R7497 - 007

Case Study on the Technical and Economic Aspects of Small-Scale Cassava Processing in a Selected Village in the Lake Zone of Tanzania

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Acknowledgements

The preparation of this case study was supported by the Food and Agriculture organisation. The data was gathered as part of a research project funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of *DFID [R7497: Crop Post-Harvest Research Programme]*.

The authors would like to express their gratitude to Han van Meerendonk, extension officers, the chairman of the village, villagers and all others who made this study possible.

1. INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is an important subsistence food crop in Tanzania, especially in the semi-arid areas. It is sometimes considered as a famine reserve when cereals fail due to its drought tolerance. An estimated 84%of the total cassava production in the country is utilised as human food, the remaining portion is used for other uses like starch making, livestock feed and export (Ministry of Agriculture and Cooperatives 2000). Both roots and leaves of cassava are of major nutritional importance in the country. The estimated annual growth of cassava consumption demand for period from 1980 to 2000 is 3.4% which is similar to the estimate for maize. Cassava is cultivated and produced in all regions of Tanzania. The main producing areas are: Mwanza, Mtwara, Lindi, Shinyanga, Tanga, Ruvuma, Mara, Kigoma, coast regions and most regions in Zanzibar (see Figure 1).

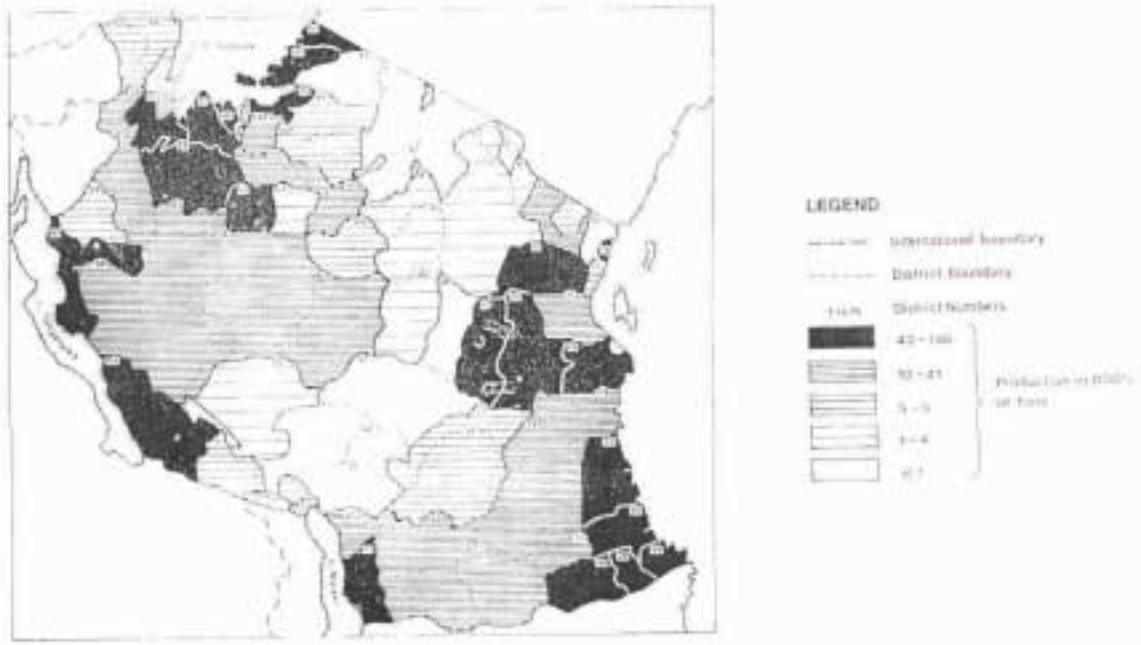


Figure 1.1 Map of Tanzania showing level of cassava production in different regions (from Kapinga *et al.* 1999). Arrow indicates the district where the selected village is located.

This report is a case study description of cassava processing practices in a selected village in the Lake Zone of Tanzania (See Figure 1.1). This village has been selected as a part of a research project funded by the United Kingdom Department for International Development. The project is entitled "Commercialisation of Cassava Processing to Enhance Rural Livelihoods in Eastern and Southern Africa". It is being undertaken as a collaboration between the Natural Resources Institute (NRI), the Tanzania Food and Nutrition Centre, the Marketing Development Bureau (MDB) of the Ministry of Agriculture and the Lake Zone Agricultural Research and Development Institute (LZARDI), Ukiriguru. The overall objective of the research project is to increase the contribution that cassava makes to the sustainable

livelihoods of poor people through improvements to cassava processing and marketing.

The objective of this particular case study is to assess the current cassava processing and marketing system in the selected village and suggest options for making improvements. Although this case study focuses on one specific village, an attempt has been made to broaden out the applicability of the study by including reference to similar or related studies within the region. Case studies of other villages in the Lake, Eastern and Southern zones will be prepared as part of the DFID funded project.

As this is a case study of a single village in Tanzania, the 'representativeness' of the village is difficult to judge. In preparation of the case study we have tried to bring in other studies that have been conducted in the region. The comparability of the village under study in relation to other villages in the region will only become clear when all of the village case studies have been completed for the DFID funded project.

2. METHODOLOGY

This report has been mainly prepared from primary information collected as part the DFID research project mentioned above. Where appropriate, the primary information collected as part of the project has been supplemented with secondary information. Many of these secondary information sources are in the "grey" literature.

Selection criteria of the village

The main selection criterion for the village to be studied was that it produces a surplus of cassava for processing, thereby providing the potential for local incomes to be improved through improved access to new markets. In addition, a number of traditional products are already produced from cassava and marketed locally.

Information collection

Information was collected for this case study using a combination of formal and informal survey techniques (Westby *et al.* 1999). Interviews were with a range of groups and individuals involved in the processing, marketing and consumption of cassava and cassava products. The checklists and questionnaires used are presented in Appendix 1. They include the following:

- Processing questionnaire (developed from the questionnaire used as part of the Collaborative Study of Cassava in Africa (Gilling and Westby 1990);
- Livelihoods questionnaire;
- Diet questionnaire;
- Marketing questionnaire;
- Focus groups checklist; and
- Checklist for cassava traders.

This research was carried out over two field visits in July and October 2000 (see Table 2.1). Interviews and group discussions were supported by direct observations of processing techniques and local markets. Visits were also made to the local school, local doctor and water sources. The main field visits were conducted by Dr Quirien van Oirschot (NRI), Ms Rahila Amour (LZARDI), Mrs Theodora Mugangala (DALDO), Ms Elisabeth Rwiza (LZARDI Ukiriguru) and Mr Mongi (LZARDI Ukiriguru). Supplementary market information was collected by Mr Fredrick Mashamba (MDB) and Mr Duncan Burnett (NRI) together with colleagues at LZARDI Ukiriguru.

Table 2.1 Number and type of interviews carried out for the study.

Visit	Activities	Methods used
July 2000	Preliminary interview (15 men present)	Processing questionnaire Agriculture checklist
	Focus group (men and women)	Drawing a village map
	Focus group of 13 women Focus group of 14 men Focus group young people (> 13 increasing number)	Focus groups checklist Processing questionnaire Checklist agriculture
	Four individual households that process cassava. 1 man, 1 woman, 1 woman, 1 men	Processing Questionnaire Agriculture checklist
	Interview with store keeper	Checklist for cassava traders
October 2000	Two focus group discussions	Focus groups checklist
	33 households 5 female-headed households 28 male-headed households (selected from a cross-section of income groups; both men and women were interviewed in every household)	Livelihoods questionnaire
	13 households (randomly selected; only women interviewed)	Diet questionnaire
	11 traders from the selected village; 25 traders in three different city market locations	Marketing questionnaire

3. Background information on the village under study

The village is located on a main road in the Kagera Region which is in the north-west of Tanzania and south-west of Lake Victoria (Figure 1.1). The village has 2,792 inhabitants, consisting of 426 households. The area where the village is located was forested up until twenty years ago. In the 1970s the forest areas were used to produce charcoal. As land was cleared, people gradually settled, built houses, started to cultivate the land, and a community developed. In 1993-1994 villagers constructed a school which was completed in 1995. In 1994 some people started to build shops around the market and along the road. The people of the area applied to be registered as an independent village in 1998, and the area has been classified as an independent village for approximately one year.

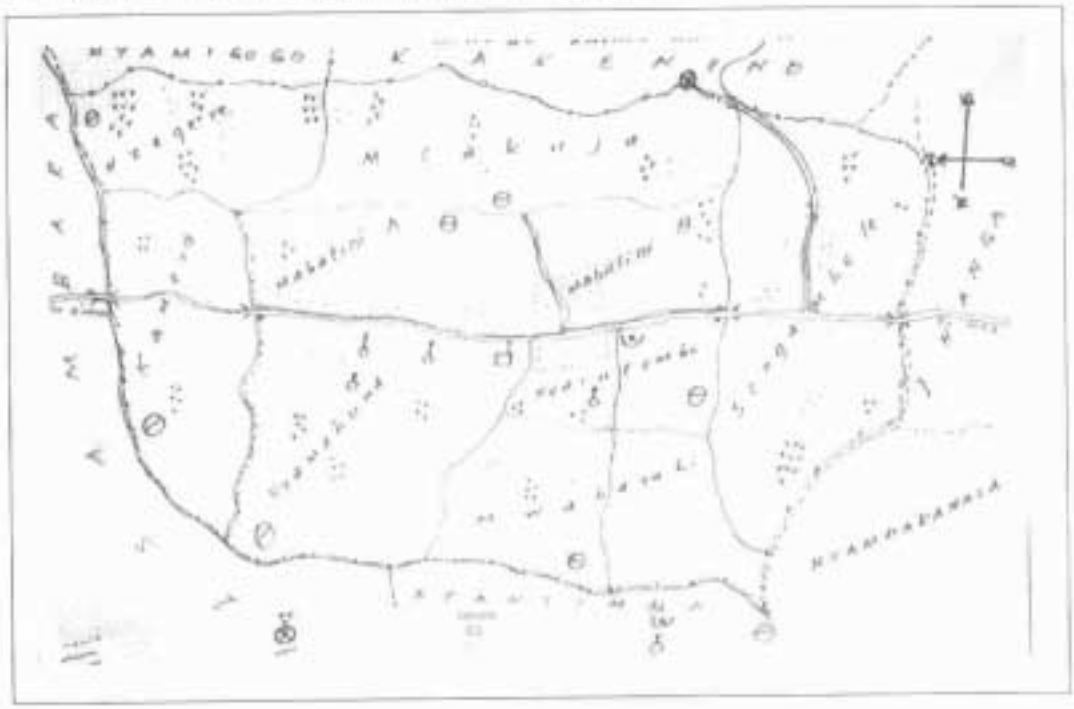


Plate 3.1 Sketch map of the selected village produced by villagers

Growth in the importance of cassava production

The income generating activities pursued by villagers have changed over time, particularly as the production of charcoal has now been outlawed. Initially villagers switched to cotton production but due to changes that they attribute to changing cotton factory policies, such as the withholding of credit, many farmers have now switched from cotton to other crops. Cassava had always been among the major crops produced in the village, but from 1988 onwards it was sold commercially, with traders arriving in the village in lorries to buy large amounts of the root crop and cassava products. Production increased in response to this growing demand, and by 1996 cassava had become more important than cotton. Currently, a large surplus of the processed products *udaga* and *makopa* is produced, and about 75% of the total volume produced is marketed.

An outline map of the village is shown in Plate 3.1. The village is divided into named areas. There are several water sources in the village, but there is no water pump. Water is collected and transported by head loading (Plates 3.2 – 3.4)

Plate 3.2. Woman collecting water from source.
Plate 3.3. Children collecting water.
Plate 3.4. Transportation of water by head loading.

Transport and access

As mentioned earlier, the village is on a main road and there is a problem with vehicles passing at speeds of over 100 km/h. The nearest markets are located in the village itself and in neighbouring villages about 10 – 20 kilometres away.

Local institutions

Health care:
Villagers have access to both traditional and formal health care services. Several traditional local doctors are active in the village. Their knowledge is handed down through generations. The nearest hospital is in a town about 60 kilometres away.

School
There has been a village school since 1995. The school has about 300 pupils between the ages of 7 and 17 (about half of the village children), and grade 1 to grade 7 are taught (Plate 3.5). The school fees are between 2,000 and 4,000 TSh (around US $2.5 - $5) per year. Among the subjects taught are: Kiswahili, English, mathematics, science, history, geography and agriculture. The school owns land and uses this for demonstration plots (for example for cassava). The school teachers do not come from the village but come other local areas.

Plate 3.5. Village school and the headteacher

Community groups
There are several community groups active in the village. Individuals can join the groups by paying an entry fee or an annual fee. Fees vary from 200 to 500 TSh per year (US$0.25 0 – 0.65). The major advantage to being a member of these groups is that they offer credit facilities. Some groups have restrictions in the amount of credit available, for example, for the church group the maximum amount of credit is 1,000 TSh at a time (about US$1.3). The interest rates charged for the credit are variable and some can be high - in most cases 20% of the amount borrowed. In some cases the maximum time for the loans is one month (Church groups), while in other groups the maximum loan time can be up to one year (one of the farmers groups).

Some of the community groups in the village are detailed in Table 3.1. Though the list is not complete, it gives some idea of the types of groups active in the village. The recent independent status of the village has led to an increasing formation of community groups and some of the groups are therefore very new.

Table 3.1. Details of some the community groups in the village.

Name of group	*Members*	No. of members	Gender	Contri-bution	Credit conditions
Ifogongo	?	30-45			
Balimi	Farmers			500 TSh	Interest: 20% Pay back period: 1 yr
Sungu Sungu	Army				
Nguvukazi	Youth (< 18 yrs)	13	M	500 TSh	
UWT	Credit	14	F		
Marika	Farmers union	15	M/F		
Ufundi	Furniture making	4	M		
Ufundi	Masons	10	M		
	Muslim Women Group	10	F		
	Church Groups			200 TSh	Interest: 20% Max. loan: 1,000 TSh Pay back period within a month
	Womens pottery group	6	F		
	Brick Making	10	M		

Agricultural activities

A calendar of agricultural activities is shown in Table 3.2. November and December are very busy months in the village. This is the time of the first rains and land preparation is time and energy consuming. All crops are planted just before the first heavy rains start in February. Weeding is necessary just after planting.

Cassava roots have a limited storage capacity once harvested, with a maximum shelf life of three to five days. The crop can however be harvested all year round as it can be stored in the ground. This makes it an important food security crop. Most cassava, however, is harvested during the dry season as the temperature and humidity at this period facilitates the drying process that is necessary to process the crop.

Table 3.2. Calendar of agricultural activities

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Season	DS	R	R	R	HR	HR	HR	DS	DS	DS	DS	DS
Agriculture activities general	LP	LP	P W	P W	W	H PR		H	H	H	H	H
Cassava	H LP	P H LP	P H W	P H W	P H	P H W	P H W	W H	H PR	H PR	H PR	H PR
Maize	LP	LP	P	W	W	H	H	PR	PR	PR		
Beans	LP	LP	P W	W	H	PR	PR					
Groundnuts	LP	LP	P W	W	W	W	W	H	PR			
Rice	LP	LP	LP	LP	P				H			
Sweetpotato	LP	LP	P W	P W	P	P	P	H	H	H	H	H
Processing activities												
Udaga									PR	PR	PR	PR
Makopa									PR	PR	PR	
Local brew												

KEY

DS = dry season
R = rainy season
HR= heavy rains

LP = land preparation
P = planting
W = weeding
H = harvesting

Processing period

PR

Peak processing period

4. CASSAVA PRODUCTION AND THE USES OF THE CASSAVA CROP

4.1 Scale of cassava production

Land ownership and cultivation

The total land area that the farmers interviewed own varies from 0 to 70 acres. Out of the sample of thirty-three households interviewed about their livelihood activities, only female-headed households were found to own no land at all. Three of the five female-headed households interviewed were hiring small areas of land in order to cultivate cassava and other crops. From these findings, it appears that female-headed households have significantly less access to land than male-headed households. The total acreage that the farmers estimated to be cultivating at the time of the research varied from 1.5 to 20. All of the farmers interviewed in the village cultivate cassava. Farmers described the ease of cultivation and the facts that the crop is suited to local soils and is drought resistant as the main reasons that they grow the crop.

Scale of production

The estimated acreage that was being cultivated with cassava varied from 0.5 to 12 acres, with most households farming between 2 and 5 acres (see Table 4.1). As the sample of households interviewed was selected to represent a cross section of income groups in the village, this may be considered generally representative of the village as a whole. Again, female-headed households appear to be a special case in point. All female-headed households cultivated one acre of cassava or less.

Table 4.1 Scale of cassava production

Acreage under cassava cultivation	0.5-1	2-5	6-10	>10
No. of households	5	20	7	1

Sample: 33 households

Cassava is often intercropped with maize, beans or groundnuts, and occasionally with sweet potato. Intercropping is practised just after the planting of cassava. As cassava takes longer to mature than other crops, by the time it matures and is ready for harvest it is the only crop left in the fields.

Households often keep cassava as an emergency crop, and have one plot of the crop that is be used only in case of food shortage. The cultivar *lumala* is especially good for this, as it can be left in the ground up to 5 or 6 years.

Other crops are produced on a smaller scale. They include sweet potato, rice, and cotton.

Varieties of cassava grown

A range of cassava cultivars is grown by the households interviewed. The varieties grown by the households interviewed are shown in Table 4.2. Farmers often consider varieties of cassava to be "bitter" or "sweet". The precise local meaning of these terms can be lost in translation, but generally what are described as "bitter" varieties are those with high cyanogenic potential that need to be processed before consumption (see Box 1). Bitter varieties are grown on a larger scale than sweet varieties. They are preferred by farmers because they give a higher yield and have a lower water content (contain more starch). Sweet varieties of cassava generally have a shorter maturity time. They are not so easy to process and are mainly used in the fresh boiled form.

Box 1. Cyanogenic potential of cassava

Cassava contains the cyanogenic glucoside linamain (Nartey 1978). This compound is broken down by an endogenous enzyme, linamarase, to form an intermediate compound, acetone cyanohydrin (de Bruijn 1973). This compound breaks down at a rate dependent on pH and temperature to form HCN and acetone (Cooke 1978). HCN is toxic when consumed are various health problems can be associated with cassava consumption. This is particularly the case with poorly processed cassava (Bokanga *et al.* 1994).

Cassava roots vary in their content of cyanogenic compounds. This is dictated by variety and growing condition, for example drought is known to increase the cyanogenic potential of roots. Generally (although not always) sweet varieties have a low and bitter varieties a higher cyanogenic potential and need to be processed before consumption.

Liongo was the most popular bitter variety amongst the households interviewed. It is popular for making the cassava products *udaga* and *makopa* (see section 5). *Liongo* needs about 1.5 to 2 years to mature, and is said to be 'early maturing'. *Liongo* is low in fibre, the flour it produces is very fine, and the yield is high. Planting material is readily available for this variety. It is drought resistant, has a low moisture content, and it bears a small number of large roots.

Table 4.2. Summary of main cultivars grown by households in the selected village.

Variety	Type	Maturing time	Other characteristics
Liongo	Bitter	20 months	Easy to harvest, high yield, good flavour
Rubona	Bitter	20 months	Large roots
Lumala	Bitter	2 years	Emergency food variety
Pananzala	Bitter	18 months	
Mudara		2 years	
Ngarabuto	Sweet	16 months	Not processed

The second most popular variety is the cultivar *rubona*, which has a maturity time of two years. *Rubona* is also a bitter variety that bears few, but large roots. *Rubona* is more susceptible to rotting than *Liongo*. Third most popular is *Lumala*, which is late maturing (up to two years) but has the advantage that it can be kept in the ground for up to five or six years. It is therefore an important cassava variety for household food security. Other bitter varieties grown are *Pananzala* (maturity time 1.5 years) and *Muotara*.

N*garabuto* is the most popular of the "sweet" varieties. It is produced to be eaten fresh cooked and takes 16 months to mature.

Plate 4.1. Cassava intercropped in the field with Sorghum.

4.2 Uses of fresh cassava

Due to the greater availability of the bitter varieties, the uses of fresh cassava are limited in the village. Bitter varieties need to be fermented to reduce the bitter taste. The processed forms of cassava are eaten every day and form a more important part of the diet (see 4.3). Only sweet varieties of cassava are therefore eaten fresh. The sweet varieties are boiled and used during the meal or as a snack. During the meal the fresh roots can be mixed with beans or with maize or with groundnuts. The sweet varieties of cassava are also sometimes eaten raw.

Just over half of the households interviewed sell fresh roots of the sweet varieties. However, their sale is generally not a major source of income, as they are sold in small quantities, in heaps of about three roots, weighing about 1 kg. The price for such a heap is 50 TSh (around US$ 0.06). Those involved in selling fresh cassava described how there is poor demand for this as a product, although better prices can be gained between October and March when sweet potato is not available.

Several of the households interviewed carry out what appears to be a less common transaction for selling fresh cassava, where households sell cassava unharvested, as "ridges" (row of uncultivated cassava) in their field. For example, a purchaser can agree to buy a ridge for TSh 1,000 (US$1.3) and it is then his/her responsibility to harvest it.

The cassava peels, which is removed from the roots before cooking or processing, are used as "green manure" fertiliser. This is collected and spread in farmers' fields.

4.3 The importance of fresh and processed cassava in the village diet

Cassava forms a major part of the diet of the people from the selected village (Table 4.3). Interviews were carried out with a random sample of twelve households as a part of this study. It was found that the most common use of cassava is as *ugali* (a stiff porridge) of *udaga* (a mould fermented dried processed product – see Section 5), often mixed with maize flour. This dish is prepared by adding the flour mixture to boiling water and stirring. The proportions mixed are: 50 to 75% *udaga* with 25 to 50% maize flour. The porridge is generally eaten with some sort of soup made with vegetables and or meat. About 75% of the households interviewed eat *ugali* of *udaga* every day, and 25% 3 to 6 times a week (Table 4.3). The next most important foods are sweet potato and maize *ugali*. Half of those interviewed eat sweet potato every day, whilst three quarters eat maize *ugali* more than three times a week. Fresh cassava is eaten on average about once or twice a week. As described earlier, only sweet varieties are used for this purpose. The roots are usually boiled, often with maize or beans, before using as a vegetable. Some sweet varieties are also eaten raw.

Rice is often eaten more frequently than fresh cassava. Other staple food crops consumed by single households include finger millet, sorghum, pigeon peas and cooking bananas.

Fresh cassava is eaten about once or twice per week, an average per household an average of 2.3 kg is purchased per week.

Fresh cassava is eaten once or twice per week.

Table 4.3. Frequency that households eat the main staple foods crops.

	Ugali of *udaga*	Sweet potato	*Ugali* of Maize	Rice	Fresh cassava	Finger millet
More than 6 times per week	9	6	3	0	0	1
3 to 6 times per week	3	4	6	4	1	2
1 or 2 times per week	0	1	3	7	10	1
Never	0	1	0	1	1	8

Sample: Twelve randomly selected households

Quantities consumed

The quantity of *udaga* consumed in the village is significant. On average, an adult in the village eats about 1.91 kg of *udaga* per week, 1.35 kg maize flour, and 870 g of rice (figure 4.2). 0.410 kg of fresh cassava is consumer per person every week, which is less than that of sweet potato (1.57 kg per week). As fresh roots consist of only 30 to 40% dry matter, the dry weight of sweet potato and cassava consumed is only about 0.550 kg/ per week for sweet potato and 0.14 kg for fresh cassava.

Cassava provides approximately 40% of the total energy source of the population of the village and is therefore the most important staple food crop.

Figure 4.2 Maximum, minimum and average quantities of the most important staple foods eaten per head per week.

5. CASSAVA PROCESSING

5. 1 Cassava products produced in the study location

Cassava processing is one of the most, if not the most important livelihood activity, in the village. The important products that are generated are *udaga*, *makopa* and *gongo*.

Udaga is a dry fermented product, consisting of chips with a fine floury texture. *Udaga* is sometimes referred to as 'cassava chips' or 'cassava pieces'. It is the most important product in the village, and is produced both for home consumption and for sale.

Makopa is a sun-dried product and considered to be non-fermented. It is mainly produced for sale.

Gongo is an alcoholic spirit produced from cassava. The product is processed from a local brew which is then distilled. It is illegal to produce this product, but it forms a substantial part of the income of some families

Plate 5.1. *Udaga* on the market (top left)
Plate 5.2. *Makopa* (right)
Plate 5.3. *Gongo*, the spirit being distilled. (bottom left)

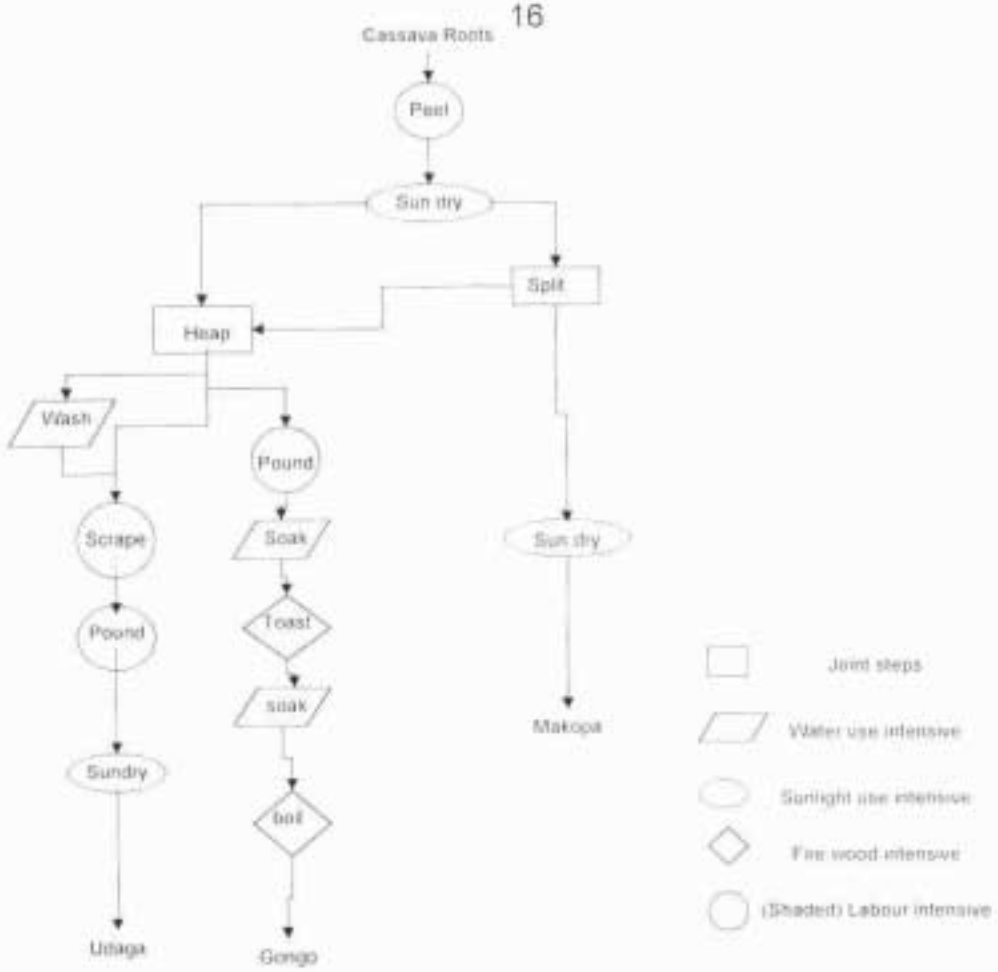
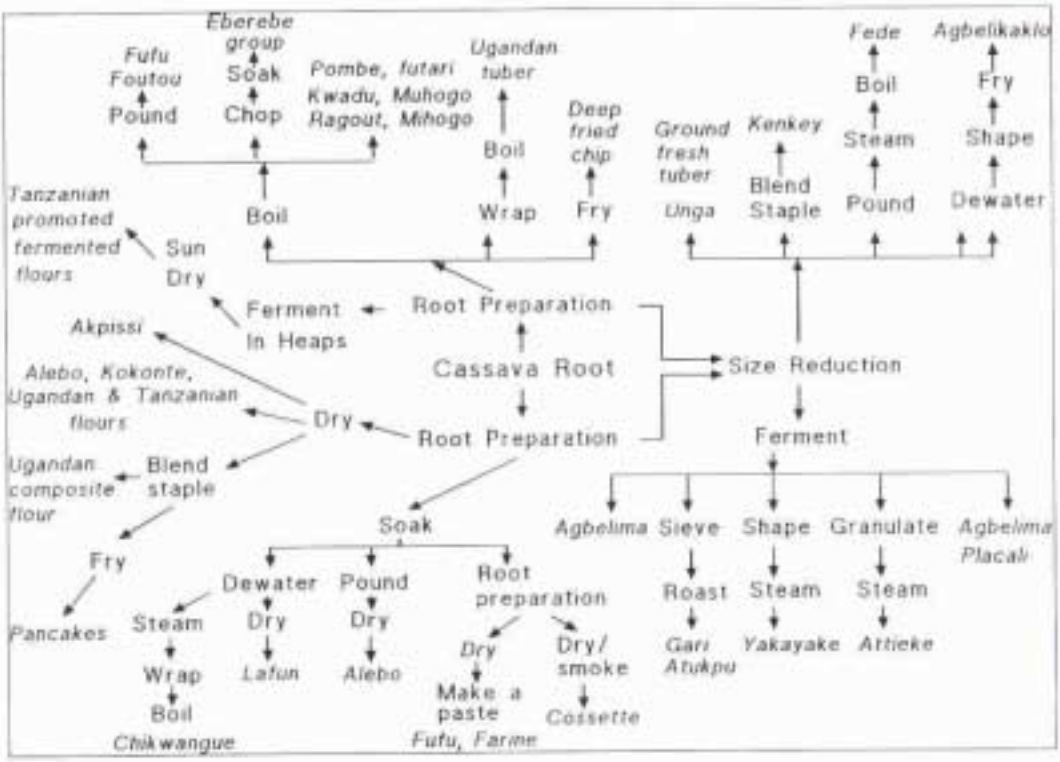


Figure 5.1. Three main processed product from cassava in the selected village Symbols are adapted from Nweke (1998).

The processing of the *udaga*, *makopa* and *gongo* are summarised in Figure 5.1

This emphasis on three key products from cassava processing in Tanzania, re-affirms existing knowledge that cassava processing in much of East Africa is less diverse than other regions, such as West Africa. Traditional village level cassava processing was characterised as part of the Collaborative Study of Cassava in Africa (see Nweke 1988 for a project description). Figure 5.2 and the supporting Table 5.1 give an overview of the diversity of cassava processing in six countries selected by COSCA (Cote D'Ivoire, Ghana, Tanzania, Nigeria, Democratic Republic of Congo and Uganda). Figure 5.2 shows the relationship between the important groups of products based on the method of processing. *Udaga* appears in the group of "Tanzanian promoted fermented flours" and *makopa* appears in the group of "Tanzanian flours". This figure highlights the lack of diversity in the selected village and Tanzania in general. Table 5.1 provides additional detail on the importance of the selected products in the 233 villages that formed the basis of the COSCA study. Figure 5.2 and Table 5.1 are reproduced from Henry *et al.* (1998) which was based on data analysis by Westby (1993).

Figure 5.2. Interrelationship of major cassava products based on their processing steps in the initial six COSCA countries (Westby 1993).



This diagram shows the main cassava products in the 233 COSCA villages. Drinks, products from leaves and sedimented starches were not included in the analysis but are shown in Table 5.1.

There are five main groups of products:

a) fresh root products (top of diagram from *fufu* to *agbelikaklo*). Many of these are different types of household food preparation.
b) acid fermented products from grated roots (bottom right from *agbelima* to *placali*). These include fermented pastes, roasted and steamed granules.
c) acid fermented products from soaked roots (bottom left from *chikwangue* to *cossette*). These include fermented pastes and some acidic dried products.
d) sun-dried root pieces (left hand side *akpissi* to pancakes). This group includes *makopa*.
e) heap (mould) fermented products (top left with the Tanzanian Promoted Fermented Flours). This group includes *udaga*.

Table 5.1 **Distribution of cassava products into major categories which can be defined from Figure 5.1**

Product Group/ Product Type	No. of alternative names	Country	No of villages where ranked 1st 2nd 3rd*	Total no villages (% of surveyed in country)
1. Fresh Roots				**108**
Ererebe group	6	Nigeria	0 1 10	11 (18%)
Foutou/fufu	2	Cote D'Ivoire	16 9 6+1	32 (80%)
	1	Ghana	10 3 2	15 (50%)
Tuber	12	Uganda	29 2 0	31 (97%)
Other		Various		19
2. Roasted Granules				**78**
Gari	7	Cote D'Ivoire	1 2 4+1	8 (20%)
		Ghana	7 13 2	22 (73%)
		Nigeria	25 22 1	48 (79%)
3. Steamed Granules				**35**
Attieke	1	Cote D'Ivoire	15 12 7	34 (85%)
Others	1	Ghana		1
4. Dried flours/pieces				**267**
Acid soaked				
Alebo	6	Nigeria	21 1 3	25 (40%)
Cossette	1	Zaire	15 16 0	33 (92%)
Fufu	2	Zaire	7 12 7+4	30 (83%)
Lafun	1	Nigeria	2 6 4	12 (20%)
Others	3	Nigeria		6
Air dried				
Alebo	5	Nigeria	10 1 2	13 (20%)
Kabalagala	2	Uganda	0 7 4	11 (34%)
Kokonte	2	Ghana	9 8 11	28 (93%)
		Cote D'Ivoire	3 8 5+2	18 (45%)
Cassava flour (Tz)	12	Tanzania	6 10 5+7	28 (93%)
Cassava Flour (Ug)	5	Uganda	0 14 7	21 (66%)
Composite flour	5	Uganda	1 5 2	8 (25%)
Others	2	Various		5
Mould fermented				
Tanzanian		Tanzania	12 5 3+8	28 (93%)
Others	1	Uganda		1
5. Fermented pastes				**47**
Grated roots				
Agbelima	2	Ghana	3 3 3+1	10 (33%)
Placali	2	Cote D'Ivoire	4 8 11	23 (58%)
Soaked roots				
Akpu (fufu)	6	Nigeria	8 13 19	40 (63%)
Chikwangue	3	Zaire	12 2 5+5	24 (64%)
6. Products from leaves				
Total	5	Zaire, Ug, Tz		7
7. Drinks				
Total	14	Zaire, Uganda		22
8. Sedimented starches				
Starch	1	Nigeria	0 2 2+1	5 (8%)
9. Unclassified				
Total	5			5

* The number after the number of villages ranking the product third is the number of villages where the ranking was not recorded. Highlighted products are those from Tanzania that are produced in the selected village

5.2 Details of post-harvest handling and processing operations (from harvest through to the point of sale)

5.2.1 *Udaga*

As already described, *udaga* is the most important cassava product in the village. Every household processes, consumes and the majority gain income from selling it.

Udaga is usually sold in small pieces that have a crumbly texture. Often some pieces of *udaga* have a grey appearance caused by the mould that grows on it. The processing of cassava into *udaga* is labour intensive. Most of the steps are carried out by hand using small tools. The major steps in *udaga* are described below. Flow diagrams of *udaga* processing are shown in Figure 5.3.

Figure 5.3. Flow diagram of *udaga* processing.

Harvesting
Cassava roots of bitter varieties are harvested 20 months after planting. Farmers use handhoes (Plate 5.5) to harvest the roots.

Plate 5.4: Cassava roots in the ground ready for harvesting.
Plate 5.5: A handhoe, a tool used for harvesting cassava.

Transport

Once harvested, the roots are transported to the house, where fermentation and processing take place. Roots are transported mainly by headloading although sometimes a bicycle is used. Sometimes the roots are peeled and dried close to the harvesting location and transported after this stage. This is practised when the field is located far away from the house. Bearing in mind that fresh roots contain have a moisture content of 60-70%, this can save a considerable amount of labour. Transport is one of the most intensive parts of the process and many households find this a burden.

Peeling

The peel of the cassava roots is unpalatable and needs to be removed. Peeling is the most labour intensive task in cassava processing and often involves many family members (Plate 5.6).

Plate 5.6 Peeling of cassava roots is the most labour intensive step of cassava processing.

Drying

After peeling the roots are left to dry for 12 – 24 hours. They are dried on canvas sheets if these are available. Other surfaces for drying include: roofs, rocks and dried cow dung. Efforts are made to keep the sand out of the product, but this can be difficult.

Heap fermentation

When partially dried, the roots are heaped and covered with bags or with leaves, usually inside a building, such as a shed. Whilst in a heap the roots ferment and mould growth occurs. A few farmers use a 'starter' culture. The starter consists of some parts of the scraped roots, or sometimes occurs by placing the heap in the same location every time. The main fungus which appears on the roots is black in colour. After three to four days of fermentation, this black fungus is scraped off.

Plate 5.7. Heaping cassava roots for fermentation for *udaga* (left hand side).
Plate 5.8. Heap covered with leaves (right hand side, top)
Plate 5.9. Dry fermented cassava roots after 3 days (right hand side, bottom).

Box 2. Heap fermentation of cassava.

The heap or mould fermentation of cassava is practised in Tanzania, Uganda and Mozambique. Essers (1995) has made an in depth study of the product. Fungal growth is promoted by heaping and covering roots. Essers et al. 1992 report that the heap fermentation was considered by the population under study in Mozambique to effective at preventing the toxic effects of cassava.

Studies on the fermentation in Uganda (Essers *et al.* 1995) indicated that the dominant mycelial growth was from *Neurospora sitophila*, *Geotrichum candidum* and *Rhysopus oryzae*. In a similar study in the Lake Zone of Tanzania were found to be the dominant microorganisms (add reference). Essers *et al.* 1995 demonstrated that the cyanogen level in heap fermented cassava were considerably reduced from an initial mean level of 436.3 to mg CN equivalents per kilogram of cassava dry matter to safe levels.

Scraping

It is important that the fungus is scraped off the fermented roots. Produce with the fungus on is of lower quality and achieves a lower price on the market. The black fungus is scraped off the roots using knives (Plate 5.11). Sometimes the roots are washed first with water which makes scraping easier (Plate 5.10).

Plate 5.10. Scraping the black fungus off the roots after washing
Plate 5.11. Dry scraping of the cassava roots.

Pounding

After scraping, the roots are spread out and pounded into smaller pieces of about 2 to 3 cm in length. For this, a wooden pestle or stick is used (Plate 5.12).

Plate 5.12. Pounding the scraped pieces of roots into smaller pieces before drying.

Sun-drying

The pieces are now sun-dried for another 4 days (Plate 5.13). If the drying conditions are good the product will remain white. However, if the humidity in the air is high, the produce might develop a greyer appearance due to mould growth. Grey *udaga* is of lower quality, and fetches a lower price. This confirms the findings of a study of the relationship between quality and value conducted in Mwanza (Ndunguru *et al.* 1999). The results of this are summarised in Box ???.

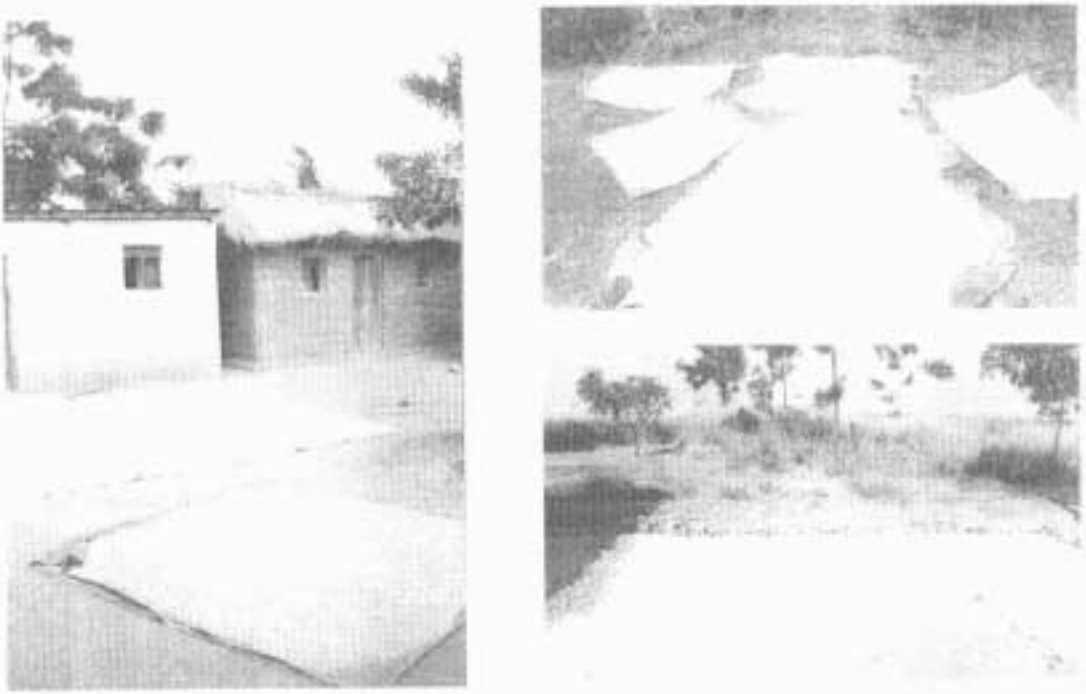


Plate 5.13. Drying *udaga* chips on canvas mats, and on animal skins.

Storage

Processors say that *udaga* could be stored up to 3 to 5 months, however most processors store their *udaga* for 2 weeks. If stored longer, the produce risks to be invaded by insect pests. *Udaga* is stored in large woven fertiliser sacks which are kept in the house or in a separate storage space near the house.

Plate 5.14 Cassava processor in his store with stored *udaga*.

Packaging

When they are dry, the pieces of *udaga* are packed in polypropylene woven fertiliser sacks. They can be stored for some time until needed for use, or until sold. Processors estimate the maximum time that the pieces can be stored is for 3 months. After this the product becomes infested with insects.

Plate 5.15. Packaging (Photo 1) and transport (Photo 2) of *udaga*

Transport to market

After packaging, the product is ready to be transported to the market. This is often done by bicycle. Sacks of up to 70 kg may be carried by bicycle.

Marketing

The *udaga* is sold in bucket measures called "debes". A debe is a standard volume measure which weighs about 14 kg.

Preparation of udaga as food

The piece of *udaga* need to be pounded or milled and sieved before they are used as a food. Pounding and milling can be carried out by hand with simple tools, but there is also a maize mill available in the which can be used for *udaga*.

Table 5.2. Tools used for processing *makopa* and *udaga*

The process	Tools	Price TSh (US$)	Expected Life
Harvesting	Hand hoes	2,000 (2.6)	1 year
Transport	Sacks	300 (0.4)	1 year
	Containers	2,500 (3)	1 to 5 years
	Bicycle	70 000 (90)	10 years
Peeling	Knives	150-200 (0.2-0.3)	2 to 3 years
Drying	Canvas matting	10 000 - 15 000 (13 – 19)	2 to 3 years
	Animal skins		
	Rocks	-	
	Roofs	-	
Fermenting	Leaves	-	
	Sacks	300 (0.4)	
Washing	Water basins	2,500 (3)	1 to 5 years
Scraping	Knives	200 (0.26)	2 to 5 years
Pounding	Pestle and mortar	3,000 - 3,500 (3.9 – 4.5)	2 years
	Wooden stick	500 (0.65)	
	Tree branches	-	
Drying	Canvas matting	10,000 - 15,000 (13 – 19.4)	2 to 3 years
	Animal skins	300 (0.4)	
	Sacks		
	Rocks		
	Roofs		

Plate 5.16 Pestle and mortar for pounding, and a platform for drying *udaga* and *makopa*.

5.2.2 *Makopa*

Makopa is a sun-dried product and consists of cassava root pieces of about 5 to 10 cm, or sometimes whole roots. *Makopa* in the selected village is said to be unfermented. In reality, the drying times are long and it is likely that microbial growth occurs.

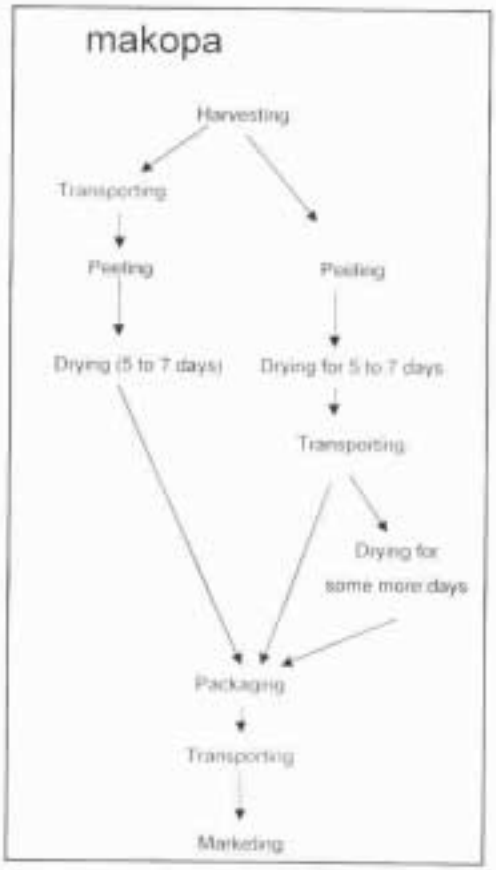


Figure 5.4. Flow diagram of *makopa* preparation.

Harvesting
Roots are harvested in the same way as described for *udaga* processing

Transport
The roots are transported by head or sometimes by bicycle. As with *udaga* processing, transport is one of the most intensive parts of the process and many farmers find this a burden. Sometimes the roots are peeled and dried in the field for one day and then transported and drying completed near to the house (Plate 5.17).

Plate 5.17. Photo 1. Peeled roots in the field. Photo 2. Head loading) peeled roots from the field to the house where the roots will be dried for *makopa*.

Peeling

Peeling is the most labour intensive part of processing *makopa* and involves many family members. The peel wastes are spread in the field and serve as 'green manure'.

Plate 5.18. Peeling of cassava for *makopa* processing

Drying

Drying is the most critical part for *makopa* processing The roots need to dry for about seven days, hence *makopa* can only be produced in the dry season and processing is avoided in the rainy season. If the drying process is not successful, the roots may become mouldy inside and therefore of low quality (Plate 5.19). Sometimes processors transform their *makopa* into *udaga*.

Plate 5.19. If cassava roots are not thoroughly dried, the inner tissue becomes mouldy.

Storage

Makopa can be stored for up to 3 to 5 months, but most processors keep it for less time then that. During storage the *makopa* might be prone to attack by insects and pests. For commercial purposes the *makopa* is mostly stored in fertiliser sacks in the house or in a storage space (just like *udaga*). But for household use it is stored in traditional storage sheds (Plate 5.20), where it is kept loose with other dried crops such as maize.

Plate 5.20. Traditional storage shed used for dried crops such as maize and *makopa*

Packaging and transport to the market

Makopa is packed woven in polypropylene woven fertiliser sacks (Plate 5.21). After packaging, the product is ready to be transported to the market. This is often done by bicycle (Plate 5.22). A sack of 70 kg may be loaded onto the back of a bicycle.

Plate 5.21. *Makopa* packed to be sold.

Plate 5.22. *Makopa* being transported to the roadside for marketing

5.2.3 *Gongo* (local brew)

The production of *gongo* is a long process and involves many different stages. It is labour, capital and resource intensive and uses a large amount of water.

Figure 5.5. Flow diagram of *gongo* processing.

After the harvesting of cassava, the roots are dried for one day, then heaped for fermentation. Unlike the process for *udaga*, the roots are not scraped after fermentation but immediately pounded. The pounded pieces are then mixed with

water, to make a stiff paste that is left in a hole in the ground for about one week. The paste is then fried in a pan, until it becomes dark brown/black in colour. This product is then soaked with water again and germinated maize is added. The product is kept in a barrel, and covered. The soup mixture is fermented for seven days.

The product is then transferred to a distillation barrel equipped with a hosepipe. For the distillation to be successful, the full barrel is first warmed up for 30 minutes. After this, the hosepipe is attached. The alcohol vapours from the barrel are conducted in the hosepipe through water. This makes the vapour cool and condense and the product can be collected in a bottle.

Table 5.3. Equipment, tools and resources used to make *gongo*.

Processing step	Tools
First fermentation	Water
	hole in the ground
Frying	Wood,
	Frying pan
	Hand hoes
Second	Barrels
fermentation	Water
Distillation	Funnel
	Wood
	Distillation barrel
	Hosepipe
	Bottle
	Cooling water

Plate 5.23. Steps in *gongo* processing prior to distillation (described left to right) Photo 1: Stiff paste of pounded heap fermented cassava mixed with water left in a hole for one week. Photo 2. Paste is scooped out of the hole. Photo 3. Paste is fried above fire until brown. Photo 4. Fried pieces are fermented with water and germinated maize in large barrel, covered with canvas.

Plate 5.24. Distillation of *gongo*. Photo 1: After one week fermentation, the liquid is decanted into a closed barrel and heated. After 30 minutes a hose pipe is connected, leading the distillate through water where it is collected. Photo 2. The spirit, called *gongo*, is collected in a plastic container.

5.3 Gender roles in cassava processing

Both men and women can be involved in making *udaga*, *makopa* and *gongo*. The division of labour was found to vary from household to household. While some households appeared to pool labour for many activities, in others there was a clear separation of tasks according to gender. Some general patterns can however be discerned,. Harvesting or uprooting is generally carried out by both men and women. Only a small number of households were found where this activity was the responsibility of women alone. Similarly, the peeling of cassava roots was found to be carried out by both sexes.

The tasks of laying the roots out to dry and heaping them were frequently found to be the responsibility of women alone, as was the management of the fermentation process, such as the scraping of roots, and the pounding of chips to make *udaga*. Although in some households men would also participate in these activities, it was never found to be the case that men alone were responsible for these tasks, while in many households the women were. Men were generally found to be responsible for the transporting of roots after harvest and the transportation of processed products.

Gender roles can be discerned in relation to specific cassava products. Villagers generally consider the processing of *udaga* to be a predominantly female activity, and in some cases male respondents claimed to know very little about it. It may be that this product is associated with women due to the number of labour-intensive "women's" tasks involved (drying, heaping, pounding etc). Also *udaga* is a product used for food security as much as for generating income.

In contrast, the processing of *makopa*, which is mainly used as a product for gaining income, and is traded on a larger scale in the market place, is considered more of a men's activity. Although both men and women are often involved in the processing of *makopa* (with women, again, taking prime responsibility for drying the roots), this is generally a less female-dominated livelihood activity. Men are more consistently involved in the processing, packaging and transport of this product. While all five of the female-headed households interviewed processed *udaga*, only one was found to produce *makopa*, and in this case male labourers were brought in from outside the household.

These findings conform to traditional perceptions about gender, with women heavily involved in activities related to food security and men are more involved in products for generating income

Little data were collected on the division of labour in relation to the processing of *gongo*, though women were found to be more willing respondents concerning this product, which may or may not reflect their relative involvement in brewing as a livelihood activity. Some households may have been hesitant to talk about this product due to its illegality.

5.4 Seasonality of cassava processing

Although cassava can be harvested all year round, production levels of *udaga* and *makopa* can be quite seasonal. The highest production period is from June to October, peaking between July and September. This is the season with the least rainfall.

The height of the dry season is the best time for processing of *udaga* and *makopa*, because they require sunlight and dry conditions to produce a good quality product. The product is whiter when dried quickly which for most consumers is the most important quality characteristic.

November to April is the rainy season. Particularly heavy rain often falls from February to April. *Udaga* is still produced although the quality is often much poorer. Most households take the drying product inside the house as soon as it starts raining. The production of *makopa* is more difficult during the rainy season. This because *makopa* consists of larger pieces of roots, which take a longer time to dry. As a result of the dependence of cassava processing on the seasonal conditions, the prices of *makopa* and *udaga* increase during the rainy season (see 6.1).

5.5 Economics of cassava processing operations described

Labour

It takes on average about 32 hours to process one sack of harvested cassava into *udaga*. For *makopa* the number of hours involved to process one sack of cassava is 33 hours.

The processing requires a number of labour intensive steps. Harvesting,for instance, is specifically labour demanding. Farmers often get extra help from neighbours or community group members for harvesting. Often the workers are offered a meal, or sometimes part of the yield, for example 20% of what they harvest.

Peeling is the most labour intensive part of cassava processing (see Figures 5.6a and 5.6b). The households interviewed estimated that peeling can take about 11.3 hours for *udaga* and 17.3 for *makopa* to produce one sack of product. Finding needs to be confirmed and explained as not immediately logical.

The intensive labour steps often involve more people: harvesting and peeling can be carried out by groups of four or five people. Household members usually participate in this activity, although some households hire labour to assist with this task.

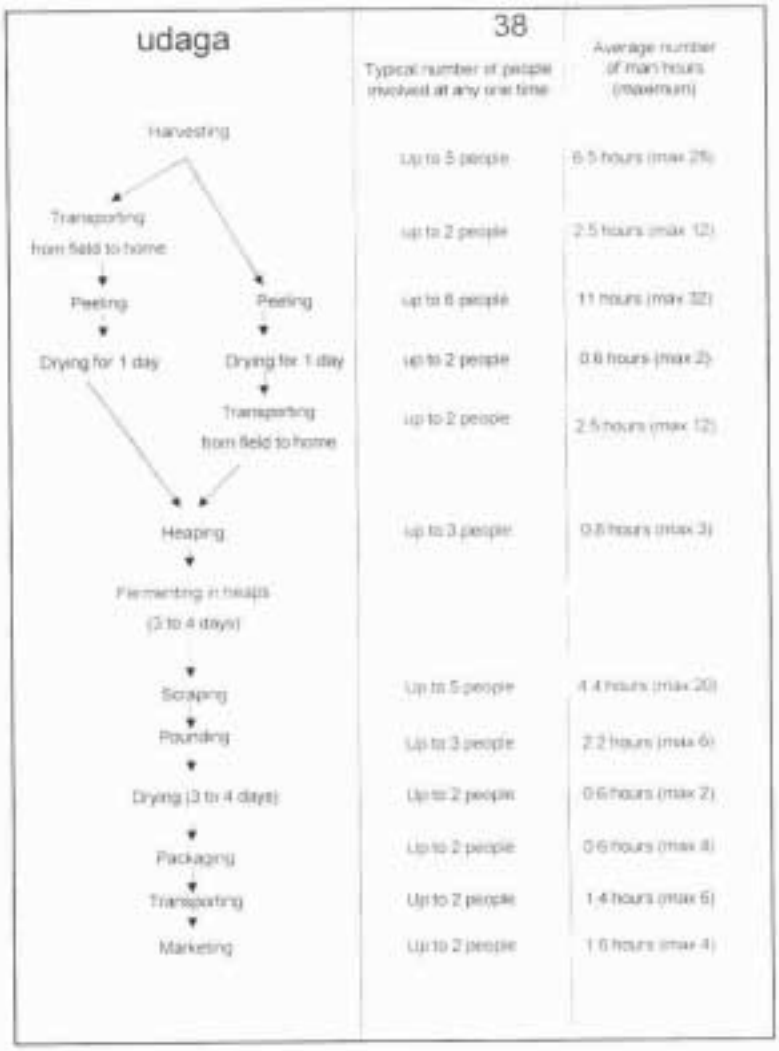
Analysis – *makopa* requires overall less input, therefore preferred as marketable product, and marketed on a larger scale, despite commanding lower price in the market? Jo

5.5.2 Labour saving technologies

Farmers do not have access to major labour technologies. Most of the tools used are basic, e.g. handhoes and pestle and mortars. Transport is often by head loading. Men often use a bicycle to transport the crops. Not all households interviewed however do own a bicycle. Time and energy can be saved by using a bicycle to transport cassava roots. It was estimated that use of a bicycle reduces the amount of time spent transporting roots by 50%. Generally one large sack is loaded onto one bicycle.

For food preparation, *udaga* pieces are milled into flour. Most households pound the *udaga* using a handheld pestle and mortar (Plate 5.26). It is a labour intensive job and it takes about 1 to 1.5 hours to pound one Debe of *udaga* into flour, and 0.5 hour to sieve the pounded flour. The village does however own a mill (Plate 5.25) and villagers can use the mill to pound both maize and cassava. It costs 200 TSh to mill one Debe of *udaga*, and 300 TSh to mill one Debe of maize.

Plate 5.25. The village mill can be used to mill *udaga* pieces into flour for 200 TSh per Debe.
Plate 5.26. *Udaga* is pounded into flour and sieved before it is prepared as a food.



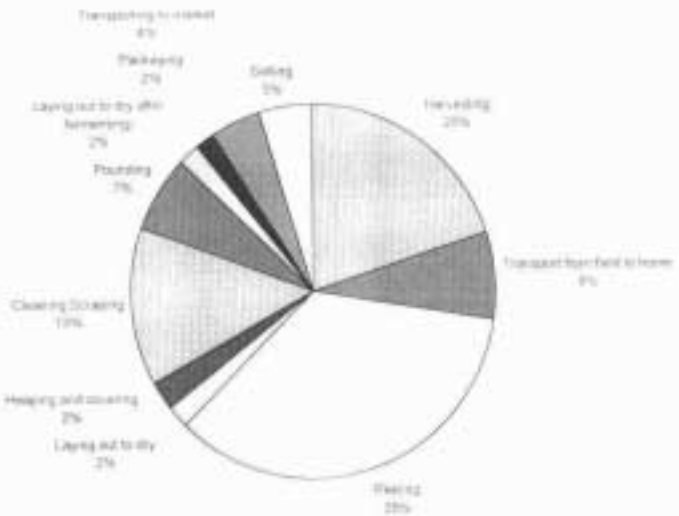
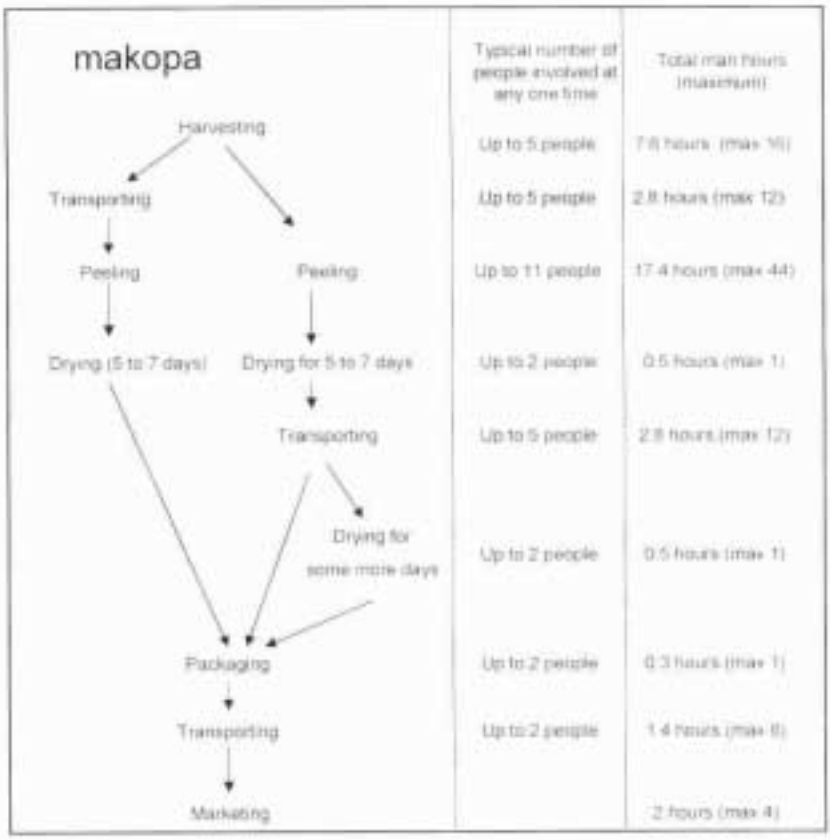


Figure 5.6a Flow diagram of *udaga* processing with the typical number of people involved in the total processing and the number of man hours in processing one sack.
Figure 5.6b. Distribution of labour (percentage of total man hours per unit of product) involved in processing one sack of *udaga*. The values mentioned are the means of 16 randomly selected households.



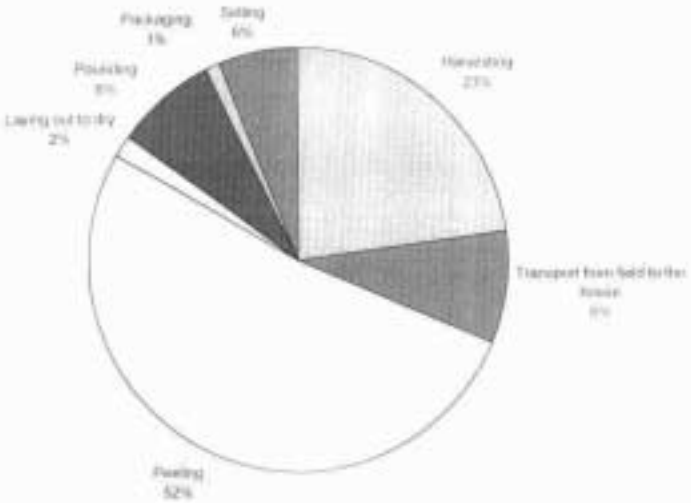


Figure 5.7a Flow diagram of *makopa* processing with the typical number of people involved in the total processing and the number of man hours.
Figure 5.7b. Distribution of labour (percentage of total man hours per unit of product) involved in processing one sack of *makopa*. The values mentioned are the means of nine randomly selected households.

Section 5.5 needs some expansion on the economic issues. Currently good on labour – but needs more on economics

5.6 The importance of cassava processing at the village level

Cassava is the most important crop for food in the village (Table 5.4). As can be seen from Table 5.8 , the majority of households interviewed (thirteen out of the sixteen presented here) ranked it as the most important crop for providing food for the family. After cassava, maize is the next most important food crop. Beans, groundnuts and sweet potato are less important[1].

Table 5.14. Ranking of the five major agricultural crops in terms of food security

H-hold	Cassava	Maize	Beans	Sw. potato	Groundnuts
20	1	3	4	2	
34	1	2	3	4	5
30	1	1	2	3	4
12	1	3	2	7	4
13	1	2	6	5	7
19	1	2	3	NR	4
32	1	2	5	NR	4
38	1	2	3	6	4
37	1	2	3	4	5
23	2	1	NR	NR	NR
5	2	1	3	4	NR
4	2	1	3	4	NR
39	1	2	NR	NR	NR
41	1	2	3	4	NR
46	1	2	4	NR	3
52	1	2	4	3	5

Key: 1=most important; 5= least important; NR not ranked

[1] It should be noted that 'cassava' here refers primarily to processed cassava (*udaga* or *makopa*).

Table 5.15. Ranking of the five major agricultural crops for income

Household	Cassava	Maize	Beans	Sw. potato	Groundnuts
20	1	2	3	4	NR
34	NR	NR	NR	NR	NR
30	NR	NR	NR	NR	NR
12	1	2	3	4	5
13	1	2	7	4	5
19	4	3	1	NR	2
32	5	4	3	NR	1
38	2	3	4	7	5
37	1	2	3	NR	4
23	2	1	NR	NR	NR
5	3	1	2	4	NR
4	2	1	3	4	NR
39	1	2	NR	NR	NR
41	1	3	4	2	NR
46	1	3	4	NR	2
52	4	5	NR	NR	3

Cassava also ranks as the most important crop for household income, followed by maize and beans. Sweet potato is the least important, and in many cases, is only used for home consumption.

All of the households interviewed for this study are farmer-processors, using their own cassava harvest to produce processed cassava products. *Udaga*, *makopa* and *gongo* are all significant products for generating income for villagers. Almost all of the villagers interviewed were processing *udaga* to sell; two thirds were producing *makopa* to sell, and five out of the thirty three households interviewed about their livelihood practices were producing *gongo* for sale. Processors described how *gongo* provided them with better profits than other processed cassava products. It is however not legal to make and sell *gongo*.

Several households described how they had moved into the production of *makopa* and *gongo* over recent years due to the income-generating potential of these products and the decline of resources available for other livelihood activities such as charcoal making.

Cassava processing also contributes to the local economy by the opportunities for paid labour that it provides. Many (** how many??) of the households interviewed both hire in labour for some processing activities and hire some of their household labour out for payment in cash or food.

6. THE MARKETING OF PROCESSED CASSAVA

About 75% of the total amount of *udaga* processed in the village is sold for cash. Almost all of the *makopa* is marketed. Some *gongo* is marketed directly from the household, but no additional information was collected on this.

6.1 Market seasonality for processed products

As described earlier, *udaga* is produced and sold throughout the year while *makopa* processing and marketing tend to be more concentrated in the dry season from July to October.

Data already exist on the seasonality of cassava markets in Tanzania from the urban marketing study of the Collaborative Study of Cassava in Africa (Ndunguru *et al.* 1997). A total of 82 marketing agents (traders) were interviewed during the survey in three cities (Mwanza, Dar es Salaam and Mtwara. Traders were asked to indicate in which months the price of cassava products was high and in which months the price was low. The percentage of traders responding "high" was plotted on a graph as is shown in Figure 6.1. There is clearly a strong correlation of price seasonality between the markets. Prices were judged high between October and April, and low between May and September. The same exercise was carried out for seasonal changes in volume, the results of which are shown in Figure 6.2.

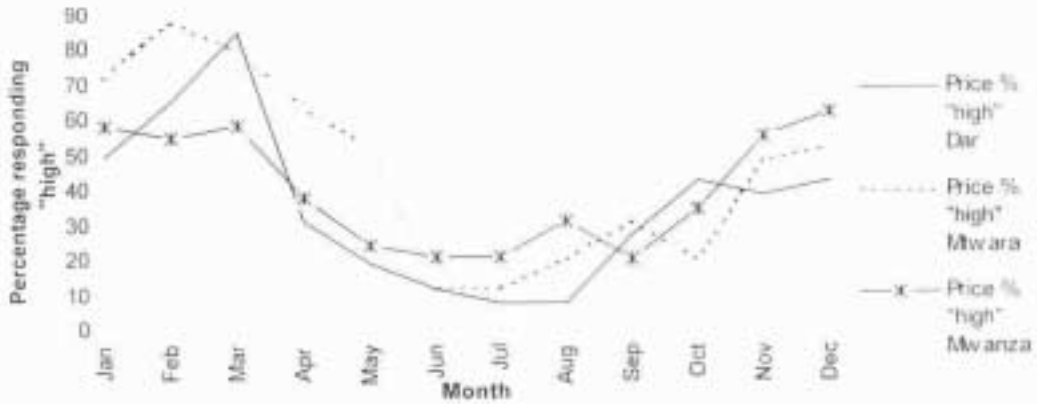


Figure 6.1. Traders' perceptions of seasonality of prices for cassava and cassava products in three urban centres (Dar es Salaam (Dar), Mwanza and Mtwara) of Tanzania.

There was not such a clear correlation between the markets with seasonality of volume as there was with prices. In Dar-es-Salaam, volumes were judged highest on the market between January and April, while in Mwanza they were judged highest between April and October. In Mtwara, volumes follow a similar pattern to Mwanza, and are highest between June and October.

The information on both price and volume seasonality for Mwanza and Mtwara corresponds to that found by Thomson *et al.* (1997) which suggests that in Mwanza

there are more dried cassava products available in the dry season, which extends from June to September. This is because it is easier to dry cassava products at this time of year. Prices of dried products in Mwanza are seen to be highest in the low season, which coincides with the short rains (October to December) and the long rains (March to May).

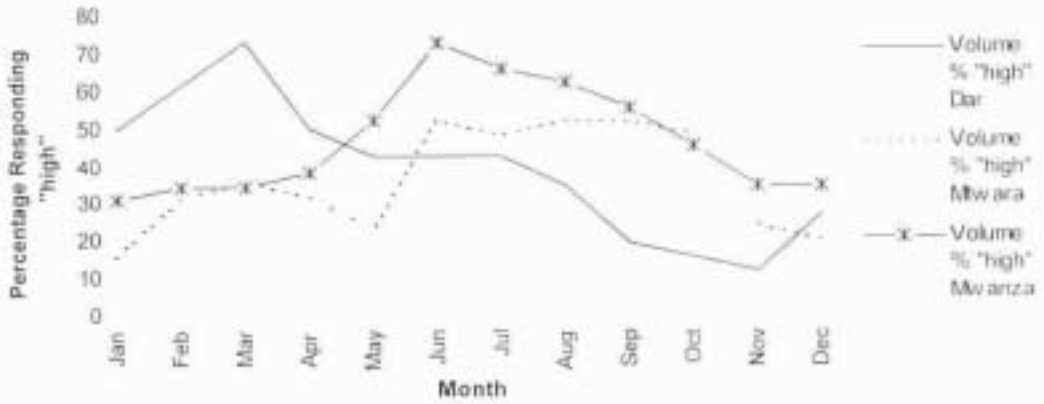


Figure 6.2. Traders' perceptions of seasonality of volume for cassava and cassava products in three urban centres (Dar es Salaam (Dar), Mwanza and Mtwara) of Tanzania.

Similar seasonality in terms of cassava product availability and price was identified by market surveys undertaken for the DFID-funded project with which this case study is associated. Table 6.1 shows how the price levels of cassava chips were found to vary in relation to the seasonality of supply and also the profit margins which occur. As the table reveals, high prices occur during the period of low supply (October-January).

Table 6.1. Price of dry cassava chips at various levels in the marketing chain and in different seasons of supply.

Season	Farm price (TSh/bag)	Wholesale price (TSh/bag)	Retail price (TSh/tin)
February-August(High Supply)	2,500-3,000	7,000-7,500	1,000
October-January (Low Supply)	4,000-5,500	9,000	1,200

Source: Mashamba et al. (2000), Survey Data, January, 2000.
Note: A tin of dry cassava chips weighs 15 kg.
A bag of dry cassava chips weighs 85-90kg

Interviews carried out with processors for this village case study revealed a similar scenario. Processors reported that the prices of *udaga* and *makopa* vary throughout the year, and the lowest prices for *udaga* are obtained during the dry season, ranging from 250 to 300 TSh (up to US$ 0.39) per Debe. In the rainy season, however, *udaga* prices can rise to 800 TSh per Debe (around US$1).

Interviews with traders revealed a similar pattern. Traders market the produce in sacks, with one sack measuring between seven and eight Debes. The lowest price reported per sack in the high season was 1,600 TSh per sack (US$2), although

2,700 TSh in the high season (US$3.48) appeared to be a more common price. The peak price reported for *udaga* in the rainy season was 4,500 TSh per sack (US$5.8).

The lowest prices of *makopa* reported by processors are similar to the prices of *udaga*: 250 to 300 TSh per Debe (up to US$0.39). Prices for this product may also rise during the rainy season, although there is much less *makopa* available at this time of the year.

6.2 Market accessibility

The processors interviewed in the village sell *udaga* and *makopa* from their homes, at the village marketplace or another local market situated outside the village. In a minority of cases male members of the household will also travel to the city (Mwanza) to sell the goods (only three out of the thirty-three households interviewed marketed their goods in the city). *Gongo* is always sold from home. Processors generally sell to anyone interested in buying their products, mostly traders or middlemen, but also to fellow villagers. All of the processors interviewed described their marketing arrangements as "random", and had no regular trading arrangements, although they are aware that certain traders, such as those that travel to the village from the city, and from neighbouring Kenya and Uganda, are likely to give them a better price. In most cases payment for the goods is made on the spot. In a very few cases processors described providing goods on credit, but this is the exception rather than the norm., and is more likely to take place between neighbours than between processors and traders.

As the sale of cassava products provides a critical source of income to processors, they have very little negotiating power at the point of sale. Processors described how traders are aware that they have few alternative means of income and need to sell their products, and so are forced to accept whatever prices they are offered. Also, as processors generally trade from home or from local marketplaces, they have limited access to price information. This puts them at a further disadvantage. Some processors store the products for several months, and try to sell at a higher price. This poses a risk for the farmers as they might lose some of the product through spoilage. Many processors who are in need of a ready cash flow are unable to consider storing the product.

6.3 Prices of cassava products

During discussions with processors in the village, they identified the following as principal factors which affect the price they can command for *udaga* and *makopa*:

- seasonality

-
- the type of trader involved
- transport costs
- quality of the product (particularly the colour of *udaga*) the whiter the product, the better the price

The importance of the quality of the cassava product for trading purposes was highlighted by the traders interviewed as the most important factor affecting prices. From the traders' perspective, the most important quality characteristic of processed cassava is colour. 55% of the traders ranked this characteristic as the most important quality aspect, and for 45% it was the second most important characteristic (Figure 6.3). The second important characteristic was the lack of sand. 36% of the traders consulted found this to be the most important characteristic, and it ranked second or third by many others.

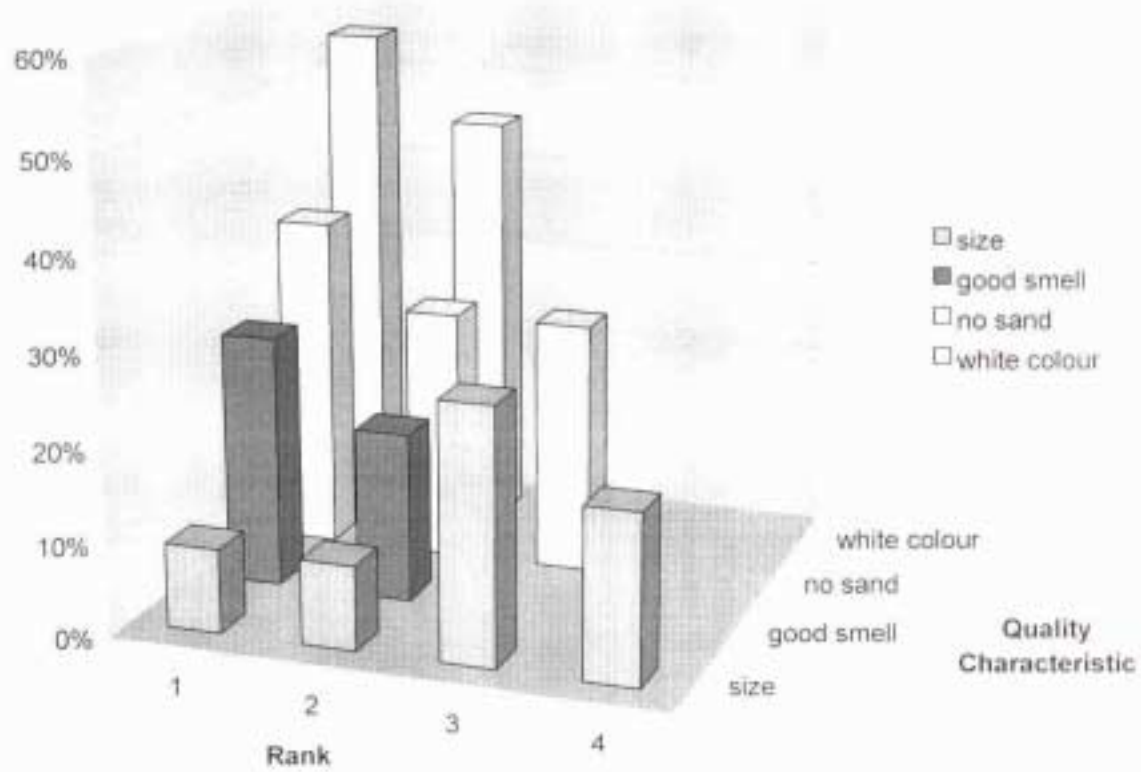


Figure 6.3. The importance of quality characteristics according to traders in the village.

6.4 Mwanza as a market for cassava processed products

These findings support an earlier study of cassava products in the urban markets of Tanzania (Ndunguru *et al.* 1998) which investigated the relationships between quality characteristics and value in the urban markets in Mwanza for the main processed cassava products, *udaga* and *makopa*. For both products, traders and customers were found to prefer a whiter form of the product because this gives better tasting and more visually appealing *ugali* flour. Ndunguru *et al.* (1998) developed a season calendar with traders in Zimbabwe market in Mwanza. The results of the participatory quality, quantity and price assessments are presented in Figure 6.4.

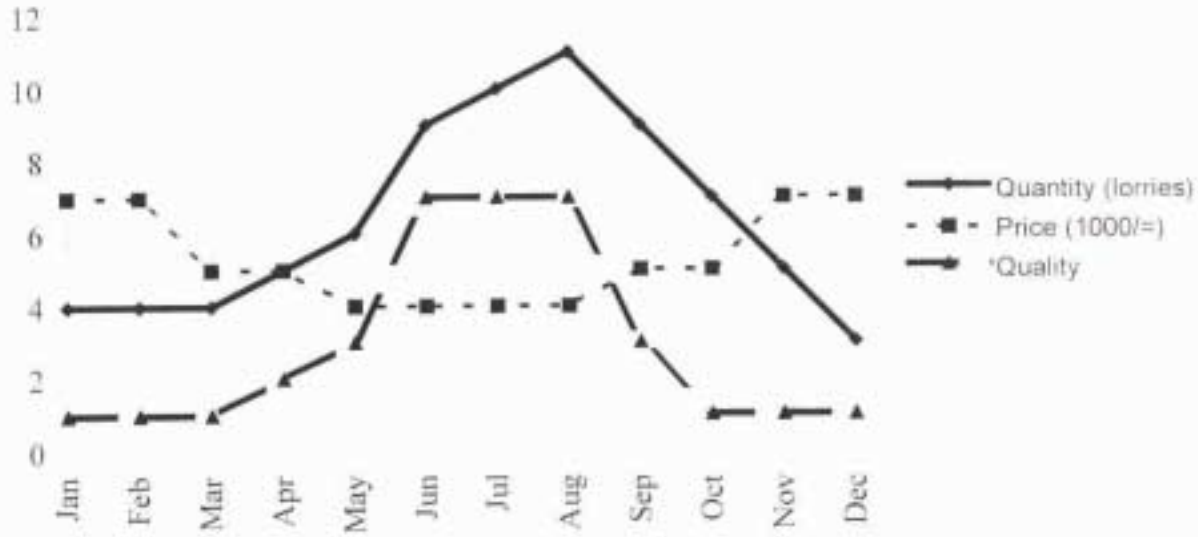


Figure 6.4. Relative relationship between quantity, price and quality for dried cassava entering Zimbabwe market, Mwanza (Sourced from Ndunguru *et al.* 1998).

Notes: The chart indicates changes in variables from month to month as perceived by two key dried cassava traders in December 1996. The quality line gives rough indications of changes but cannot be used to measure absolute values. For prices, each scale unit represents approximately 1,000 Tanzanian Shillings on the average wholesale price of a sack. For quantity, each scale unit represents approximately one lorry of average seven tonnes capacity.

This study found that there is a negative correlation between product price and product quality. Prices are highest when the quality is the worst and lowest when quality is best. At any given time however, a better quality product can be expected to be valued more higher than a lower quality one. Perceived valuations show a 30 - 50% discount for dark *udaga* compared with white *udaga*. In the market, *makopa* is valued approximately 10% below *udaga* of similar colour and piece size.

Moulds of various colours appear on *udaga* during the rainy months. No visible mould is liked, but some types are disliked more than others. Average valuation discounts are 10 - 15% for orange coloured mould, 20 - 25% for green coloured mould and 35 - 40% for black coloured mould (Ndunguru *et al.* 1999)

The Ndunguru study also found that the trends in product quality closely follow the trends in quantity. This is because most cassava is harvested and processed in the dry season when dried cassava products are less spoiled by rain. Little is harvested when it is raining and the quality of the dried product declines.

Similar to the findings of other studies cited earlier (Table 6.1, Figure 6.1), Ndunguru *et al.* (1999) found that quantities traded are lowest between November and April, rise to a peak between June and September (when most cassava is harvested) and then fall. Estimates suggest that peak volumes are three or four times those of the low season. Prices bear a very close relationship to volume, with lowest prices at harvest time and highest prices between November and February, approximately double the peak season levels.

6.5 Markets for processed cassava

The marketing and trading of *udaga* and *makopa* involves several transactions before it reaches the consumer. There are several different key players in the marketing chain. They can be characterised as follows:

Local small traders
Local small traders live locally and buy from farmers in the village and nearby villages. They sell the produce at the market or to large traders. The amount they trade varies between four and 20 sacks per week.

Local traders
Some local traders sell their produce both locally as well as in Mwanza city. They are often store owners. All traders in the village have other occupations as well as trading. Most are farmer-processors themselves, and generate the products that they sell.

Middlemen
This group buys from the farmers, and stores the produce temporarily after that they sell the products on to traders. Often they sell to the large traders.

Plate 6.1. Transporting *udaga* to the roadside where large traders will meet middlemen and processors.

Large traders

The large traders mostly specialise in one product and prefer to trade large quantities at a time. *Makopa* traders tend to trade on a larger scale than *udaga* traders, and buy between 100 and 300 sacks of produce at a time, often from the middlemen. These traders often visit several locations on one trip and collect their produce from different outlets. Large traders sell to other traders, or in some cases sell *makopa* to millers at a large town xx km away (Bukoba). Most traders have other activities to earn income. Trading cassava based products only adds 25 to 50% of their income. However, four of the six large traders interviewed did not produce any makopa or udaga themselves. This is between 25% and 50% in most cases, although one large trader produced 75 to 100% of the *udaga* himself.

Makopa traders sell mostly in the more western parts of the country, for example Bokoba or Ngara. Distance is: 250 km to Ngara. Traders pay a lot for transport but the returns on this investment are high. For example, the price of a sack of *makopa* in Burundi is 12,000 TSh (US$15.50).

City traders

City traders operate on different scales, but both small and large city traders buy their produce from large traders. Some of the city traders, however, buy directly from farmers or smaller traders near the place of production. They store their products in the market stores. For most city traders, trading is their primary occupation.

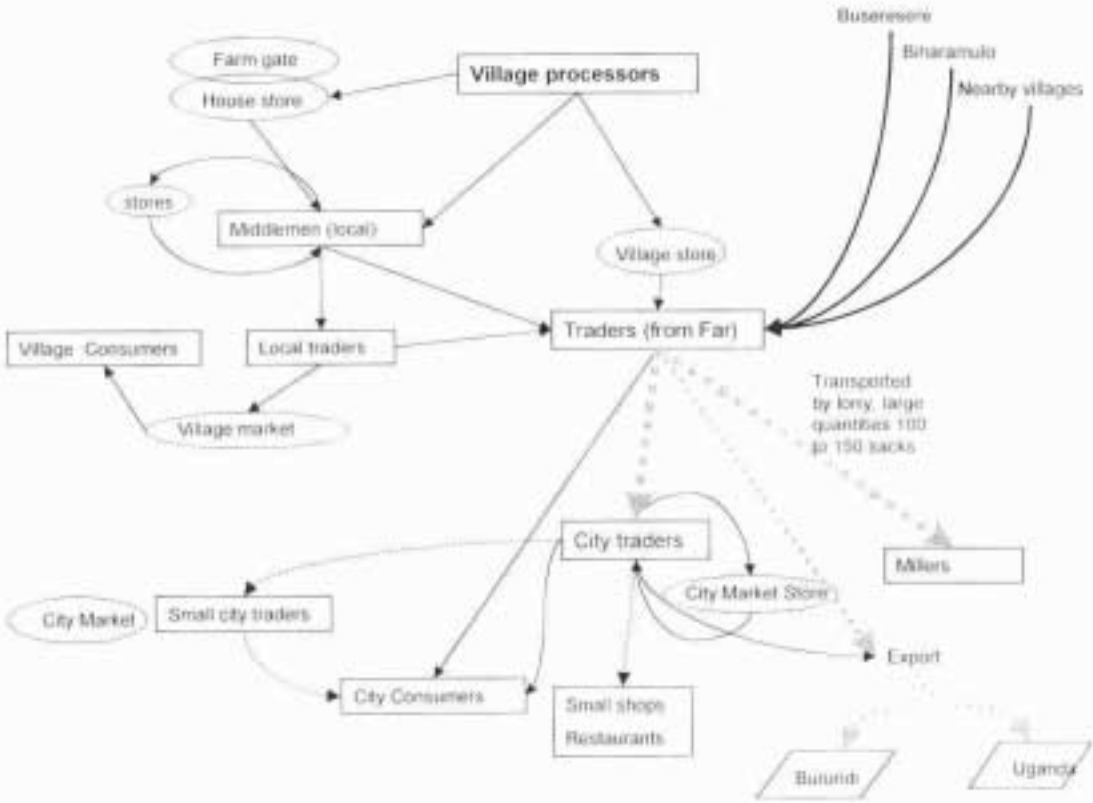


Figure 6.3. Flow diagram of marketing of processed cassava.
(unfinished)

Market trends

Most traders in the village see a moderate growth in the market. One of the traders mentioned that there was a rapid growth up to 1998, but according to him the market is now moderately declining. However, some of the traders interviewed were relatively new to the business and had been involved in trading cassava products for less than half a year, which implies that the market is still dynamic.

The urban study as part of COSCA (Ndunguru *et al.* 1997) gives some further indications on the dynamics of the cassava market. The data suggests that many people have entered into the business of trading fresh and processed cassava over the past five years (study done in 1997), possibly because cassava products are becoming more significant in the diet of urban consumers. One reason for an increase in demand of cassava could be urbanisation, possibly leading to a larger sector of the population demanding cheaper staples such as cassava. Furthermore, consumers moving from rural areas where cassava is a part of the diet may continue to demand cassava products once they have moved to the urban centres.

Table 1.2. Number of years of trading different cassava products

Years Trading	*Udaga*		Fresh Cassava Roots		*Makopa*		Flour	
	No.	%	No	%	No.	%	No	%
0-5	15	68	23	54.7	10	71.4		
6-10	5	23	11	26.2	4	28.5		
11-20	1	4.5	7	16.7			1	100
>20	1	4.5	1	2.4				

Other costs of trading

Most of the traders take several days to do their business. A business trip can sometimes take up to 14 days. Although for several traders it takes a little less. There is also extra cost involved for traders if they need to spend the night in guest houses and eat out.

Transport

Prices for transporting goods were found to vary from 200 Tsh (US$0.26) per sack up to 1,700 TSh (US$2.19) per sack. These prices do not vary during different seasons but depend on the final destination of the product. . Generally transport from the village to Mwanza is expensive, and costs from 1200 TSh (US$1.55) up to 1500 TSh per sack (US$ 1.94). Transport to Ngara is expensive as well, and was in one case estimated to be 1600 TSh (US$2) per sack. Some traders pay for transport by paying the petrol.costs. An example of marketing transport costs is presented in Table 6.3.

Table 6.3. Marketing costs involved in transporting dry cassava chips from Buselesele to Zimbabwe market in Mwanza town.

Cost Item	TShs per bag
Buying price	3,000
Transport (Buselesele to Zimbabwe market)	1,200
Loading	100
Village levy (council levy in Biharamulo)	300
Municipal levy (in Mwanza municipality)	300
Off-loading	100
Security charge	100
TOTAL COST	**5,100TSh (US$6.58)**

Source: Mashamba et al. (2000). Internal report. Survey Data, January, 2000.

Storage by traders

Traders do not actively store product for a long time, but as it can sometimes take one or two weeks before they sell their product, they therefore keep the product in specifically built stores. These are located either in the village centre near the market, at traders' houses, or on the roadside. These stores are often used to hold maize and other dried products, as well as cassava. Some of the traders rent these stores locally or the larger traders who come from great distances have their own

stores built in Ngara or Bukoba. Most traders do not pay for the store to be watched, particularly when the store is near the house. Some traders have dogs that watch the stores overnight. Only one trader was found who pays people to watch her store; she was a large trader from Ngara who buys large quantities of product at a time.

City traders store their produce at the market and all traders pay for the product to be watched. Different markets have different arrangements. At Kirumba market for example, the price for storage is often included in the market fee. At Mikuyuni market however the traders need to pay extra for the storage space (1000 TSh per month). At Zimbabwe market the sacks of udaga are stored in large piles, and covered with plastic to prevent it from rain (Zimbabwe market is open air).

The deals are made in the location near to the market. Then mostly the lorry picks up the sacks from the farms. In case where there is no road to the processor's house, the sacks are transported to the road side by bicycle. This transport is paid for by the processor.

Loading and offloading

The trader pays the porters to stack the sacks in the lorry. In most cases a sack is carried by just one person. Sacks may weigh 80-95 kg. The traders pay the loaders 50 or 100 TSh per sack. Loaders are generally available near the places of trade, they tend to hang around at the market place looking for jobs.

During loading the sack is lifted up to the shoulders of the loader, who than carries the sack up right to the lorry. In the lorry the sack is dropped. Sacks are stacked in the lorry. When traders buy directly from farmers the lorry drives often close to their house.

Plate 6.2. Loading and of- loading of a lorry. A sack is lifted on the shoulders and stacked into the lorry.

Tax
All traders have to pay a village levy per sack traded to the village government, or to the city market. Generally this amount is TSh 300 per sack of *udaga* or *makopa* traded. In the city the tax-man comes to the traders.

Market fees
Traders must pay fees for renting a stall on the markets.

6.4 Gender roles in marketing processed cassava

Among the processors who produce cassava products, men are responsible for marketing cassava products when they are sold in large quantities of, while women are responsible for smaller-scale marketing.

The traders that come from great distances are mainly men, although there are some women traders. Two of the 11 traders interviewed in the village were women. Both of the women traders sell large quantities of *udaga* flour. In the city markets ten of the traders were women. City women tend to trade on a smaller scale than men.

6.5 Marketing of fresh cassava

Fresh cassava is a minor marketed product in the selected village. Some data on marketing of fresh cassava was gathered from market studies in Mwanza.

The price of fresh cassava varies per season and may also depend on the demand. However, a peculiar phenomenon was that lower prices coincided with low demand and low supply and higher prices with high demand and high supply. The demand in the main season is low because of other crops are available (March-September). During Ramadan there is generally a high demand high season (October-February) period.

Table 6.4. Producer, wholesale and retail prices of fresh cassava.

Season	Producer Price (per sack)	Wholesale price (per sack)	Retail price			
			Large heap		Small heap	
			Tsh/heap	roots/heap	Tsh/heap	Roots/heap
Oct-Feb (high supply)	1,500	5,000-6,000	200	3	100	6-8
March-Sept (low supply)	1,200	3,000-3,500	200	6	100	9-10

Source: Survey Data, January-Feb, 2000, Mashamba et al. (2000) preliminary report
Note: A bag of fresh cassava weighs about 85-90 kg.
From October-February one bag can give 35-40 heaps, each with 3 roots/heap.
From March-September one bag of fresh cassava can give 18-23 heaps, each with 6 roots.

The retail prices remain the same throughout the year, TSh 200 per large heap and TSh100 per small heap (Table 6.4). The sizes of heaps may vary according to the season. Large heaps often consist of fewer but larger sized roots.

The prices may vary according to the source (location). Due to the soil quality e.g cassava from Lunzewe was considered to be of high quality, as it is grown in a fertile soil, whereas cassava from Shinyanga is of low quality due to the poor soil. When fresh cassava from these different locations (Lunzewe division in Bukombe district and areas in Shinyanga rural district) happen to coincide at the market, the Lunzewe cassava will be sold first and at a high price, while the one sourced from Shinyanga rural District will be sold last, and probably at a low price.

An example of the marketing costs for fresh cassava sourced from Lunzewe is given in Table 6.5.

Table 6.5. Marketing costs for fresh cassava sourced from Lunzewe, Bukombe District

Costs Item	TShs/bag
Harvesting (Uprooting and packing)	200
Collection (Transport from farm to collection point)	500-700
Loading	50
Transport from Luzewe to Kahama	500
Off-loading in Kahama	50
Transport from Kahama to Shinyanga	50
Off-loading at Nguzonane market	1,000
Municipal council level	50
Security and cleaning charge	100
	50

Source: Survey Data, Jan-Feb, 2000

Plate 6.3. Marketing of processed cassava products.

As part of the urban study of the Collaborative Study of Cassava in Africa (Ndunguru *et al.* 1997) the important quality characteristics for fresh cassava in Mwanza, Mtwara and Dar es Salaam were established. These are summarised in Table 6.6.

Table 6.6.. Ranking of the importance of different characteristics for fresh cassava in terms of their effect on price.

Rank	Characteristic	Preferred Quality
1	Taste	Sweet
2	Starch content	Hard
3	Outer skin colour	Reddish Brown
4	Inner skin colour	Red
5	Water content	Low
6	Root size	Large
7	Pulp colour	White or Cream
8	Texture	Mealy
9	Fibre content	Low

7. TRANSFORMING CASSAVA PROCESSING AND MARKETING

7.1 Areas of the processing and marketing chain requiring technical and economic improvement

General Points

Cassava forms a major part of the livelihoods strategy of every household in the selected village. It forms a major part of household diet and the marketing of processed products provides a very important source of income. Interventions targeted at improving the cassava processing/marketing sector are therefore likely to have a large impact on the people who live in the village.

The research has shown how both men and women are actively involved in cassava processing and the marketing of processed products. The development of any technical or marketing improvements should therefore be carried out in liaison with both male and female household members.

The village-based research also revealed the vulnerability of female-headed households, their lack of access to land and their limited access to other resources. For improvements which are introduced to be equitable, specific attention may need to be paid to the situation of women-headed households.

Areas of the processing and marketing chain that could benefit from improvement are presented below. In the analysis, processing and marketing are separated, although they clearly form a continuum, and are not always distinguishable. Any changes in the processing system such as improving the efficiency of processing or enhancing the quality of the final product(s) are only likely to be taken up if the economic returns for processors are enhanced.

The majority of the issues outlined in this section were identified by processors and traders during the survey work carried out in the selected village, supplemented by observations by researchers in the field. More generic problems identified in other studies in the region have also been included where appropriate, but these are clearly distinguished in the text.

It can be seen that *makopa* and *udaga* share some similar technical constraints, but also pose problems particular to their different processing methods involved for the two products. These will be specified where relevant.

Processing related factors

a. Labour intensive nature of production and processing

The cultivation and processing of cassava are labour intensive. The scale of cassava production and processing which farmer-processors in the village undertake appears to be dictated by the amount of family labour available and the resources for hiring temporary labour at particular times of the year.

In terms of the overall resources influencing both agricultural production and cassava processing, the most common limiting factor in this village therefore appears to be

the availability of labour. At the peak season of harvesting and processing, the lack of labour poses a bottleneck. Any proposed improvements to both the technical and economic aspects of cassava processing should therefore be based on an understanding of labour dynamics and availability.

b. Short shelf-life of fresh cassava

The problem of the physiological deterioration of fresh cassava was raised by processors. The short shelf life of fresh cassava roots limits their use, particularly as there is very little local trade in the sale of fresh roots. Steps are already taken by villagers to avoid this problem, including the preparation of processed products. This confirms the earlier work of Digges *et al.* (1994) and Ndunguru *et al.* (1996).

However, despite these measures, the short shelf life of fresh cassava limits the flexibility of processing as farmer-processors need to process their roots immediately after harvesting. This constraint, together with that of labour availability, affects the scale at which processing can take place.

c. Transportation

Most processors referred to transportation as one of the major constraints to processing. Fresh cassava roots are moved from the field to the village for processing by "head-loading" and sometimes by bicycle. This is very labour intensive and time consuming and limits the amount of cassava that can be processed at one time. For cassava processing to be scaled up, methods for transporting roots or the relocating of processing facilities closer to cassava fields need to be considered. Transportation is also an issue affecting the marketing of cassava products (see Marketing).

d. Peeling

The peeling of roots prior to sun drying is the most labour intensive task relating to processing, and one in which the whole family is often involved. This activity is required for all of the processed products produced in the village. The development of cassava-based products that do not require peeled cassava or the introduction of some form of mechanical peeling would therefore increase the productivity of current processing methods.

e. Mycotoxins in dried cassava products

While *makopa* has the simplest processing stages of the cassava products produced and sold in the village, the slow drying method employed for this product enables mould growth. Research has indicated that a range of mycotoxins can be present in mouldy cassava. While this is not an issue that cassava farmers, processors and traders would recognise as a problem, it is recognised that mould growth can result in a low quality (and hence lower value) product. A detailed study of dried cassava products has recently been completed in Ghana, where the most common product is *kokonte* which is similar to *makopa* (Wareing et al. 2001). This study reveals that the most commonly isolated fungi were yeasts and Cladosporium spp. (44 out of 49 samples). Other fungi isolated included Aspergillus spp. (20 samples); Penicillium spp. (15 samples) and Fusarium spp. (30 samples).

Sterigmatocystin was detected in 10 samples at 0.17-1.67 mg/kg; patulin in 4 samples at 0.55-0.85 mg/kg; cyclopiazonic acid in 4 samples at 0.08-0.72 mg/kg; penicillic acid in 5 samples at 0.06-0.23 mg/kg and tenuazonic acid in 3 samples at 0.02-0.34 mg/kg. Aflatoxin was not detected in any of the samples. Mycotoxin contamination of mouldy kokonte was considered as a potential problem and it was recognised that there was a need to avoid mould growth. A similar study in Tanzania is required, but it is likely that it would yield similar results. More research is needed to understand the factors that influence fungal growth would, however, be useful.

The slow sun drying of *makopa* therefore raises issues of poor product quality and, potentially, food safety, and existing processes may benefit from some improvement. As *udaga* is only dried for a shorter period of time, mould growth and mytoxins may be less of a problem for this product.

f. Udaga – scraping and pounding

The scraping and pounding of cassava roots for the processing of *udaga* are labour-intensive activities. While they do not rank as highly as other labour-intensive tasks involved in cassava processing, such as peeling, these activities are more likely to be the responsibility of women. Technical improvements in this area would be very likely to reduce women's drudgery.

g. Storage

The shelf life of *udaga* and *makopa* is generally estimated at 3 to 5 months, although most farmers only keep it for 2 weeks. The storage of both *makopa* and *udaga* can lead to physical and therefore economic losses. Villagers reported that a certain volume of all dried cassava products that are produced is lost due to storage pests. The larger grain borer has been reported to be a major pest of dried cassava (Hodges *et al.* 1983; Hodges *et al.* 1985). More detailed surveys have, however, given variable results as to the importance of pest damage, and further research may be useful.

Due to the potential loss of stock through storage, processors invariably only produce small amounts of dried processed products at a time rather than take the risk of attempting to store their products over the long term. This prevents then from storing their product and taking advantages of the higher prices during the low season. Technical improvements to the storage potential of the products would enable processors to sell their products at different times of the year, and therefore to obtain a much higher price for the product, thereby increasing their incomes.

h. Quality of traditional processed products

Both processors and traders identified the need for high quality *udaga* and *makopa*. These products are considered to be of high quality when they are white in colour. The colour of these products can be linked in part to the quality of the roots which, in turn, may be attributed to the variety of cassava used and cassava cultivation practices. Improvements in these areas through the use of appropriate varieties or through improvements to processing and storage may enhance the marketability of cassava products.

i. *Cyanogens in cassava*

Problems with cyanogens from cassava were not specifically mentioned in the village. As acute problems only happen in circumstances of extreme food insecurity it may be that the village has not experienced and problems. The safe processing of cassava should however be considered when improvements to processing are introduced. Much knowledge already exists on cyanogens in cassava and their removal by processing (see Bokanga *et al.* 1994).

Economic factors

As has already been described, improvements to the quality of the processed product and the efficiency of the inputs involved in processing cassava might improve the market potential of these products and the profit margin of farmer-processors. Other measures, specifically related to existing market dynamics may also improve the marketing chain.

a. Information on market prices

Currently traders at the village level appear to dictate the prices of the cassava products which they purchase and farmer-processors who are selling at the farm gate or at local markets feel they have little negotiation power. This is partly due to their limited awareness of the wider market value of their products.

b. Processor organisation

Processors are not organised into groups but are highly dependent on random sales at an individual household level. This means they have no common front for dealing with traders, and hence lack the means to improve their negotiation power.

c. Stored product

Currently the sale of *makopa* and *udaga* and the market prices of these products are seasonal. If storage methods were improved processors would be able to sell products for higher prices in the low season.

d. Transportation to market point

Improvements to transport facilities would enable a larger number of families to move outside the village to sell their products. This would allow them to gain a more competitive price for their goods.

e. Limited range of products/lack of knowledge about other market opportunities

If cassava processing is compared to processing in other parts of Africa, it is relatively unsophisticated and there is a limited range of products. There may be the potential to either expand the range of products or produce cassava or processed cassava for new markets.

7.3 Approaches to upgrading both the technical and economic aspects of cassava processing.

This section proposes some approaches to improving the technical and economic aspects of cassava processing. Some of these ideas were proposed in a meeting that was held with the village leaders during the fieldwork on October 2000. The conclusions from these discussions are presented in Box 7.1.

Box 7.1. Meeting with village leaders, October 2000.

A meeting was held with the village leaders and aspects of cassava production and processing that needed improvement were discussed.

Need for improvements in cassava production and storage

The village leaders described how farmers feel that there is some scope to improve existing practices in relation to cassava cultivation and storage. The following improvements were suggested:

- Training of agricultural assistants in the village to enable them to advise local people on farm management, including improved crop varieties, the spacing of planting materials, soil fertility improvement, plant diseases and insect pest control techniques. Farmers are particularly interested in being trained in how to use herbicides for weed control.
- Access to improved planting material.
- Insecticides for stored products or training in good practices for product storage.

These improvements would enhance the volume of production and the quality of the cassava produced and processing, which would have a potential knock-on effect in terms of the scale of processing and the quality of processed cassava products.

Need for labour saving technologies

The labour intensity of certain tasks poses a constraint. Land preparation, weeding and harvesting demand a significant labour input., as does the processing of cassava into dried products. Transport was also considered labour intensive. Certain improvements were proposed:

- The introduction of labour saving tools or equipment. Tractors, ox-ploughs, or ox-drawn weeders would all enhance production.
- Tools to facilitate the drying of cassava.
- New means of improving transportation could be introduced, such as wheelbarrow and handcarts.

Economic Aspects

Processors feel that the prices they obtain for cassava products are low as traders currently dictate the market price. There is no stable marketing system which benefits the producers as there used to be for cotton.

Possible areas of improvement suggested:

- New market outlets to be explored so that crops can be marketed with ease.
- Alternative products could be manufactured to enhance market opportunities, e.g. by setting up a small-scale cassava processing starch industry or factory.

It is worth noting that during the discussions with village leaders that as well as suggestions for improving cassava processing methods, some emphasis was also placed on the need for improvements in cassava production. This may reflect the overall importance of agricultural production to local livelihoods *per se*, as well the

relationship between agricultural production and cassava processing which, given that all families are farmer-processors, is clearly important.

A number of approaches are suggested below to improve cassava processing and marketing. Experience has demonstrated that for interventions to have a higher chance of succeeding, the following criteria should be followed:

- interventions should be developed in collaboration with the community;
- interventions must be within the resource capacity of the community;
- interventions must take into account the social and economic context in which people operate; and

Where appropriate, the principles presented in the Global Cassava Development Strategy (Pluckett *et al.* 2000) could be followed.

a. Improving labour productivity

Labour productivity for both cassava production and processing can be enhanced through the introduction of labour saving techniques such as better tools and equipment, or through the promotion of wider strategies which can improve access to labour:

- Some form of *mechanical peeler* would increase the productivity of current processing methods. The development of cassava products that do not require peeling would also decrease labour costs. Although such products exist, such as the *fufu* produced in some regions of Nigeria, these products may not be acceptable to all consumers.

- Improved equipment to facilitate *scraping and pounding* of cassava roots would enhance existing processing activities.

- The introduction of *hand carts* or *wheel barrows* could save villagers time and effort and enable larger quantities of goods to be transported. The local environment (roads and terrain) is conducive to wheel transport. Ideally the manufacture and maintenance of these carts could be carried in the village itself. This could generate income, enhance livelihood diversification and stimulate local markets.

- Another possibility is the use of animals for transport. Already some households own cattle and these could be used to draw *ox carts*. Households who do not own livestock could hire them from owners, enabling the development of a new income-generating activity within the community.

If new or improved technologies are to be introduced then they need to be affordable and there needs to be good infrastructural support. For example, local extension networks will need to have adequate resources to disseminate new technologies, facilitate training and monitor their use.

The overall issue of labour availability, particularly at certain times of the year, and the need for methods of facilitating households' access to labour, could also be

addressed in a wider developmental context. For example, interventions that lower the substantial amount of time which women and children spend collecting firewood and water would free their time up for other productive tasks.

b. Credit facilities

To invest in tools and equipment, many villagers will need access to capital. Credit facilities might facilitate farmer-processors' purchase of labour saving equipment. However, while labour-saving devices have the potential to decrease labour inputs, there may also be other means of easing the seasonal labour demands of cassava production and processing. Anecdotal evidence has revealed that in some areas in the Lake Zone, communities are accessing credit facilities to pay for temporary hired labour, such is the need for human resources at certain times of the year.

c. Livelihood diversification

Another way that labour could be saved could be by encouraging specialisation. As the farmer-processors that sell *udaga* and *makopa* grow and process the cassava themselves, the production chain is short. There may be scope for encouraging a specialisation in activities relating to processing which would lengthen the production chain, and would ultimately enhance the diversification of local livelihoods. The introduction of new technology would be critical to this process. For example, the manufacture (and subsequent hiring) of wheelbarrows or handcarts, the construction of improved drying tables.

d. Technical improvements to cassava processing

(i) Short shelf-life of fresh cassava

A possible approach for reducing physiological deterioration of fresh cassava is the practice of pre-harvest pruning. Pre-harvesting pruning of the stems 2 to 3 weeks before harvesting reduce the susceptibility to physiological deterioration by 50% (Van Oirschot *et al.* 2000). This technology has not been widely adopted but has the potential to reduce losses.

The introduction of cultivars with lower susceptibility to physiological deterioration is also a possibility. Varieties are already available that are not susceptible to physiological deterioration. Further research on resistant varieties acceptable to local farmers would be useful.

(ii) Improvement of processing methods

The quality of the final product could be optimised by the introduction of improved processing methods. For these to be successful, resources would need to be invested both in developing improvements and, once they are developed, raising awareness of their benefits and working towards their uptake on a wider scale.

(iii) Sun drying methods

Existing drying practices could be improved by speeding up the drying process and using more effective drying surfaces. Currently canvas matting and cow hides are often used for drying and are placed on the ground, where sand becomes easily mixed with the processed material. Improved drying methods using elevated surfaces such as tables would have an effect on the level of sand in the products and would maintain the quality of the product better. If the drying tables could be manufactured within the village then this would provide the added benefits of facilitating livelihood diversification and contributing to the local economy.

If the drying process is speeded up this could prevent the unwanted mould growth on the dried pieces, which would increase the safety of cassava products. Preventing extra mould growth would also improve the colour quality of the product and hence give a higher price for the product. The use of specially designed dryers is one possibility.

(iii) Storage

Introducing methods of storage with lower risks for pest damage would increase the storage life of processed cassava products and would provide farmer-processors and traders with more flexibility in their trading activities. Also processors would be able to produce on a greater scale and would be able to continue selling products into the low season, which would be likely to improve their profit margins.

e. Economic improvements

(i) Quality of processed products

As mould discoloration affects the price obtained for *udaga*, product value might increase if mould was scraped off the roots prior to sale. It is also important that the mould is of the correct colour. (The safety of mouldy cassava products may require further investigation).

(ii) Grading of cassava products

Produce is usually ungraded in the markets. It may be that if *udaga* was well graded when it entered the market, improved price differentiation could occur. Consumers who are willing to purchase better quality products could meet their needs by paying more, while those who are satisfied with (or could only afford) poorer quality could pay less.

(iii) Formation of marketing groups

Farmer-processors currently deal with traders on an individual basis. By forming themselves into organisations or co-operatives they might place them a better position for negotiating the prices of their market products *udaga* and *makopa*. As noted above, the development of credit facilities or the targeted use of existing credit association could enable improved tools and equipment or labour power to be purchased.

(iv) Product diversification

Product diversification could be an important improvement. Currently many villagers depend on the production of *udaga* and *makopa* and some *gongo* as principal market products. If the products generated were more diverse this could improve the marketing potential of cassava.

The approach suggested in the Global Cassava Development Strategy (Plucknett *et al.* 2000) could be followed to identify new market outlets for processed cassava and develop appropriate rural agro-industries to meet the market opportunities. The main features of the approach suggested by Plucknett *et al.* (2000) are:

- **The identification of markets that are growing or could potentially grow**
- **The provision of a consistent supply of a relatively uniform product.**
- **Providing the market with a competitively priced product that meets consumers' requirements; and**
- **Securing the co-operation of those associated with the market opportunity.**

A focussed marketing study would be required to identify new market outlets accessible to the village studies. However, this case study provides some relevant background to such a marketing study, not least by detailing the nature and scale of resources currently available to villagers who process and sell cassava products, and the range of products which currently exist in local markets. Building relationships with people in the selected village was vital to the process of carrying out this case study, and working to develop such co-operation amongst processing communities will be equally important to the development of any further interventions in the cassava processing sector.

Conclusion

Cassava is both vital to food security and forms an important source of income in the village studied. It is therefore a major, if not the most important, contributing factor to the livelihoods of the people living there. It is hoped that this case study has identified some of the ways that cassava processing and marketing can be improved. Action is now needed to assess more closely the options proposed and develop solutions in consultation with villagers.

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