STATUS OF CASSAVA IN TANZANIA

IMPLICATIONS FOR FUTURE RESEARCH AND DEVELOPMENT

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1 FOREWORD

This report is based on the findings of a one month assignment executed by IF AD and implemented by the Tanzanian national staff involved in cassava research and development. The work was designed to analyse the past and present situation of cassava in Tanzania with a view to describing the lessons learned from the past experiences and their implication for future investment in cassava research and development.

The national cassava working group of seven members drawn from the National Root/Tuber Research Programme, Tanzania Food and Nutrition Centre, Marketing Development Bureau and the headquarters of the Department of Research and Training participated fully in compiling the report.

The report is based mainly on the secondary information collected from existing documents gathered from different departments dealing with cassava in one way or another. Also different reference materials of the previous case studies were consulted

Results obtained from the study are summarized below:

Cassava in Tanzania is an integral component of most cropping systems and is among the more important staples in many zones. It plays an important role as a food security crop and provides useful opportunities for extending labour use and exploiting price peaks in the food market.

The country realizes the importance of cassava and has given the second priority ranking in its national research. The crop is ranked number one in three zones and second in only two zones.

The National Root Crops Improvement Programme where cassava falls has no set major priority objectives and strategies for developing cassava but lacks resources for executing them except for the collaborative activities done with the external funding.

Networking with various regional and international networks contributes substantially in support to cassava research

The current cassava productivity is near the lower end of internationally reported yields. Among major constraints are: prevalence of devastating pests/diseases, shortage of planting material; drought, poor soil fertility, use of varieties with low genetic potential; and low adoption rates of research recommendations. Other key constraints include the low level of utilization of cassava and poor post-harvest handling techniques of cassava at farm level. There are a limited number of convenient products from cassava which makes cassava less competitive with other staples particularly in the urban areas where there is an assured market.

Poor transportation makes market accessibility by cassava growers difficult. Other market infrastructures including credit facilities, presence of processing machines, etc. are low compared to other countries in Africa.

Research interventions, their successes and limitations are discussed in the report. Lessons learned and implications for strategies are outlined. Some proposed strategies to improve the efficiency of cassava research and development include:

- emphasis to be given on the improvement of cassava genetic potential so as to develop varieties with desirable acceptability, good resistance to pests and diseases and high root yield. This should go along with the strong commitment in multiplication of clean healthy planting materials of the released varieties and other potential local varieties. This can be achieved only if support to research can be increased both in terms of funds and human resources. Facilities for rapid propagation could boost the efforts of multiplication;
- improvement of cropping systems with cassava especially in the area of low input costs in soil fertility maintenance cannot be overemphasized.. Control of pests and diseases through use of integrated pest management could serve as a low cost, environmentally friendly approach towards minimizing the problems at farm level;
- the need for cassava food products which are acceptable and ready to use is indicated. Proposals are made for the market evaluation of such products, with provision for food education and pilot scale production if further development, is merited. Integration of cassava as a raw material in the industrial sector and livestock feed is yet to be investigated.

Similarly proposals have been made to improve the capability of the extension service through a programme of training, staff development and emphasis on client oriented research.

A very big potential for increased cassava production can only be achieved if key issues identified are addressed at national level.

2 ACKNOWLEDGEMENTS

Acknowledgements are extended to the different administrators of the respective offices for granting permission to undertake this study. The Office of Commissioner, Research and Training Department, Dar-es-Salaam is thanked for all the logistical support provided. Mr G. Mitawa, the Assistant Commissioner for Crops Research is highly acknowledged for his technical input to improve the report.

Appreciation is expressed to the various key informants visited for providing information. The International Fund for Agricultural Development (IFAD), Rome, Italy is highly acknowledged for soliciting funds to support this work.

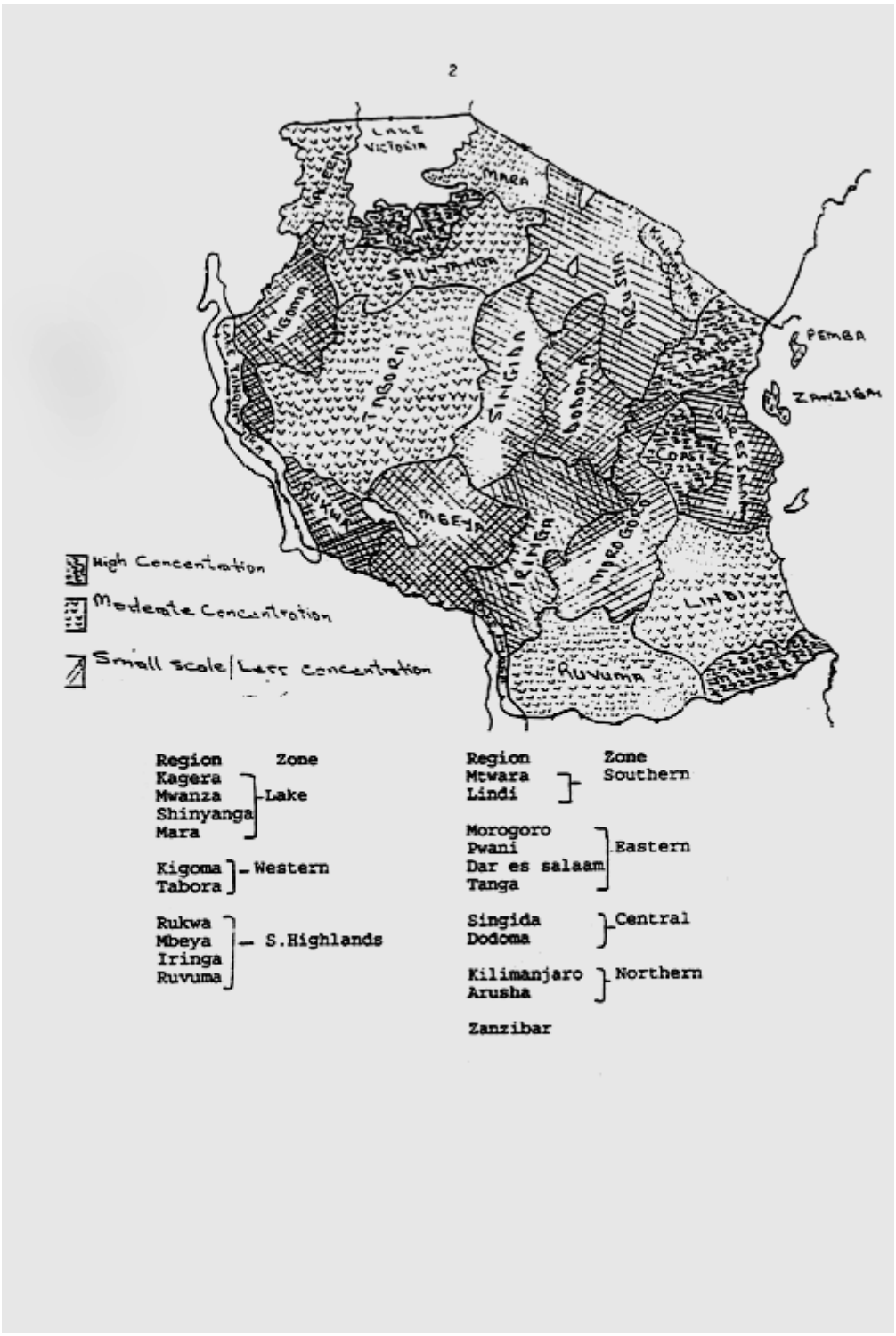
3 INTRODUCTION

The United Republic of Tanzania is the largest country in East Africa, covering 940 000 km^2 , 60 000 of which is inland water. Tanzania lies south of the Equator and shares borders with eight countries i.e. Kenya and Uganda to the North, Rwanda Burunck Zaire and Zambia to the West, and Malawi and Mozambique to the south.

The main climate feature for most of the country is the long dry spell from May to October, followed by a period of rainfall during November/December. The main rainy season along the coast and the areas around Mount Kilimanjaro is from March to May with short rains between October and December. Around Lake Victoria in the western part of the country, rainfall is well distributed throughout the year, with the peak period between March and May.

Cassava (Manihot esculenta Crantz) is an important subsistence food crop in Tanzania, especially in the semi-arid areas and sometimes considered as a famine reserve when cereals fail due to its drought tolerance. Eighty-four (84) percent of the total production in the country is utilized as human food, the remaining percentages are for other uses like starch making, livestock feed and export. Both roots and leaves of cassava are of major nutritional importance in the country. The estimated annual growth of cassava consumption demand for the period from 1980 to 2000 is 3.4 percent 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 (Figure 1).

Figure 1. Map of Tanzania showing cassava-producing areas



Region	Zone
Kagera	Lake
Mwanza	Lake
Shinyanga	Lake
Mara	Lake
Kigoma	Western
Tabora	Western
Rukwa	S.Highlands
Mbeya	S.Highlands
Iringa	S.Highlands
Ruvuma	S.Highlands

Region	Zone
Mtwara	Southern
Lindi	Southern
Morogoro	Eastern
Pwani	Eastern
Dar es salaam	Eastern
Tanga	Eastern
Singida	Central
Dodoma	Central
Kilimanjaro	Northern
Arusha	Northern
Zanzibar	

The Roots and Tuber Crops Improvement programme, which was established in 1974 and has its headquarters in the Ukiriguru Agricultural Research and Training Institute in Mwanza, is actively involved in the improvement of cassava and sweet potato. Other governmental agencies involved in the improvement of these crops include the Ministry of Agriculture of Zanzibar, Sokoine University of Agriculture and the Tanzania Food and Nutrition Centre (TFNC). The last two institutions are dealing mainly with the development of post-harvest technologies. International collaborators include: members from the Natural Resources Institute (NRI), United Kingdom, International Institute of Tropical Agriculture (IITA) Nigeria, Southern Africa Root Crops Research Network (SARRNET) and the International Potato Centre (CIP).

Both local and external markets for cassava are available. Since the crop is bulk in nature and perishable, fresh storage roots and leaves are sold at local markets near centres of production. Dried cassava (makopa) is transported to distant markets within or outside the country. Limited transport and storage facilities make access to markets a problem

The activities of the Roots/Tubers Research Programme has been collection, maintenance and evaluation of cassava germplasm, development of high yielding early maturing varieties with resistance to cassava mosaic virus disease and cassava green mite, with acceptable qualities by the consumer. Identification of appropriate technologies in crop management practices, multiplication of improved materials and distribution to farmers. Also emphasis is put on the integrated pest and disease control measures, improvement of storage methods practised at household level, mid quantification of hydrocyanic acid content in cassava varieties and their products.

The purpose of this report is to analyse the past and present situation of cassava development in Tanzania, with a view to describing the lessons learned from past development interventions and their implications for future investment in cassava research and development. This report consists of topics on production and utilization, agronomic, breeding, plant protection, post-harvest interventions and marketing, pricing policy investment in cassava research and infrastructure extension services, gender in cassava production and utilization of critical analysis of major interventions, lessons learned from past experiences and a synthesis for strategy on the future research and development of cassava in the country. Lastly the proposed future projects are outlined.

The report is based mainly on the secondary information collected from various departments which have dealt or are dealing at present with the cassava sector. Also key informants and reports from various case studies have been used. Production statistics reported are based mainly on the available national statistics. Proposed projects for future interventions are a result of the findings from this study and previous missions by FAO.

4 CASSAVA PRODUCTION AND UTILIZATION IN TANZANIA

4.1 TRENDS IN CASSAVA PRODUCTION

Cassava production trends and land area expansion in Tanzania have been fluctuating over a period of years. In all major cassava production zones the production declined from 1985/86 to 1988/89 except in the Eastern zone where cassava production increased (Figure 2). Other zones Eke, the Western, Central, Northern and Southern Highlands experienced low and almost constant production (Appendix 1). There was an increase in production in the season of 1989/1990 in all zones except the east. The highest cassava production was reported in the southern zone in the season 1991/92 and was over 750 000 tonnes of dried cassava chips. This was followed by decline of production in the subsequent seasons. The changes in production are reflected very well in the land area under cassava especially in the areas where extensive farming is practised.

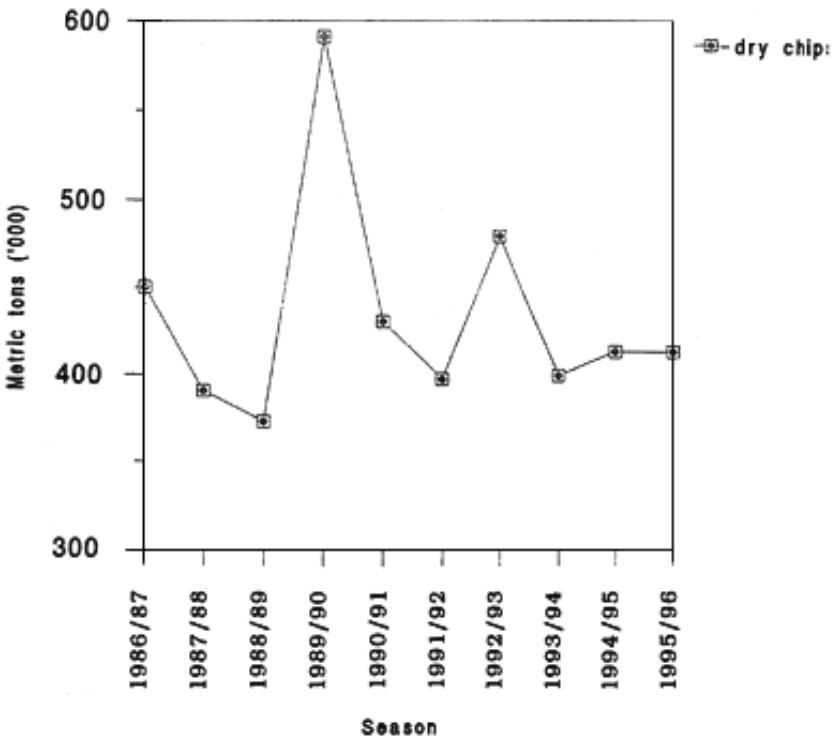
The area under cassava in most of the zones declined from 1985/86 to 1988/89 except the southern zone where a slight increase was observed. In all zones the area under cassava was fluctuating over seasons.

Also cassava yields, which is a measure for productivity, have been fluctuating by season, the highest yield was observed in the eastern zone in 1985/86 and 1989/90 which was almost 4.5 tonnes/ha. In the subsequent seasons, the zone recorded low yields, probably due to the outbreak of cassava mealybugs. The only zone which indicated increase in yield was the central zone. The estimated yields by the national statistics department are far below the average of 10.5 tonnes/ha recorded during the countrywide study by the Collaborative Study of Cassava in Africa (COSCA) project between 1989 to 1992 (COSCA Tanzania, 1996). Also FAO information shows that the national average yield in Tanzania was 10.4 tonnes/ha in 1991. The disparity in the yield estimates might be due to numerous difficulties encountered during these studies. Therefore, at country level very few farm level studies have included yield measurements for cassava.

4.2 CASSAVA WITH MAJOR COMPETING CROPS

Estimates of production of other food staples in the country namely maize, paddy and millets/sorghums are presented in Table 1. The annual production figures for the period from 1986/87 to 1995/96 showed that the highest annual mean production of 2 151.3 millions tonnes per year was recorded for maize followed by cassava. The annual rates of growth recorded in the production of food crops were greatly influenced by expansion in land area (MALD, 1982). The trend in land area expansion as indicated in Table 1, followed almost the similar trend.

Figure 2. Quantity of cassava dry chips produced from 1986–87–1995–96



Source: Planning and Marketing Division, Ministry of Agriculture and Cooperatives, Dar-es-Salaam

Table 1. Production of main food crops ('000 tonnes) and land area (hectarage) from 1986–87 to 1995/96

Season	Production				Land area			
	Cassava	Maize	Paddy	Sorghum/ millets	Cassava	Maize	Paddy	Sorghum/ millets
1996/97	1 965.8	2 360.8	652.1	954.5	652.6	219.0	353.3	710.9
1987/98	1573.1	1 973.9	704.7	589.1	746.8	193.2	419.2	805.3
1988/89	1 353.8	2 154.6	787.8	624.4	712.3	193.4	394.9	752.9
1989/90	1931.9	1 957.0	773.4	673.6	679.3	177.4	321.9	632.9
1990/91	1 834.4	1 635.3	424.3	559.5	622.1	187.6	376.4	1 003.9
1991/92	1 993.4	1 878.3	483.3	718.6	701.3	196.2	313.0	983.9
1992/93	1 949.4	2 298.7	656.7	730.1	697.8	162.2	361.5	967.4
1993/94	1 968.8	2 078.5	647.6	634.9	651.0	177.4	377.7	1 063.0
1994/95	1 633.3	2 522.3	722.6*	139.5	597.9	179.0	478.1	1 064.8
1995/96	1 632.3	2 663.2	869.5*	124.6	601.6	178.2	467.3	1 052.9
Total	17 736.2	21 512.6	6 722	5 748.8	6 662.7	1 863.6	3 863.3	9 037.9
Mean		2 151.3	672.2	574.9	666.3	186.4	386.3	903.8

Source: Planning and Marketing Division. Ministry of Agriculture and Cooperatives, Dar-es-Salaam

Appendix 2 shows the trend in production of major food crops. In the countrywide survey by COSCA, the farmers groups interviewed in the 45 representative villages indicated that cassava land area was increasing in about 50 percent of the villages. The major crops considered to be replacing cassava are maize and paddy and where cassava land area was reported to be increasing it was replacing pasture. The major factors reported to be affecting cassava production and increase in land area are disease incidences particularly cassava brown streak virus (CBSd) and cassava mosaic disease (CMD). Also pests, mainly in cassava, grew mites (CGD and cassava mealybug [CM] [Table 2]).

Table 2. Percentage distribution of villages which reported decreasing cassava land area by reasons for the decrease

Reason for decrease in land arm	Percentage distribution of villages
Pests/diseases	63
Drought	6
Land shortage	6
Market unavailability	6
Shortage of planting material	6
Preferred crops available	6
Others	7

Of the disease and pests mentioned, CGM was the most wide spread. This was observed in more than 90 percent of the representative villages (COSCA Tanzania, 1996).

4.3 TRENDS IN CASSAVA UTILIZATION

Cassava is an important subsistence food crop in the semi-arid areas and sometimes considered as a famine reserve when cereals fail due to its drought tolerance and the fact that the roots can readily be stored underground (Department of Research and Training, 1991). Studies conducted by the COSCA project between 1989 and 1992 showed that cassava in Tanzania is used in chips/flour form in most villages and in fresh form and alcoholic beverages in a relatively few villages (COSCA Tanzania, 1996).

Africa-wide cassava roots are used in a wide range of forms of food products which can be grouped into fresh roots (unprocessed), granules, pastes, chips/flour, starch, etc.

Analysis of the information on the farmer's rank of three major cassava products showed that the range of the products is low in Tanzania where more than 90 percent of the representative villages reported that their most important cassava product was chips/flour (Table 3). Other products reported as being of primary importance were starch, alcohol and fresh (unprocessed) roots (COSCA Tanzania, 1996). Cooked paste was reported in one village but of secondary importance.

In the few areas that use cassava root in fresh form, cassava was grown on 50 percent of the staple land. These are peri-urban areas which supply the cities with fresh cassava

roots. Where cassava roots were used for alcoholic beverages or staidi, cassava was found in an average of 35 percent of staple land area.

These two cassava products are produced for sale rather than for home consumption. In contrast, cassava chips/flour is used more for home consumption than for sale. Cassava chip production for export is however a growing activity particularly in the southern zone of Tanzania (COSCA, 1996).

Cassava leaves are also used both in fresh and processed form. Succulent cassava leaves are crushed or pounded and boiled/cooked before eating. For processing, cassava leaves can be sun-dried for three to five days to get a local vegetable known as 'sansa' (Tanzania Department of Research and Training, 1991). This is a processed form of cassava leaves common in areas around Lake Victoria.

Table 3. Percentage distribution of representative villages by most widely used cassava food product, all representative countries compared with Tanzania

	Percentage distribution of villages	
Cassava product	**Africa**	**Tanzania**
Fresh root	20	6
Pastes	9	0
Clips/flour	51	91
Granules	17	0
Others	3	3*

* Starch accounts for 1 percent
Source: COSCA Tanzania, 1996

4.4 OTHER USES

These include manufacture of livestock feeds and industrial starch. In livestock feeds a small percentage of processed cassava is utilized in domestic animal feeds. In 1985 the Tanzania Animal Feeds Company used dry cassava in feeds for poultry and pigs (MALD, 1987). The poultry feeds contained 5 to 10 percent cassava flour and the feeds for pigs contained 20 percent cassava flour (Msabaha *et al.*, 1986). The manufacturing of such cassava based feeds was however, stopped because it was expensive when compared to meal based substitutes. Industrial processed cassava starch was produced by the Tanzania Starch Company located at Sengerema Mwanza in 1984. The factory had a capacity of producing 40 tonnes of wet cassava or 15 tonnes of dry cassava per day (WILD, 1987) but was closed down in the early 1990s due to a shortage of fresh roots (raw materials). Plans are underway to re-establish it in Dar-es-Salaam with the assurance of raw materials from the cassava farms owned by the starch factory.

COSCA surveys showed that there were some attempts particularly in the Tanga region, eastern zone for farmers to extract starch locally. Tins starch was part of the 1 percent in other cassava products mentioned in the surveyed villages.

4.5 CONSTRAINTS IN CASSAVA PRODUCTION

4.5.1 Pests and diseases

Cassava green mites (Mononychellus sp.) were first reported in the country in 1972 at Ukerewe Islands (Msabaha, 1990). At present cassava green mites have spread throughout the country. Studies to establish the distribution of different mite species were initiated in collaboration with the International Institute of Tropical Agriculture (IITA) in Nigeria and the International Centre for Insect Physiology (ICIPE) in Kenya. It was noted that mite population density is highest during the driest periods; and high humidity conditions tend to suppress major outbreaks and damage (Msabaha, 1990). Estimated losses in yield of cassava roots in Tanzania vary from 50 to 80 percent (Shukla, 1976) depending on the susceptibility of cassava varieties.

Cultural control measures such as early planting, intercropping with other crops and use of NPK fertilizers appeared not effective in controlling the green mites. While breeding programmes for host-plant resistance or tolerance to cassava green mite are in progress, there are good chances for the development of resistant cultivars as several clones showing resistance to green mites have been identified and mechanism of resistance studied.

To date the national root and tuber crops improvement programme, has selected a few varieties namely: Alpin valenca, Ali Mtumba, Liongo, Kwimba, Msitu Zanzibar, Kibaha, Kigoma-red and Maparigano that show moderate resistance to the pest. These are being multiplied under proper sanitation techniques so as to generate enough planting material for farmers. The experiences under multiplication tasks will be highlighted in the coming sections.

Surveys undertaken recently between 1992 and 1993 to establish the distribution of CMD in the country showed that CMD is widely distributed all over the country with much incidence along the coastal belt of the Indian Ocean and the lake zone. The two areas mentioned above have higher CMD, may be due to long establishment of the crop (Raya *et al.,* 1993). These two areas are the major cassava producing areas in the country with a long history of cassava cultivation.

Another reason for the persistence of the disease is due to the continuous use of affected planting materials by farmers. It was noted that CMD is mostly transmitted through cutting infection (81 percent) and only 19 percent by whitefly vector (Raya *et al.,* 1993). Surveys conducted throughout the major growing areas by COSCA showed that CMD was next to cassava green mite in spreading symptoms which were observed in about 70 percent of the villages (COSCA Tanzania, 1996), Table 4. Recently, the East African Cassava Mosaic Disease (EACMD) was found distributed along the coastal belt of the Indian Ocean and the Lake zone (Ogbe *et al.,* 1996).

CBSD incidences were observed along the coast of the Indian ocean particularly in Mtwara and Lindi regions. Recently, tins disease has spread to the coast region. The

disease is more devastating because heavy attacks by CBSD can result in high magnitude yield loss and storage root quality.

For cassava bacterial blight (CBB) the disease is sporadic in nature. In Tanzania, the disease was very widely distributed in the 1970s (Nyango, 1990). CBB appeared to be widely spread in the Lake Victoria zone which necessitated the set up of quarantine measures to stop movement of planting material from these areas to other parts of the country.

For all three major diseases, the following is being carried out to contain the diseases:

- host - plant resistance;
- cultural practices;
- regulatory control/sanitation measures.

There are other diseases attacking cassava in the field but are not of economic importance. These include brown leaf spots (Cercospora henningsii), white leaf spot (Phaeramularia manihots) and blight leaf spots (Cercospora vicosea).

Table 4. Incidence and severity of cassava plant pests/diseases

Pest/disease	Incidence		Severity score	
	Percent villages[1]	Percent landraces[2]	Number[3]	score[4]
Cassava mealybug	33	11	34	1.8
Cassava green mites	92	51	157	1.3
African cassava mosaic	72	27	83	1.3
Cassava bacterial blight	23	7	22	1.1

[1] Percentage of 39 villages where problem was observed
[2] Percent of 308 landraces assessed infected/infested
[3] Number of landraces infected/infested
[4] On a 14 scale
Source: COSCA Tanzania, 1996

4.5.2 Agronomic problems

Cassava is known to be an easy crop to cultivate. Most farmers thus tend not to manage the crop properly (Masabaha, 1988). Most of the time, cassava is planted into exhausted soils. Recent studies have established that infertile sods produce 40 percent less cassava storage root yields and the same trend was observed in cassava shoot yield (Roots Tubers Annual report, 1994). In areas where crop rotation cycle is practised, cassava is usually grown at the end of the cycle, when the soils have already been exhausted.

Late planting of the cassava crop is also a problem, even though cassava is drought tolerant relative to other arable crops. Studies have shown that cassava planted earlier yields higher than that planted late. Unweeded cassava crop, especially when in monoculture is a constraint to increased cassava yields. Work done on weed management

in the 1970s indicated that if weeding was not carried out within the first two months, there was a 70 percent reduction in yield. One hand weeding only at one month after planting gave 3 1 of the expected yield (TARO, 1983).

4.5.3 Shortage of planting materials and continuous use of low genetic potential cassava varieties

Lack of adequate planting materials is another constraint to expanding cassava land area. There is no institution in Tanzania responsible for multiplication and distribution of the improved varieties of cassava (Msabaha, 1988). Consequently, farmers plant any materials they come across. Most of the varieties grown by farmers have been selected mainly on their characteristics. Most of such varieties have low genetic potential for yields/or resistance to the major pests and diseases.

Recent studies by COSCA have revealed that shortage of planting materials is generally a constraint in dry areas where biomass production is usually low in comparison with moist areas; and when new materials such as improved varieties are being introduced for the first time (COSCA Tanzania, 1996). This is because multiplication rate is low in comparison with crops such as grains propagated by seeds. This problem has also been accelerated by lack of irrigation facilities at the stations where multiplication is being carried out. This has contributed to tremendous loss of many materials particularly during the dry period and also it makes it impossible to multiply cassava planting materials for future use.

4.5.4 Inadequacy extension services to farmers

There is limited knowledge of the shortage of extension personnel, topped with severe logistical problems in most regions where cassava is grown. Inadequate transport, makes it impossible for the extensionists to cover a number of villages. Poor farmer, research extension linkages and lack of integrated research approach have sometimes led researchers to come up with messages which are not farmer problem oriented. Tins ultimately leads to low adoption rates of extension messages (Lema and Hemskeerk, 1996). Even when researchers want full involvement of extensionists in transfer of technology, meagre resources do not allow for this.

Low level of interaction between researchers and extension agents has also contributed to the farmers' lack of improved varieties. Presently however, research-extension linkages have been emphasized and there have been bimonthly workshops between researchers and extensionists.

Under the National Agriculture and Livestock Extension Rehabilitation Project, some logistical support has been provided in some regions. However, it is still not adequate to fulfil the requirements of executing the extension workload.

4.5.5 Access to market

Limited transport and storage facilities make access to market a problem (Masabaha, 1990). Both local and external markets for cassava are available, however, due to the bulk nature of the crop, farmers are obliged to sell their cassava at nearby markets mainly at reduced prices. Roads to producing areas are mostly not good (Appendix 5).

In COSCA studies it was noted that the cassava production cash income was higher in villages which had easy access to markets or to production credit (COSCA Tanzania, 1996). Farmers who had access to markets earned more cash because they had greater access to market demands for the products. Also the same farmers earned more cash from cassava because they had greater access to supply of inputs which enabled them to expand production. A farmer produces a crop with a purchased input orgy if he is able to earn cash to recover his cash expenditure on the production of the crop.

4.5.6 Availability of preferred crops and rudimentary cassava processing technology

The preferred crops available were cited as a reason for declining cassava land area in Tanzania (COSCA Tanzania. 1996). A crop can be preferred if it is available in a form which the housewife finds convenient to prepare into food. Cassava is not a homogenous food product, it is transformed into several products during processing which vary in taste, texture and particularly in convenience.

The main cassava product processed in most cassava growing zones is cassava chips/flour. This product is not able to compete effectively with food grains such as maize and rice on the market.

During the COSCA studies, it was shown that in the areas where cassava was reported to be declining, cassava was mostly being replaced by various cereal grams. These grams included maize, 36 percent among the villages surveyed, rice, 22 percent, sorghum and millet, 21 percent, sweet potato, 7 percent and cotton, 17 percent (COSCA Tanzania, 1996).

Data from the COSCA study, show that almost all the villages which processed cassava into convenient food products reported expanding cassava land area. The use of the unproved post-harvest handling facilities expanded market demand because it improved product quality.

Quality processed cassava products are more convenient to urban consumers and are more competitive with food grains in the market. Easy access to market centres did not make as much impact on the cassava land area expansion as the improved, post-harvest handling practices.

Farmers would be able to expand cassava land area under conditions of difficult access to market centres, provided improved processing technologies were available.

Lack of diversified cassava products in Tanzania has very much hindered the widespread usage of cassava in the country. The cassava flour obtained as the final product after

milling or pounding the chips is only consumed as Usual. The recent research advances on the improvement of processing techniques and diversified uses of cassava flour into cakes, chinchin and doughnuts might increase the demand of cassava in urban areas where there is an assured market.

The recent introduction of the low cost storage technology for fresh cassava roots in some areas to extend the shelf life of the roots for urban consumers will also contribute positively to increased utilization of cassava.

5 INTERVENTIONS

5.1 CHANGES IN FOOD MARKET DEVELOPMENT MODEL

According to Mkandawire and Maltosa (1993), the marketing system of food crops in Tanzania has undergone various changes. Most of these changes have been in marketing arrangements, reallocation of marketing facilities and pricing. Long-term policy efforts for improvement of marketing efficiency through investment in improved infrastructure facilities, particularly transport and storage have, to a large extent, been left to take their own course. The stages of evaluation of the marketing system of food crops were categorized during the following periods:

- the colonial pattern of marketing (1957–1962);
- state-controlled marketing system (1963–1984/85);
- market liberalization (1985/86 to date).

5.1.1 The colonial pattern of marketing system

This type of marketing system continued to exist up to the first two years of independence. During this period, a multichannel marketing predominantly free market but with limited government control was basic. At the primary level, private traders (Asian traders) purchased food crops from producers, who in turn sold them to wholesalers and brokers who sold them to millers and export/import firms. Following the 1961 drought, food prices, particularly of maize, increased sharply. This necessitated the Government to ban private traders for high food prices. This type of marketing system dealt mainly with food grains, particularly maize.

5.1.2 State controlled marketing system (1963–1984/85)

After reviewing the previous marketing system, the Government thought that the former system was inefficient with regard to the operations of private traders in curbing frequent food price increases. Government introduced the Agricultural Product Act. This Act led to the establishment of the National Agricultural Product Board (NAPB) in 1963 whose major aim was to control and regulate the cultivation and marketing of food crops, together with keeping famine reserve stock for distribution in needy areas. The act was used as a basis for instituting the three-tier single marketing system whereby primary

procurement was limited to cooperative societies. The marketing system described above is summarized in the chart below.

Unlike the previous marketing system, NAPB started to trade in cassava in addition to other food grains. However, in the course of its operation, NAPB was not cost-effective and incurred serious losses, hence, it was dissolved in 1972. The dissolution of NAPB led to the establishment of the National Milling Corporation (NMC) which maintained a single channel marketing system. The main objective was still to achieve food security by ensuring stable consumer prices and incentive producer pricing.

The NMC dealt directly with Cooperative Unions. However, due to some operational difficulties such as lack of skilled human resources, mismanagement of cooperatives and financial constraints, they were abolished in 1976 in favour of villagization.

Under the new arrangement, the NMC was to procure staple food directly from village governments which were more numerous than primary societies. This changed the situation from a three-tier single channel marketing system to two-tier single channel marketing system (NMC Village Government -Farmer). The National Milling Corporation was responsible in the distribution of foods to other intermediaries before it reached the ultimate consumer. At the wholesale level, the Regional Trading Companies (RTCs) were generally in charge of up-country regions and the National Distributors Limited (NDL) served only Dar-es-Salaam. Only retailing of staple foods was not under direct state control.

Like the other state controlled institutions, NMC faced numerous operational problems, including liquidity difficulties and mismanagement which called for government subsidy. However, the government budget could not sustain such crops of which world market prices had fallen far below cost. On account of this situation, in 1984 all forms of subsidies coincided with the re-introduction of cooperatives and marketing boards. This awed pressure towards the into-store price which rapidly became irrelevant. As a result, from 1986 official consumer prices were higher than those offered by private traders which led the Government to withdraw its support to the official marketing channel.

5.1.3 Market liberalization

Tanzania has progressively liberalized the food crop marketing since the mid-1980s. This move is within the framework of the Structural Adjustment Programme (SAP), aimed at restructuring the agricultural sector and the country's economy in general (Coulter, 1992). This land of economic reform involved the curtailment of legalized monopoly of state controlled institutions (NMC and cooperative unions) over the marketing of food crops and at the same time allowing private traders to venture into food trading in the same line with these institutions, thus transforming the system from a single channel to a multichannel marketing system, dominated by private traders. Under liberalization, private traders are now free to buy and sell any crop, anywhere. Producer and consumer prices of food crops are now determined by market forces of demand and supply.

5.2 MARKETING OF CASSAVA

5.2.1 Dry cassava chips

As discussed previously, food crops were marketed through either government institutions (NMC and cooperatives) or private traders. The relative importance of the buyers depended on the marketing system in place; NMC has been the main buyer of food crops. Available information on a national basis, indicates that between the 1980/81 and 1990/91 season, the major food crops traded by NMC were maize (73.4 percent), rice (13.5 percent), cassava (8 percent) and sorghum/millet (5.1 percent). The southern zone (Mtwara and Lindi regions) contributed about 77 percent of all cassava traded by NMC. The quantity marketed in different zones was variable. It was high in the southern zone (90.5 percent), but low in other zones, ranging from 0.1 percent in the northern zone to 8.2 percent in the western zone. Data from private traders were not available during the study period.

Marketing of dried cassava was done by both government institutions (NMC and cooperatives) and private traders. In urban centres, NMC had been the main supplier of dried cassava. Nevertheless, the role of NMC in marketing of cassava has ceased since 1990/91, leaving private traders as the orgy buyer and seller of cassava products in the country (personal communication with NMC manager, 1997).

Apart from domestic trading, NMC and private traders had been exporting food crops. Data from the Central Bureau of Statistics indicate that a total of 379 840 tonnes of food crop (cassava, maize, rice and sorghum/millet) were exported between the 1982/83 and 1993/94 seasons. Cassava contributed about 51.8 percent of the total quantity exported. While the export contribution of maize, rice and sorghum/millet were 38.2 percent, 2.9 percent and 7.1 percent, respectively.

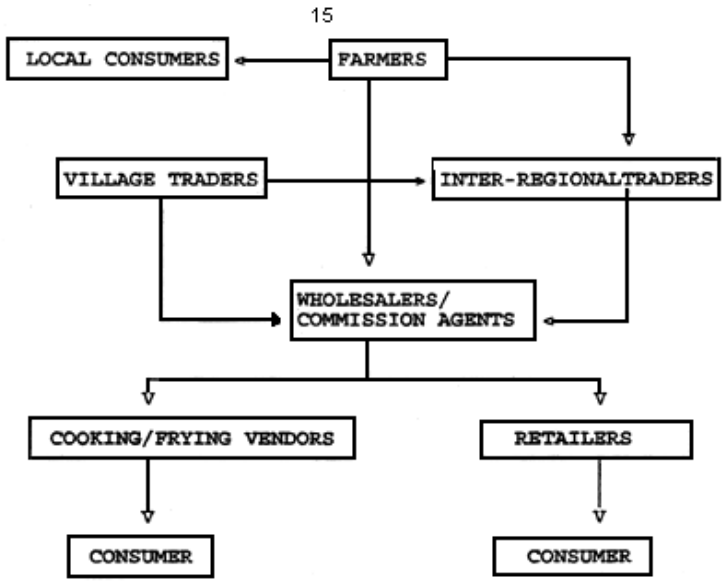
However, NMC stopped exporting cassava in 1987/88. Since then cassava export has been undertaken by private sector. Cassava is mainly exported to European countries (Belgium, France, Germany and the Netherlands) where it is used as an ingredient in the manufacture of animal feeds. The country through NMC and the Strategic Grain Reserve (SGR) has been importing maize, rice and wheat (Appendix 3); and of recent, private traders are involved in importing rice and wheat. However, cassava has never been imported into the country.

5.2.2 Fresh cassava

Fresh cassava marketing is currently dominated by private traders. A study conducted in 1994 by TFNC in collaboration with the Natural Resource Institute (NRI) United Kingdom on urban demand for non-grain starch staples in Dar-es-Salaam revealed that fresh cassava trading is characterized by having a large number of small-scale traders scattered all over the marketing chain (Ndunguru *et al,* 1994). This study also identified the key players in the marketing system and the major supplying areas.

A schematic presentation of the marketing system is depicted in Figure 3. At farm level, fresh cassava, after being produced is sold directly to either local consumers, village traders or interregional traders through local village markets. There after, the interregional traders transport fresh cassava, using lured trucks to wholesale urban markets in Dar-es-Salaam. At the wholesale level the wholesaler/commission agents dispose of fresh cassava consignments on behalf of the interregional traders or farmers to either cooking/flying vendors or retailers who in turn sell to ultimate urban consumers. The same marketing system as the one explained above was observed during the COSCA study in 1995 on fresh cassava trading in other urban centres of Mtwara, Lindi and Mwanza regions (COSCA Tanzania, 1996).

Figure 3. A schematic marketing system of fresh cassava roots in Dar-es-Salaam



5.3 CHANGES IN FOOD PRICING POLICIES

Since about 90 percent of food crops production in Tanzania is undertaken by smallholder farmers, it is logical to experts that material incentives, price being one of them, should play a key role in guiding overall agricultural production (Santorum and Tibaijuka, 1994). Tanzania has experienced a number of pricing systems which have existed since the re-independence period. These pricing policies include:

- pre-independence pricing policy;
- pricing policy prior to 1974;
- pan-territorial pricing policy;
- open market pricing policy.

5.3.1 Pre-independence pricing policy

According to Santorum and Tibaijuka (1994) this policy existed during the colonial era and was extended even further in the first two years of independence. The prices of food crops were established by white settler and Asian private traders. Under this pricing policy, both producer and consumer prices of cassava and other food crops were free to change, depending on the wish of the buyer or seller.

5.3.2 Pricing policy prior to 1974

Before 1974/75, Tanzania employed a pricing system that allowed NMC and cooperatives to determine their exchange prices (in-store prices); and the latter returning to the former that portion of receipts less their (cooperative) expenses. This meant that tremendous downward pressure was exerted on producer prices thus forcing farmers to be hostages to their particular societies or unions whose level of efficiency determined the score of farmers' income. In most cases, producers suffered from both the relatively high cooperative costs compounded by comparatively low basic prices in the first place. As a result the ineffectiveness of food crop pricing became more evident with the precipitation of the food crisis in 1973/74 (Mkandawire and Maltosa, 1993). The pricing system was cited as one of the basic causes of depressed food production. An examination of producer prices of cassava and other food crops in the period prior to the crisis had shown that in most regions, these prices had stagnated or declined in both real and nominal terms.

5.3.3 Pan-territorial pricing policy (1974/75–1984/85)

This is the pricing system where prices at given levels in the marketing chain are the same regardless of geographical location and transport costs (Coulter, 1994).

At the beginning of the 1974/75 marketing season, the Government assumed an active role in the determination of producer prices of all food crops. By fixing producer prices of these crops, a reversal direction of pressure from these prices to into-store prices was created. With consumer prices of these crops fixed by the Government, this meant a fierce struggle for marketing margins between cooperative unions and NMC.

The pricing policy of this nature had some setbacks because the offered prices were not sufficient to offset rising costs of agricultural inputs and mounting costs of living in rural areas. In addition, this policy also favoured farmers in remote areas (subsidizing farmers residing in remote areas) while it provided a disincentive to farmers residing in accessible areas (taxing farmers living nearby roads and markets).

5.3.4 Open market pricing policy (1985/86 to date)

This pricing system started to exist during the onset of trade liberalization. Within the framework of this policy, both producer and consumer prices of food crops have since been determined by the market forces of demand and supply.

Until 1989/90, the Government completely decontrolled all grains, cassava, beans and oilseeds in the country (Mkandawire *et al.*, 1993). Following this action, the Ministry of Agriculture through the Marketing Development Bureau (MDB) started to provide market information on producer and consumer prices on a regional basis through the radio and market bulletins issued every three months. This information provides a guide to both farmers and private traders to negotiate prices in a profitable manner.

5.4 IMPACT OF CHANGES IN DEVELOPMENT MODEL ON FOOD CROPS PRODUCTION

Since 1974 real producer prices for staple foods (maize, paddy, cassava and sorghum/millet) have been variable. Producer prices for cassava have been the lowest followed by sorghum/millet and maize. While paddy enjoyed the highest producer prices throughout the period (Figure 4). Generally, producer prices were low for all crops between 1974 and 1989, when the state-controlled food marketing system was in place. Although market liberalization started in the mid-1980s, it was not fully liberalized until 1989 when the Government withdrew completely. Therefore, a true free market started in the 1990/91 season and thereafter producer prices of the food crops have been increasing as shown in Figure 4. Nevertheless, producer price of cassava is still the lowest implying that the market value of cassava is low (low demand). Therefore a deliberate effort is needed to improve its marketability.

Following the severe food shortage experienced during 1973/74 the producer prices of food crops increased substantially. This situation necessitated the Government through NMC to increase the food crop purchases during the 1975–1978 period in order to ensure food security. The emphasis was on drought resistant crops (cassava, sorghum and millet). However, no major changes in quantities of food crops purchased were observed between the 1979/80 and 1989/90 seasons as prices remained low due to food surplus witnessed during this period (Appendix 4).

Since the inception of market liberalization in the mid-1980s and its fully-fledged implementation in the early 1990s the quantity of food purchased through official channels, has reduced considerably. Tins have been attributed by an increase in producer prices with which the state controlled institutions (NMC and cooperatives) could not offer such high producer prices in competition with private traders. However, studies have shown that a considerable increase in the volume marketed has been observed particularly for the major staple foods (maize and paddy). Since the private sector has dominated the marketing system, reliable data on volume traded could not be obtained.

The analysis of the changes in levels of food production relative to producer prices shows that during the 1974/75–1977/78 period there was a remarkable increase of real producer prices of cassava, sorghum/millet and paddy which triggered an increase in their respective production levels. An exception was observed for maize after 1975/76 whereby its producer prices trended downwards while its production levels were increasing albeit in a fluctuating fashion. However, data from 1981/82 to 1995/96 show a

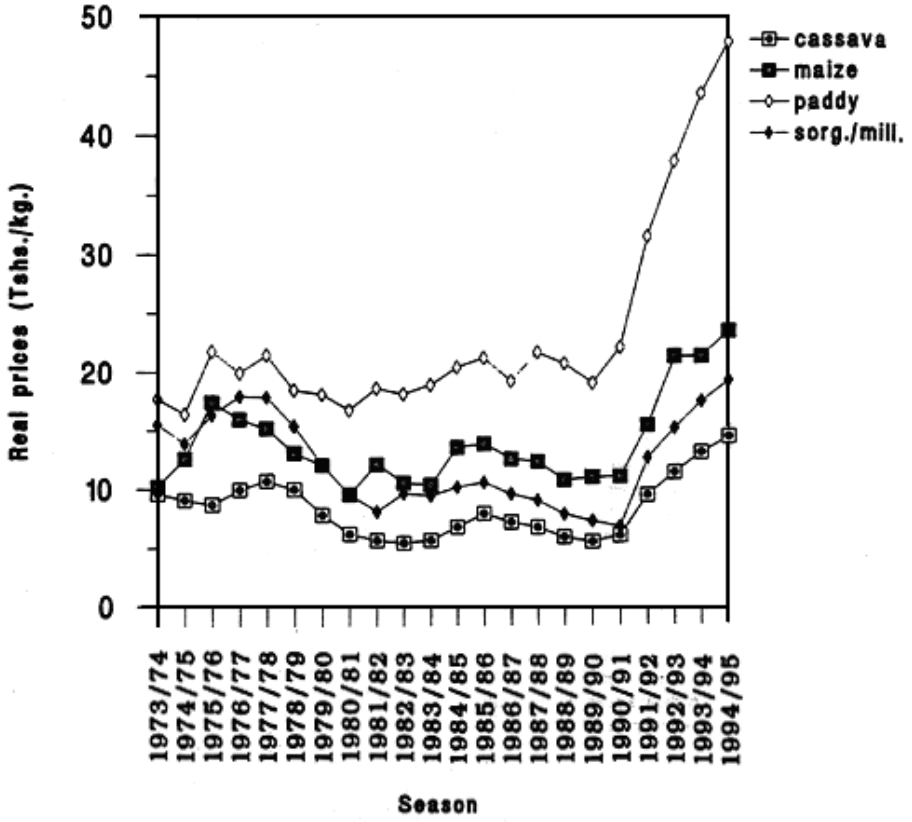
positive relationship between production levels of maize and rice and their producer prices during the later stages of trade liberalization (1990/91 to date).

For the case of cassava and sorghum/millets, the situation is quite different as there was a negative relationship between production levels and real producer prices.

The impact of the pricing system on cassava production was further assessed using supply elasticity. The result showed that producer prices could not influence cassava production, by having a negative elasticity of supply of 0.14. This means that, despite government policy on production incentives and food security, in real terms, producer prices could not motivate cassava producers.

Several factors have contributed to this situation, including low market potential of cassava and sorghum/millet as compared to paddy and maize, hence low response to market prices. However, in the absence of price elasticity, it is difficult to quantify the above-mentioned argument. Furthermore, cassava production has been affected by the outbreak of cassava mealybug in the late 1980s which forced farmers to uproot almost all cassava fields as a control measure. In so doing, the production of cassava particularly in the 1990s has been greatly reduced. This situation also led the producer prices to increase substantially during this period.

Figure 4. Food crops producer prices from 1973/74–1994/95



Source: Marketing Development Bureau (1992–1993) and Crop Early Warning Unit (1994–1995), Ministry of Agriculture and Cooperatives

5.5 INVESTMENT IN CASSAVA RESEARCH

5.5.1 Agricultural research policy

The national agricultural research policy recognizes the importance of drought tolerant crops i.e. cassava and sorghum and millet, for assurance of basic food security, income generation and employment growth. In 1995 the national agricultural research policy was developed with the following objectives for drought tolerant crops (MALDC, 1995):

- the Government will take steps to ensure that support services are concentrated on drought prone areas in order to stimulate production of these crops. Distribution of seeds, control of pests and extension services to promote the use of available technologies will be given special attention;
- the Government will assist the private sector to develop a strong marketing system for these crops. Collection and dissemination of information on availability, demand, prices and quality requirements will be a key responsibility of the Government;
- the Government will encourage the private sector to install processing facilities in both production and consumption areas in order to promote commercial consumption of these crops;
- the Government will ensure that when famine relief is required in drought-prone areas, as far as possible, only drought resistant crops will be delivered to the victims in order to encourage the production and utilization of these crops in these area;
- the Government will assume the role of providing farmers and traders with export marketing intelligence in order to promote the export of these crops when surpluses are available;
- research into more processed products and their utilization will be initiated in order to promote domestic consumption of these crops thus expanding demand.

The Government came up with the above-mentioned policy statements after recognizing that cassava has reverted to subsistence consumption and that it plays a crucial role in maintaining food security for millions of rural families. Proper support is to be given for this crop for food security purposes in both rural and urban areas; and as a non-traditional export crop in which the country could earn additional foreign exchange (MALDC, 1995).

5.5.2 Government contribution to cassava research

Since cassava research started in Tanzania in the early 1970s, the Government of Tanzania has been investing in cassava development in various ways. One way has been by funding research. The funding levels for cassava with other competing staples for the past ten years are shown in Table 5. These levels were not adequate and the trend shows that maize was receiving twice as many funds as for roots and tubers (cassava and sweet potato) in the mainland, while in Zanzibar cassava was given priority over other staples. In recognition of its inability to adequately fund cassava research, the Government has

been very active in soliciting research funds from other international organizations. The International Institute of Tropical Agriculture (IITA) has provided financial support for cassava research related activities. Also through networking with projects like Eastern and Southern Africa Root Crops Research Network (ESARRN) (1988–1992) and Southern Africa Root Crop Research Network (SARRNET, 1994) technical, financial and material support is provided.

Table 5. Funding levels for cassava and competing crops from the Governments of Tanzanian and Zanzibar ('000 Tshs)

Year	Tanzania Mainland				Zanzibar	
	Cassava	Maize	Rice	Sorghum/ millet	Cassava	Other crops**
1986/87	1 422	-	-	-	-	-
1997/88	1 577	3 581	2 131	2 187	-	-
1988/89	2 042	-	-	-	-	-
1989/90	2 252	7615	4 531	4 652	-	-
1990/91	1 582	10 600	5 500	5 500	-	-
1991/92	5 340	10 000	6 000	6 000	-	-
1992/93	2 690	10 000	6 000	6 000	3 072	2 048
1993/94	4 435	8 925	5 355	5 525	2 940	1 960
1994/95	5 000	91 000	7 000	6 000	3 150	2 100
1995/96*	6 500	10 000	8 000	6 000	1 755	1 170
1996/97*	10 000	12 000	10 000	8 000	2 606	1 737
Total	36 340	8 1721	54 517	49 864	13 523	9015
Average	3 304	9 080	6 057	5 540	2 705	1 803

Source: Ministry of Agriculture, Planning Unit, Dar-es-Salaam and the Ministry of Agriculture, Zanzibar
* Approved but not yet released due to financial constraints facing the country
** Maize, sorghum and vegetables

The Government has also invested in physical and human resources. The physical resources include land for research which is available at the following research stations: Ukiriguru, Naliendele, Kibaha, Tumbi Maruku, Hornbolo and Tengeru. Communication equipment, laboratory facilities, vehicles and housing and training of staff on cassava research has been ongoing on a long- and short-term basis. Currently, the cassava research programme has the following research staff (Table 6).

Table 6. Current research staff and requirements in Roots and Tuber Research Programme

Discipline	Current staff		Staff required			
	B.Sc	M.Sc	Ph.D.	B.Sc.	M.Sc.	Ph.D.
Agronomy	1	3	1	-	2	1
P/protection n	-	4*	-	-	4	2
P/breeding	-	2**		-	2	1
Soil science	-	-	-	-	-	-
Total	2	8	1	-	8	4

NB: The same staff work on other crops such as sweet potato and round potato
* 1 on Ph.D. training
** 1 on Ph.D. training

In an effort to increase research output, the Ministry of Agriculture has gone through a prioritization exercise for all the commodity crops in the country both nationally and by zone (Table 7).

Table 7. Priority setting of cassava and competing crops

Crops	Zones							
	Lake	East.	West.	Central	North	S.High.	South.	National
Cassava	1	2	1	2	2	3	1	2
Maize	1	1	1	1	1	1	2	2
Rice	1	1	1	2	3	1	2	1
Sorghum/millets	1	2	2	1	3	3	2	2

Source: Department of Research and Training (1994), Ministry of Agriculture and Cooperatives, Tanzania

Out of seven zones, cassava is a number one priority crop in three zones, number two priority crop in four zones and number three priority crop in one zone. With the exception of maize, cassava has equal standing with other competing staples as shown in Table 7. Nationally cassava has been categorized as a second priority crop similar to other staples with the exception being maize.

5.5.3 Cassava research advances

Cassava research is carried out under the auspices of the National Root and Tuber Crops Improvement Programme headquartered at Ukiriguru. In the past, work was initiated at Amani Tanga and in the 1970s was transferred to Muguga Kenya under the East African Community. Later in 1974 the programme was transferred to Ukiriguru Mwanza. The main objectives of the programme are:

- to improve the cassava genetic potential with the major emphasis on: reactivating exchange of improved materials and networking with other research institutions; developing cassava varieties with desirable characteristics; evaluating the

performance of improved varieties in different targeted environments; testing and disseminating appropriate varieties to fanners and establishing breeders' seed and multiplication plots for generation of enough materials of superior clones. Advances made from the past to date, in fulfilling the objective are summarized in Table 8;

- to improve the agronomic packages with major emphasis on: improving the cropping systems practised in cassava production, improving soil fertility through integrated soil fertility management techniques; improving cassava densities, fallows and time of planting; and also to involve farmers in testing of appropriate technologies. The advances made and key players in fulfilling the major objective are summarized in Table 9;
- to reduce the major cassava pests and disease incidences with emphasis on: monitoring pests and diseases, determining the economic thresholds, developing integrated pest management packages; integrating local knowledge in disease and pest control techniques. The research interventions and results/outputs attained so far in addressing the issue are summarized in Table 10;
- to study and develop a more efficient system for cassava planting material: special emphasis is to multiply and distribute cassava and planting material of improved varieties; to involve NGOs and other key players at all levels in this important activity, to disseminate the technology of rapid multiplication techniques to farmers and other key players to ensure maintainability. The advances made so far are summarized in Table 11;
- to improve the cassava post-harvest handling practices through documentation of indigenous technical knowledge; introduction of alternative uses of cassava products; and improved cassava processing techniques. Research efforts made with all key players and outputs to date are summarized in Table 12.

Table 8. Research advances on the improvement of cassava genetic potential in Tanzania

Period	Priority area (s)	Activity (ies)	Location (s)	Output/findings	Remarks/implications
1930 to 1960	Monitor and establish economic thresholds or major cassava diseases (CMD and CBSD). Screen for host slant resistance to CMD avid CBSD.	Studies on causal agents of CMD and CBSD. Yield loss studies due to CMD, acid CBSD. Epidemiology studies of CMD and CBSD. Interspecific avid interparental hybridization for host plant resistance and high root yield.	Amani, Tongs (under the auspices of the Fast African Community).	Causal agent of the disease. A virus. CMD and CBSD cause loss in storage root yield that varies from 80 to 90 percent. CMD widely spread in the country whereas CBSD is very much localized along the coast and very sporadic. More than 40 interspecific hybrids released to farmers including Amani 4026/16.	Constant attack by CMD some released hybrids lost their resistance. Roughing of all plants attacked by CMD and use of clean healthy materials recommended.

Period	Priority area (s)	Activity (ies)	Location (s)	Output/findings	Remarks/implications
				Amani 4020; Amani 46106 and Amani 476/16	
1961 to 1971		As above	As above	Liongo and Ukerewe recommended for the Western Cotton growing area (WCGA).	Cassava research stopped at Amani and moved to Kenya. Cassava varieties Amani 405/1, Amani 40106/26 and 476/16 dropped due to their breakdown of resistance to CMD.
1972 to 1980	Initiating exchange of improved materials and networking with other research institutions. Continuing with weeding activities.	Cassava germplasm collection and evaluation of local and improved varieties. Screening the germplasm for resistance 14) important diseases; CMD, Brown Lear Spot and scales and high storage root yield. Introduction of CMD resistant varieties front East African Agriculture and Forestry Organization (EAAFRO), Muguga.	Ukiriguru	101 cassava varieties in the germplasm bank, out of which: 23 varieties selected resistant to CMD varieties Kayeba, Kachanga, Mzimbial Njemu and 9223 U-CVB/27-1 selected for resistance to green mites, namely CMD. Average cassava root yields of selected varieties ranged from 15-29 tonnes/ha in a year as opposed to 5–15VU in two years obtained from local varieties around Valenca region. Selected varieties were accepted for “ugali” making with the exception of Amani hybrids. Cassava varieties: Alpin Valenca Maltu Zanzibar and Amani hybrids: 4763/16,46106/6, 46106/27 (known as 27) and Agriculture Mzungu) were released and accepted by farmers more so Amani hybrid 46106/27.	Cassava research transferred to Ukiriguru In 1972 under the National Roots/Tubers Research Programme. Some mite resistant varieties: Mzimbltala, Njemu, Warns, Kanyasizige, acid Kongolo do root flower freely hence dro9224pped in breeding programme. Also they are not high yielding and lave poor processing qualities hence not widely accepted by farmers. Variety Amani 53IW34 and IITA clone from family 59308 very bitter and poor root yielding hence not adopted by farmers.
1981	Cassava	Evaluation and	Uldriguru	Variety	D ositive relationship

Period	Priority area (s)	Activity (ies)	Location (s)	Output/findings	Remarks/implications
to 1989	germplasm development and evaluation.	selection of cassava varieties with desirable traits.	Tumbi, Mwanhala, Chambezi, Naliendele, Mtopwa.	recommendations vlwanza Lake zone) Liongo Control, All vltumba. Maltu Zanzibar, Alpin Valencia. Tabora (Western zone); Llongo control Vlapangano, Kibah;. Mtwara (Southern zone): Llongo control, Mapangano, Kibaha Llhumbukwa, Kigoma red.	between cassava root yield and its components. Interactions between yield and environment very positive, lence variety selection for yield should be specific. Varieties recommended had moderate resistance to CMD and CGM but some succumbed to cassava mealybug Liongo control, All Mtumba). Selection for resistance to cassava mealybug to be incorporated In the breeding.
	Germplasm collection and maintenance.	Collection and maintenance of cassava gene bank.	Uldriguru, Mtwara, Tumid.	Germplasm collection sank increased to 300 accessions of Amani hybrids, local varieties and Introductions from IITA, Nigeria.	More collections and introductions of desirable varieties to continue.
	Germplasm exchange and evaluation of new varieties.	'Testing superior cassava varieties developed at IITA, Nigeria. Eighteen (18) introduced in tissue culture form 36 families introduced in true seeds.	Ukiriguru	TMS 30555 bitter and 4 (2) 1425 (intermediate) selected over local check llongo control. Clones 83101762 (6) 33101720 (3) selected over yield check variety all Mtumba	Multiplied for multilocational trial. However, due to the outbreak of cassava mealybug in 1987–1989, materials could not move beyond Uldriguru. This slowed down the process of adaptability.
					Acceptability of IITA materials was realized by farmers who process cassava roots because of their bitter taste. Exchange of germplasm was facilitated mainly by the East and Southern Africa Root Crops Research Network (ESARRN).
1990 to 1996	Evaluate the performance of cassava germplasm in	Characterization of environments for germplasm development.		Different environments identified: lowland warm and	SADC similar agro-ecologies ^Mozambique, North Angola) Zambia. Angola and patches in

Period	Priority area (s)	Activity (ies)	Location (s)	Output/findings	Remarks/implications
	different targeted environments in the country and other similar environments in the SADC region.			subhumid (Coast and Mltwara; highland warm and subhumid (Mwanza Tabora). highland warm semi-arid (Dodoma Shlnyanga). Highlandwarm and cool (Kagers Kigoma). highland cool Mbeya, Arusha).	Vlalawi and Mozambique. North Namibia, North Botswana, South Angola South of Zambia patches in Malawi and Zimbabwe. Angola, Zimbabwe, Malawi, Zambia, South Africa research not yet initiated. In the country. South Africa could develop materials for this agro-ecology. All cassava germplasm development activities supported by the Southern Africa Root Crops Research Network (SARRNET) Project executed by IITA/CIP.
	Develop and select cassava varieties with desirable characteristics.	Germplasm introduction mid evaluation	Kibaha Tengeru, Arusha	47 clones Introduced from IITA in 1995, multiplied at Kibaha and distributed to other centres.	These are being evaluated under PYT in 1996/97.
		Germplasm collection mid maintenance.	Ukiriguru Kibaha Naliendele	102 varieties 94 varieties 47 varieties.	Many varieties at Ukiriguru were lost in the past due to outbreak of cassava mealybug. More collections to continue.
		Hybridization and population development (one crossing block).	Hombolo	Several seeds harvested from the crossing blocks for the cassava seedling nurseries.	More cassava varieties with desirable traits to be included in the use of crossing block.
		Evaluation and selection of cassava varieties with desirable characteristics.	Ukiriguru Hombolo Naliendele Klbahm, Butulwa, Tumbi.	1 143 seedling clones out of 4 652 selected for CET. Eighty-eight clones out of 389 selected for UYT. Six (6) clones out of 13 selected for UYT.	Evaluations at different stages still ongoing.
		Farmer's selection of die cassava advanced line from UYT for on-farm testing In 1995/96.	Ukiriguru	Clones 4 (2) 1425, 83/017,62(6), MuIundl/5, KIryuuukwe/8 unit Kiryunukwe/11 selected bv farmers	Clones Kiryunukwe/8 Kiryunukwe/11. All advanced to farmers due to their susceptibility to CMD. Varieties Alibi Valenca and Maltu

Period	Priority area (s)	Activity (ies)	Location (s)	Output/findings	Remarks/implications
				for on-farm testing In the semi-arid /one.	Zanzibur provided instead for reassessment by farmers 1995/96.
	As above -	As above -	Maruku	Clones 4 (2) 1425, Mulund 1/5, Kiryunukwe/8, and Kirunyukwe/11 selected by farmers for on-farm testing in the high rainfall area of Kagera region.	Clone 83/01762 (6), although high yielding was not selected because of its bitter taste, and for Uldriguru clones susceptible to CMD were not given to farmers. Full participation of farmers in selection of varieties provided feedback to researcher on criteria used in selecting a good variety.
	To involve farmers in the selection of cassava varieties with desirable traits and adaptable to traditional cropping systems. To test and disseminate appropriate cassava varieties.	Conducting of on-farm variety selection trials 1995/96.	Killima village, Kagera region.	Flexible recommendations on suitability of varieties as assessed by farmers together with researchers: Mulundl/5 and Aipin Valenca for ntercropping: Mann Zanzibar and Alpin Valenca for an early harvest. Mulund 1/5 for jig roots; Maltu Zanzibar for relish production: Mulundl/5 and Msitu Zanzibar for fresh roots.	Comparable trials to be carried out in other agro-ecological zones. Target group analysis needed to be able to maven die importance of cassava for household class, extension leaflets needed to diffuse the recommendations to farmers and train farmers on the control measures of bacterial blight. Multiplication of planting materials of selected varieties or future distribution to farmers required to diffuse the varieties quickly. Since this is an expensive exercise, support by NGOs and missionary agents urgently required.

Source: Msabaha *et al.* 1988, SARRNET Technical Reports (1994/95 and 1995/96 COSCA Tanzania, 1996 Roots/Tubers Annual Report (1980–1996) Ministry of Agriculture, Tanzania
TARO (1993, 1988) Department of Research and Training (1991) (1990), Kapinga *et al.*, 1996

Table 9. Research advances on the improvement of cassava crop management practices.

Period	Priority area(s)	Location	Activities	Outputs/findings	Remarks
1960 to 1972	Soil fertility maintenance by cassava for increased cotton production in Western Cotton Growing Area (WCGA).	Ukiriguru	Cassava rotation cycle studies.	A cassava break of 2–3 years in a rotation cycle with cassava.	Recommended only for WCGA.
1973 to 1981	Improvement of cassava field management practices.	Ukiruguru	Conducting studies on: 1. Needs management.	First weeding to be carried out during first month after planting and thereafter, two consecutive weedings at monthly intervals.	Delay in first weeding beyond two months reduces yield by 70 percent. One hand weeding only one month after planting reduces the yield by 60 percent.
			2. Planting methods.	Horizontal, vertical and inclined placement can se used.	
			3. Plant population.	Spacing of 75 cm x 150 cm most suitable.	Recommended spacing specific for the lake zone where 1.5 metre ridges are commonly used.
			4. Intercropping systems.	Cassava/maize and cassava/groundnut combination in terms of gross returns.	Findings not supported later where cassava monoculture earned the highest financial returns.
			5. Time of planting.	Best time to plant cassava in the semi-arid (subhumid areas is November and December.	Although planting can be extended to February with little sacrifice in rat yield.
1982 to 1986	Putting packages of inputs and practices which can be adopted by farmers to increase cassava production.	Naliendele	Conducting studies on: i. Planting methods in rlat cultivation.	Vertical or slanting placements of cuttings were suitable.	Confirms the previous findings from the Lake zone.
			ii. Spacing studies under flat cultivation.	1 m x 1 m or 0.75 m x 1.5 m can be used in planting cassava.	Confirms the previous Findings from the lake zone.
		Ukiriguru	1. Studies on cassava leaf	Leaf harvesting by detopping is more	Studies to be expanded to other agro-ecologies

Period	Priority area(s)	Location	Activities	Outputs/findings	Remarks
			harvesting.	detrimental to the root yield as opposed to plucking. Losses in yield increases as the harvesting frequency increases. Cassava leaves should be harvested by plucking method at an interval longer than three months to minimize the losses on yield.	where leaf harvesting for relish is of importance.
			2. Studies on the responses of cassava to fertilizers.	Farm yard manure (7–5 tonnes/ha) applied every two seasons profitable to non-fertilizers.	Recommendation suitable for farmers with cattle. More low cost ways with the aim of improving soil Fertility to be investigated in future.
			3. Studies on improvement of cassava based cropping system.	Cassava + maize + sorghum cropping system very productive and cassava + sorghum east productive.	Nine promising cassava based intercroppings selected for further evaluation and improvement.
1987 to 1992	Documentation of indigenous knowledge on the management of cassava at farm level in the country.	Lake, western, coast, eastern and other zones.	Village and house hold level surveys by COSCA Project in selected zones where cassava is of importance.	1. Declining fallow periods constituted a constraint to expansion in cassava production because of cassava's long growth cycle. Farmers were not able to grow the crop under continuous cultivation as frequently as they were able to grow some other crops.	The concluded surveys call for emphasis on re-visiting the recommended packages and modifications to suit the existing practices at farm level.
				2. Cassava is grown more in an intercropping system (80 percent) than sole cropping. Maize and beans or peas followed by sweet potato were mostly frequently intercropped with cassava.	
				3. Recommended management practices especially plant density and ages at harvest were not adopted at optimal levels by farmers.	

Period	Priority area(s)	Location	Activities	Outputs/findings	Remarks
				4. In high market pressure area where superior practices were adopted, root yield increased significantly '40 percent).	Futures studies to embark on verification and testing of recommended practices on-farm incorporate the existing practices.
				5. There was a low level of use of porch re inputs which led to no change in cassava root yield and and area expansion under cassava.	
				6. Lack of planting materials was earmarked one of the major constraints in cassava production.	Emphasis to be put on establishment of multiplication plots of cassava planting materials of selected varieties to involve key players e.g. NGOs
	2. Improvement of cassava based cropping systems.	Ukiriguru	1. Studies on the intercropping of cassava and sweet potato.	Intercropping cassava sweet potato reduced the yield of cassava by 32 percent and that of sweet potato by 23 percent. High and medium branching cassava types are suitable for intecropping with sweet potato. Cassava plant densities (10 000 and 23 000 plants/ha) are suitable for intercropping with sweet potato at 33 333 plants/ha). Large share of soil N. P and K is depleted in the order cassava/sweet potato sole sweet potato sole cassava.	Integration of alley cropping techniques in the system to be evaluated for increased mixture productivity and soil ? fertility maintenance. The use of organic matter, crop residues, and integration of leguminous plants needs to be investigated further for promotion at farm level.
			2. Alley cropping studies with cassava	Cassava storage root yield increased by 30 percent with the use of prunings for three consecutive seasons. Soil N and K increased by 20 percent under continuous cropping of cassava with the incorporation of pruning	Results obtained to be verified on-farm with the inclusion of three more tree legumes as options. The system to be tested with the intercropped cultures of cassava with the intercrops (maize and sweet potato). Other

Period	Priority area(s)	Location	Activities	Outputs/findings	Remarks
				for three consecutive seasons.	benefits of the system include provision of fuel wood.
		Naliendele	Assessment, of common cassava intercropping system	Cassava/Pigion pea (dwarf) and cassava/sorghum identified to be productive	More studies needed on-farm to verify the findings.
	Testing and disseminating suitable cropping systems with cassava.	Ukiriguru and surrounding villages.	Verification of nine selected cassava based cropping systems under farmer conditions.	Full participation of farmers in assessing the technology attained Three beat suitable cropping systems identified as: - Cassava + maize - Cassava + maize + Sweet potato - Cassava + sweet potato.	Future studies to incorporate the improvement of soil ertility in the selected cropping system
1993 to date	Improvement of cassava cropping systems and soil fertility maintenance	Naliendele	Determination of the best time for planting cassava in the southern zone.	Wanting of cassava in the southern zone can be done from November through January.	Similar studies to be done in other important zones.
		Ukiriguru	Studies on the use of N, P and K fertilizers in cassava	Due to low prices of cassava sales there was no economic benefit in the use of fertilizers at H60 P30 K30 kg/ha per season. However 400 increase in root yield is realized with the application of Nitrogen (40 kg/ha) or Nitrogen (40 kg/ha) + Potassium (30 kg/ha).	More emphasis to be concentrated on the low root source of nutrition
				Mixture productivity was 30 percent higher than respective sale crops after two seasons. Soil N increased by 20 percent by incorporation of Leucaena and Gliricidia pruninas.	Still ongoing until December 1997. There after the package to be tested on-farm.

Source: Msabaha *et al*, 1988. SARRNET Technical Reports (1994/95 and 1995/96), COSCA Tanzania, 1996. Roots/Tubers Annual Reports (1980–1996), TARO (1988), TARO (1983), Tanzania Department of Research and Training (1991)

Table 10. Research advances on the reduction of cassava pests and disease incidences in Tanzania

Period	Location	Activities	Findings/Outputs	Remarks
1970 to 1980	Ukiriguru	Yield loss assessment caused by cassava green nut	Percent yield loss was established (30–50 percent) depending on varieties. - Local varieties with good level of resistance were identified (Mzimbitala, Kanyanzige, Njema, Dalama and Kongolo). - Six (6) varieties were selected, which were resistant to CGM - multiplied for distribution.	The varieties were not accepted by farmers due to low yielding abilities. Due to poor flowering it was difficult to improve them.
	Lake zone	Studies on the spread of cassava Bacterial Blight	- The disease was found in all regions of Lake zone (Mwanza, Shinyanga, Mara and Kagera). - High severity was observed on young cassava crop and on monoculture system. - Control strategies suggested were quarantine measures, selection of resistant varieties, encourage mixed cropping. - Encourage fallow and rotation, also field sanitation and deep ploughing.	
1961 to 1986	Naliendele (Mtwara)	Studies on chemical control against termites	Chemical called Aladrin 40 percent W.P. was found to be effective on termite control (the rate was 12.5 g in 10 litres of water). - Infestation rate was low (8.5 – 11 percent)	Residual effects of the chemical on cassava root were not established hence shelved.
	Ukiriguru	Cultural control of cassava Masaie disease	Proper planting time with less infection was identified - early planting had less incidences. - Late planting higher incidences and low marketable root yields also losses were between five to 26 916.	
	Ukiriguru	Distribution of cassava green mite population within plants	- More mites were observed in susceptible varieties compared to resistant varieties. - The number of mites decreased with an increase in leaf number from the top.	
1987 to 1989	Whole country (countrywide)	Survey of high risk areas for cassava mealybug attacks	Distribution of cassava mealybug in the country was established, the areas were along coast of Lake Nyasa, Lake Tanganyika, Coastal belt near Indian Ocean, Lake Victoria.	The identified areas suspected to be the entry point through fine exchange of planting materials. Uprooting and burning

Period	Location	Activities	Findings/Outputs	Remarks
			Losses were estimated to be between 52–100 percent in Lake Nyasa - this depended on age of the crop, 60–90 percent yield loss in the lake zone. Control strategy, Quarantine* * - Uprooting and burying all severely infested plants.	recommendation rendered to famine in most families.
		Importation of lactic natural enemy. Epidinocassis from IITA and test release then in infested areas.	Encouraging results were obtained in the released areas. Rearing units for natural enemies was established at Kibaha Research Institute.	Establishment of wasps was low at the beginning. Lack of regular monitoring due to financial constraints. - Financial constraints to run the rearing unit efficiently.
1990 to date	Ukiriguru	Cultural control of cassava mealybug and yield crops assessment	Early planting red-corn damage and yield losses.	
	Countrywide	Survey on cassava Mosaic virus	- The disease spread along the coastal belt and lake zone. - Higher ACMV Incidence in these areas Was due to the long, establishment of the crop, or due to the use of susceptible varieties. - ACMV - transmitted through cuttings (810) and through whitefly Vectors (190). Control strategies suggested: - use of clean materials.	Roughing practices kept the field clean i.e. less secondary infection.
	Countrywide	Survey on cassava Brown streale virus	- The disease found confined in coastal belt of Tanzania, extending from Northeast bordering Kenya along to Msuabiji border. Found also in the southern, western and lake zones.	
	Naliendele, Ukiriguru and Kibaha	Rate of spread of cassava mosaic disease	Rate of spread is indicated by the dynamics of the diseases incidence which is also the infection vector pressure of the location. Clean cassava crop could be maintained by sanitation coupled with selection of healthy slanting materials.	Symptom expression depends on local environmental conditions. - Roughing of diseased plants is vital for reduction of disease incidence. The trial still under investigation
	Naliendele and Kibaha.	Cassava yield loss	Average loss observed to be 34 percent	- Healthy plants yield more than diseased.

Period	Location	Activities	Findings/Outputs	Remarks
		assessment due to Brown.		
	Ukiriguru	Screening cassava varieties for host slant resistance against cassava mealybug.	- Three cassava varieties were selected to lave moderate resistance (Rangiabili, 83/017220(2) and Dalama)	Cassava mealybug pressure was low during experimentation.
	Countrywide (lake, southern and eastern zones).	Diagnostic survey of cassava Mosaic gominivirus	Two types of virus strains were observed (East African Mosaic virus and African Mosaic virus near Lake Victoria - The combination of two strains shows severe symptoms.	
	Kara	Pro-release survey for cassava mealybug	Cassava mealybug, cassava green nuts, cassava bacterial blight and cassava VIosaic disease were observed in all districts of Mara region. - Comprehensive IPM training for extension staff, farmers on post and disease control needed. - Collaboration between extension with research institute, needed on cassava bacterial blight.	Sources of clean material need to be identified. Comprehensive IPM training for extension staff, farmers on pent and disease control needed. Collaboration between extension and research institute needed on cassava bacterial blight.
	Mara Catholic Relief Services (CRS) and Biocontrol Programmes, Kibaha.	Selection of mostly affected communities and supplying planting materials. Training seminar for agricultural extension officers conducted. Monitoring and technical advice provided. Establishment of the Cassava Rehabilitation Project in Mara region by training farmers on IPM (pests and diseases).	Cassava land area at farm level increased. More farmers using methods of improved techniques. 600 000 cuttings of cassava distributed. Time, energy and money paves by farmers in reduced search for planting materials. All village and district extension officers trained in Mara region Few farmers in every district trained.	Training in IPM packages at all levels needs to be emphasized and continued. Inadequate funds of the Biocontrol Programme affected the rearing unit. Lack of integration with other advanced institutions such as ICIPE and IIBC.

Period	Location	Activities	Findings/Outputs	Remarks
		identification, selection of planting materials, cultural control, etc.		

Source: Bsabaha at al 19813, Bsabaha 1990, Raya *et al.,* 1993, TARO, 1983
Ogbe *et al.,* 1996, Roota and Tubers Annual Reports (1980–1995). IFAD, 1996

Table 11. Research advances on the multiplication and distribution of cassava planting material in Tanzania

PERIOD	EMPHASIS	ACTIVITIES	LOCATION (M)	OUTPUT(S)	REMARKS
1980 to 1990	To establish nucleus multiplication plots of planting material of selected/potential cassava varieties for distribution to farmers.	Establishment of multiplication plots of cassava planting material of selected varieties - LiongoControl - Aipin Valenca - Msitu Zanzibar	Ukiriguru (Lake zone).	i) Limited number of Cassava planting material distributed to various districts in the lake zone through extension offices 90 percent distributed and 10 percent maintained for future use in experiments.	Tremendous loss of material. Almost 300 of the material collected by extension dried up before planting because materials were collected from the research station before land preparation.
				ii) Revenues worth Tshs. 100 000/US$9 000.	Forty (40) percent of the total planted material could fail to sprout. Twenty (20) percent of sprouted material sprouted without vigour. Thirty (30) percent of the established material was roughed out because of diseases and sometimes the established material was not distributed to farmers due to lack of resources. This sometimes led to the abandonment of the whole field and marked the end of the exercise. Follow-up/backs topping from the research very limited or non-existent. . Lack of trained skills on multiplication techniques at extension level. . Lack of demand driven

PERIOD	EMPHASIS	ACTIVITIES	LOCATION (M)	OUTPUT(S)	REMARKS
					forces from clients/farmers. . Outbreak of cassava mealybug in 1987–1990 made it impossible for the exchange of cassava planting material from one area to the other.
1991 to 1994	same as above but in addition to farmers other beneficiaries NGOs and special project.	Limited scale of multiplication of selected/common varieties expanded in to other zones (eastern and southern) from 1994/95 season with the support by SARRNET.	Ukiriguru (Lake zone).	Five varieties multiplied: plant population hectarage in 1994/95 Liongo Kwimba 10620(5.31 ha) Msitu Zanzibar 8094 (4.00 ha) Alpin Valenca 3 290 (3.29 ha) LiongoControl 2 239 - (0.90 ha) AliHtumba411 - (0.16 ha) Total: 2 4654 (13.66 ha) Cassava root sales generated were Tshs.15 000 = US$2 500.	- Attack by cassava mealybug in some plots of varieties of Msitu Zanzibar and Aipin Valenca red-corn, the expected hectarage to be covered by 9 percent. . Distribution of planting material limited only to surrounding villages due to lack of transportation for distribution of the planting material.
1994 10 1996	To establish breeders seed and nucleus multiplication plots on station for future use in experimental trials and distribution to farmers and NGOs/projects.	Multiplication of cassava planting material of selected/common varieties per targeted environments.	Ukiriguru (Lake zone).	Number of cuttings produced and area to be planted in 1995/96. Aipin Valenca 29 020 (9.0 ha). Msitu Zanzibar 178 536 (17.9 ha) Liongo, Kwimba 89192 (8.9ha) Subtotal 296748 (29.7ha).	Eight thousand (8 000) cuttings distributed to farmers free of charge. 260748 cuttings sold to IFAD Project and Catholic Relief in Mara region.
			Kibaha Eastern Zone) Mtopwa (Southern Zone).	Kibaha-143 490 (14.3 ha) Kigomared -9 000(0.9 ha) Kaniki - 3 000 (0.3 ha) Misugusugu - 49 50 (0.5	Materials distributed for farmers. Ratooning and expanded planting continued on

PERIOD	EMPHASIS	ACTIVITIES	LOCATION (M)	OUTPUT(S)	REMARKS
				ha) Kigoma cheupe - 9 00 (0.9 ha) Subtotal 161 340 (16.9 ha). Kibaha-214 500(21.4ha) Kigoma red-80 00 (0.8 ha) Subtotal - 222 500 (22.2 ha) Grand total: 680 588 (68.8 ha)	station as well as with farmers. . Site selection with low CBSD pressure required for clean healthy planting material in Kibaha and Mtopwa. Funding sources are being solicited to establish more multiplication units.
	2. Training of farmers and extensionists in rapid multiplication techniques.	Conducting by monthly workshops in collaboration with extension department through NALREP Project.	Lake Zone.	Several bimonthly workshops organized.	Training of farmers on the rapid multiplication techniques needs to be strengthened for ensuring sustainability.
		Organizing fanners field days and training demonstrations. Dissemination of the technology through extension leaflets. Contracting pilot farmers to multiply the planting materials.		Several field days organized. One leaflet on the rapid multiplication techniques and sanitation produced at Ukiriguru and tested with fanners and extensionists in 1996.	Strong linkage with NGOs and other projects to be strengthened for continued support in this expensive exercise.
			Mara region (IFAD Project).	Participation of farmers in multiplication of planting material attained.	
	To establish cassava multiplication fields of local varieties previously grown in Wanda, for refugees from Wanda hosted in Ngara district -	Establishment of 8 ha of different cassava varieties (Kitamisi) shingwin, Gachachari Ngunda, rusula and Kasimbaruze in January 1994.	Rusumo prison, Ngara district(Kagera region).	Number of cuttings distributed in 1996 and area to be planted Ngunda-53 500 (5.4 ha) Lushingwinkuba -272 850(27.3 ha)	Objective to give materials to refugees not achieved because refugees had not returned back to their homes. All cassava materials were

PERIOD	EMPHASIS	ACTIVITIES	LOCATION (M)	OUTPUT(S)	REMARKS
	Kagera region. Materials to be distributed to the refugees when returning back home after peace has been restored. The project executed by IITA, Nigeria.	In March, 1996 all ratooned crops were fertilized and roughed.		Kasinbaruzi - 27 250 (2.7 ha) Rusula-10 350(1 ha) Kachachali - 21 750. (2.2 ha) Katamizi - 7 500 (0.8 ha). Total:393 200 (39.4 ha).	given to farmers in Ngara district to replant the cassava fields devastated by the influx of refugees. Cassava planting materials to be distributed in 2 997 to more farmers. . Multiplication of cassava planting material to continue in Ngara district.
	To multiply planting material for farmers in Mara region.	Establishment at village level of cassava multiplication schemes.	Mara region. Mara Region Farmers Initiative Project.	Primary centres of multiplication established. Distribution of planting material to pilot farmers.	The project is at infancy stage to realize the full impact.
		Assist farmers in: preparation of seed multiplication programme; organizing the multiplication network; supersizing the selection of pilot seed producers; purchasing and distributing the initial stock of planting material; controlling the quality of materials; generated before large-scale distribution; training the pilot farmers in seed selection, multiplication and storage techniques to ensure sustainability.		Accomplished. Special attention given to drought and post hit districts. Linkages with all key players in cassava research strengthened. Support to A.R.I. Ukiriguru to multiply the improved materials of cassava provided. Protocols with Ukiriguru and Biocontrol Programme.	

Source : SARRNET Technical Reports(1994/94 and 1995/96), Kapinga, R.E. (1996), Roots/Tubers Progress Reports 1993–1996

Table 12. Research advances on the improvement of cassava post-harvest handling techniques and utilization in Tanzania

Period	Emphasis	Activity(ies)	Location	Output/finding	Remarks
1985 to 1990	(i) Problem identification, processing and utilization of cassava in Tanzania.	Situational analysis of cassava in the country.	Mtwara, Shinyanga and Zanzibar.	Potential role of cassava for improved household food security and nutrition known.	Sokoine University worked on improvement of traditional processing of cassava. TFNC focused on development of cassava weaning foods. TBS/tonne FNC directed efforts towards establishing quality standards for cassava flour.
	(ii) Cassava processing and cyanide exposure in Tanzania	Investigations on: i. Outbreak of paralytic disease (konzo) in Tarime district; ii. Outbreak of acute intoxications in Masasi; iii. Goitrogenic role of cassava in Kigoma district.	Tarime, Masasi and Kigoma districts.	Cyanogen levels in cassava products Tom Masasi and Tarim were known. Estimation of cyanide metabolite (Thiocyanate) in humans urine and serum were determined.	Awareness of the role of cassava cyanide causing health problems was created. Insufficient cassava processing was identified as a major role.
1990 to 1994	Documentation of indigenous technical knowledge	Village level surveys with farmer groups during COSCA studies.	Cassava growing zones in the country	Traditional cassava processing methods documented. Narrow range of processed products identified. Resources for cassava processing were known. Desirable quality characteristics for cassava processed products were elucidated. Efforts to introduce low cost cassava processing equipment were nitiated.	Post-harvest handling activities were emphasized by Roots and Tuber Programme, TFNC and SUA. Product development and diversification of secondary products Root/Tuber Programme and TFHC. Training of staff on post-harvest handling and product development.
	Documentation of indigenous technical knowledge	i. Case studies conducted.	Lake Zone Tanga	The problem with poison (cyanogens) in cassava was known. Sensitization of farmers	Improvement of the existing processing methods. Workshops on

Period	Emphasis	Activity(ies)	Location	Output/finding	Remarks
				on improved methods of processing and new uses of cassava for home consumption. No gander balance in cassava production, post-larvest and marketing.	efficient pocessing methods to be organized. Labour saving technologies need to be developed.
		(ii) Survey on reasons for use of sitter cassava.	Mtwara, Masasi and Newala districts.	Reason for use of litter cassava identified varieties, cultivated n the area were known. Methods for processing and problems - associated with bitter cassava varieties documented.	Efficient processing methods to remove cyanogens in cassava advocated for by TFNC and Roots/Tuber programme.
		(iii) Heads assessment studies conducted for non-grain starch staples (NOSS).	Lake Zone and Tanga	Market demand for cassava in Dar-es-Salaam determined. Constraints and opportunities in VGSS post-harvest system documented.	Quantification of market losses in fresh cassava roots need to be investigated. Low cost fresh cassava root storage technology needs to be disseminated.
	Introduction of alternative uses of cassava	Training demonstrations to rural communities on cassava product development.	Tarime and Kwimba districts.	350 trained through demonstrations.	Follow-up to assess the adoption of the processing technology.
	Introduction of improved techniques of cassava post-harvest handling.	(i) Demonstration in villages on improved processing methods for cassava.	Musoma rural and Kwimba district.	250 farmers involved in the activity.	Follow-up to be carried out. More efficient processing equipment needed
		ii) Staff training	Ukiriguru and TFNC	Seven food scientists trained in cassava post-harvest handling and product diversification.	Dissemination of the gained knowledge to rural communities, urban entrepreneurs and processors
		iii) Cassava processing and toxicity workshops were held for regional district, divisional and village extension workers.	Lake and southern zones	75 regional, district divisional and village workers trained.	Follow-up of adoption of *gari*processing in lake and southern zones.
		(iv) Needs	Morogoro	16 staff trained in the	

Period	Emphasis	Activity(ies)	Location	Output/finding	Remarks
		assessment training workshops for regional technology transfer for NGSS crops in Sub-Saharan Africa.		national needs assessment workshop.	
1995 to date	Introduce improved techniques for cassava post-harvest handling	1) Training communities on product development and diversification	Lake and eastern zones	A total of 140 extensionists, farmers, processors and small entrepreneurs were trained.	Follow-up on the adoption of the technology is needed.
		(ii) Demonstrations on improved cassava processing methods	Lake and eastern zones	A total of 250 farmers, extensionists processors and small entrepreneurs received training.	Follow-up adoption of the improved methods.
		(iii) Acceptability study for the developed cassava secondary products.	Lake zone	Ninety (90) farmer extensionists and village leaders, participated Three products identified as being very acceptable.	Promotion of the three most acceptable products to continue. Expansion of the activities to other areas.
	Introduce improved techniques for cassava post-harvest handling.	(iv) Testing of modified graters with farmers.	Lake and eastern zones	Packages and suggestions for modification of the graters were obtained.	Modification of the fabricated graters to be made.
		(v) Impact assessment of cassava product development and diversification.	Lake zone	More than 60 percent of the people trained are still using the technology preparing the three most accepted products. 47 percent of the trained people prepare products for home consumption while 13 percent prepare them for selling.	Similar study to continue in other areas.
	Introduce improved techniques for cassava post-harvest.	(vi) Improved cassava processing in Southern Tanzania.	Mtwara region	Studies still ongoing.	Findings will be replicated in other cassava growing zones.
Cont'd		(vii) Post-harvest problems of cassava storage in Tanzania.	Lake western and southern zones.	Important pests responsible for losses of stored cassava products were identified. . Quantification of storage losses was made.	Efforts to control the identified posts need to be instituted.

Period	Emphasis	Activity(ies)	Location	Output/finding	Remarks
	Development of improved cassava post-harvest technologies by ensuring safety for human consumption.	Linking with A.R.I, ukiriguru on expertise on post-harvest handling techniques at farm level. Formulation of Protocols with A.R.I. Ukiriguru on cassava product development and introduction of improved post-harvest technologies	Mara Region - Farmers - Initiative - Project	Protocols for implementation already established.	Proposed activities to be undertaken in mid 1997.

Source: Msabaha *et al.,* 1986; Mlingi *et al.,* 1992; Mlingi *et al.,* 1991; Mlingi *et al.,* 1995; Mlingi *et al.,* 1996; COSCA Tanzania, 1996 ; Kapinga *et al,* 1994; Digges *et al,* 1994 ; SARRNET technical reports 2994/95 and 1995/96; Ndunguru *et al,* 1994 ; Roots/Tubers Programme Progress Report 1995/96; Wright *et al,* 1996; Thro, A., 1993, IFAD, 1996

5.6 INFRASTRUCTURE AND SERVICES

5.6.1 Inputs

Cassava being a subsistence crop is produced by small holder farmers under marginal lands. Among the inputs in the production of food crops which a household may be lacking is availability of farm land, hired labour and mechanization (COSCA Tanzania, 1996). In this case land has to be acquired by requesting land allocation from the village government or the community in which he/she is living, or be bought. Most subsistence farmers own at least a small piece of land where food crops such as maize, cassava, millet, etc., are grown.

In Tanzania households are headed by 80 percent men and 20 percent women. Gender influence the frequency of the use of purchased inputs, while the uses of hired labour and mechanized transportation are less frequent among fields of female headed households than among fields of male headed households (COSCA Tanzania, 1996). Farm mechanization such as seedbed preparation or farm transportation is less frequent among female owned fields than among male owned fields. The frequencies of use of other purchased inputs were about the same. Transport vehicles are operated by the male while carrying of farm produce by head load is mostly a female operation. In a few cases farmers (especially cattle owners) use ox-drawn implements for activities such as land preparation. Transportation of farm produce from the fields to their homes and cassava products to the markets after processing. The combination of all the above (i.e. hired/group labour, field to home transportation and land availability) may influence cassava land area expansion (COSCA Tanzania, 1996).

Food crop milling machines are available at the village level, to individual farmers on a custom basis. A farmer takes his food crops to the village square or to the market place to be milled for a fee. The milling machines are not crop specific; with different appliances

the same machine is used to mill different crops or the same crops of different farmers whether wet or dry. Therefore, mechanized food processing although an important purchased input in the smallholder agriculture is a unique type of input and it is treated as a village level infrastructure.

5.6.2 Market accessibility

Ease of access to market centres, availability of cassava marketing middleperson, credit and unproved post-harvest handling facilities which would link the farmers to sources of demand for farm products and supply of farm inputs is called farmers' access to market (Nweke, 1996b). Information collected in Tanzania during the COSCA study on cassava market accessibility showed that means of access to the market was either by motor vehicles, foot or other means such as usage of bicycles, animal or boats (COSCA Tanzania, 1996). Proximity to market was grouped into categories above or below 10 km based on a subjective estimate of the distance a farmer can walk in a day with a head load of cassava products. Farmers in 50 percent of the villages surveyed attended markets on foot, over a distance of not more than 10 km (Table 13).

Availability of middleperson (traders and processors) facilitates the marketing process for farmers especially to distant markets. The farmers will spend more time on production activities rather than on marketing. Communication to the cassava producing areas in Tanzania is poor and very limited among the COSCA study countries, with the exception of Zaire, the relative number of villages that had paved road access to market centres was lowest while the relative number which used dirt roads was highest in Tanzania (Appendix 5).

Most roads from the district headquarters or towns close to the cassava producing villages are poor and some are impassable for three to six months in a year. This renders transportation of cassava and its products from the producing centres to the marketing centres difficult and very costly. Good road links expand the market demand for cassava because farmers can reach more consumers with their harvest (COSCA Tanzania, 1996). A fine example in Tanzania is the urban supply of fresh cassava roots in Dar-es-Salaam city where the market is flooded with fresh roots from Coast, Morogoro and Tanga regions which are connected to the city by the tarmac road. The southern zone is a big producer of cassava but cannot sell their bumper harvests to the needy regions like Dar-es-Salaam, Coast, Tanga and Morogoro. However, cassava produce in the southern zone finds its market, especially the dried product, through ships and boats which can load and off load at Mtwara port because of poor road infrastructures some roads to the southern zone are impassable for about six months of the year.

From the overall analysis, the level of investment in village-level road construction is low compared to other cassava producing countries.

Table 13. Percentage distribution of surveyed villages by indices of market access in Tanzania with other major producing countries (1990–1992)

Market	Côte d'lvoire	Ghana	Nigeria	Tanzania	Uganda	Zaire	weighted mean
Distance and means to market places motor vehicles, any distance							
Non-motor vehicles any distance footless	28	46	38	27	3	5	24
More than 10 Ian foot, 10 km and above							
Total	3	4	5	12	28	7	9
	59	39	54	50	69	47	53
	10	11	3	11	0	41	14
	100	100	100	100	100	100	100
Main cassava mot buyers:							
Middleperson	52	81	86	19	31	42	54
Consumers	48	19	14	81	69	58	46
Total	100	100	100	100	100	100	100
Credit institutions							
Money lenders							
Available	33	7	17	11	5	12	15
Mot available		93	83	89	95	88	85
Total	67	100	100	100	100	100	100
	100						
Cooperative service							
Available	93	53	91	79	82	17	70
Mot available	7	47	9	21	18	83	30
Total	100	100	100	100	100	100	100
Trade loans							
Available	28	13	31	11	0	26	20
Mot available	72	87	69	89	100	74	80
Total	100	100	100	100	100	100	100
Mechanized processing technologies							
Greeting machines							
Available							
Not available	10	17	52	0	0	0	15
Total	90	83	48	100	100	100	85

Market	Côte d'lvoire	Ghana	Nigeria	Tanzania	Uganda	Zaire	weighted mean
	100	100	100	100	100	100	100
Milling machines							
Available							
Not available	18	83	55	33	62	1	38
Total	82	17	45	67	38	99	62
	100	100	100	100	100	100	100

Source: COSCA, 1996

5.6.3 Storage facilities

In ground storage of fresh cassava roots is practised in most of the cassava growing zones whereby roots are left in the ground and harvested in piecemeal when the family requires them. Harvested cassava roots may be stored in sacks on a short-term basis since deterioration starts two days after they are harvested. Recent efforts to introduce the low cost cassava fresh roots storage technology is meant to extend the shelf-life of the fresh roots of cassava soon after harvesting. The technology has long been used in various parts of the world and has been transferred, tested and validated in local Tanzania conditions. It has been found useful in extending cassava fresh roots supply from Kisarawe district, coast region, since 1995 (G. Ndunguru, 1997. Personal communication).

Traditional storage facilities are employed in the storage of cassava products especially the dried cassava pieces or chips called “makopa” and “udaga”. Storage in the form of flour is not preferred, in order to minimize flavour changes and insect infestation. Lack of storage facilities for flour products may be another setback. Dried pieces/chips are usually stored in sacks, large woven round baskets called “Whenge” on the floor in the house, in the attic, etc. When stored in the house on raised platforms heaped above the cooking place in the kitchen or in the attic, there is an additional advantage of getting the product smoked which preserves it further. Makopa can be stored for two to three months before insect damage but the smoked ones can be stored for one year. Dried cassava chips are easily marketed because traders find it easier for transportation and often the products fetch higher prices in the market (Wright *et al.,* 1996).

In the local markets farmers sell dried chips to traders or middlepersons who in turn transport the products to big towns or the cities and sell them to retailers or market vendors. At national level, the National Milling Corporation (NMC) used to purchase dried chips which could either be stored in the sacks or heaped on the floor in the godowns. The NMC has of recent, stopped purchasing cassava chips where in some areas businesspersons have taken over the purchasing and exporting.

5.6.4 Processing infrastructure

The need for cassava processing is for ease of marketing, reducing bulkiness and perishability, extending shelf-life, removing cyanogens, reducing transportation costs and

adding value to a unit weight. This applies to fresh cassava root because it contains between 62–65 percent water and starts deterioration within two days after harvest. Cassava processing methods include a combination of several procedures that are performed during specific time periods and in specific sequence. On average, 75 percent of the total cassava produced in Tanzania is processed and only 25 percent is used in fresh form (COSCA Tanzania, 1996). The proportion of total cassava processed is higher among farmers who grow bitter cassava than sweet varieties.

The main activities involved in traditional cassava processing include peeling, crushing, milling, slicing, sun or smoke drying, frying/roasting, fermenting by soaking or heaping, stacking or sedimentation, sieving, cooking, boiling or steaming (COSCA Tanzania, 1996). When carrying out these activities one can achieve the intermediate products which need further preparation for a meal or end products which can enter the marketing system directly.

Traditional processing methods and major processed products

The numerous technological pathways of cassava processing take advantage of locally available processing resources such as water for wet fermentation and sunlight for drying and firewood for frying, etc. These environmental factors are complemented with the availability of the processing equipment and available technologies. Labour for peeling, pounding/milling and roasting is the only processing resource constraint which no traditional technique has been able to address. Certain convenient cassava food products such as roasted or fried fresh root pieces, which are attractive to urban consumers are however made whenever market demand exists irrespective of whether the necessary processing resources such as charcoal or firewood for frying are available.

The major cassava product processed in Tanzania, chips/flour is known by various names such as chinyanya “makopa abutega kondowole, onnindyenge, udaga, chikondole, bada, dimwehe uhu, undule, mbule, makonga, obusanobwe or kivunde”. The products are made by a wide range of alternative traditional processing methods. These were grouped by COSCA under one major product namely cassava chips/flour. Elaborate notes on the processing techniques and cyanide levels of some processed products are presented in Appendix 6.

Processing equipment

The various techniques used in cassava processing at household level involve manual labour and in most cases traditional processing tools are employed as a means to obtain desirable end products. Traditional tools include knives for peeling and slicing, mats for sun-drying, big clay pots for fermentation and pestle and mortar for pounding, etc. Most of these tools are rudimentary hence limited in operational capacity, causing the labour input invested in the processing chain to be high. Available processing resources sometimes determine the type of cassava product to be processed. In Tanzania the bulk of cassava crop is processed during the dry season when there is strong sunshine for drying purpose.

Although chips being dried on a mat or in flat baskets may be moved to protect them from bad weather, those dried on rocks in the field, roadside, on the roof top, etc. are often not moved. If it rains, the chips get soaked and drying is started all over again (Mlingi, 1988). The wide range of drying surface possibilities and practices are such that the products can gather significant amounts of mould, dust and other dirt which influence the taste and colour of the end product.

5.6.5 Extension services

Organization of extension services for cassava crop in Tanzania starts at the ministry level where the responsible person for all the extension activities is the Assistant Commissioner for Extension and Agriculture. At this level a subject matter specialist is the implementer of all the activities. At the regional level three people are responsible for extension services. These are the Regional Agricultural and Livestock Development Officer, the Regional Extension Officer and the Subject Matter Specialist (RSMS). The next stage is at the district level where there is implementation of all the extension service. The DALDO, DSMS, DEO and DCO work together. The execution of all activities and setting of target is carried out while implementation is carried out by the Division Extension Officer (DIVEO) and Village Extension Officer (VEO).

The flow of research recommendations/information is channelled through different levels depending on the type of clients. As from 1989 there has been some strengthening of the farmer-research-extension linkages through the National Agricultural Livestock Rehabilitation Programme (NALERP) administered by the Ministry of Agriculture. Several bimonthly workshops have been conducted to train extension agents. In the bimonthly workshops researchers participate fully in the sessions.

6 GENDER ROLES IN CASSAVA PRODUCTION AND UTILIZATION

Gender roles in cassava production do not differ very much from one area to the other. For example land preparation in the lake zone is done by both men and women, with the exception of ox-ploughing. Generally land preparation is done using hand hoes (Karlen, 1991).

Planting is also a shared activity in some regions Eke Mwanza, however, in general situations, this activity is mostly carried out by women. Weeding is carried out by both male and females, but with more labour input from female farmers (Rugimbana and Nyanga, 1995). Harvesting is mainly women's work with more labour input especially in transporting of crops to the homestead (Thro, 1994). In Tanzania women provide much of the labour for the staple crops such as maize, rice, cassava and sweet potato. Food processing, preservation and storage is a major responsibility of female farmers. COSCA studies in main cassava growing areas showed that about 75 percent of the arable fields were owned by men, 15 percent by women and about 10 percent by whole families (Table 14).

Table 14. Percentage distribution of crop fields by gender ownership

Crops	No. fields	Whole family	Men	Women	Total
	Percentage				
Cassava	249	10	82	8	100
Sweet potato	21	19	0	81	100
Banana	19	28	67	5	100
Maize	102	10	10	79	100
Rice	34	34	23	59	100
All	424	12	75	13	100

Source: COSCA-Tanzania (1996)

Decisions pertaining to the sale of cassava products are made by the male head of the household where large proportions of the products are intended for sale. In such cases the man usually dictates on the use to be made of the cash earned. Small cassava sales are controlled by women and the money obtained is mostly used for small necessities such as soap, matches, salt, notebooks for school children, etc. (Thro, 1994).

As already noted women's labour input in cassava production and post-harvest handling is enormous. This is further aggravated by the use of traditional implements, which are in most cases limited in terms of operational capacity and also by the additional responsibilities that a woman has to fulfil.

A case study conducted in Kwimba district, in the lake zone, on gender role distribution in various activities indicated that involvement of women in agricultural production goes parallel to their involvement in domestic chores i.e. house and childcare, food preparation, water and fuelwood fetching etc. (Appendix 7).

In view of the above-mentioned analysis, the promotion of appropriate technologies to reduce women's workload is inevitable. Some efforts have already been directed towards addressing these issues but only in a limited way, hence further promotional activities are necessary.

7 CRITICAL ANALYSIS OF SUCCESSES AND FAILURES

7.1 MARKETING MODELS

The main objective of government intervention in the food crop marketing system in Tanzania has been to ensure food security. Several pricing mechanisms have been tried in order to provide incentives to producers while keeping consumer costs low. This has led to continuous reform of marketing systems in the country. The semi-controlled marketing system inherited from the colonial period, could not achieve the national objective. The system provided low producer prices, while charging high prices to the consumers. Lower producer prices discourage production of food crops, hence national food insecurity.

The state controlled marketing system ensured that producers are encouraged to produce more through provision of higher prices. However, before 1974, the system employed could not fulfil the objective. Producers were further penalized by the cooperative unions who incurred high costs which were transferred to producers through low prices. On the other hand, consumers paid relatively low prices. Pan-territorial pricing systems discouraged food crop production in accessible areas, while encouraging remote producers.

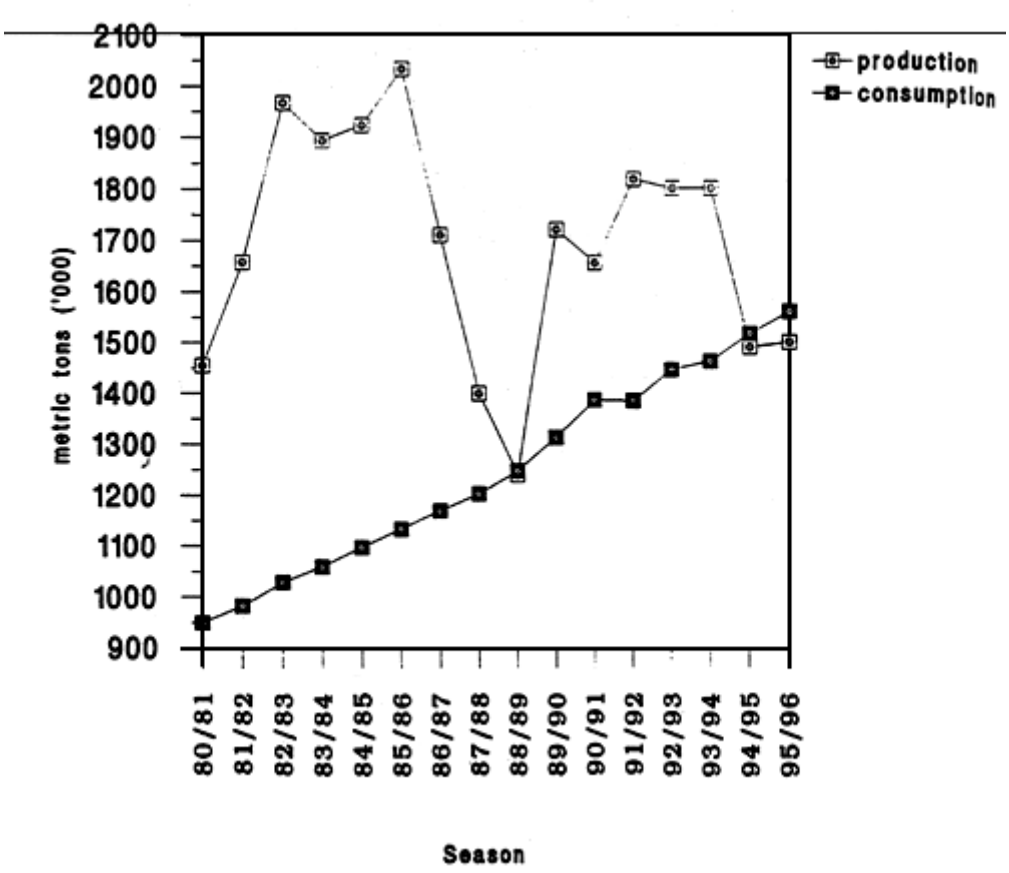
Trade liberalization has improved marketing of food crops because of easy access to markets such as local village markets 'magulio'. Also, it has increased competition which increases producer prices in accessible areas, hence encourages production of food crops. Tins has facilitated efficiency allocation of resources. However, more resources are allocated to the most profitable crops, while the less profitable food crops like cassava will be marginalized

7.2 PRODUCTION AND CONSUMPTION TRENDS OF CASSAVA IN TANZANIA

Trends of production and consumption (estimates) of cassava in Tanzania between the 1980/81 and 1995/96 season are shown in Figure 5. Consumption of cassava includes quantities consumed within and outside the country. Local consumption was estimated based on expected population and consumption growth rates as explained by FAO (1986). However, quantities exported are underestimated as reliable data could not be obtained.

The results show that in recent years consumption of cassava has exceeded local production. Major reasons could be due to outbreak of cassava pests (mealybug) and diseases which have led to low production.

Figure 5. Cassava production and consumption trend from 1980–81 – 1995–96



Estimated domestic consumption and official consumer prices were used to estimate demand elasticity for cassava. The result indicated that consumption of cassava increases with consumer prices, having a demand elasticity of 0.15 implying that demand for cassava depends on population growth. Nevertheless, it should be noted that, the driving force behind an increased demand for cassava is due to low production levels of the preferred staples caused by drought and the increased demand for carbohydrate food crops (FAO, 1986).

7.3 ECONOMIC BENEFITS AND RETURNS TO INVESTMENT

The Government together with other donors have invested in the development of the cassava sector in Tanzania. Available data indicates that cassava research and other complementary services particularly marketing and extension have not been adequately funded. As such the impact of research at farm level has been minimal. Studies have shown that when farmers use recommended practices the net benefit per unit area and labour productivity are higher than when traditional practices are used (MDB, 1983; COSCA Tanzania, 1996). Since information on the rate of adoption was not available, return to investment on research was not quantified. However, enterprise analysis shows that investing in cassava research has high return when the recommended practices are

adopted by farmers (Table 15). Moreover, cassava has contributed to the national economy as an export crop (Appendix 8) as well as a food security crop. It should however be noted that documentation and proper records of the exported dry cassava chips to European countries were not readily available. The current model on the trade liberalization actual records is not captured because of different informal channels by which cassava products are exported in foreign countries.

Table 15. Cassava production costs and return to labour, for 1994–95: A case of Mtwara region, Southern Zone

Local		Improved
Yield (tonnes/ha)	4.0	8.0
Producer price (Tshs)	25 000	25 000
Realization (Tshs)	100 000	200 000
COSTS		
Labour input requirement (person-days)		
- Land preparation	30	30
- Planting	12	15
- Weeding (x 2)	21	21
- Plant protection	0	3
- Harvesting	11	12
- Transport/marketing	4	6
Total labour days	78	87
Operational costs (Tshs)		
- Land preparation		
(Ploughing & Ridging)	18 000	18 000
- Plant protection	0	1 800
- Weeding (x 2)	12 600	12 600
- Planting	7 200	9 000
- Harvesting	6 600	7 200
- Transport/marketing	10 000	25 000
Total operational costs (TShs)	54 400	73 600
GROSS MARGIN	45 600	126 400
RETURN TO LABOUR (Tshs)	584.60	1 452.90

US$1 = Tshs 580

When the crop is marketed as dry chips/flour (makopa) it does not fetch high prices due to competition with the preferred grain staples particularly in urban centres, but when marketed as fresh roots, its prices are high (Ndunguru *et al*, 1994). However this trend is not sustainable because of bulkiness and persistability of fresh roots. Ways to improve the processing techniques in order to come up with a good quality product which can compete well with gram staples need to be envisaged. The case study conducted by the Tanzania Food and Nutrition Centre (TFNC) in collaboration with the Natural Resource

Institute (NRI) on the analysis of fresh cassava marketing costs and margins for cassava traded between Kisarawe (Coast Region) and Dar-es-Salaam market is shown in Table 16.

Table. 16. Cassava marketing costs and margins between Kisarawe (Coast region) and Dar-es-Salaam, 1994

Producer price (shs/bag)*	2 000
Uprooting and packing	400
Loading	200
Carrying to collection point in Kibuta	200
Village levy	5
Transport to DSM (Buguruni Markets)	800
Unloading	200
Commission fee	100
Market levy	10
Security charge	20
Storage charge	7
Carrying to the retail selling point	150
Total costs (Tshs)	4 092
Retail selling price (Tshs)	6 800
Profit (Tshs)	2 708

* = One bag of cassava fresh roots weighs 80 kg
Source: Ndunguru *et al.*, 1994
US$1 =TShs 580

An impact assessment study on the acceptance of introduced cassava products in the Lake Zone showed that cassava doughnuts and cakes were highly marketable in Mwanza and Mara regions which will increase the demand of cassava (Kapinga *et al.*, 1996). The net benefit analysis of cassava doughnuts shows a profit margin of Tsh 597.65 when one kilogram of makopa is processed and sold as doughnut (Table 17). The findings do not imply that cassava products are superior over others, but it is an indication that even in places where cassava is grown at large, farmers could still earn cash income from selling the processed products. Tins could raise the status of cassava from being an emergency crop after others have failed, to a cash crop.

Table. 17. Cost-benefit analysis of cassava product diversification: A case of doughnuts

Revenue: (Tshs)	
Output (doughnuts/kg)	75
Price (Tshs/ piece)	30
Gross margin (Tshs)	2 250
Processing Costs: (Tshs)	

Material	
Dry cassava chips kg	80
Miffing	11.7
Margarine 170 g	112.5
Baking powder 750 g	750
Sugar 75g	46.9
Cooking oil (610 ml)	307.5
Kerosinetcharcoal	93.75
Labour charges	250
Total Costs	1 652.35
Net benefit (Tshs)	597.65

Small-scale starch processing has been observed to have high returns to investment. However, this opportunity has not been utilized. A cost-benefit analysis was undertaken to assess financial benefits of scale cassava starch production in Dar-es-Salaam (Table 18). The result indicates that small-scale starch processing is a viable economic activity. Although the first round of operation has a higher negative balance, the second production has higher net benefit which off-sets investment costs.

Table 18. Economic analysis of small-scale cassava starch production in Dar-es-Salaam, 1996

Revenue: **Cassava starch (kg)** **Price (Tshs/kg)** **Gross Benefit**	**1st Prod.** **150** **1800** **270 000**	**And Prod.** **150** **1800** **2 700**
Production costs (Tshs)		
Fresh cassava roots (tonnes)	45 000	45 000
Transportation	1 500	2 000
Grating	6 100	6 100
Filtering cloth	8 000	0
Sedimentation drums	219 960	0
Drying mats	24 000	0
Packaging (bags)	4 500	4 500
Labour costs	12 000	12 000
Total costs	321 060	69 100
Net benefit	-133 215	200 900

Note: Production is estimated at two operations per month. All production is undertaken in one month

Investment in the multiplication of cassava planting material is another venture where farmers can benefit as indicated in one of the case studies in at Ukiriguru Research Institute, lake zone (Table 19). The estimates of the operations have put into account only the basic requirements for the good quality planting material. The cassava multiplication

plots are discarded after two cropping seasons to ensure production of good healthy planting material.

From different case studies analysed it is obvious that cassava can enter well into a commercial sector to realize its full potential. Efforts to add the value to cassava need to be strengthened.

Table 19. Benefit-cost analysis of multiplication of cassava planting material, in the Lake Zone

Benefit :	Year 1	Year 2
Output:		
Planting material (number of plants/ha)	15 000	15 000
Price for planting material (Tshs ./plant)	20	20
Price for fresh roots (Tshs/ plant)	0	20
Gross benefit (Tshs./ ha)	300 000	600 000
Operational Costs:		
Land hire	20 000	0
Labour costs:		
Land preparation	18 000	0
Planting	9 000	0
Thinning	0	3 600
Weeding (x3)	18 900	26 838
Farm yard manure (lOt/ha)	50 000	0
Inorganic fertilizers	55 000	65 000
Plant protection (rouging)	10 000	14 200
Harvesting of planting material	10 000	14 200
Total costs (Tshs)	170 000	128 3838
Net benefit (Tshs)	109 000	476 162

US$1 = Tshs 580. Estimates are based on the experiences of Root/Tuber Research Programme at Ukiriguru Research Institute 1994/95–1995/96. The variety used is Liongo Kwimba.

7.4 COMPARATIVE ADVANTAGE OF CASSAVA PRODUCTION

In Tanzania, cassava is an important food security crop and its production is becoming more important throughout the country due to its drought resistant and storage (in ground) characteristics. The crop has more advantage over the major grain staples in dry areas. It is logical therefore, to invest in cassava production in such areas because, normally, the same areas have poor soils in which only crops with low resource requirement, such as cassava, can perform well. Some areas in Tanzania have been identified to have a comparative advantage in cassava production over other zones. These areas include: lake zone, eastern zone, southern zone and Zanzibar. However, lack of data make the quantitative analysis difficult in determining the comparative advantage.

Nevertheless, proxies such as weather (rainfall) and soils are used in selection of areas (zones) with comparative advantage in cassava production.

To measure the comparative advantage of Tanzania in production of cassava and hence its economic efficiency from the national point of view, the Domestic Resource Cost (DRQ) was used (Table 20). The results show that DRC for improved and traditional production practices were 0.59 and 0.93, respectively. This implies that both cassava production practices, by comparison have comparative advantage, with DRCs less than one. However, traditional production practice is not as efficient as the improved one by having a higher DRC of 0.93.

Analysis of producer prices through PAM gave a Nominal Protection Coefficient (NPC of 0.78), which is lower than one, implying that prices paid by buyers to farmers were lower than the international parity prices for cassava. Tins means that cassava producers were taxed by the Government.

Table 20. Policy Analysis Matrix (PAM) for cassava production (1991/92)

		Cost of production		
	Revenue	**Tradables**	**N-Tradables**	**Profit**
	Tradition Improved	**Tradition Improved**	**Tradition Improved**	**Tradition Improved**
Private Values	15000 39000	0.0 0.0	22698 28192	-7698 10808
Social Values	19275 50115	0.0 0.0	17874 29446	1401 20669
Divergence	-4275 – 11115	0.0 0.0	4824–1254	-9097–9861

NPC= Both practices = 0.78
DRC: Traditional practices = -0.93
Improved practices = 0.59

7.5 AGRICULTURAL POLICY

The Tanzania economy is dependent on agricultural production which contributes to 55 percent of the Gross Domestic Product, 60 percent of the foreign exchange earnings and employs about 81 percent of the labour force (Wilson, 1994).

The present policy emphasis is to expand production of domestic food crops for ensuring food security and export crops for increased earnings. As a result of this policy, there has been a shift towards cassava particularly in the drought prone areas because of the need for more drought tolerant crops (MALDC, 1995). Successes and weaknesses of the current policy are summarized in Table 21.

Generally the research policy has succeeded in promoting cassava production by funding research, developing human resources, infrastructure and creating awareness on the importance of cassava to the farmers. The limitations have been low level of funding, lack of enough human resources and infrastructure, dependence on external funds for cassava research and limited motivation packages to research staff.

7.6 FULFILMENT OF OBJECTIVES AND SCIENTIFIC ADVANCES

7.6.1 Germplasm development

The major objective of cassava breeding is improvement of genetic potential of the crop. Since its inception, the breeding programme has increased research efforts towards developing varieties adapted to targeted environments. Some varieties which have been released since the 1960s are still with the farmers in various agro-ecological zones. These include: Aipin Valenca, Lyongo (Liongo), Kigoma, Mzungu, Kibaha, Njema, Agriculture, Msitu Zanzibar and Kaniki (Table 22).

The breeders are aware that varieties released are subject to different criteria set by the consumers to ensure good adoption, even after release. A participatory research approach in which farmers are involved from the beginning in selecting the desirable varieties has recently been adopted by researchers. Strengthening of this approach in future is a must in order to minimize research costs and maximize selection efficiency.

Limitations of the breeding activities are that development of cassava varieties for targeted environments are very expensive because of the time required to complete a breeding cycle. Funds allocated are limited. At present the programme depends entirely on the external sources of funds. External funding is the only source for breeding activities. Sustainability of this activity is questionable, as once the external funding ceases, there is a chance that most promising activities will freeze. So the whole process of improving the cassava genetic potential will slow down.

Breakdown of resistant varieties due to diseases especially CBB, CBSD, ACMD and pest CGM CMD is prevalent in the country (Msabaha *et al.,* 1988). This has slowed down the process of breeding and rapid diffusion of improved varieties to farmers. Susceptible varieties but with good root qualifies need to be addressed.

There is also limited utilization or acceptability of cassava varieties with high cyanide levels particularly in Zanzibar and coastal areas. Good varieties are rejected by some farmers because of high HCN content (COSCA Tanzania, 1996). Research towards addressing HCN has been initiated at the Tanzania Food and Nutrition Centre (TFNC) for processed cassava products Mlingi, 1995). However, there is a need to strengthen this activity, at the same time initiate studies on cyanide levels in fresh roots of cassava.

Table 21. Successes and limitations of the national agricultural policy

Problem	Intervention	Successes	Limitations
Government policy on agricultural food crops not very clear	Research on some food crops initiated	Government allocated land for research - Little human resources devoted some time to food crop research	Research on food crops not given importance - The emphasis on research was on cash crops.
Government policy needed on	Policy statement on importance of cassava as a	More land allocated to research in various agro-	- Low level of funds for cassava research

Problem	Intervention	Successes	Limitations
the status of food crops in the country	food crop and emphasis on expansion of food crops	ecological zones in the country - Some funds allocated for cassava research - Human resources allocated for research of cassava - Infrastructure developed for food crops research	- Limited human resources development - Limited development of cassava infrastructure.
Clear policy on Agricultural food production needed	Policy on agricultural food crops formed and emphasizes on the importance of drought tolerant crops and sensitizes people.	- There has been a shift towards cassava particularly in drought prone areas. - Cassava prioritized as a second Driority crop in crop research in the country, its status evaluated.	- Cassava considered as an emergency food crop when cereals fail.
		- Effort in human resources development increased: three M.Sc. and two Ph.D.s are still on training - Short-term training undertaken - Physical resources attained at a minimum requirement five vehicles nine motorcycles and 25 bicycles allocated to the programme. - Government policy encouraged collaboration with other international and national institutions	- Staff morale is low due to lack of motivation by the Government - Funding levels still on the lower side - Infrastructures still to be developed - Research activities too dependent on funding from donors therefore sustainability for future research activities is questionable.
	Government support of production and control of pests/disease of cassava. Government policy on increased efficiency of its human resources.	Some major pests and disease (cassava mealybug) have been controlled. - Wide coverage of cassava research in the country has made it possible to conduct research throughout Tanzania. - Retrenched some unskilled staff	Level of funding to support biocontrol activities. - Few research staff on cassava, has made full attainment of research goals impossible. Retrenchment exercise has slowed down field activities tremendously.

Source: MALDC(1995)

Table 22. Successes and limitations of research interventions on cassava crop genetic potential improvement

Problem	Interventions	Successes	Limitations
Cassava varieties with low genetic potential in yield resistance to diseases/pests and undesirable quality characteristics	- Develop and select cassava varieties with desirable characteristics - Exchange and introduction of germplasm in the country.	- Research efforts increased towards developing varieties adopted to targeted environment - Various good varieties released and are with the farmer, six varieties in the lake zone, five in the southern zone, four in the eastern zone and two in the southern highland - Incorporation of various criteria set by consumer to ensure good adaptation of varieties even after release. - Participatory approach in which farmers are involved from the beginning in selection of desirable varieties - Some varieties with good resistance to diseases and with good quality released.	- Breeding/developing cassava varieties for targeted environments appears expensive because of a long breeding cycle of cassava - Funds allocated to breeding are limited and also at present depend mainly on external funds. Sustainability of this approach in questionable, as once external funding ceases, promising activities will have to be frozen. - Protocol involved in exchanging and introducing new germplasm from other countries is cumbersome, need for the Government to shorten the procedure. - Prevalence of outbreak of important diseases (CMD CBB, CBSD) slows down the breeding process
Bitterness/toxicity of cassava varieties	Research on HCN levels initiated at TFNC and SUA	- HCN levels of cassava processed products determined	-No research is being done on establishing cyanide levels of Tesh cassava roots - Some good varieties rejected by farmers due to their high HEN content.

7.6.2 Adoption or non-adoption of varieties

There have been informal releases of cassava varieties to farmers. Varieties Aipin Valenca, Msitu Zanzibar, Amani 4763/16, Amani 46106/27 and agriculture are among the varieties with high yielding abilities still with farmers. However, it has been difficult to trace many varieties because they might have acquired local names. Appendix 9 shows the names of varieties selected from research institutions and still with farmers in different zones as observed from COSCA studies and key informants that worked in the past with the Amani Research Station. Studies to establish the distribution of improved varieties is needed, while molecular marker DNA finger printing techniques could help to characterize the same varieties that might have acquired different local names. This will remove uncertainties on the adoption of improved varieties at farm level. Also the underestimation or overestimation of the adopted varieties will be minimized.

7.6.3 Improvement of cropping systems with cassava

Improvement of cassava agronomic practices has been to some extent addressed by research (Table 23). Poor soil fertility under continuous cropping of cassava is an issue which requires attention. Integration of the legumes in continuous cassava cultivation seems to improve solution for soil fertility. However the system has not been tested on-farm and therefore recommendation of this practise to farmers is yet to be done; and socioeconomic implications of this practise has to be determined before popularizing this practise (Roots and Tubers Annual Report; 1994).

Other studies so far have been location specific calling for attention to other zones. Some research recommendations have been adopted while others are yet to be adopted. Research efforts towards addressing this issue are still at an infancy stage.

Limitation to this activity is that multiplication of planting materials is a very expensive exercise particularly in dry areas because biomass production is low in comparison to moist areas (Table 24). Also the multiplication rate of cassava is low relative to food grains. Training of farmers in multiplication and off-season storage of planting materials could sustain this exercise.

Absence of facilities for rapid multiplication of vegetatively propagated crops complicates management of root and tuber crops and slows release of new disease and pest tolerant cultivars (Wilson, 1994). Facilities for this activity need to be in place, for easy execution of the whole exercise. For the initial stages the external funding support for multiplication of planting materials is required urgently. For sustainability however, farmers and all key players should participate fully in the process.

7.6.4 Reduction of pests/disease incidences

Vulnerability of cassava to devastating diseases and pests are causes for concern (Wilson, 1994). ACMD which has become a devastating disease along the coast regions, Zanzibar and the Lake Zone. Recently another strain namely East African Cassava Mosaic Disease was reported along the coastal belt of the Indian Ocean and North Western parts of Lake Victoria. However, there are hopes that devastation can be substantially reduced by some improved cassava varieties (Wilson, 1994). Research successes and limitations towards addressing this problem are summarized in Table 25.

These cultivars are at present in research stations and surrounding villages but their release, multiplication and distribution are still at the infancy stage due to financial constraints and the country is yet to benefit from them. The same trend has been observed in Cassava Brown Streak Disease (CBSD) observed mainly along the coastal regions stretching down to Mtwara region. Cassava mealybugs and cassava green mites are major potentially devastating pests in major growing areas of cassava; particularly in the semi-arid areas. It is very obvious that food shortages being experienced in some of the drier areas of northern Tanzania are partly due to cassava mealybug attacks. This also slows down the process of multiplication of cassava planting material in these areas. Biological

control through the predatory wasp *E. lopezi* has been introduced in the country but has had mixed success (Wilson, 1994). Some areas have reported successful control while others have reported no significant change and sometimes very little establishment of the wasps. Monitoring of the pest by researchers has been difficult because of lack of resources. These together with lack of commitment by the Government on containing this problem have led to increased pest attacks at farm level. Unless new measures of combating these devastating pests are taken, the increased production of cassava per unit area at farm level, particularly in the dry areas, remains doubtful.

Table 23. Successes and limitations of research interventions on the improvement of cassava agronomic practices

Problem	Intervention	Successes	Limitations
Poor soil fertility maintenance at farm level.	Use of organic and inorganic fertilizers - Integration of tree legumes in continuous cassava cultivation - Rotation studies.	- Fertilizer packages for sole crop identified. - Alley cropping with the legumes recommended. - Recommended packages for rotation with cassava identified.	- Inorganic use of fertilizer not economical to subsistence farmers because of high price of fertilizers versus low market value of cassava. - Use of farm yard manure limited to livestock owned only. - Alley cropping technique not yet on-farm and therefore socioeconomic implications not determined. - Rotation packages recommended for only one zone WCGA, not tested anywhere else.
Management practises on cassava fields very poor	- Weeding regime studies - Spacing studies on cassava - Plant density studies - Consequences of plucking leaves.	Weeding regimes identified and recommended - Appropriate densities recommended for various zones - Effects of plucking leaves noted and yield loss determined - Regimes of plucking leaves identified.	- Farmers not weeding appropriately - Plant densities of cassava depend on importance of cassava by the farmers. Time needed between harvesting leaves recommended for one zone only.
Lack of indigenous knowledge on the cassava field management practises.	Baseline studies by COSCA Project undertaken	- Existing Agronomic practises at farm level identified and documented. - Farmers distinguish between a major and a minor crop in recropping. Aggregate output main reason for intercropping. - Plant density of cassava in farmers' fields identified. Age of harvest identified Fallow system identified, diseases/pests, levels in cassava intercrops established.	- Need to incorporate existing agronomic practises into agronomy research. - Cassava densities low in farmers' fields. Fallow systems practised is very limited due to shortage of land. - Diseases/pests pressure in intercrops not significantly different from cassava monocrop.

Table 24. Successes and limitations of the research interventions on cassava multiplication and distribution of planting materials

Problem(s)	Intervention (s)	Successes	Limitations
Critical shortage of clean healthy planting materials at farm level	Establishment of multiplication plots of cassava planting materials at research institutions and nearby villages	Cassava varieties Liongo Kwinba, Msitu Zanzibar, Aipin valenca and Liongo Control, Kibaha and Kigoma Red distributed in their targeted areas.	Multiplication of planting material in dry areas is a very major constraints
Lack of well-defined mechanisms at national level on the multiplication and distribution of cassava planting material.	Training of extensionists and farmers on rapid multiplication techniques	Generation of income/revenue through sale of planting material and roots to support research.	Multiplication rate of cassava is low compared to other crops such as grains propagated seeds.
Timely availability of cassava planting material of superior varieties developed by research institutions.	Organization of farmer field days and demonstrations.	Awareness by farmers on the new techniques on storage and multiplication of planting material at level attained.	Bulkiness and perishability of the crop.
	Contracting farmers in multiplying the planting material.	Contribution towards rehabilitation of food production in Ngara district (refugee hit area) achieved.	Regular attack by pests and diseases.
		Involvement of NGOs and other special projects in the exercise achievement.	Multiplication and distribution is an expensive exercise
			Low level of trained farmers and extensionists in multiplication techniques

Table 25. Successes and limitations of research interventions on the reduction of pests and disease incidences

Period	Problem	Intervention(s)	Successes	Limitations
1970 to 1980	Outbreak of cassava green mites (CGM)	Establishment of economic threshold for the pest Investigation of resistant varieties	Economic threshold for CGH was established Varieties with good levels of resistance were identified	The identified varieties were not accepted by farmers due to poor yielding ability and their flowering ability made improvement impossible
	Sporadic appearance of Cassava Bacterial Blight (CBB)	Studies on the rate of spread of the diseases.	Distribution and extent of severity of CBB was established in the Lake zone. Some control strategies were identified.	Economic threshold was established Awareness of the disease at farm level not created.
1981 to 1990	Termite attack in cassava fields.	Use of chemical control strategy.	A chemical called Alandrin was identified.	Residual effects of the chemical were not analysed. Economic analysis of the use of chemical and implications at farm level not assessed. The testing of generated technology not carried out. Less costly and safe control method not identified.
	High incidences of CMD in major cassava growing areas.	Establishment of the distribution and economic threshold. Identification of control strategies. Selection of varieties with good level of	Cultural control measures were identified. Distribution of the disease was established. Several varieties were earmarked for good level of resistance to ACMD.	Economic threshold not determined because of difficulties in obtaining the disease free materials for establishment of the trial. Rate of spread of the disease through vector infection was high even in the assumed clean plants (disease free plots) making it

7.6.5 Improvement of cassava post-harvest handling techniques and product diversification

Various studies conducted by different key players in the cassava sector identified a critical problem of poor and rudimentary ways of cassava post-harvest handling (processing, storage and utilization). The range of cassava food products was narrow, cassava was transformed predominantly into inconvenient food products which could not compete effectively with food grains on the market; and therefore did not have as much market opportunities as cassava food products made in other countries, especially in West or Central Africa (Msabaha, el al., 1996; FAO, 1986, Wilson, 1994 and COSCA Tanzania, 1996).

In urban areas where there is an assured market, cassava is mainly consumed in a fresh form. Fresh roots are very susceptible to biodegradation hence can be kept for a few days after harvest. Although some techniques are being developed to extend this period (Table 26), it is still insufficient to permit transport and sale to distant markets. The technologies being developed by TFNC on low cost storage of fresh roots have some limitations in their adoptability because of insufficient resources for farmers to secure raw materials required. For instance, securing the wax for treating the fresh roots might not be economical to farmers and traders who have to transport fresh roots to the city.

The issue of hydrocyanic acid in the fresh roots is another limitation on the use of cassava in a fresh form. This may be so high in some varieties as to make it safe after processing (FAO, 1986). TFNC is working currently on the quality aspects of the processed products, the HCN content in fresh roots commonly traded is yet to be dealt with. Interventions on the introduction of new processing techniques particularly grated products *'gari'* appear to be promising (Table 26). However the use of fuelwood in one of the processing steps which limits its adoptability particularly in drier areas. This technology is contrary to the government policy on the rehabilitation of the natural environment through afforestation. In this way it is enough to introduce the technology with complementary technology on fuel saving techniques. Alternatively, directly sundrying the cassava mash instead of roasting, the product obtained will be different. On the use of the latter option the HCN levels in the dried cassava mash should be determined firstly to produce the safe product for human consumption.

Table 26. Successes and limitations of research interventions on improvement of cassava post-harvest handling practices and utilization

Period	Problem	Intervention	Successes	Limitations.
1984–1990	Traditional processing methods were considered to be poor and could not meet the nutritional needs.	Improvement of traditional processing methods and development of cassava weaning foods.	. Studies and documentation of traditional processing methods done for Masasi and Tarime districts.	Issues on traditional storage facilities for dried cassava products have never been addressed.
			. Development of cassava weaning food	Weaning foods for other cassava growing

Period	Problem	Intervention	Successes	Limitations.
			recipes in Mtwara region under CSPD programme.	zones not yet developed.
			Method for cyanogen analysis in cassava was established.	
			.Cyanogen levels in cassava products from Masasi and Tarime were determined and reported.	Dissemination of findings on health problems associated with consumption of insufficiently processed cassava was not carried out in communities which were not affected.
				Socioeconomic studies associated with cassava processing and consumption were not carried out.
1990–1994	Narrow range of products derived from cassava.	Product development and diversification of secondary products	Introduction of diversified cassava products to some areas within lake and eastern zones was carried out. Preliminary observations show that there is potential market opportunities for cassava secondary products.	Convenient cassava products not yet introduced in other cassava growing areas.
	Improved cassava post-harvest handling practices were not known.	Introduction of cassava post-harvest handling practices.	Advice given to farmers on hygienic conditions in traditional cassava processing e.g. peeling and sundrying. Limited efforts were made to introduce cassava graters for *gari*processing.	Gender issues, in cassava processing not addressed at all. The product was acceptable but the technique has not yet been adopted, because of laborious equipment and lack of resources.
		Staff training	Root/Tuber Programme staff were sensitized on cassava post-harvest handling techniques.	Human resources not sufficiently developed e.g. training for post-graduate diploma/degrees..
	The role of cassava in urban and rural food supply system not	Need assessment studies conducted for Non-Grain Starch	. Market demand for fresh cassava roots in Dar-es-Salaam was	Market losses in fresh cassava roots not yet investigated.

Period	Problem	Intervention	Successes	Limitations.
	known.	Staples (NGSS) (cassava, sweet potato and banana).	established. Low cost fresh cassava root storage technology introduced in a few villages in Dares-Salaam and coast regions.	Technology not yet replicated in other cassava growing zones. Follow up on the adoption of the technology not yet done.
1995o date	Improved cassava processing and developing diversified cassava products was inadequate.	Introduction of cassava post-harvest handling techniques.	A member of extensionists, farmers processors and small entrepreneurs received training in cassava post-harvest handling practices especially in product development. Six hundred (600) clients trained in product development and diversification adopted the technology.	Only two zones were involved hence a need to cover more zones. Only one dissemination model was employed i.e. training demonstrations other models (e.g.) recipe books need to be considered. Failure to achieve 100 percent adoption may have been due to poor follow-up, poor quality flour, lack of resources and facilities.
INFRASTRUCTURE				
	Limited and inefficient cassava processing methods, equipment used and products processed.	Introduction of convenient cash products and improvement of cassava processing methods. Introduction of graters, teaching and demonstrating processing of different products.		Intensive resource requirement hinders improvement of traditional processing methods. Very little labour saving technologies have been introduced.
			Recent introduction of local village markets has improved cassava marketing, market accessibility trading and volume traded.	There is poor market accessibility in the country (poor transport facilities, location, active middleperson, etc.)
				. Traditional storage facilities lave never been given attention (investigations, expansion, improvement, etc.). Issues on traditional cassava processing infrastructure have not been designed.

8 LESSONS LEARNED FROM PAST EXPERIENCES AND FUTURE STRATEGIES

Cassava is well integrated into the Tanzanian crop production systems. It plays an important role as a food security crop and provides useful opportunities for extending labour use and exploiting price peaks in the food market. There is a marked potential for cassava secondary products to compete well with other products from other crops such as wheat. Also return to labour investment on the use of improved varieties against local varieties appears to be significant and rewarding. The involvement of farmers/beneficiaries from initial stages to testing of developed technologies by researchers to suit the local conditions appears a breakthrough to slow adoption rate of disseminated technologies experienced in the past.

Changes in models of marketing food crops to open markets might help the producers, however caution should be taken when exercising tins because of the uncontrolled prices which might not favour the consumers. Cassava production at farm level is still low because of various problems as outlined below.

8.1 LABOUR

Since cassava is largely produced by family labour, development possibilities are constrained by the amount the family can produce (FAO, 1986). The farmer is then obliged either to hire additional labour capable of increasing productivity, with the tins trend, wealthier farmers are favoured and the less wealthy disadvantaged. Farming with family labour, in an economy with a strong subsistence bias, affords equitable access to land and the rewards of production. More heavily capitalized production, with the inevitable tendency to commercialization, holds out the prospects of greater efficiency, but with uneven allocation of production.

8.2 CASSAVA RESEARCH CAPACITY BUILDING

Although climate and sods limit the level of yields obtained from cassava in Tanzania, it is obvious that varieties with good tolerance to important pests and diseases would be more productive. Yield advantages could also be derived from the use of varieties with better adaptation to local conditions. Research advances to date appear promising, but one wonders with the current level of funding from the Government how sustainable this system will be. The number of research staff currently undertaking these activities is inadequate. Higher numbers of elite varieties/clones at most of the institutions cannot be tested due to limited irrigation capability.

The current research work on cropping systems is justified on the grounds that optimum levels for the various practices are location specific. If this is so, the inadequate cover in other stations where cassava crop is of importance would limit the application of findings. Therefore, it appears that the programme requires resources in terms of personnel, finance and physical facilities:

- since cassava is vegetatively propagated, the risk of accidental introduction of pests and diseases with imported plant material is high. The use of tissue materials should be promoted to minimize such risk. In this way training in plant quarantine methods and in handling *in vitro* material needs special attention.

Special resources should be provided to support the biological control project for cassava mealybug and this should be extended to include control of cassava green mites. The rearing facilities may need expansion and more scientists should be supported for training at the biological control unit at IITA Ibadan, Nigeria:

- availability of clean, healthy planting material of potential cassava varieties has been identified as a critical problem to cassava production expansion particularly in drier areas. Apart from a few initiatives by research institutions and some NGOs there is a responsible institution for multiplication and distribution of cassava planting material in the country.

Therefore, the recommendation is to establish facilities for propagation and distributing clean healthy planting material from the varieties of resistance to pests and diseases.

Also the establishment of multiplication plots at locations where the materials are to be used ensures good adaptability of the introduced varieties to local conditions. This exercise is however expensive, hence the need for external support cannot be over emphasized.

8.3 UTILIZATION

- there is limited utilization of cassava due to the low level of processing and lack of alternative convenient products. Emphasis to preferred crops was mainly noted as a reason for declining the cassava utilization trend. A crop can be preferred for food if it is available in a form which a housewife finds convenient to prepare into food. The major product chips/flour is not a convenient food product and it is not attractive to urban consumers as other products processed in other countries of Africa.

Therefore if cassava is to find a niche in the urban supply system it is imperative to transform it into a durable and ready to use form. Some efforts already initiated by the National Root/Tubers Programme in collaboration with TFNC, NGOs and other key players should be strengthened. A likely product suggested by FAO could be granular with roasted particles to obtain *"gari"*. Such material is readily packaged and stored.

A self-contained project should be prepared to select and evaluate the market potential for an improved cassava based food product. If successful this should be followed with pilot-scale production and a food education programme to establish the selected product.

- there is a well defined market for cassava starch in Tanzania. The establishment of a starch plant to meet this demand has been unsuccessful due to insufficient

supply of cassava roots. The attempts of the traditional processing based on human labour to meet the supply requirement for commercial production is still questionable on its sustainability based on the past experiences. Industrial processing could be promoted with the sufficient supply of basic raw materials (cassava roots).

This goes along with the promotion of cassava as a component since the information on these aspects was scanty, there is a need for further investigation to study the potential role of cassava in the industrial sector.

8.4 MARKETING OF CASSAVA

Changes in the marketing models did not influence marketing of cassava. Competitive products were not available, so prices remained low. The open market is the major marketing channel in existence. However, quantities marketed through this channel are not documented. Cassava production campaigns did not go hand in hand with the efficient marketing information system.

There has been no credit policy geared towards the development of the cassava sector compared with the cereals. To make this a reality, rewards to agriculture, in terms of the price paid to the farmers, should reflect this contribution to the economy. There is a clear need for a pricing policy which not only encourages production but provides sufficient income to provide a margin for investment. Consistent with this would be the improvement in the availability production inputs.

8.5 INFRASTRUCTURE

- poor transportation was earmarked as one of the key problems. Poor roads contributed substantially to failures of cassava to contribute more to food stability. Where roads are bad, movement of traffic is slow or impossible and consequently surfaces from wetter regions cannot be effectively moved to starving drier ones. The problem also faces the movement of planting material and consequently the ability to restart production after droughts.

There is very little, if any, intervention which can be affected from the research side apart from advising the policy-makers on the priority given to improving the condition of roads at village levels. This could enhance the marketing of the crop:

- extension liaison linkages are still weak. This has led to slow process of information dissemination. The formal procedure established in the past lacks commitment by all key players. The problem could be readdressed by improving the quality of extension staff through specific training for extension personnel. The current system practised in some of the zones by establishing a client oriented research through contractor relationship between clients and researchers could help. Such policy would be given a measure of reality by placing specific research

funding at the disposal of extension, with which specific research may be contracted.

Care should be taken when exercising the latter approach in order to strike a balance of research issues on both technology development and technology development and technology dissemination.

Lesson learned from the past experience indicate that it is very obvious that support to cassava research and development in Tanzania cannot be overemphasized. Therefore to address this, external assistance in the form of human, physical and financial resources is urgently required. Appendix 10 summarizes the protocols for the identified areas that need support from external funding.

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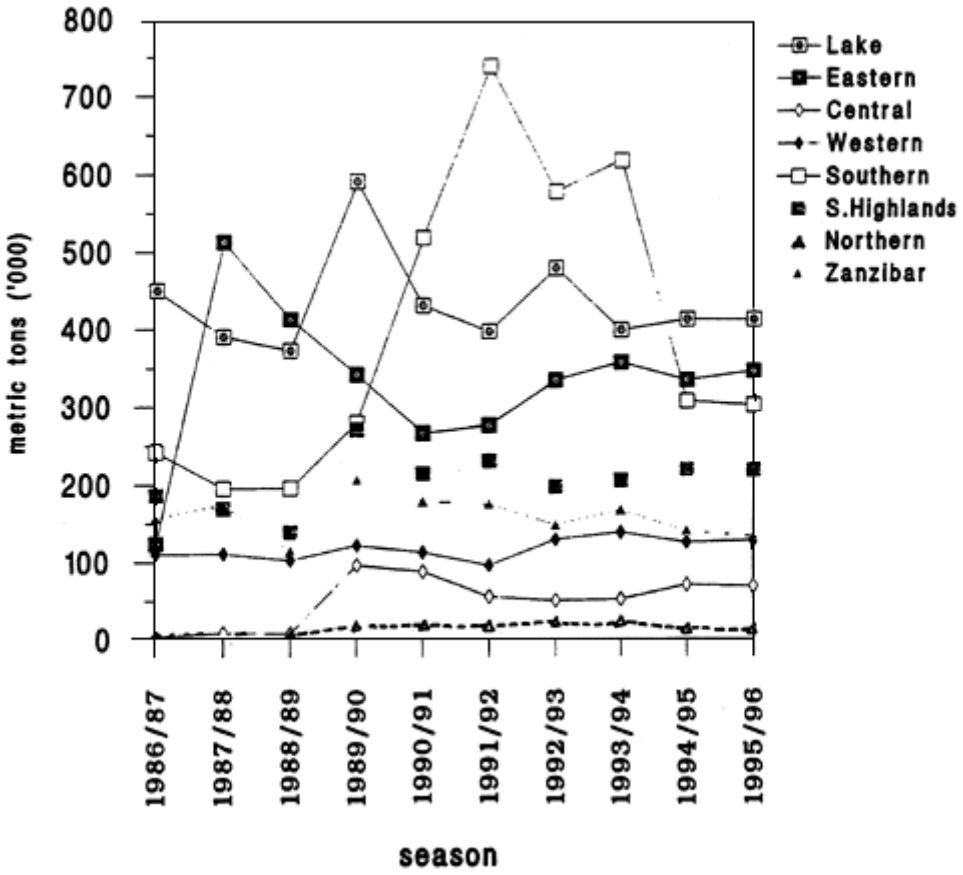
APPENDIX 1

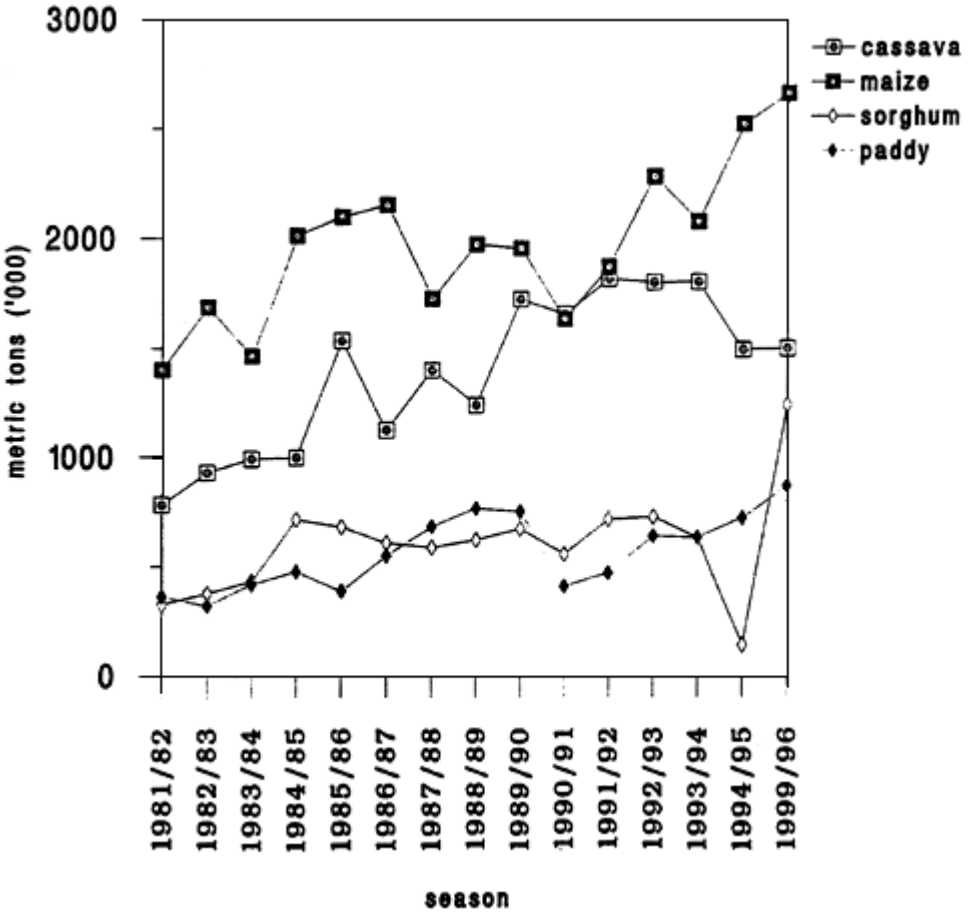
Cassava production trend per zone from 1986–87 – 1995–96



Source: Planning and Marketing Division, Ministry of Agriculture and Department of Statistics, Zanzibar

APPENDIX II

Major food crops production in Tanzania from 1981–82 – 1995–96



Source: Planning and Marketing Division, Ministry of Agriculture 1983–84 – 1992–93

APPENDIX III

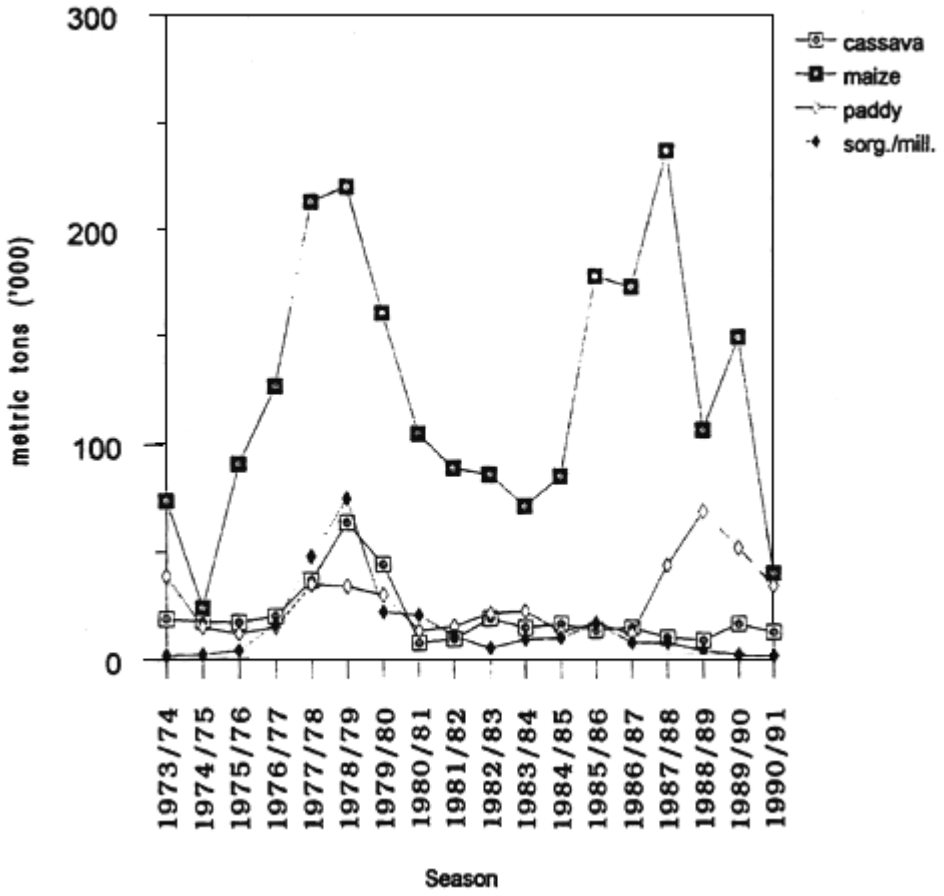
Tanzania food imports (tonnes) 1975–76 – 1993–94

Year	Maize	Rice	Wheat grain
1975/76	10 700	21 000	Na
1976/7	41 600	5 000	61000
1977/78	34 300	49 000	342 000
1978/79	na	41 000	41 000
1979/80	322 500	55 000	782 000
1990/81	274 600	63 200	332 000
1981/82	234 600	70 200	48 700
1982/83	123 400	292 400	83 100
1983/84	194 300	57 100	29 400
1984/85	1 282 500	36 100	461 300
1985/86	6 100	32 900	33 300
1986/87	93 800	83 500	21 800
1987/88	na	52 300	53 500
1988/89	na	19 500	331 700
1989/90	2 208	5 020	28 800
1990/91	1651	3 600	3 300
1991/92	24 500	44 000	19 000
1992/93	na	na	40 000
1993/94	24 900	507 500	Na

Source: National Milling Corporation, 1991/92 and Customs Department, Tanzania, 1994/95

APPENDIX IV

Major food crops purchased by NMC from 1973–74 – 1990–91



Source: Marketing Development Bureau, Ministry of Agriculture and Cooperatives.

APPENDIX V

Percentage distribution of representative villages by nature of farmers access road to main market by country

Nature of road	Côte d'lvoire	Ghana	Nigeria	Tanzania	Uganda
Tarmac	28	19	49	9	17
Dirt	68	58	49	82	80
Foot path	12	23	2	9	0
Water	0	0	0	0	3

Source: (COSCA Tanzania, 1996)

APPENDIX VI

Summarized notes on the processing techniques of cassava in Tanzania

Processing of cassava is expected to reduce hydrogen cyanide (HCN) levels to negligible levels but for cassava chips/flour processed by direct sundrying of peeled roots, traces of residual cyanide levels are sometimes left. It has been reported that samples of cassava flour from Morogoro, Tanga and Dar-es-Salaam contained cyanide levels that varied from 38.2 mg/kg of dried white flour to 71.2 mg/kg of dry dark flour (Mwang'onda, 1980). A product with less than 50 mg/kg level of cyanide is considered safe when ingested (Bolhuis, 1954). A recommended level is still under development by TBS and TFNC. The method for direct sundrying peeled roots is used for processing non-bitter (sweet) cassava varieties. The other alternative method of making cassava chips/involves fermentation by heaping prior to sun or smoke drying. Chips made in any of the foregoing increases reliance on cassava both as a source of local food security in time of drought and as a source of steady real income for rural households. In areas where water is available for only a few months of the year, the possibility of relying on piece-meal harvesting and processing of cassava to even out seasonal variation in income and food supply may be significantly reduced (Berry, 1993). Traditional methods are converted into flour by milling.

Making of chips/flour is most efficient in dry climates. The products are made in areas remote from the market centres; because as dry products they are not bulky and they have long shelf-life hence relatively inexpensive to transport over long distances. In contrast to chips/flour, fresh root is the main cassava product in peri-urban centres such as those adjacent to Dar-es-Salaam. In such areas cassava genotypes low in cyanogens, are grown for sale to urban working class to whom fried cassava roots are convenient snacks at lunch break.

One of the cooked pastes reported is known as “mbute” in the Lake zone area or (“lowe”) in the western zone. This is processed by immersing whole roots in water for three to five days for them to soften and ferment. After that they are peeled, fibres removed and the pulp heaped on a rack for further fermentation or can be covered with leaves and pressed with heavy objects to drain off excessive liquid. The pulp is grounded or pounded and the fine pulp is wrapped firmly in leaves and steamed. These products are ready to eat as part of a meal without further cooking. The making of cooked pastes is expensive and labour intensive. The high production costs and the strong flavour of the product has restricted the production and consumption of the product to limited areas.

However processing is dependent on availability of water and the importance of water for processing is potentially serious

In 3.33 percent of the villages visited during the COSCA studies, plate and hammer mills were available. However, such mills are used for converting chips into flour and are also used for milling grains, beans and peas. Mechanization of cassava processing appears to

be driven by market forces and the mechanization of various cassava processing steps is more common among villages which sell large proportions of their total cassava production. It is more common among villages which have good market access infrastructure.

APPENDIX VII

Participation of men and women in selected activities: Kwimba district

Activity	Percentage contribution per activity	
	Men	**Women**
1. Ox- ploughing	95	5
2. Harvesting	38	62
3. Weeding	38	62
4. Hand hoeing	48	52
5. Crop transportation	28	72
6. Processing and preservation	18	82
7. Firewood collection	0	100
8. Water collection	5	95
9. Household chores	0	100
10. Land preparation	55	45

Source: Female farmers as clients for agricultural technology

APPENDIX VIII

Quantities of food crops exported in Tanzania (tonnes) from 1982–83 – 1994–95

Year	Cassava	Maize	Rice	Sorghum/millet
1982/83)	13410	na	na	na
1983/84	9 120	na	na	na
1984/85	11 000	na	na	na,
1985/86	17 384	na	na	na.
1986/87	15 215	na	na	na,
1987/88	8 591	90 800	na	8 732
1988/89	13 772	18711	na	14 729
1989/90	36 997	30 348	na	3 422
1990/91	67 121	57 039	2 588	na
1991/92	21370	7 000	451	233
1992/93	35 878	4 141	505	na
1993/94	3 937	16 140	1439	na
1994/95	9 000	2 525	6 191	na

Source: National Miffing Corporation, 1991/92; Customs Department 1994/95; and Regional Agricultural and Livestock Development Office, Mtwara

APPENDIX IX

Cassava varieties currently grown by farmers in four zones with an origin from the research institutions

Name of varieties per zone			
Eastern	Lake	Southern	Western
Mahiza	Aipin Valenca	Kigoma	Kigoma
Kibandameno	Kigoma	Mzungu	
Kiguu chaninga	Nj emu	Agriculture	
Dide	Agriculture	Kibaha	
Sufi(Agriculture)	Kaniki		
Kasese	Liongo		
Kigoma			
Tingisha ndevu			
Mkexumbe(37244E)			
Kasunga			
Kibaha			
Msitu Zanzi -bar			

Source: COSCA Tanzania, 1996 and key informant from Amani Research Station, Tanga. Februaryl997

APPENDIX X

Identification of cassava research and development projects

- **Justification:**

Synthesis of cassava status in Tanzania has shown that cassava is very well integrated into the Tanzania farming and food systems. It plays an important role as a food security crop as well as a provision of useful opportunities for return to labour investment. Also the crop has a good chance to stand as a cash crop in exploiting price peaks in the food market. This was noted in the various case studies on the comparative advantages for investing in cassava under different sectors.

From the report and the previous missions by FAO, it is very clear that current cassava productivity is near the lower end of internationally reported yields. These are considerably lower than the rhetorical potential for the crop. Emphasis on improvement of cassava genetic potential through cassava germplasm development and priority on improvement of production practices could result in better returns for labour and material inputs. Improvements in farming practices could raise soil fertility, reduce the risk of declining productivity of the land resources and minimize the vulnerability of cassava crop to major pests and diseases. While improving the production practises for maximum yields, the issue of phytosanitation should not be overlooked. Since cassava is vegetatively propagated, the risk of accidental introduction of pests and disease with imported clones is high. Emphasis on the use of tissue culture materials and true seeds during the introduction would minimize such risk. Hence there is a great need to strengthen the plant quarantine services.

Various missions have noted the discrepancies on the national agricultural statistics offices and FAO estimates of cassava production. The report notes the inefficiency in the data collection mainly due to lack or little formal marketing of the crop. The yields at farm level both from different case studies and on-farm trials, contradict greatly with the national agricultural statistics and that of FAO. The knowledge use of improved varieties and the impact of these varieties at farm level is lacking. This in turn underestimates the impact of research in cassava despite its long history as noted in this report. One major factor has been the confusion existing on the identification of varieties because many have acquired local names. According to key informants in Amani, Tanga where the research of cassava began in the country, there is a very big chance of tracing the distribution of the improved varieties; in so doing the impact and all relevant information on cassava production could be determined.

A shortage of cassava planting material at farm level has been identified as one of the limiting factors in cassava production. For a sustainable solution, propagation centres of elite materials need to be established. Along with this, farmers and all key players need to be trained in the techniques of multiplication and management. The proposed propagation centres would serve to provide initial stock of planting material which could be

distributed to pilot farmers and NGOs working directly with stakeholders. It is believed that at a certain stage farmers will be in a position to take over the responsibility of multiplying and storing their own planting material for future use.

A durable and convenient way to use cassava food is likely to increase the competitiveness of cassava with respect to cereals. In addition, emphasis on the improvement of existing rudimentary processing techniques would reduce the health hazards caused by insufficiently processed products. As noted in the report, cassava products are readily acceptable on the food markets, more so when their producer prices are more profitable.

From this background, it is very obvious that while the needs for root crop development are extensive, a project to *meet all* the requirements would be expensive and possibly unsustainable by Tanzania after the support grant has ceased. Therefore, recommendations put forward by the FAO missions (Wilson, 1994) and FAO, still hold. The recommendation is for a project that emphasizes the propagation of nucleus materials; processing and storage; impact assessment of improved cassava varieties and updating of the national cassava statistics; and an integrated approach of cassava production systems.

The project could be set for seven years for full realization of the achieved outputs per activity. Below is the outline of protocol for the proposed projects.

APPENDIX X.1

Cassava planting material propagation and distribution

Counterpart agency:	Ministry of Agriculture and Cooperatives (Departments of Research and Training and Extension)
Objective:	To multiply and distribute clean healthy initial stock of cassava planting material of elite varieties
Duration:	Three years
Activities	Train specialists in the techniques through study tours, in: - service training short courses; - establishing propagation nurseries; - selecting suitable sites; - establishing infrastructure and acquiring irrigation equipment; - recruiting local staff; - acquiring 7 tonne lorry and 4WD vehicles; - propagating material of elite lines with best techniques available; - distributing clean elite fines to farmers through extension.
Donor contribution:	Personnel short-term consultancy on irrigation.
-	Materials
-	Transport
-	International travel
-	Funds
Government contribution:	Counterpart personnel
-	Field staff, labour
-	Land
Outputs:	Trained specialists
-	Propagation nurseries established
-	Clean planting material distributed

APPENDIX X.2

Improved processing and storage techniques for cassava and extending the range and competitiveness of cassava based foods

Objectives:	To introduce new processing techniques To diversify the products of cassava with new technologies To introduce new storing techniques To commercialize cassava products.
Counterpart agencies:	Ministry of Agriculture and Cooperatives (Department of Research and Training) and Tanzania Food and Nutrition Centre
Activities:	Train specialists in processing techniques
-	Establish infrastructure
-	Recruit local staff
-	Advertise and launch campaigns for processing and storage
-	Demonstrate the techniques
-	Disseminate the techniques through leaflets, etc.
-	Seek commercial agents for cassava products
-	Monitor sale and use of cassava products
-	Encourage private entities to manufacture cassava products.
Duration:	18 person-months
Donor contribution:	Short-term consultancy on the training aspect
-	Procurement and operational costs
-	Vehicle(s)
Government contribution:	Counterpart personnel
	Post-harvest team
	Labour
	Land
Outputs:	Increased opportunities for cassava production and use through introduction of new processing techniques
	New storing techniques
	New commercial cassava products

APPENDIX X.3

Institutional strengthening on cassava research and development

Objectives:	To improve the capability of the research programme to generate extension messages capable of improving cassava production with special emphasis on:
	Germplasm, development Soil fertility maintenance IPM packages on pest and disease control
	To improve the general capability of the quarantine services to ensure the safe importation of cassava material. To acquire a capacity to receive and multiply *in vitro* cassava planting material

Counterpart agencies: Ministry of Agriculture and Cooperatives (Department of Research and Training and Tropical Products Research Institute and Plant Protection Division):

Duration:	Seven years
Activities:	Establish cassava breeding and agronomy trials
	Field experimentation
	Farmers field demonstrations and technology verification trials
	Train in plant quarantine methods and in handling *in vitro* material
	Rehabilitate the laboratory facilities for tissue culture
	Test and disseminate improved production technologies
Donor contribution:	Short-term consultancy on plant quarantine
	Counterpart training in tissue culture and plant quarantine
	Laboratory and material
	International travel
	Vehicles
	Equipment
Government contribution:	Land, personnel
	Existing programmes
	Office accommodation
	Laboratory space materials
Output(s):	Improved production packages of cassava identified and disseminated
	Improved plant protection services

APPENDIX X.4

Impact assessment of improved cassava varieties in cassava growing areas of Tanzania

Objectives:	To assess the rate of adoption of improved cassava varieties and agronomic packages
	To assess the impact of improved cassava varieties in the production of cassava at farm level
	To identify the factors that determine the adoption of research packages by farmers
	To update the cassava production statistics at farm level for future follow-up
Counterpart agencies:	Ministry of Agriculture and Cooperatives (Departments of Research and Training and Planning and Marketing Division) Tanzania Bureau of Statistics Department.
Duration:	Eight person months
Activities:	Design of the study
	Development and testing of the questionnaire
	Training of enumerators site selection
	Conducting the survey
	Data collection from key informants
	Data processing and report writing
	Feedback seminars to farmers and policy-makers.
Donor contribution:	Short-term consultancy on designing and development of the questionnaire
	Financial support
Government contribution:	Counterpart personnel
	Survey teams
	Vehicles
	Data processing
	Preparing reports
Outputs:	Number of improved varieties adopted
	Coverage
	Impact on production and potential role in household food security and cash income
	Future strategies to suit farmers' needs identified
	National statistics updated