

**R2350(S)**

**CONSTRAINTS IN THE POST-HARVEST  
PROCESSING OF CASSAVA AT  
HOUSEHOLD LEVEL IN TWO  
DISTRICTS OF SOUTHERN TANZANIA**

A0528

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## **ABBREVIATIONS**

ARI	Agricultural Research Institute
CSPD	Child Survival Protection and Development
ODA	Overseas Development Administration
FSR	Farming Systems Research
NRI	Natural Resources Institute
PRA	Participatory Rural Appraisal
RALDO	Regional Agriculture and Livestock Development Office
RIPS	Rural Integrated Project Support
TFNC	Tanzania Food and Nutrition Centre

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## EXECUTIVE SUMMARY

(i) This project, funded by the Overseas Development Administration (ODA), aims to improve rapid cassava processing methods in rural households where a need is evident. The development and adoption of appropriate processing methods will be through participatory research involving, to a high degree, those who will use the technology. The project is being undertaken in partnership with the Tanzania Food and Nutrition Centre, as lead collaborator; Regional Agriculture and Livestock Development Office, Mtwara; Agricultural Research Institute Naliendele, Mtwara; and Rural Integrated Project Support Programme, a FINNIDA funded project in Mtwara and Lindi.

(ii) This participatory rural appraisal (PRA) study included eight villages in two districts of Southern Tanzania and aimed to: (1) obtain an inventory of existing traditional processing methods; (2) document information on farmers and processors preferences for processed products and situations that influence their choice of processing method, such as varietal preferences, storability, food safety, marketing and indigenous knowledge; (3) identify processing needs and constraints to develop improved processing methods; and (4) learn from the experiences of previous cassava processing technology transfer activities undertaken by the extension services.

(iii) It was observed that cassava processing methods have been developed to obtain a storable cassava products that are palatable. There is one main primary product, *makopa*, which is processed by sun-drying whole peeled roots. *Makopa* can then be stored until required. This product provides food security to households throughout the season. *Makopa* has desirable sensory characteristics after cooking, good storage qualities and low labour requirements for processing. The constraints associated with this method are the length of time required for processing, the inability to use the method during the rains and the requirement of a 1-2 month storage period before the product is considered ready to use.

(iv) Through discussions with farmers and processors and documented secondary information from previous food security studies, it was found that food shortages are most likely to occur during the rainy season. The shortages are a result of declining stocks of *makopa* in the store and the lack of other crops in store or ready for harvesting. During this period households may harvest immature cassava or hire labour out for payment in food or money, thus diminishing time devoted to their own farming activities. Minor primary processing methods for cassava are adopted during food shortage periods because of the reduced processing time required. The processed products prepared include *chinyanya*, *chiwalehi* and *kondowole*. These processing methods provide a flour in 1-3 days, however, communities participating in the study did not favour these products. Reasons given included poor palatability, laborious nature of processing and problems of food safety. The labour requirement for processing was a key criterion for women who are the decision makers and provide the labour for harvesting and processing cassava. Availability of labour during the food shortage periods is low because it is the peak time for farming activities. The use of rapid methods was associates with poverty and food insecurity. Poorer households are forced to use these methods during food shortage, whilst wealthier households have sufficient food resources or money to buy food throughout the year.

(v) Secondary information concerning the degree and extent of food shortages in the region suggest that significant problems are experienced by the poorest households for two to six months of the year. During the early 1990s the percentage of households suffering from food shortage was in the region of 50%. Although it may be argued that this was due to drought and current levels are lower, the level of food security is dynamic and periodic food shortages are a historic problem in the study area.

(vi) Current cassava processing practises need to be improved to address the food safety problems and the need for rapid processing methods. The importance of women, who make decisions and provide the labour for cassava harvesting and processing activities, was clear. Innovations in processing are currently being made by women. In order for the project to develop appropriate solutions to processing constraints, it will be of paramount importance to involve women in the research and development process. The project will focus on improvement, to rapid processing methods to alleviate food shortages. The target groups are those households where food security is an annual problem. The stigma attached to rapid processing methods means that a sensitive approach to the research will have to be adopted.

## INTRODUCTION

### *Improved cassava processing in Tanzania - project summary*

1. The aim of this project is to improve rapid cassava processing methods in rural households in Southern Tanzania where a need can clearly be demonstrated. The development and adoption of appropriate methods will be through participatory research involving, to a high degree, the owners of the technology.

2. The project is funded by the Overseas Development Administration (ODA) and contributes to the Crop Post-Harvest Programme with collaboration with the Tanzania Food and Nutrition Centre (TFNC), as lead collaborator; Regional Agriculture and Livestock Development Office (RALDO), Mtwara Region; the Agricultural Research Institute (ARI) Naliendele, Mtwara; and Rural Integrated Project Support (RIPS) Programme in Mtwara/Lindi (funded by the Finnish Government).

3. The first activity of the project was to review the current status of research in East Africa on the development of primary<sup>1</sup> processing methods for cassava (Bainbridge & Mlingi, 1996). This review outlined the first principles of the approach to be used throughout the project. Key issues identified as important in directing the project towards developing sustainable interventions to relieve constraints in cassava processing are listed below:

- ◆ identify processor groups and individuals that are constrained in processing bitter cassava roots and thus have a need to improve their current techniques;
- ◆ identify processor entrepreneurs that have identified a market niche for the products of rapid processing methods;
- ◆ develop appropriate processing methods that take into account labour saving devices and use of easily available cheap resources;
- ◆ novel processed products must have quality characteristics that are acceptable to consumers including taste, texture, food safety, cookability and storability; priority should be given to the improving the quality of current products;
- ◆ monitoring and evaluation must be an important feature of the technology development process; this will allow the ideas and innovations of the processors to be included into the technology development process;
- ◆ improving quality of cassava products will enhance the status of the crop as a food staple.

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<sup>1</sup> Primary processing methods refers to those methods that produce products for storage or use in preparing secondary products.

### *Objectives of the study*

4. Through discussion with all project collaborators, the objectives for this study were decided upon and included the following:

- ◆ to obtain an inventory of existing traditional processing methods;
- ◆ to document information on farmers/processors preferences, and factors that influence their choice of method. Issues may include varietal preferences, storability of the final product, food safety, marketing and indigenous knowledge;
- ◆ to identify processing needs in order to develop a participatory research strategy to affect improvement to current practices; and
- ◆ to learn from the experiences of previous cassava processing technology transfer activities undertaken by the extension services.

## **METHODS**

### *Criteria for selecting villages*

5. Two districts, Masasi and Newala of the Mtwara Region, were selected for the study because of their contrasting social, physical and agronomic environments. Within each district, two villages were selected where there had been some previous interventions in cassava processing and two where no previous interventions had been made. Additional criteria that assisted in the selection of villages included the predominance of bitter varieties utilised by the community and the distance from major marketing centres.

### *Villages selected*

6. The following villages were visited during the study. Selection was made through discussion with the District Extension Services.

1. Mumbaka Village, Masasi District (<10 km from Masasi)
2. Mkarango Village, Masasi District (<10 km from Masasi)
3. Lulindi Village Masasi District (20-30 km from Masasi)
4. Msikisi Village Masasi District (20-30 km from Masasi)
5. Nakahako Village, Newala District (<10 km from Newala)
6. Nambungu Village, Newala District (<10 km from Newala)
7. Mtunguru Village, Newala District (20-30 km from Newala)
8. Makukwe Village, Newala District (20-30 km from Newala)

### *Participatory rural appraisal*

7. The study was conducted by three food technologists, four nutritionists and an economist. In order to cover more villages, the team was divided into two with the various expertise represented in each group where possible.

8. One day was devoted to each village. After introductions to the village leaders, the chairman was requested to invite both men and women to participate in discussions concerning cassava processing. Participatory rural appraisal (PRA) methods (Nabasa *et al.*, 1995) were used to elicit the information required. The following techniques were used:

- ◆ ranking of products and/or processing methods against preferences and characteristics;
- ◆ seasonal calendar of processing activities; and
- ◆ participatory observations

9. A degree of flexibility is inherent in the use of these qualitative methods where groups respond differently and approaches must adapt to the dynamic situation at hand. In some villages women and men were approached separately. The number and structure of the groups varied greatly, invariably there were more than 15 individuals participating. The approaches to data collection varied slightly between villages according to circumstance. This allowed a greater breadth of information to be obtained.

## **RESULTS AND DISCUSSION**

### *Study area*

10. The Makonde Plateau covers an area of 7,500 km<sup>2</sup> and is within the boundaries of the Newala District and part of the Masasi District. The altitude of the Plateau ranges from 100 m at the lowest to 870 m at the highest point. The physical diversity provides contrasting climates including differences in temperature and rainfall, soil structure and water catchment capacity. There is a high population in both the Masasi (mostly low lying) and Newala (plateau is at high altitude) Districts. Both districts are highly populated. In the Masasi District the predominant tribes are the Makua, Yao, Mwera and Makonde; whilst in Newala District is largely populated by the Makonde tribe.

11. Cassava, maize, sorghum and rice are the main starch staples in the farming system. Cassava is usually the last crop in the rotation prior to the fallow period, because it performs relatively well on poor soils. Cassava is considered important for food security and is consumed in the greatest quantity although rice and maize are preferred. Cassava is also the second most important cash crop after cashew (ARI Naliende, 1992; Brown, 1985).

### *Cassava cultivation*

12. Cultivation practices for cassava were similar in all villages and included land cleaning, digging (few farmers), planting, weeding and harvesting when mature.

### *Cassava varieties*

13. The production of cassava in the Southern Zone has increased significantly due to its active promotion in 1983/84 and 1989/90. These campaigns initiated by the Government of Tanzania were in response to widespread food insecurity. All able bodied persons were encouraged to cultivate one acre of cassava. During the survey, farmers suggested that the production of maize and sorghum was decreasing.

14. The majority of cassava varieties are traditional. New varieties have been developed through farmers own research or introduced by the National Agricultural Research System (NARS) and from neighbouring Mozambique. A list of cassava varieties mentioned in Masasi and Newala districts is given in Table 1.

**Table 1 : Cassava varieties cultivated in the eight villages of Masasi and Newala Districts.**

MASASI DISTRICT		NEWALA DISTRICT	
Bitter	Sweet	Bitter	Sweet
Chimage	Chinanyanga	Nanjenjeha	Kigoma
	Mreteta	Limbanga	Mnoda
Limbanga	Liumbukwa	Salanga	Chinanyanga
Mpunda nyumba	Yuda		Imbwani
Kigoma	Pembe	Mbwani	Kalinda
	Mweda		Wa imani
	Kigoma		Kaselewende
	Mbwani safi		Nannowela
			Ulenje
			Nakulangoha
			Aulizae
			Mayunda
			Unannyime mtwao
			Bintiali
			Kifuu cha nazi
			Mnaliihakolo
			Nannowekujoko
			Imbwani

15. Both bitter and sweet varieties are cultivated in the Mtwara Region with a predominance of the latter (Table 2). It was apparent that a greater diversity of varieties was available in Newala District. Farmers cultivate particular varieties for a range of reasons including agronomic performance, post-harvest qualities and pest/disease tolerance characteristics. The cassava varieties cultivated are described by the farmers as bitter or sweet ("sweet" varieties also include those that are neither bitter or sweet). These categories are not distinct, as some varieties are bitter during the dry season and become sweet during the rains (de Bruijn, 1971). Other reasons for



varieties becoming bitter included poor soil fertility, pest infestation or disease infection (Bokanga *et al.*, 1994; van der Grift *et al.* unpublished results).

**Table 2: Types of varieties grown in the villages surveyed**

Village	Number of common varieties per type mentioned		
	Bitter varieties	Bitter/sweet varieties	Sweet varieties
1. Mumbaka	1	0	1
2. Mkarango	0	1	3
3. Lulindi	2	1	2
4. Msikisi	1	1	3
5. Nakahako	1	0	2
6. Nambunga	0	0	2
7. Mtunguru	4	1	10
8. Makukwe	4	2	6

16. The use of the cassava varieties is dependent on the post-harvest characteristics of the root. In general, sweet varieties are used as a fresh vegetable or processed into secondary products (refer to paragraph 19) for consumption. Bitter varieties are always processed into primary products (refer to paragraph 19) that are either suitable for storage and/or processed into secondary products for consumption.

17. Although fewer bitter varieties are grown, their cultivation was considered important for the following reasons: they are less likely to be stolen by either animals or humans; it was perceived that they are high yielding and more pest resistant. In one village in Newala District, close to the Newala town, the farmers preferred to avoid bitter varieties such as Limbanga due to the difficulty of processing it sufficiently and issues of food safety. This was probably due to the reduced risks of theft in areas of higher population.

18. All of the farmer/processor groups participating in the discussion were aware of the potential toxicity of cassava. They related toxicity to the bitter flavour. All bitter varieties were processed into primary products before consumption and certain processing methods were considered more effective for these varieties.

### ***Cassava processing methods***

19. Processing methods for cassava have been divided into three categories based on the type of product produced:

- ◆ primary products - are storable and generally processed into secondary products for consumption;
- ◆ secondary products - are prepared from fresh roots or primary products and are ready for consumption;
- ◆ other product forms - are prepared from fresh roots or leaves, are ready for consumption and are often eaten as snack foods.

20. Table 3 provides a list of all the primary processing methods used in the Masasi and Newala Districts. A general description of the processing methods is given and variations on this are particular to individuals. The dominant product was *makopa* in both districts. The heap fermented form of *makopa* was mentioned in one village in Masasi. *Kondowole*, a product prepared by soaking roots in water, was processed in Masasi but not in Newala due to the severe shortage of water. *Chinyanya* processing was known to the farmers in both district. There are two forms: firstly the pounded type that is used to prepare flour for consumption when time for processing is short or the rains have started; and the finger-sized pieces, which was used to prepare the local brew. The latter was also known in Newala as *chiwalehi*. Drying of this product was fire assisted during the rainy season.

21. Bitter cassava varieties are processed into primary products. However, in one village the group preferred not to use bitter roots for processing *chinyanya*.

**Table 3: Processing methods for primary cassava products.**

PRIMARY PRODUCTS - FOR STORAGE AND FLOUR PRODUCTION		
PRODUCT	DISTRICT	METHOD
<i>Makopa</i>	Masasi Newala	Fresh roots are peeled and placed out to sun-dry for 1-2 weeks. Once dry the pieces are stored until required.
<i>Makopa</i> - heap fermented or <i>Chikwemba</i>	Masasi Newala	Fresh roots are peeled, heaped and covered until moulds have grown. The pieces are placed out to dry and then stored until required.
<i>Chinyanya</i> - pounded	Masasi Newala	Fresh roots are peeled, chopped into pieces and pounded in a pestle and mortar (kinu). The mash is placed out to sun dry for a few hours. Repounding is used to reduce the particle size and hasten drying. Modifications include holding overnight to ferment and roasting over a fire. Product is not stored and is used immediately for food. Total preparation time is 1-2 days.
<i>Chinyanya</i> - pieces	Masasi	Fresh roots are sliced into small pieces and placed out to sun-dry for a 2-3 day period.
<i>Kondowole</i>	Masasi	Fresh roots are peeled and soaked in water either whole or in pieces. Once softened the roots are removed and sun-dried. Once dry the product can be stored until required.
<i>Chiwalehi</i>	Newala	Fresh cassava is sliced into thin pieces and either sun-dried for 1-2 days, or put on a fire or in the ashes to dry.
<i>Uhu wa makahi</i>	Newala	Flour prepared from the inner cassava peel. This method was said to be practised during severe food shortages.
<i>Kuparata</i>	Newala	This term means grating and was used to refer to the product <i>gari</i> which the group had received training on i.e. grating fresh peeled root, fermenting/dewatering for one day, sieving and roasting over a fire.

22. Fresh cassava roots of sweet varieties and *makopa* were used to prepare a range of secondary products for consumption (listed in Table 4). In both districts, the most common way to consume cassava is as *ugali*, a thick porridge which is eaten with a relish. Other common ways to prepare cassava for the family were boiling *makopa* to give *machoba* or boiling the fresh root as a vegetable or to prepare *bokoboko*. In Newala, there were a variety of dishes prepared by adding vegetables and nuts or seeds



to boiled *makopa* or fresh roots. In both districts cassava was eaten as a snack food; raw, fried chips or roasted pieces. Cassava roots are also used in soups and drinks whilst the leaves are commonly used to prepare a relish, *kisamvu*.

**Table 4: Processing methods for secondary cassava products and other uses of fresh roots.**

SECONDARY PRODUCTS - PREPARED FROM FRESH ROOTS OR PRIMARY PRODUCTS		
PRODUCT	DISTRICT	METHOD
<i>Ugali</i>	Masasi Newala	Stiff paste prepared by adding cassava flour to boiling water and kneading to form a stiff, consistent texture
<i>Machoba</i>	Masasi Newala	Prepared by soaking and cooking makopa.
<i>Bokoboko</i>	Masasi	Fresh root pieces boiled until very soft. This can also be made from <i>machoba</i> by extending the boiling time.
<i>Futari</i>	Masasi	Is prepared from <i>bokoboko</i> and involves cooking fresh roots or <i>machoba</i> until very soft and adding a soup to make a very thick soup.
<i>Mkojoo</i>	Newala	<i>Makopa</i> is pounded and made into a soft drink, this product is known as <i>togwa</i> in Kiswahili.
<i>Mkongohu</i>	Newala	<i>Makopa</i> is pounded and a thin porridge prepared, this can be used as a starter for <i>pombe</i> . This product is known as <i>uji</i> in Kiswahili.
<i>Limbunya</i>	Newala	<i>Makopa</i> flour is wetted and fried, the end result being large gelatinised particles
<i>Chitundunya</i>	Newala	Fresh sweet cassava is boiled and pounded, sim sim or pumpkin seeds are roasted and pounded and added to the pounded cassava.
<i>Chikalowa</i>	Newala	Fresh sweet cassava is cooked and kneaded with depending on availability ground nuts or coconut.
<i>Chihuhumi</i>	Newala	Fresh cassava and pigeon peas are cooked and pounded separately, they are then mixed and coconut soup is added.
<i>Chitabwa</i>	Newala	Fresh cassava is cooked and pumpkins seasoned with coconut or ground nut soup. During the dry season this may also be prepared with pawpaw and nut soup.
<i>Mbowa</i>	Newala	The leaves of pumpkin are cooked and mixed with cooked fresh cassava, cooked pumpkin seeds are then added.
<i>Pombe</i>	Masasi Newala	Alcoholic drink prepared from the fermentation of cassava flour.
<i>Nkongohu</i>	Newala	Cassava based porridge mixed with cashew fruit juice.
OTHER MEANS OF CONSUMING CASSAVA MENTIONED		
<i>Kutafuna mbichi</i>	Masasi Newala	Sweet varieties are chewed raw as a snack
<i>Kupika</i>	Masasi Newala	Fresh roots boiled as a vegetable
<i>Chips dume</i>	Masasi Newala	Fresh cassava fried in oil
<i>Kisamvu</i>	Masasi Newala	Relish prepared from cassava leaves
<i>Kuchoma</i>	Newala	Roast on charcoal and chew as a snack

### *Preferences and constraints in processing of primary cassava products*

23. The preference scores for the primary cassava products are summarised in Tables 5-8. Detailed information on the reasons influencing these preferences is given later, under specific headings: labour demand; seasonality of processing activities; product quality; and food security.

24. In each village overall preference scores for the various processing methods and their products were obtained (Table 5). The preference scores were obtained by individuals scoring against each product, the data have been normalised to allow comparison. *Makopa* is the preferred method in both the Masasi and Newala Districts obtaining maximum scores in most villages. The liking for *chinyanya* - pounded and pieces, was more variable but in general was less preferred, obtaining upto ~50% of the maximum score in some villages. *Kondowole* was only practised in Masasi although it was known in Newala where lack of water prevents its use. Some individuals preferred this product and the reasons are discussed later.

**Table 5: Normalised preference scores for processing methods and their products in four of the villages surveyed.**

Processing method	Percent maximum score (%)						
	Masasi District			Newala District			
Village code No.*	2	4		6	7		
Gender	W	W	M	W	M	W	M
No. of persons/group	7	7	5	5	2	5	15
<i>Makopa</i>	86	100	98	100	100	100	100
<i>Makopa</i> - dry fermentation	1	NM	NM	NM	NM	NM	NM
<i>Chinyanya</i> - pounded	9	20	54	4	50	54	10
<i>Chinyanya</i> or <i>chiwalehi</i> - sliced pieces	1	16	NM	4	50	NM	10
<i>Kondowole</i> - soak fermented	10	14	68	NM	NM	NM	NM
<i>Gari</i> like method - grating and roasting	NM	NM	NM	24	0	NM	NM

Key: \*The numbers refer to villages: (2) Mkarango and (4) Msikisi villages of Masasi District, (6) Nambunga and (7) Mtunguru villages of Newala District.

W - women, M - men, NM - not mentioned by the group.

Individuals from the group were able to score upto 10 against each of the processed products mentioned by the group. The data have been normalised by calculating the percentage maximum score.

25. Tables 6 and 7 are summary tables of preferences for the processing methods and palatability of the *ugali* prepared from the primary product. Again *makopa* was preferred for the ease of processing and its palatability when cooked as *ugali*. For *chinyanya* and *chiwalehi*, the majority did not prefer the method of processing the

product and once cooked some regarded them favourably although a significant number disliked them. In villages where *kondowole* was prepared, the processing method was disliked by women, however, the palatability of the cooked product was preferred by some. In further discussions it became apparent that there were distinct groups that liked the flavour obtained by lactic fermentation of cassava, however, the processing method was found to be odious because of the strong fermentation odour.

**Table 6: Preferences for processing methods**

Product	Percentage of the maximum score for preferences											
	Dislike				Like				Like very much			
Village reference No.	1	3	5	8	1	3	5	8	1	3	5	8
<i>Makopa</i>	0	0	53	0	0	0	6	6	100	75	41	94
<i>Chinyanya</i>	27	81	82	94	40	0	6	0	0	0	6	0
<i>Kondowole</i>	7	37	nm	nm	27	26	nm	nm	40	37	nm	nm
<i>Chiwalehi</i>	nm	nm	85	94	nm	nm	12	0	nm	nm	3	6

Key: nm - not mentioned. The numbers refer to villages: (1) Mumbaka and (3) Lulindi villages of Masasi District, (5) Nakahako and (8) Makukwe villages of Newala District. Scores were obtained by giving each person in the group one stone for each processing method.

**Table 7: Palatability of ugali from cassava products.**

Product	Percentage of the maximum score for palatability											
	Not palatable				Palatable				Very palatable			
Village No.	1	3	5	8	1	3	5	8	1	3	5	8
<i>Makopa</i>	0	48	51	20	0	14	0	0	100	38	46	51
<i>Chinyanya</i>	100	81	100	70	0	14	0	0	0	5	0	30
<i>Kondowole</i>	78	24	nm	nm	0	48	nm	nm	22	29	nm	nm
<i>Chiwalehi</i>	nm	nm	92	69	nm	nm	3	2	nm	nm	0	0

Key: nm - not mentioned. The villages numbers refer to: (1) Mumbaka and (3) Lulindi villages of Masasi District, (5) Nakahako and (8) Makukwe villages of Newala District. Scores were obtained by giving each person in the group one stone for each processing method.

26. The information summarised in Table 8 provides a more in depth view of the characteristics preferred by groups in four of the villages. The groups were asked to list the reasons that influenced their like or dislike of a processing method and its products and to score against each product to give a maximum score of 10. The average score is given in Table 8. The number in parenthesis is the number of groups of a total of four that mentioned the given characteristic as important.

**Table 8: Average preference scores for quality characteristics as mentioned by the villagers**

Characteristic	Average preference score* for a given characteristic (no. in parenthesis is number of groups mentioning a particular characteristic)				
	<i>Makopa</i>	<i>Chinyanya</i>	<i>Chinyanya / chiwalehi</i>	<i>Kondowole</i>	<i>Makopa - heap fermentation</i>
Ease of processing	<b>12345</b> <b>67</b> (3)	<b>12345</b>  (3)	<b>1234</b>  (2)	<b>12</b>  (2)	nm
Ease of drying to a flour	<b>1</b>  (1)	<b>12345</b> <b>678910</b> (1)	<b>12345</b>  (1)	<b>12345</b>  (1)	<b>12345</b>  (1)
Good during the hunger period	<b>12345</b> <b>678910</b> (1)	<b>12345</b> <b>6789</b> (1)	<b>12345</b> <b>678</b> (1)	<b>12345</b>  (1)	nm
Nutritional value	<b>12345</b> <b>678910</b> (3)	<b>12345</b> <b>678</b> (3)	<b>12345</b> <b>678</b> (3)	<b>123</b>  (2)	<b>12345</b>  (1)
Satisfies appetite	<b>12345</b> <b>678910</b> (3)	<b>12345</b> <b>6789</b> (3)	<b>12345</b> <b>678910</b> (2)	<b>12345</b> <b>678910</b> (2)	<b>12345</b>  (1)
White colour (preferred)	<b>12345</b>  (4)	<b>12345</b> <b>6</b> (4)	<b>12345</b> <b>678910</b> (2)	<b>12345</b> <b>678910</b> (2)	nm
Good flavour	<b>12345</b> <b>678</b> (2)	<b>12345</b> <b>6</b> (2)	<b>12345</b> <b>678910</b> (1)	<b>12345</b> <b>67</b> (2)	nm
Not-sticky in texture	<b>12345</b>  (4)	<b>12345</b> <b>678</b> (4)	<b>1</b>  (3)	<b>12345</b> <b>678910</b> (2)	<b>12345</b>  (1)
Good aroma	<b>12345</b> <b>6</b> (2)	zero  (2)	<b>12345</b>  (1)	<b>12345</b> <b>678910</b> (1)	nm
Sour taste (preferred by some)	zero  (1)	<b>12345</b> <b>678910</b> (1)	zero  (1)	zero  (1)	nm
Reduces poisons	<b>1</b>  (1)	<b>12345</b>  (1)	nm	<b>12345</b> <b>678910</b> (1)	nm
Causes dizziness	zero  (2)	<b>12345</b>  (2)	zero  (1)	nm	nm

\*Scores were obtained from groups in the following villages: (2) Mkarango and (4) Msikisi village of Masasi District, (6) Nambungu and (7) Mtunguru village of Newala District. The higher the score the greater the preference.

27. The most important characteristics of the processing methods and their products are those that were mentioned by most groups such as: ease of processing; whiteness of colour; texture when cooked; and satisfying when eaten. Less important characteristics included: rapidity of drying; important during food shortage; flavour; aroma; and problems of food safety. Where a characteristic was mentioned only once the score obtained may be biased, for instance: *kondowole* has a high score for aroma

in one village while in most villages this aroma was not preferred; *chinyanya* received a high score for sour taste in one village, this would only be achieved if problems of sun-drying were encountered.

28. The following section combines conclusions drawn from Table 8 with the observations and comments made by the farmers - processors during the PRA.

### *Labour demand*

29. In general, a large degree of the labour required to cultivate and process cassava is provided by women. Men were involved in clearing the land. Women undertook the cultivation, post-harvest handling and processing operations. The decision as to which processing method is undertaken is a decision made by the women and depends on food availability in the household.

30. The processing methods may be divided into two categories: major and minor products. The first category includes *makopa*, which is the main primary product for storage. This method was preferred above all and it was considered as their traditional staple. Other minor processing methods, including *chinyanya*, *kondowole* and *chiwalehi* are important during periods of food shortage when the length of time for processing may be short. Although *makopa* is easy to prepare, the whole root pieces once peeled take 1-2 weeks to dry while the other products due to the small piece/particle size take between 1 and 3 days to provide a flour.

31. In discussion and from the data in Table 5 concerning the preferences for given processing techniques, it was clear that women had strong ideas on which methods they preferred. For some methods, such as *kondowole* and *chinyanya*, the preferences given by the different genders differed. The reasons for these methods being disliked by women were generally due to the increased labour demand.

32. The labour needed to process cassava was mentioned as an important criterion influencing preference (refer to Table 8). *Makopa* was the least labour intensive in comparison to other methods, although some complained that pounding the dried pieces was difficult and laborious. In some cases the fields under cassava cultivation are some distance from the homestead, this has an impact on the preference for different processing methods. *Makopa* can be processed in the field and carried back to the homestead when dry and is approximately 60 % lighter than fresh roots because of the loss of peel and moisture. For *chinyanya*, *chiwalehi* and *kondowole* processing, fresh roots must be carried to the home for processing because of the risk of theft. The work load due to carrying is greater for these products than for *makopa*. Other labour requirements that had an influence on preference included: pounding of fresh roots in *chinyanya* processing; pounding dried pieces in *makopa* processing; and fetching water for soaking in *kondowole* processing.

33. An understanding of the reasons behind women's preferences is instrumental in identifying areas of constraint. Component activities that were said by women to be laborious were: peeling fresh roots; transportation of fresh roots from the field to the processing area or homestead; pounding fresh roots; fetching water for soaking roots;



and pounding dried pieces to provide flour. Labour demand is clearly a vitally important factor in the identification and development of cassava processing techniques. Labour saving devices will be key to the uptake of technology.

### Seasonality of processing activities

34. Seasons influence processing practices as illustrated in Figure 1 below. *Makopa* can only be processed during the dry season, as early as June until December. During the rains, *chinyanya*, *chiwalehi* and *kondowole* are prepared due to the reduced drying time required (refer to the section on food security). In addition, most of the varieties cultivated were considered to be watery during the rains, this meant that the roots did not boil and soften well and were difficult to process. Only one variety was mentioned, Kigoma, that had a high dry matter and was good throughout the year.

**Figure 1: A representative example of a seasonal calendar of processing activities as presented by womens' groups.**

	*○				◇◇	◇					
	*○				◇◇	◇◇	◇				
	*○				◇◇	◇◇	◇				
	*○				◇◇	◇◇	◇				
	*○	◆			◇◇	◇◇	◇				
	*○	◆*○			◇◇	◇◇	◇				
	*○	◆*○			◇◇	◇◇	◇				
	◆*○	◆*○			◇◇	◇◇	◇				
	◆*○	◆*○			◇◇	◇◇	◇				
	◆*○	◆*○			◇◇	◇◇	◇				
J	F	M	A	M	J	J	A	S	O	N	D
Month											
RS			><		DS			><			RS

**Key**  
 ◆ *Kondowole* - soak fermentation  
 ◇ *Makopa* - sun-dried  
 \* *Chinyanya* - pounded  
 ○ *Chinyanya* - pieces  
 RS Rain season  
 DS Dry season

### Product quality

35. Nutritional value (comparative for cassava products only) of the products was mentioned as an important criterion. *Makopa* was considered to have greatest value closely followed by *chinyanya* and *chiwalehi*. *Kondowole* and heap fermented *makopa* were considered of poor value. It was believed that the nutrients were washed away during the soak fermentation.

36. Colour, flavour and aroma were also important characteristics. *Makopa* had the preferred flavour, although it was said to be coloured by smoke during storage in the roof space. For those that prepared *kondowole*, the lactic fermentation smell and flavour and white colour of the flour were preferred. In the case of *chinyanya* problems of drying this product during the rains sometimes resulted in the lactic (sour) flavour as indicated in Table 8.

37. The texture of prepared *ugali* was of particular importance. This is because *ugali* is eaten with the hands. The paste must break when an amount is taken in the hand and should not stick to the fingers. For those that enjoyed *kondowole* the texture of the *ugali* was preferred. *Makopa* and *chinyanya* were similar in texture. Some preferred to prepare *ugali* from damp flour as it believed the texture was improved, however this has food safety implications (see below).

38. In three villages reduction in toxins and dizziness as a result of exposure to cyanogens were identified as important preference criteria (refer to Table 8). *Makopa* processing was considered to be less efficient at reducing toxins. In one village it was said that fresh *makopa* should be left in the store for 1-2 months to avoid dizziness. *Chinyanya* was more efficient at reducing toxins but was said to cause dizziness sometimes. *Chiwalehi* was less liked than *chinyanya*, the combination of potential toxins present and the strong flavour of smoke was disliked greatly. *Kondowole* was preferred for rapid processing and removal of toxins for those who were able to practice this method, the constraint being the requirement for water.

39. Although the problems of toxicity were not listed by all groups, there was a great awareness of it. However, only one man mentioned the symptoms of konzo and he linked these to the consumption of cassava. *Chinyanya* was not preferred because of this food safety issue. In most villages only sweet cassava varieties are processed using this method during favourable conditions. *Chinyanya* or *chiwalehi* would not be used to feed children. The incidence of acute intoxications was mentioned and some requested better methods for processing. The toxins were said to be in the latex and the need for efficient drying was recognised by some.

40. Women processors described innovative adaptations that they have made to the *chinyanya* method that increase the efficiency of toxin removal. Fresh roots were pounded and heaped and left overnight to stand. The following day the material could either be sun-dried or, if raining, roasted over the fire. These modifications developed through time were thought to produce a safer product. This could be considered to be a rudimentary form of *gari*, a product known for its high quality in terms of low cyanogen levels.

#### *Introduction of gari processing*

41. *Gari* processing involves grating, fermentation and roasting and is not traditionally used in Tanzania. Endeavours were made by the extension services to introduce this method in three of the villages visited. In one village in each of Newala and Masasi Districts, equipment and training were provided. The method was practised by some although it was not preferred as it was considered to be similar to *chinyanya*. In the remaining villages lack of resources and follow-up resulted in a low level of technology uptake and dissemination.

## *Food security*

42. According to Lamboll *et al.* (1993) in their study of NE Masasi, 98 % of households surveyed reported that cassava is their most important staple. This study supported this in that *Makopa* in the store provides the household with food security. It was mentioned by a number of groups that preparing other minor products during the rains was considered a waste of cassava in the field that could be processed into *makopa* later in the year. In some households, i.e. those that are low in resources, the *makopa* present in the store or in ground is not sufficient for the season and shortages occur. The groups indicated that the lean period or food shortage period occurred in February to March or April. During this period, which coincides with the rains and the peak labour period, rapid processing methods are used to fulfil the households immediate needs. It was said that “people who process *makopa* are wealthy, those that process *chinyanya* are poor. You would be surprised to see a wealthy household preparing *chinyanya*”. It was a common perception in all villages that poverty and the need for rapid processing practices were linked.

43. It was not within the scope of this study to obtain data as to the level of food security in Masasi and Newala Districts, however, there are a number of recent reports of studies that have undertaken wealth ranking using food sufficiency as a ranking criterion. It should be noted that these studies were undertaken during or shortly after a severe drought where food shortage was widespread, this is explained in more detail below.

44. A study undertaken by the ODA Cashew Improvement Project suggested that a large proportion of households do not produce enough food for consumption throughout the year in Masasi, period of sufficiency ranges from 3 months in poor household to 12 months in wealthy households. Food shortage is apparent from December to March (ARI Naliendele, 1992). Kabelele and Koda (1992) reported that 30 % of households in Masasi District have enough food throughout the year, 50 % have food shortage for 3 months while 20 % suffer food shortage for at least 6 months. Similarly, Lamboll *et al.* (1993) estimates that in the villages surveyed 28 % households are food insufficient throughout the year, over 60 % of households produce sufficient food for at least 9 months, 90 % produce enough for 6 months. Under more severe situations such as the drought of 1980s, whereby widespread food shortages existed, 76 % of household in 3 divisions studied experienced food insecurity (HFS & CSD, 1990).

45. Analysis of the three wealth groups (WG) and the degree of food sufficiency revealed that: all of WG1 (wealthy households) had sufficient stores for 12 months; WG2 had sufficient cassava from August until Jan after which self-sufficiency declines and cash purchases are made from Jan to July; in WG3 (poorest households), cassava is consumed from August to December, during January to March households become even more dependent on cassava and will purchase or work for cassava (Lamboll *et al.*, 1993).

46. The most critical food shortage period was January to April. This coincides with the peak work period. In the poorest wealth group a cycle of poverty exists whereby labour is sold to obtain food allowing less time to attend to their own farming



during the planting season. In this cycle households are unable to obtain food self-sufficiency.

## CONCLUSIONS

47. This study has shown that cassava processing methods have been developed to obtain storable cassava products that are palatable. There is one main primary product (*makopa*) produced that involves sun-drying of whole roots and storage until required. This product provides food security to the household throughout the season. The *makopa* product has the preferred characteristics of palatability when cooked, good storage qualities and low in labour requirement to process. The constraints of this method, however, include the length of time required to process, inability to use this method during the rains and the suggestion that a 1-2 month storage period is required before the product is considered ready to use.

48. Through discussions with the farmers and processors and documented food security studies, it was indicated that food shortage can occur during the rainy season. This shortage is the result of declining stocks of *makopa* in the store and the lack of other crops in store or ready for harvesting. During this period households may harvest immature cassava or hire labour out for payment in food or money, thus diminishing time to devote to their own farming activities. Minor primary processing methods are adopted during food shortage periods because of the reduced processing time required. The products prepared include *chinyanya*, *chiwalehi* and *kondowole*. These products provide flour in 1-3 days, however, communities participating in the appraisal did not favour these products. Reasons given included poor palatability, laborious to process and problems of food safety. The labour requirement for processing was a key issue for women who are the decision makers and provide the labour for harvesting and processing cassava. Availability of labour during the food shortage periods is low as this is also the peak time for farming activities. The use of rapid methods was linked to wealth and food security whereby poorer households are forced to use these methods during food shortage while wealthy households would have sufficient throughout the year.

49. Secondary information concerning the degree and extent of food shortage in Masasi and Newala districts suggests that significant problems are experienced by the poorest households for two to six months of the year. During the early 1990s the percentage of households suffering from food shortage was in the region of 50%. Although it may be argued that this was due to drought, and current levels are less than quoted here, the level of food security is dynamic and periodic food shortages are a historic problem in the study area (Lamboll *et al.*, 1993).

50. To avoid the problems of food safety associated with rapid processing methods as mentioned by the communities, improvements to current practices are required. The importance of women, who make decisions and provide the labour for cassava harvesting and processing activities, has been clearly indicated by this study. Innovations in processing to tackle this are currently being made by women (Paragraph 40). In order for the project to develop appropriate solutions to processing constraints, it will be of paramount importance to involve women in the research and

development process. The project will focus on improvement to rapid processing methods to alleviate food shortages. The target groups are those households where food security is an annual problem, however, the stigma attached to rapid processing methods requires a sensitive approach to be adopted.

## **RECOMMENDATIONS FOR THE PILOT PHASE OF THE PROJECT**

51. The following recommendations for the pilot phase are suggested.

- ◆ Participation of villages where food security is an issue will be selected. Within the village participation of women from various wealth groups will be sought in order to avoid poverty association.
- ◆ Participation from communities with differing ethnicity, farming and post-harvest systems villages in Newala and Masasi will be sought.
- ◆ Field trials for rapid processing methods will be undertaken in February-March, which coincides with the food shortage period. This will enable testing of steps to improve processing within the season and context of their normal use.
- ◆ The importance of investigating labour saving devices should be emphasised, as rapid processing methods are usually required during the peak labour period of the year.
- ◆ Efforts will be made to encourage the participation of the women in the testing and evaluation of the improvements suggested.
- ◆ Simple steps to improve processing are currently being assessed, those that provide significant improvements to quality and safety will be tested during the pilot phase.

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