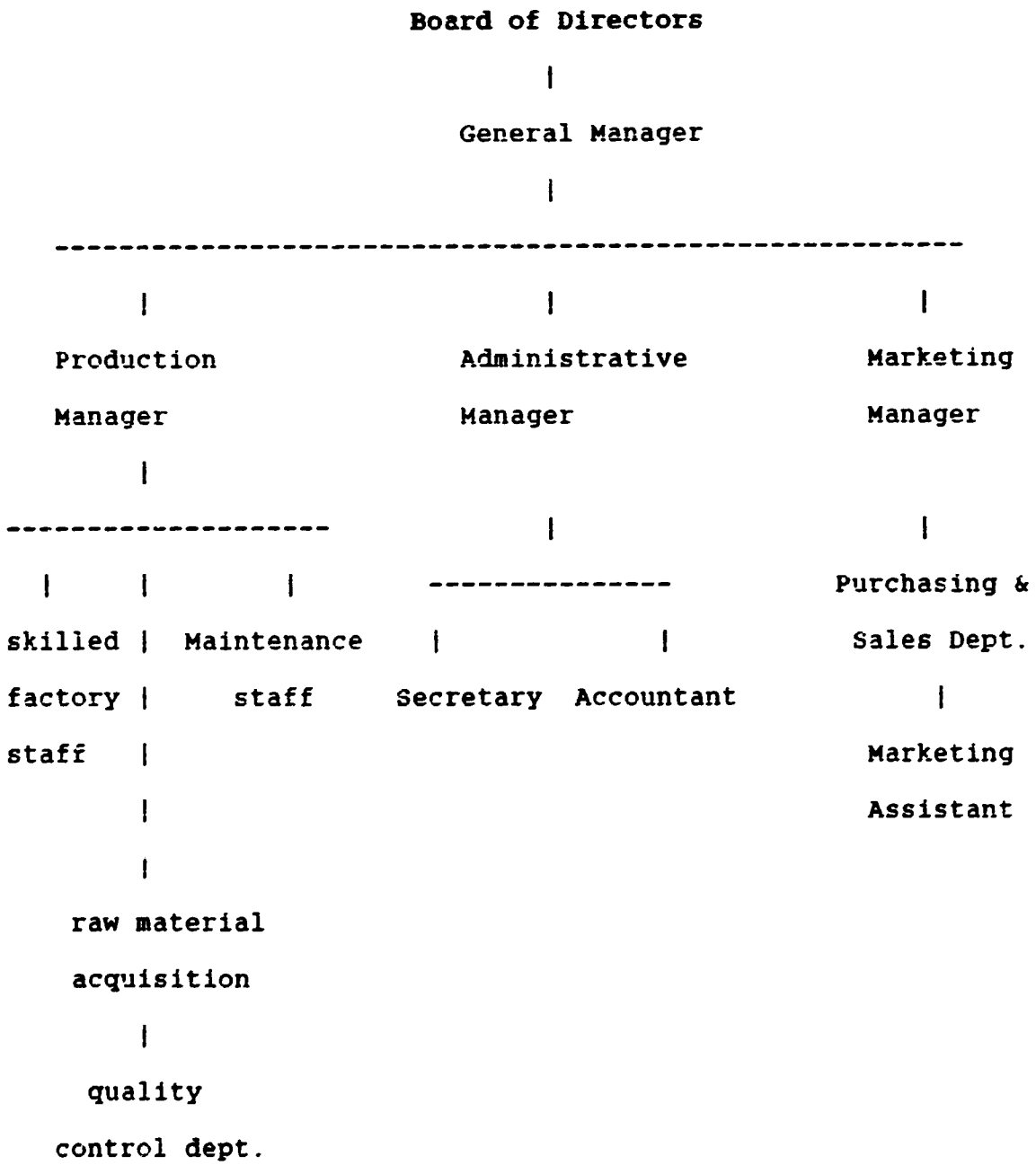
Food Technologists
Agric Engineer
Foreman
Mechanic (2)
Operators (10)
(for peeling washing loading etc.)

Accounts clerk
chemists
clerks (4)

Proposed organisational chart for Cassava processing in Liberia



Proposed organisational chart for Cassava processing in Liberia



CONCLUSIONS

The review of information on cassava production and the visits to the major cassava growing areas in Liberia together with discussions with farmers, government official provided the basis upon which the following conclusions are made:-

(1) Cassava food products come second to rice as a dietary staple in Liberia. As the supply of rice becomes inadequate, the utilisation of cassava will continue to fill the gap. However, there is need for a general reform of agricultural policy such as removing the price subsidy on imported rice in order to enable cassava products find their appropriate price level in the economy.

(2) The production of cassava, especially with the improved cassava varieties, (caricass I,II,III) will continue, given good management practices in order to match the demand consistent.

(3) Information on the marketing of cassava, especially, the raw tuber and processed products in Monrovia, showed that the value added is a result of processing into either gari

or farina is about 20 time the amount realised from selling the raw tuber. Thus indicating that the processing operation, even at the artisinal level with low production output, brings about higher profit margin than the raw tubers.

Establishing the cassava processing factories in the main production areas would seem to have enormous advantages on the rate of population growth.

(4) There is a high demand for good quality cassava food products, both for domestic consumption and export market. With the current level of production, the possibility exists for processing cassava into chips which could be used as food, feedstuff or industrial raw material.

(5) The supply of processed cassava food products is partly being met by hot-type and artisinal processing techniques. Both in terms of quantity and quality, the output of cassava products is low, industrial processing of the cassava could create the required demand for the tubers, and create a multiplier effect on the agricultural and industrial sector and reduce the labour output associated with the traditional cassava processing.

(6) The indigenous cassava processing industry in Liberia which is located in Monrovia will have to be assisted through the appropriate mechanism of institutional or financial support so that it could play a leading role in the industrial processing of cassava in Liberia. Alternatively, the factory may be relocated to a new site to make it functional.

(7) In order to upgrade the artisinal processing of cassava to industrial stage, the need for multi-product factory has to be examined as well as raw material provisioning to the technology of industrial processing of cassava in Nigeria and other West African countries.

(8) Based on the market demand, the mechanic could be adopted for the production of gari, farina, fufu, dippa and work on a batch or continuous basis.

(9) The information gathered on the household consumption pattern, retail price of gari, fufu and farina indicates that price fluctuations would be minimized when the cassava is processed, and that wholesale profit accrues to the processor. One or more processing factories could be established at the major cassava production belt in Nimba or Bong county. The industry when established would reduce

post-harvest losses of cassava tuber, reduce transportation costs since the bulky tubers would have been converted to dry in storable forms, provide employment and income to the farmers, and improve the living standards through earned income.

The industry would also stimulate the production of cassava tubers which are otherwise unharvested due to lack of demand or market outlet.

Fortunately, UNIDO has taken a pioneering initiative in this effort. The Federal Institute of Industrial Research, Oshodi, (FIIRO), was commissioned by UNIDO to design and fabricate a gari-plant that could be operated at the village level. This equipment is now in operational though it has some limitations. Mr. J. Woods of Monrovia Vocational Technical Institute has also designed some aspects of the gari-processing machine. Some Features of FIIRO UNIDO-sponsored machine could be combined with the machine developed by Mr. Woods for a multi-product based factory in Liberia. These machines could perform the operations of grating, mechanical pressing, sifting and garifying, drying and nulling thereby, reducing labour input and improving through put of the cassava products.

RECOMMENDATIONS

(a) Most of the urban income earners in Liberia live in Monrovia an still prefer cassava products in spite of the availability of rice. It will be necessary to satisfy this population with the supply of processed cassava foods. it will be economically feasible and profitable to have a processing factor to supply the market in Monrovia.

The Moldaco factory which is not currently producing to meet the domestic market could be rehabilitated with management and financial resources to resume operation. From discussions with the owner of the factory, the reasons stated for its non-functioning since 1984 can be described as poor management judgement which are not related to the factors of production. Mr. Davis, the owner of the factory stated that he needed assistance for operational expenses to be able to continue production at full capacity.

UNIDO might wish to consider both technical and financial assistance to revitalize this company or support Mr. Davis' request to the Government of Liberia through the appropriate institutional frame-work such as Agricultural credit scheme etc.

(b) In the alternative, the government of Liberia should consider installing a new factory to serve the Monrovia market.

Such a factory should be operated strictly as a private enterprise through the organisation of artisinal processors who are willing to operate within the industrial enterprise promotion scheme of the Liberian Government.

(c) Cassava production is quite high in Bong and Nimba counties. Poor Network of road and lack of portable water, electricity in these areas prevent the cassava the cassava growers from utilising the output from their farms. It is recommended that one or two units of decentralised multi-product cassava factory be established in this area. The factory should be operated as a self-help community-based project with technical support being provided by UNIDO.

Fortunately most people in Liberia cherish group effort which are associated with low external inputs. The form of technical assistance could involve provision of equipment and a

small amount of seed-money to get the project off the ground. In this way the community will be assured of sustainable development.

(d) Since no local equipment supplier is available in Liberia, UNIDO should install the FIIRO - gari machine and other modifications using Mr. Woods approach in Tappitta District in Nimba county for a start. Here, other groups in processing of different cassava products would be trained. This center could prepare operators for repairs of machine and technology transfer to other communities.

(e) Cassava production has usually been regarded as subsistence crop with little input to the farmers. Government should encourage the farmers to increase their production in order to meet the needs of the factory. It is therefore strongly suggested that farmers should designate extension workers from county agricultural divisions to advice farmers on management practices etc. Chemicals and fertilizers should also be provided at commercial rates to the farmers.

Most farmers complain of the lack of guaranteed producer price for cassava tubers as a disincentive for increased production. While there may be merit for guaranteed price for

some agricultural commodities. There might be a dislocation in the supply and demand if such approach is adopted for common foodstuffs. The experience of the author in the case of yam in Nigeria is relevant, once the price is not favourable, producers will shift the production of food crops or crops that would earn them higher income.

The caution would be to allow market forces determine the price paid for cassava at present. It is urgently important, however, that infrastructures like roads be improved and adequate inputs be supplied.

The Liberian Government's Economic Programme has a long-term goal of assuring self-sufficiency in food production and utilising fully, all the agricultural food output.

No commercial farming or plantation type farming for the production of cassava is envisaged or recommended. However, processing has to be actively encouraged to supply domestic and export market to prevent food loss and develop the rural areas.

Further investigation is recommended in order to adopt the result of pit storage cassava to ensure continuous supply of the tubers to the factory.

(f) Specifically, since cassava is next available to rice in Liberia, and to ensure food security without relying on 'rice' as the only staple, it is suggested that:

1. Government should provide adequate assistance in the form of inputs to cassava farmers in order to maintain and increase production.

2. It is strongly suggested that government should improve the rural infrastructure such as network of roads to enable the tubers to be transported at reasonable costs to the urban areas. Government should also provide electricity and portable water so that food processors ca be encouraged to stay in the rural areas.

3. UNIDO in collaboration with the government of Liberia should consider as a matter of priority, the establishment of one or two cassava processing factories in Nimba or Bong counties as a country project. This factory should be a multi-product in output and initially UNIDO should construct, equip and operate the factory as a demonstration unit for a limited period not exceeding 2 years. This project should be run initially and subsequently as a

private enterprise by a management committee of representatives of government, UNIDO, group of entrepreneurs and community associations and growers. The factory should provide opportunity for industrial linkage with CARI (Central Agricultural Research Institute, Souakoko) to test and demonstrate quality characteristics, yield etc., of newly developed cassava varieties.

4. The factory will serve as a training place for university graduates to help the rural population in:

   a) adoption of technology and

   b) conservation practices - No sophisticated equipment is envisage, since the technological needs are simple and labour input is semi-intensive.

5. Cassava production has remained stable for the past few years, the only outlet for increasing the cultivation is through processing of that for products like gari or farina where fresh roots supply is the 'ideal' raw material, the conditions of harvesting and damp-pit storage for the tubers be explored while for the dippa production, cassava

chips produced by the farmers or as intermediate producers under well-defined conditions with quality characteristics be used.

For the latter proposition using cassava chips, standards of quality need to be established and this requires training and education of the producers or methods of peeling, washing, dicing and drying. Given the level of development in Liberia, this approach may be somewhere in the further. UNIDO might wish to commission a further exploratory study on alternate forms of cassava processing that could be recommended to the tropical countries.

ANNEX 1

PURPOSE OF PROJECT

Fact-finding study for the development of cassava processing industry in Liberia.

Terms of Reference:

a) Review the cassava production sector and draw conclusions on the quality and quantity of cassava raw material available for processing

b) Review the cassava product market situation and estimate the varieties, quantities and quality of cassava based products in demand

c) Review existing cassava processing sector, comment on the product produced, the production scale, the technology applied, the raw material provision operations and often relevant factors.

d) Review infrastructural situation and comment on the available transport means and ways as well as storage of raw material and products and the utilisation/disposal of by-products and wastes

e) Based on the results of the reviews and studies made, draw conclusions forwards the techno-economic usefulness of the further development of the cassava processing sector.

f) Discuss specific recommendations for specific development action to be taken with regard to the improvement and/or rehabilitation of existing cassava processing plants and/or the establishment of raw cassava processing factories

g) Prepare a final mission report for consideration and formal submission to the relevant Government authorities.

TRADITIONAL CASSAVA PROCESSING EQUIPMENT

ANNEX II

TWO HANDED CASSAVA GRATER

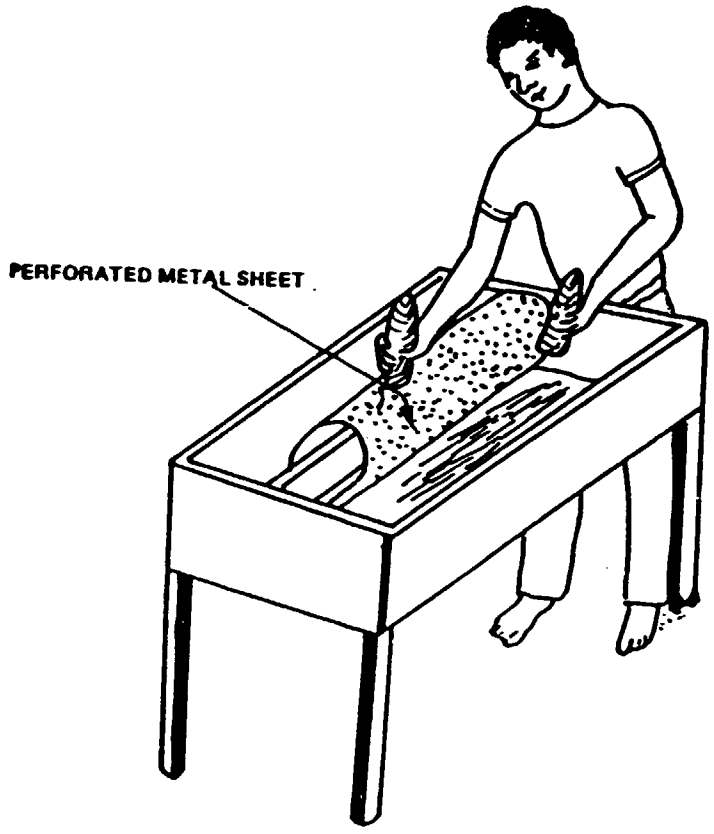
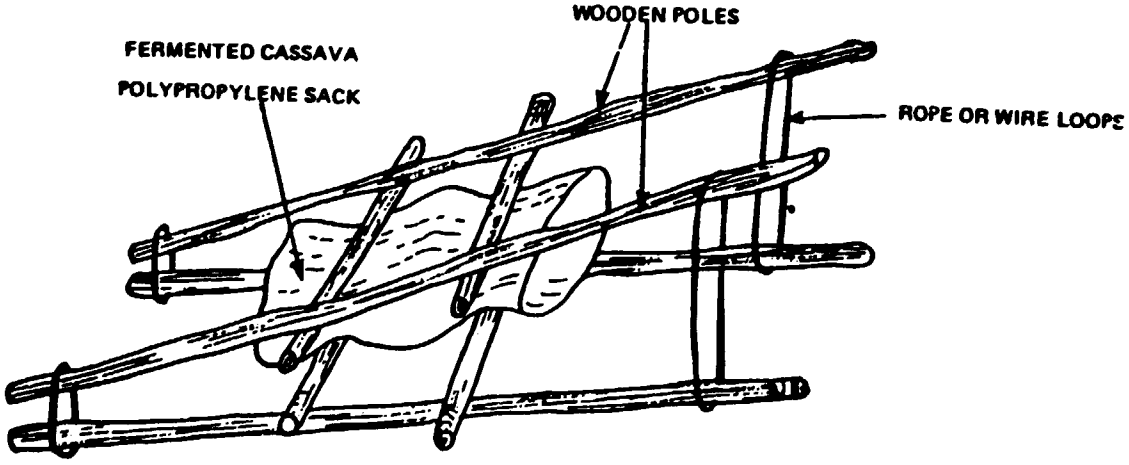


FIGURE A7.2.2 PRESSING FRAME FOR GRATED CASSAVA



RUBBING FRAME TO BREAK UP LUMPS

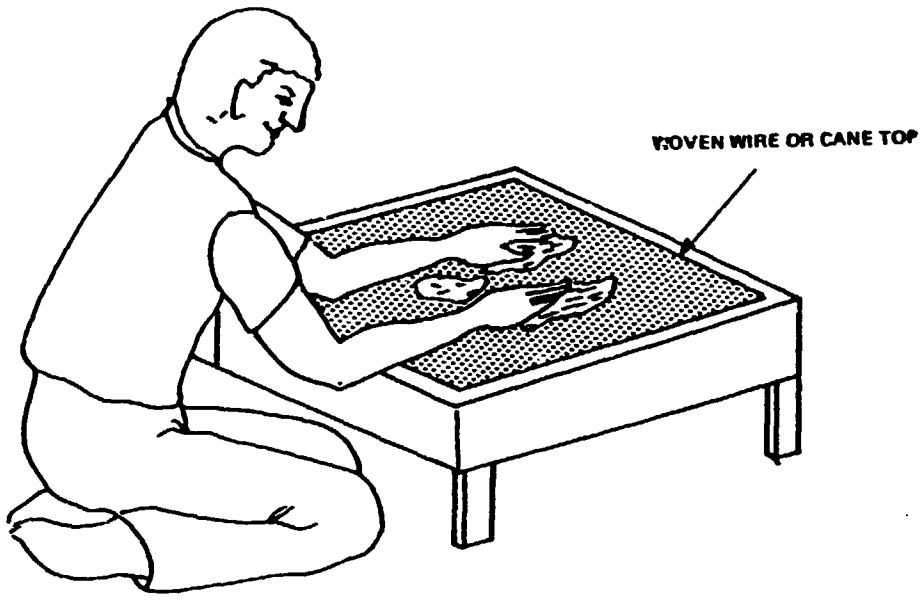
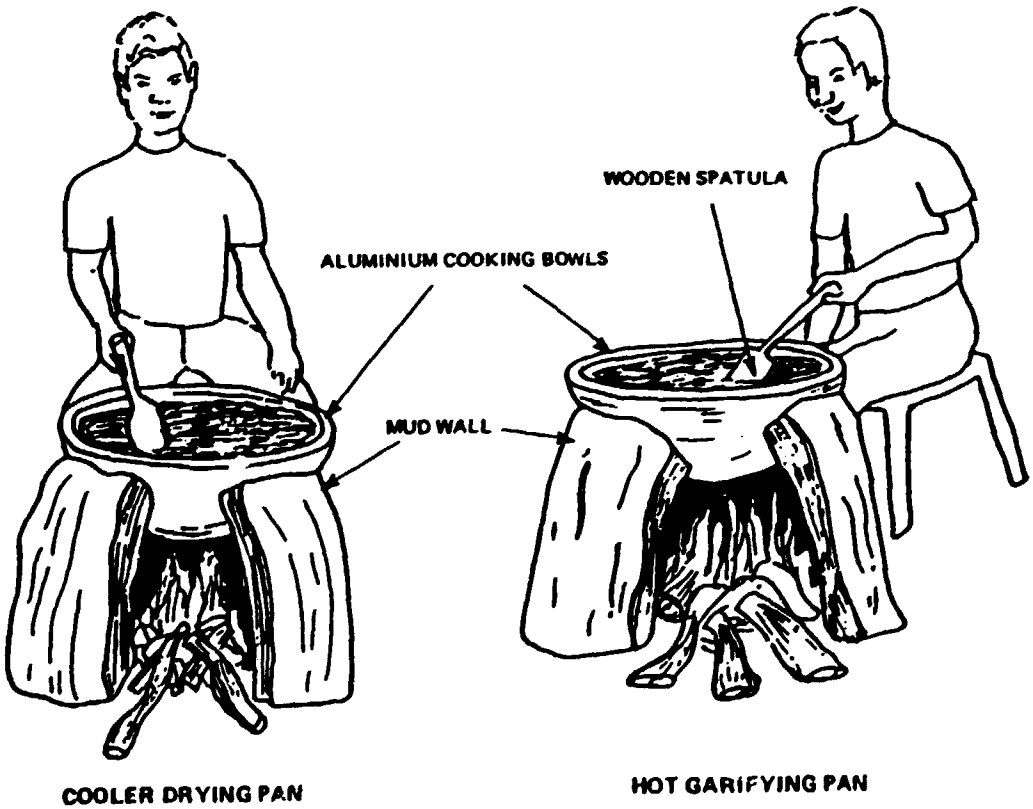


FIGURE A7.2.7



FLAT BED FARINA FRIER

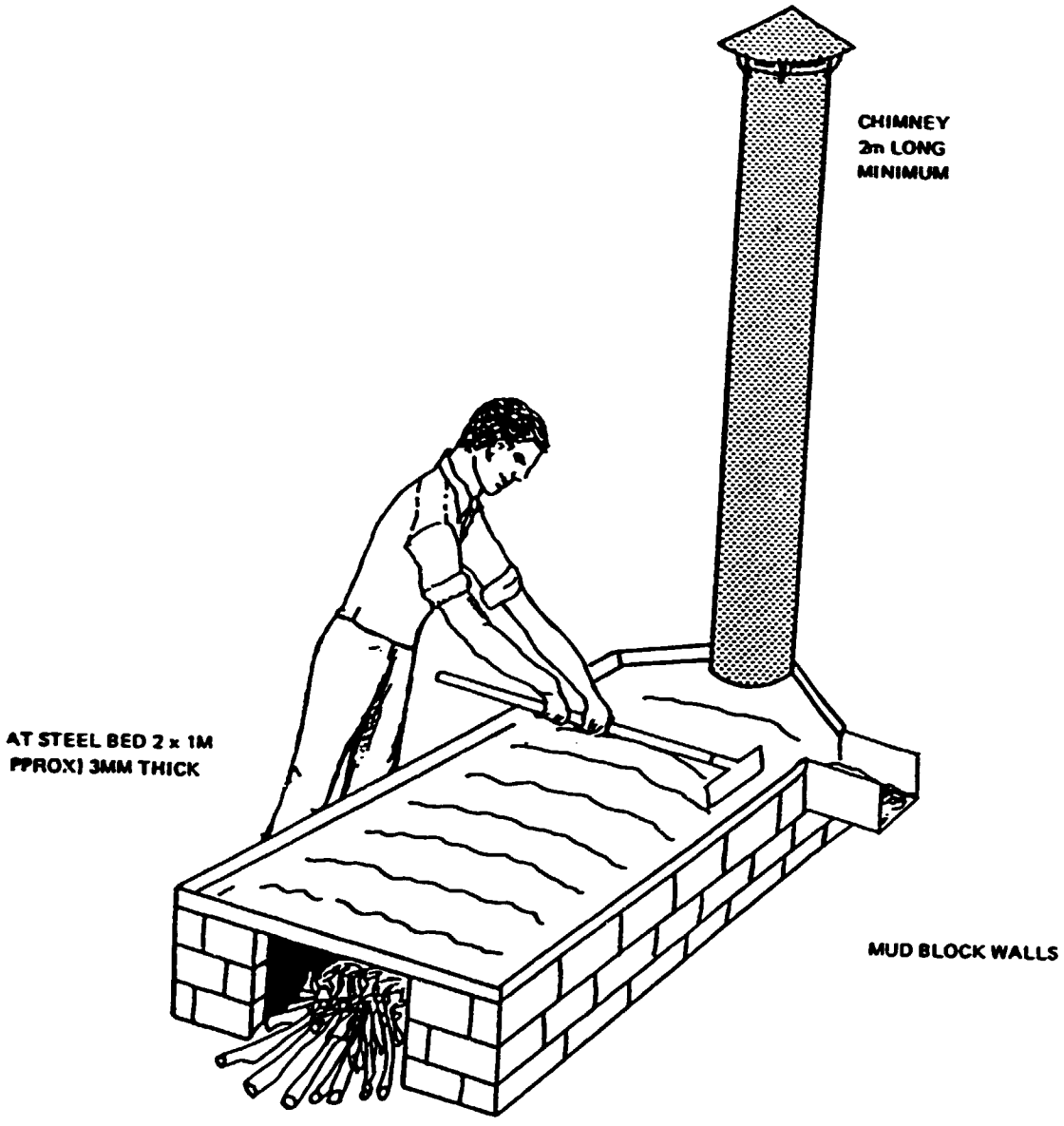
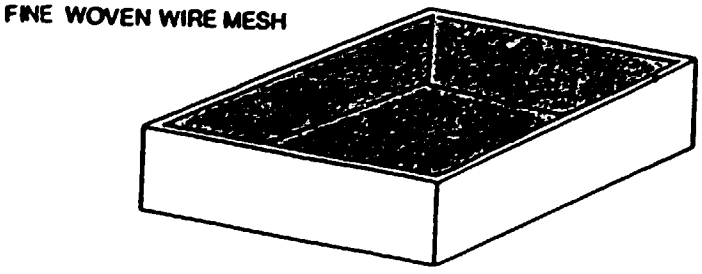
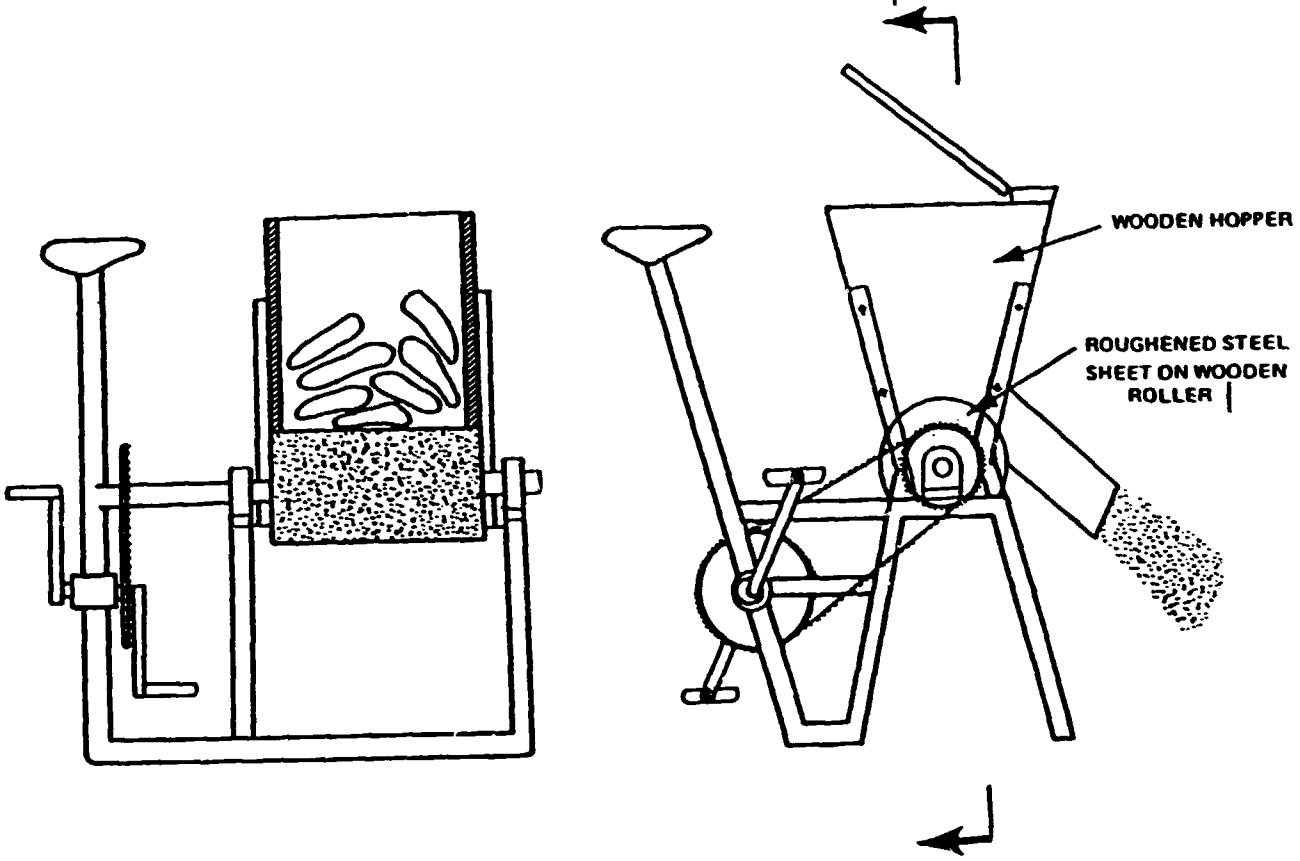


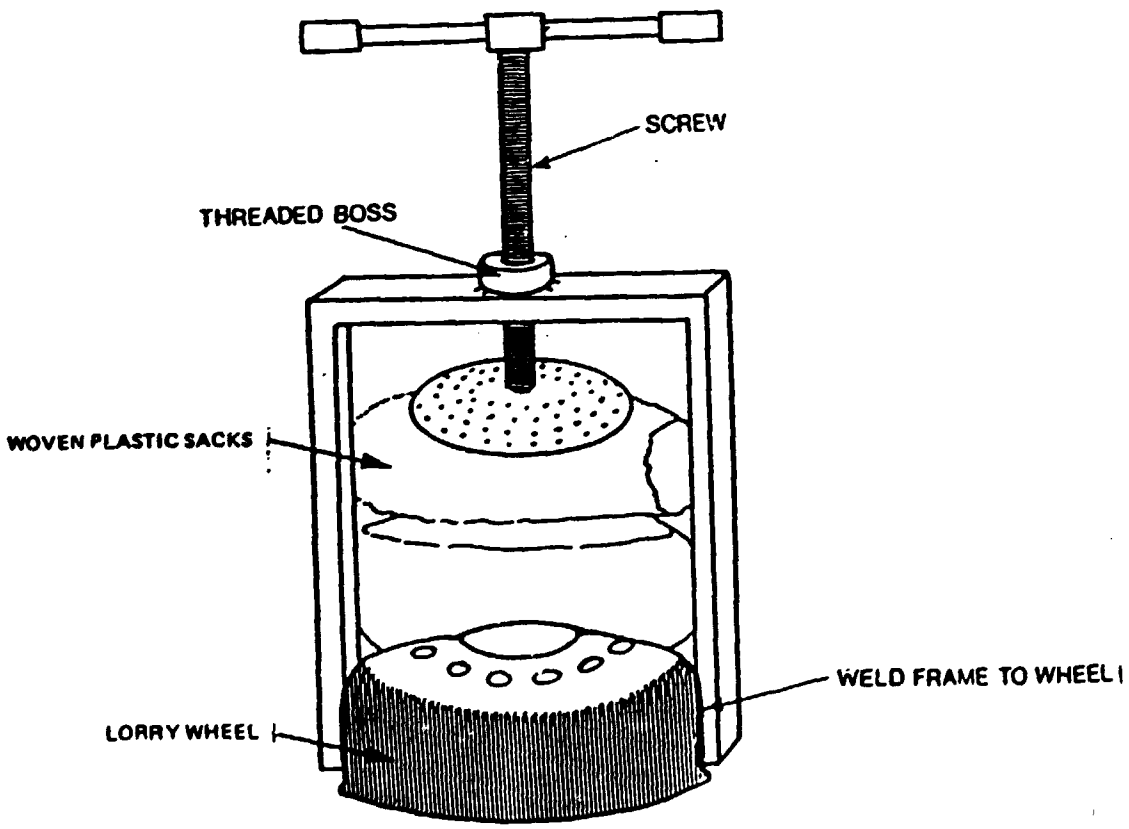
FIGURE 9.6 MANUAL SIFTER



PEDAL OPERATED CASSAVA GRATER



SCREW PRESS



TYPE OF PRESS USED BY MOLDACO

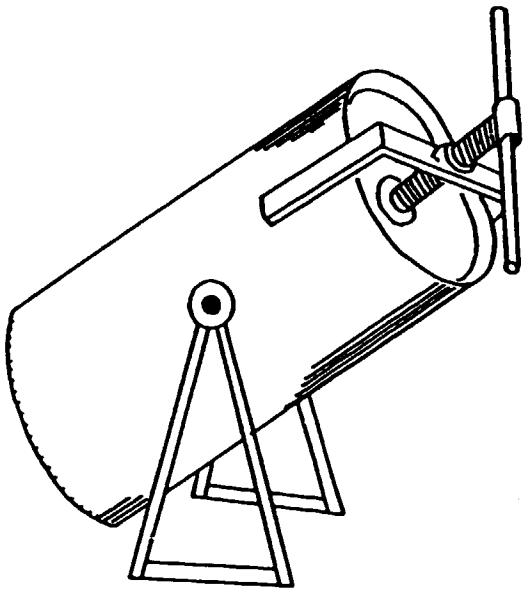
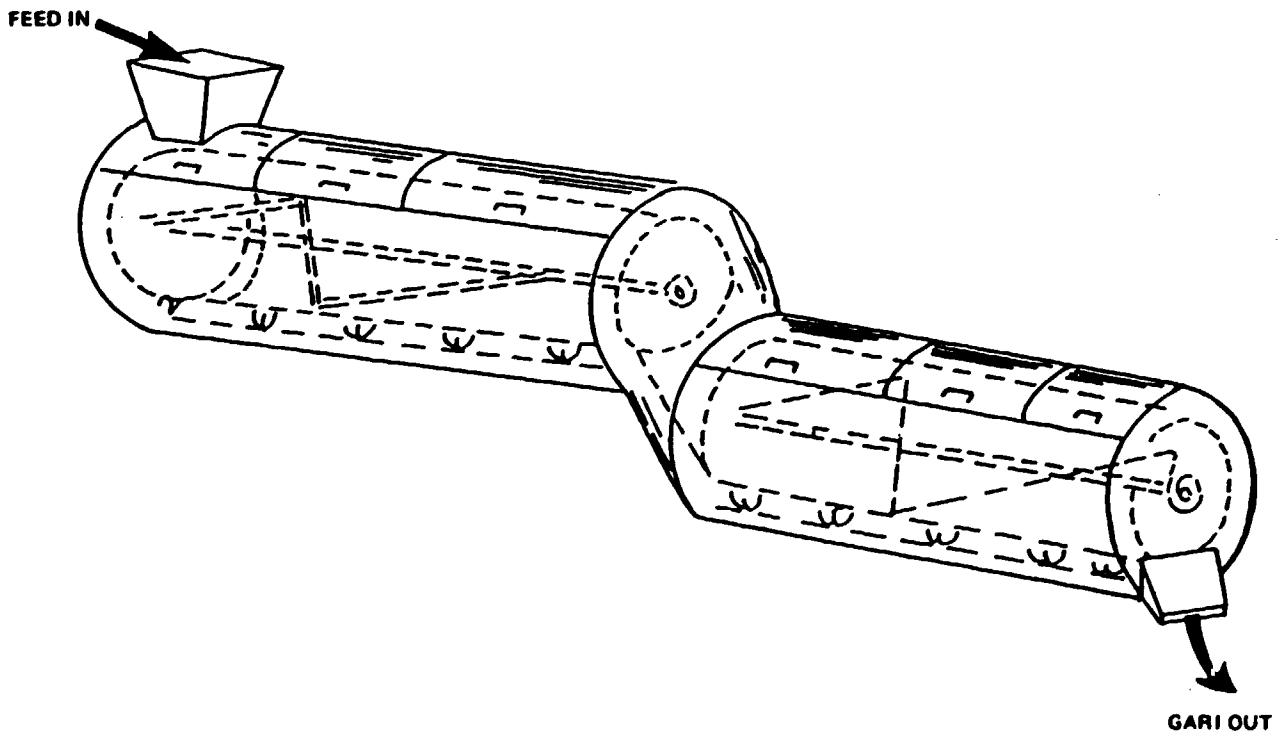
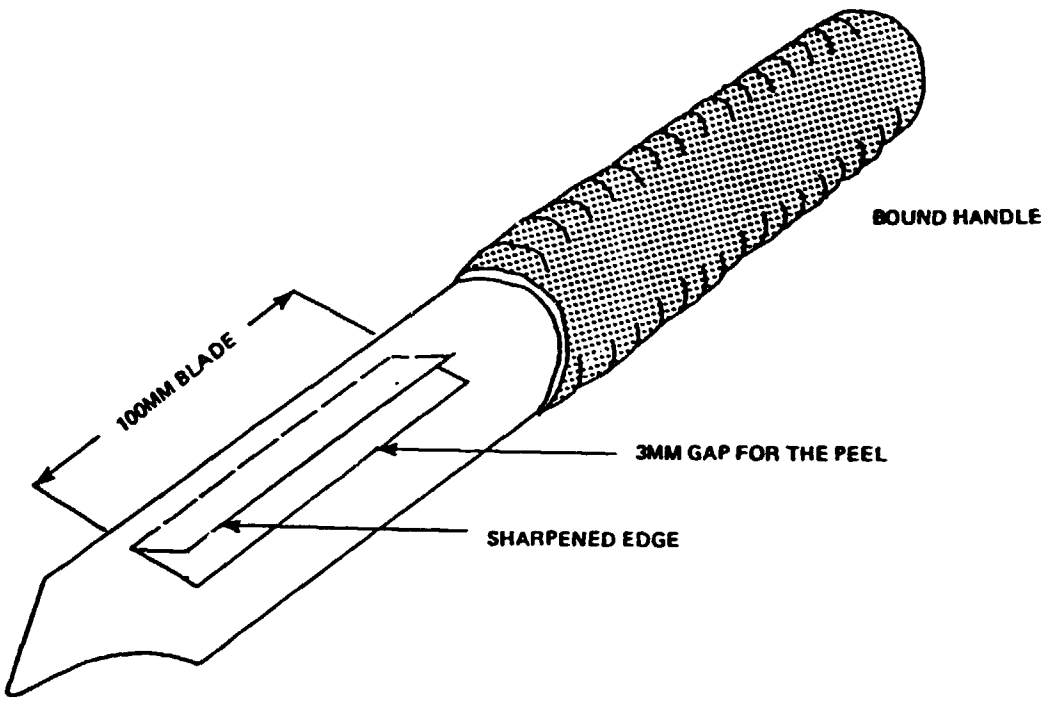
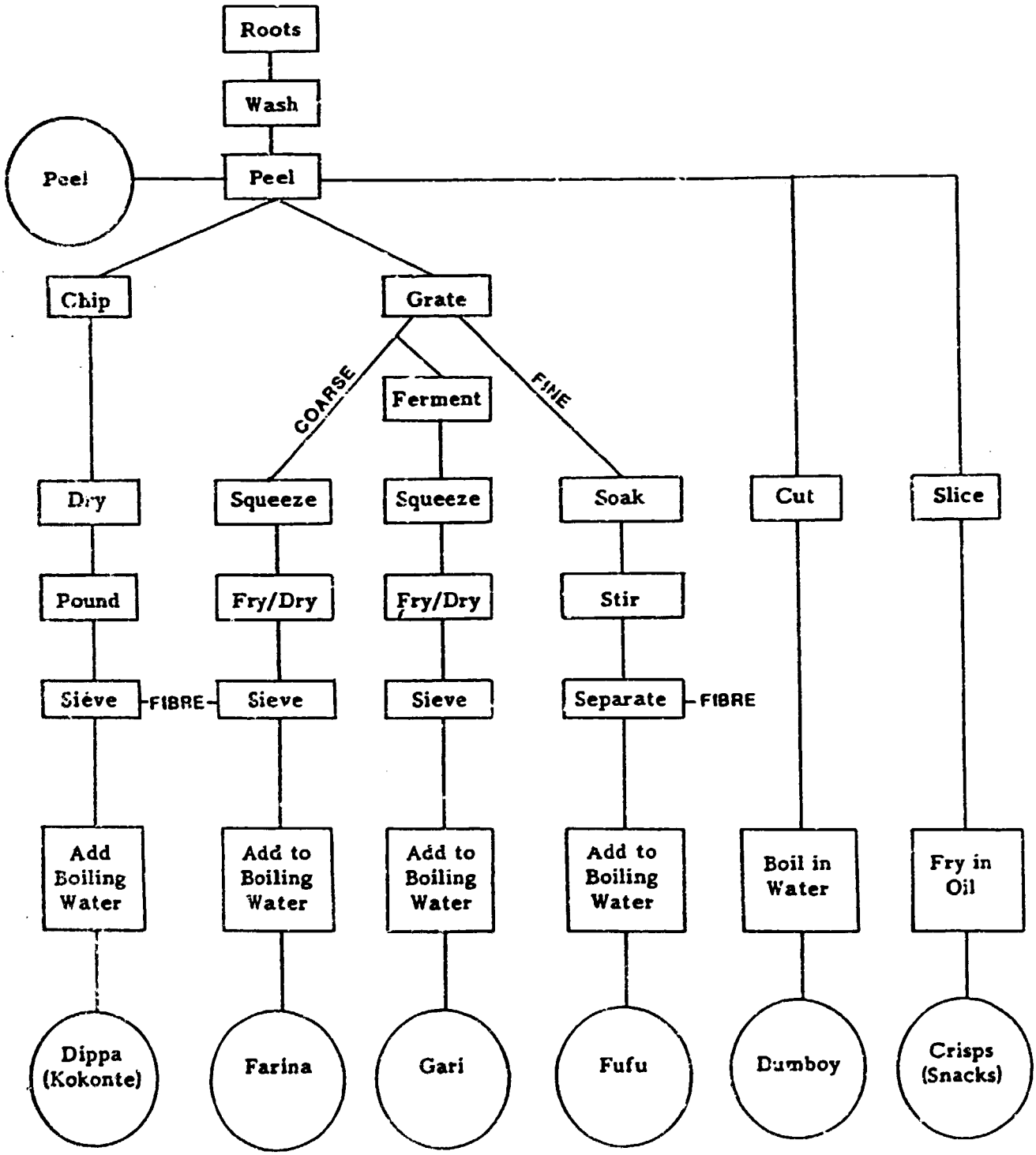


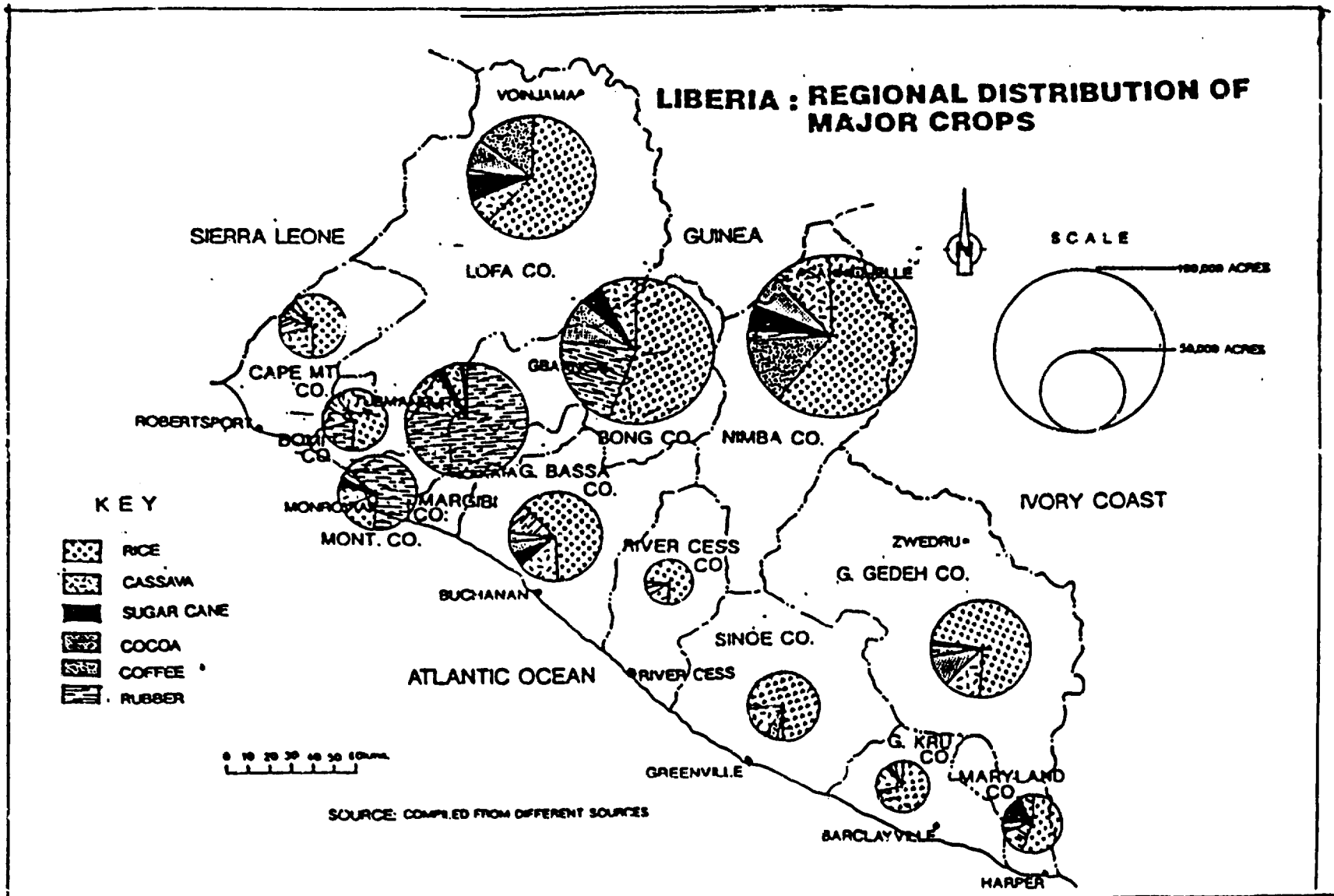
FIGURE A7.2.4 TYPE OF GARIFIER USED BY MOLDACO




BOUND HANDLE
100MM BLADE
3MM GAP FOR THE PEEL
SHARPENED EDGE

ARTISANAL PROCESSING OF CASSAVA





The boundaries shown on this map do not imply official endorsement or acceptance by the United Nations Industrial Development Organization.

ANNEX III

COUNTIES VISITED AND LIST OF PERSONS MET DURING THE MISSION

	COUNTY	HEADQUARTERS
1.	NIMBA COUNTY	Saniquelle
2.	BONG COUNTY	Gbarnga
3.	BOMI COUNTY	Turbmanburg
4.	MARGIBI COUNTY	Kakata
5.	CAPE MOUNT COUNTY	Robertsport
6.	MONTSERRADO COUNTY	Monrovia
7.	GRAND BASSA COUNTY	Buchaman

PERSONS MET DURING THE MISSION

1.	Mr. OMEIJA	F.A.O. Office, Liberia
2.	Mr. JOHN M. DORLIAE	Chief County Agricultural Officer, Nimba County
3.	Mr. THOMAS WALKER	Chief County Agricultural Officer, Margibi County
4.	Mr. RITU KUMAR	UNIDO Junior Industrial Officer
5.	Mr. MEHN	Deputy Minister for Planning, Ministry of Agriculture, Monrovia
6.	Mr. MUSAH	Acting Assistant Minister for Planning, Min. Of Agric.
7.	Mr. MOORE	Director of Marketing
8.	Mrs. FAHNBULLEH	Senior Marketing Officer, Ministry of Agriculture
9.	Mr. SUAH	Deputy Director Of Statistics Ministry of Agriculture
10.	Mr. YOUNG	Deputy Minister, Technical Services
11.	Mr. HOOVER DENNIS	Chief Agricultural Officer, Gharnga, Bong County
12.	Mr. MOSES DAVIS	Chairman & Executive Director, MOLDACO, Monrovia
13.	Mr. K.D. KHOSLA	C.T.A. UNIDO, UNDP Project
14.	Mr. DAVID KENPEN	PFL Officer, Central Agricultural Research Institute, Suakoko
15.	Mr. ISAAC F.L. MULBAH	County Agricultural Officer Bomi County
16.	Mr. PETER NORMAN	Director, (Small and medium Enterprise), Department of National Investment Commission, Liberia