ADOPTION OF CASSAVA PROCESSING AND UTILIZATION TECHNOLOGIES: A CASE OF MTWARA RURAL AND NEWALA DISTRICTS, MTWARA REGION

BY

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ABSTRACT

The study was conducted on adoption of cassava processing and utilization technologies in Mtwara region. The main objective of the study was to determine the status of cassava processing and utilization technologies in Mtwara region. Structured questionnaire and Focus Group Discussion (FGD) were used to collect information from cassava farmers. Random sampling was used to draw respondents for interview. Sample size was 120. Descriptive statistics, logistic regression and gross margin were used for data analysis. Results revealed that, both traditional and improved cassava processing technologies were used by respondents. It was found that 77% of the respondents used traditional cassava processing methods and about 17% were using both traditional and improved processing technologies. Also, the findings showed that, institutional support to farmers was an important factor in adopting improved cassava processing technologies by farmer groups. The coefficient of the institutional support was statistically significant at 0.05 probability level. Age of respondents, occupation and marital status of respondents were not statistically significant. Gross margin analysis showed that improved cassava processing technologies contributed relatively high to households income with a gross margin of Tsh 78 400 per tonne when compared to traditional processing methods with a gross margin of Tsh 11 774 per tonne of fresh roots processed to flour. This study recommends that, the government and other agricultural stakeholders need to promote and educate farmers on the importance of improved cassava processing and utilization technologies to human health, food security and poverty alleviation. In order to improve market of cassava products, the government should promote and encourage food processing industries to use cassava as an ingredient in some of food products to increase the demand for cassava products and accelerate the adoption of improved cassava processing technologies.

DECLARATION

I, MGENI SHAMTE SHOMARI, do hereby declare to the senate of the Sokoine University of Agriculture that this dissertation is my own original work and has neither been submitted nor being concurrently submitted for a higher degree award in any other institution.

.... 28/10/2011 ....

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(M.A. Candidate)

The above declaration is confirmed

.... 28/10/2011 ....

H.S. Laswai (Prof.) Date

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DEDICATION

I dedicate this dissertation to my beloved father. the late Mussa. A. Mazonge and my mother the late Achoto Daudi. who laid the foundation of my education. I pray that the Almighty God to rest their souls in peace. AMEN.

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LIST OF ABBREVIATIONS AND SYMBOLS

ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASDP	Agriculture Sector Development Programme
CAVA	Cassava Added Value for Africa
CIAT	Centro Internationale de Agricultural Tropical
COSCA	Collaborative Study of Cassava in Africa
DADPS	District Agriculture Development Plans
DFID	Department for International Development
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization of United Nations Statistical Database
FGD	Focus Group Discussion
GMA	Gross Margin Analysis
IGAs	Income Generating Activities
IITA	International Institute of Tropical Agriculture
ISTRC	International Society for Tropical Root Crops
MA	Master of Arts
MAFSC	Ministry of Agriculture Food Security and Cooperatives
MDG	Millennium Development Goals
MOAC	Ministry of Agriculture and Co-operatives
NGO	Non Governmental Organization
NPES	National Poverty Eradication Strategy
NRCRI	National Root Crops Research Institute
OED	Operation Evaluation Department
PR	Poverty Reduction

PRA	Participatory Rapid Appraisal
SADC	Southern Africa Development Committee
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Sciences
TAS	Tanzania shillings
UPT	United Peasants of Tanzania
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Cassava (*Manihot esculenta,Crantz*), sometimes known as manioc, yucca or tapioca is a key food security and a perennial root crop of South American origin that was introduced to Africa in the 16th century by Portuguese traders. Cassava is adapted to zones within latitudes 30^0 North and South of the Equator, at elevations of not more than 2,000 m above sea level, in temperatures ranging from 18^o to 25^o C. It grows well in areas with low rainfall and on suitable soils with a pH from 4 to 9.0. It serves as a staple food for more than 500 million people worldwide (Poulter, 2000). This importance is largely on a consequence of cassava's agronomic advantages, particularly its high yielding of carbohydrates even on poor soils, good tolerance to droughts, is relatively resistant to pest infestation and diseases and because it can be stored in the ground until required (Togglum *et al.*,1990). Thus it contributes to food security and it has high energy content that helps in minimizing incidences of energy malnutrition (Hahn, 1998). Global cassava production in 2004 was estimated as 203 million tonnes; out of which Sub-Saharan Africa produced 107.6 million tonnes (FAOSTAT, 2008).

In sub-Saharan Africa including Tanzania, cassava *(Manihot esculenta*) is an important staple, where it fulfill a major role as smallholder farmers' crop in the more difficult agricultural environment (Burrell, 2003). Tanzania is the fourth largest cassava producer in Africa and the first in Eastern and Southern Africa. Out of national food production of 10 million tones per year, maize contributes 31%; followed by cassava (19%), potatoes (13%) and then banana (11%) (MAFSC, 2006). The estimated cassava production figures obtained by the MAFSC (Statistics Unit) in the 2002/2003 harvesting season shows that high production was achieved by Mtwara followed by Coast region, Mwanza, Mororgoro, Kigoma, Rukwa, Tanga, Singida, Mbeya, Kagera and Ruvuma. Manyara and Arusha produced the least out of the twenty two regions (Mkamilo, 2009a). Therefore, Mtwara region is the largest producer of cassava in Tanzania and cassava is the most important staple food and also a cash crop in the region. However, there are several constraints to cassava production, marketing and utilization in the region. These include poor working tools and processing technologies, which increase labour requirement in all cassava operations and discourage the expansion of the cassava production by small farmers. Many studies have emphasized that efforts on improving production should be well integrated with efforts in improving the processing technologies (MOAC, 1997).

Other important constraints are low genetic yield potential of many local varieties, pests and diseases, low soil fertility, unfavourable climatic conditions (drought and floods), poor agronomic practices and also postharvest problems, which include poor quality of cassava, particularly dried cassava locally known as 'makopa', inadequate market, storage pests, high concentration of hydrogen cyanide especially for bitter varieties and inadequate diversified use of cassava. Cassava postharvest problems may be minimized through the use of appropriate cassava processing technologies. (MOAC, 1997).

Processing of cassava is important in transforming cassava to edible and value added products. It is essential for marketing as it reduces the bulkiness and transport cost, increases the shelf life of product and reduces postharvest losses. Also, it improves the timing of the marketing and good prices in areas where demand is seasonal and with price fluctuations. On the average, 75 percent of the total cassava produced in Tanzania is processed and only 25 percent is used in fresh form (COSCA, 1996).

Processing methods may be traditional or improved but include a combination of several procedures that are performed during specific time periods and in a specific sequence (Nweke *et al.*, 1992). The most common processing procedure for fresh cassava involves peeling, washing , cutting /crushing of the cassava roots into cassava chips, grating and sun drying in open air before pounding or milling into cassava flour (Nweke *et al.*, 1998, Ndunguru *et al.*, 1997).

Traditional cassava processing entails the use of hand knife in peeling the roots and slicing into irregular cubes/chips before drying. Peeling takes more than 20% of time involved in the subsequent size reduction process by hand knife, with peeling the thinner roots expected to take much longer. Manual processing requires a minimum of four person-days to peel and wash, and 23 person-days to chip one tonne of fresh cassava roots (Kolawole *et al.*, 2010). This rate is very low and renders enterprise level processing difficult. Improved processing technologies involve the use of motorized grating and chipping machines, which are less time consuming, efficient in removing hydrogen cyanide, increase shelf life and also the quality of cassava products.

Improved cassava processing technologies were introduced in Mtwara region by IITA and other organizations in the past ten years. The major aims of introducing improved processing technologies were to solve the problem of removing hydrogen cyanide from cassava, shortening processing time, improving quality of cassava products, increasing cash value and improving shelf life and marketability. The National Root and Tuber Crops Research Programme has been demonstrating cassava processing technologies, using motorized chippers and graters and dewatering machine, to policy makers, political leaders, extension staff, farmers, private sectors and NGOs. The objective has been to create awareness on these cassava processing technologies.

To date, there are established farmers processing groups using improved cassava processing technologies supported by government and non governmental organizations. For example, CONCERN Worldwide, an NGO operating in Mtwara and Lindi, has initiated one pilot centre at Hiari village in Mtwara rural district, about 12 km from Mtwara town, a pilot site for improved cassava processing supported by IITA and Naliendele Agricultural Research Institute (NARI) was established at Chisegu village in Masasi district, Muungano processing group (Mtangalanga village, Newala district), Mbuo women processing group (Msijute village, Mtwara Rural), Ukombozi women group (Mpanyani village, Mtwara Rural) and Mbawala processing group (Mbawala village, Mtwara Rural) supported by district agricultural offices in collaboration with other stakeholders. (Mkamilo, 2009_b). However, the adoption of improved cassava processing and utilization technologies is still low.

The high perishability of harvested cassava and the presence of cyanogenic glucosides in cassava requires immediate processing of the storage roots into more and safer products (Boccas, 1997). However, in the study area, traditional cassava processing is a predominant practice. These processing techniques are laborious and time consuming and flour from these traditional processing techniques is poor in quality and safety and hence wasted market opportunities. The extent to which the potential market and utilization for cassava may be expanded depends largely on the degree to which the quality of various processed products can be improved to make them attractive to various markets i.e. local and foreign (ASARECA, 2006).

1.2 Problem Statement and Justification

Since 1970s the Government of Tanzania in collaboration with different local and international organizations, have been investing in cassava development in various ways, like improving the genetic potential, improving agronomic packages, reducing major cassava pests and diseases, developing more efficient systems for cassava planting material and improving cassava post-harvesting practices to other . However, the performance of the crop in terms of processed products and consumption have been on the lower side compared with traditional crops, such as maize and beans and consequently causing low stimulation to increased cassava production and utilization (TAC, 2004). In Tanzania, traditional cassava processing is a predominant practice in all regions where cassava is grown. These processing techniques are laborious and time consuming and flour from these traditional processing techniques is poor in quality, safety and hence wasted market opportunities. These processing methods include a combination of several procedures that are performed during specific time periods and in a specific sequence (Nweke *et al.*,1992).

The major problems of the traditional processing techniques as documented by Mlingi (1995) are (a) heap fermentation, which leads to fungal growth and potential discolouration and aflatoxins contamination. (b) General lack of washing of roots during processing or (c) Use of unclean water for washing or soaking. (d) Contamination during drying on the floor and storage and (e) Occasional use of processing operations that are inadequate in reducing toxic cyanogenic compounds to safe level. The last factor is the most serious because it has in the past caused major public health hazards in many cassava consuming villages in Tanzania. Particular examples are Mtwara region, where cases of cyanide-related food poisoning Konzo diseases have been repeatedly reported (Mlingi, 1995).

In the year 2001, improved cassava processing technologies were introduced in the study area with the objectives of adding value to cassava and increase farmer's returns and availability of cassava products in all seasons. However, despite these efforts taken by the Government, NGO, and other institutions, the adoption of improved cassava processing and utilization technologies is still low. This study therefore intends to find empirical information on the processing and utilization technologies of cassava and also the socio-economic factors influencing the adoption of improved cassava processing and utilization technologies in Mtwara region. Results of the study will help to provide information to cassava growing households on the constraints and opportunities available for improved cassava processing and ways forward for increased adoption of the technologies.

1.3 Objectives of the Study

1.3.1 Overall objective

The main objective of this study was to determine the status of cassava processing and utilization technologies in Mtwara region.

1.3.2 Specific objectives

i. To identify the current cassava processing and utilization technologies in the study area.

ii. To investigate socio-economic factors influencing adoption of improved cassava processing technologies in the study area.

iii. To evaluate the contribution of introduced cassava processing technologies and utilization to income of the farmers in the study area.

iv. To identify opportunities and constraints related to cassava processing and utilization in the study area.

1.4 Research Questions

i. What are the current cassava processing and utilization technologies?

ii. What is the contribution of cassava processing and utilization technologies to incomes of smallholder farmers?

iii. What are opportunities and constraints related to cassava processing and utilization technologies?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Cassava Production in Tanzania

In Tanzania, cassava is grown in many parts of the country and major growing areas are Mtwara, Mwanza, Lindi and Tanga. Productivity of cassava crops in Tanzania between 1994/95 and 2000/01, remained relatively constant, ranging from 2 149 to 2 604 kg/ha. Cassava is grown mostly as human food, but it is also an important animal feed, and it has several industrial uses. As one of the cheapest sources of food/feed energy, cassava should play a major role in meeting developing countries rising consumption of both food and feed (FAO, 1995).

2.2 Cassava Processing in Tanzania

In Tanzania, cassava processing is constrained by the size reduction method practised at village level. This entails use of hand knife in peeling the roots and slicing into irregular cubes/chips before drying. Peeling takes more than 20% of time involved in the subsequent size reduction process by hand knife, with peeling the thinner roots expected to take much longer.

Cassava leaves are normally sun-dried in the open or may be dried in ashes but this takes a longer time (10-15 days). The resulting hay is then mixed in the diets in the required proportions. In the dried form, cassava leaves can be stored for a long time. Drying the leaves also reduces HCN contents. Mngulwi (1993) reported HCN content of 1210 ppm of dry matter for fresh leaves and 30 ppm for dried leaves. It is a common practice to sun-dry the roots when they have been chopped into small pieces. Peeled roots are normally fed to pigs and poultry while unpeeled roots are fed to cattle. The peel is rich in protein, fat and ash. Peeled fresh roots can be fed to pigs and poultry at low levels without any signs of toxicity.

2.3 Agricultural Products Processing

Processing of agricultural products may be in wider contexts as an activity for adding value to agricultural products before marketing the products to consumers. It is an activity creating utility by altering the product in some ways from raw state (Slee, 1991). He continued to define farm processing as activities of adding value to agricultural products by growers before selling the produce to consumers. Consequently, MAFSC in Tanzania now places high priority to the processing of agricultural crops like cassava at farm/village level by farmers selling products to processing centre (Kabigi, 2002). Processing, marketing and consumption are important functions in agriculture and rural development in general.

2.4 Cassava Processing in General

Fresh cassava root consists of 60 to 70% water and has a shelf life of 2 to 3 days. Once harvested, it has to be either consumed immediately or processed into more stable product forms. Processing it into dry form reduces the moisture content and converts it into a more durable and stable product with less volume, which makes it easier for transportation. Processing is also necessary to eliminate or reduce the level of hydrocyanic acid (HCN) in the crop and to improve the palatability of the food products. Processed cassava is also used as raw materials for a number of small or medium scale industries in Africa. Objectives of cassava processing are to reduce postharvest losses of fresh roots, eliminate or reduce the cyanide contents, improve the taste of cassava products and provide raw materials for cassava based industries (Nweke, 1994).

2.5 Reasons for Cassava Post-harvest Processing

Most common used processing method is drying, either by sun or by artificial means. The most important groups of processed cassava products in Tanzania and subSaharan Africa in general are dried pieces and flours. Processing cassava from fresh roots to dried pieces and flour form reduces the moisture content and converts it into a more durable and stable product with less volume, which makes it easier for transportation. Processing is also necessary to eliminate or reduce the level of hydrocyanic acid (HCN) or cyanide in the crop and to improve the palatability of the food products. Processed cassava is also used as raw materials for a number of small or medium scale industries in Africa. Objectives of cassava processing are to reduce postharvest losses of fresh roots, eliminate or reduce the cyanide contents, improve the taste of cassava products and provide raw materials for cassava based industries (Nweke, 1994).

2.6 Cassava Processing Technologies Available Worldwide

Technologies available worldwide for processing of cassava involve those for the production of chips, pellets, native starch, modified starch/adhesives, alcohol (ethanol), Monosodium glutamate (MSG), citric acid, sweeteners, e.g., glucose, fructose and sorbital. In addition, the use of cassava for the production of foods in Africa, such as gari, fufu, instant flour, fermented flour and other products exists. The processing of cassava leaves for the production of hay, as well as for leaf protein concentrates are gaining grounds (Lundquist, 1993).

2.7 Traditional Cassava Processing in Tanzania

In Tanzania, traditional cassava processing is a predominant practice in all regions where cassava is grown. The processing of cassava is mainly done at household level for home consumption and the surplus obtained is sold to get cash. In the Lake Zone, there are two processing techniques used by local processors: (i) dry fermentation method where cassava is peeled, sun dried for 3-5 days, fermented for five days, scrap the developed moulds, crashed into small pieces locally known as udaga, sun-dried for 2-3 days and the product is milled to flour. (ii). Wet fermentation method whereby cassava is peeled, soaked in water for 3-5 days, crushed into small pieces and sun dried for three days, then milled to flour ready for consumption. In Southern and Eastern Zones, cassava is peeled, sliced into small pieces (*Makopa* and *Kivunde* in Southern Zone and Eastern Zone, respectively) , sun-dried for about seven days and stored in various storage structures it isthen milled into flour ready for making stiff porridge (ugali). These processing techniques are laborious and time consuming and flour from these traditional processing techniques is poor in quality, safety and hence wasted market opportunities (Fig. 1).

Figure 1: Traditional cassava processing to chips (locally known as 'makopa') in Tanzania

Poor processing of cassava resulted into health problems in some of the villages in Mtwara region. Households sometimes skip some important operations during processing of the bitter varieties to food. A rapid survey of 'konzo' affected households in three villages of Mtwara rural in Southern zone (Migombani, Njengwa and Nkunga) in 2007 showed that between October and April every year most households depended on cassava consumption (Mkamilo, 2009b). The most affected households facing acute food shortage adopt a shortcut process for making 'Chinyanya' to prevent hunger and death. The shortcut method involves peeling, pounding, squeezing of the water (omitted in some cases or substituted with roasting) and drying the mashed cassava at the same day of harvesting. The repeated consumption of this improperly processed cassava in those villages during food shortages that occurred in 2003 led to children and women developing several symptoms of 'konzo' and other diseases including weak legs, difficulty in standing , difficulty in speaking (heavy tongue), false noise, headaches followed by sudden paralysis of two legs (konzo).

The problem is related to inadequacy in the dewatering, which leaves large amounts of the cyanohydrins and other cyanogens in the food, particularly because the foods are either sun dried or roasted and prepared for consumption immediately after pounding without giving sufficient time to the volatile fractions of the toxic cyanogens to volatilize. The method was used even with the extremely high cyanogenic potential cassava varieties. The use of this improper processing method led to outbreak of 'konzo' in the villages whereby mostly children and women had weak legs, difficulty in speaking (heavy tongue), false noise, headaches followed by sudden permanent paralysis. The lack of knowledge about the cause of the disease made the community to name it 'baloka' and in other village 'Nandenga' linking it to some traditional believe (Mkamilo, 2009_b).

2.7.1 Unit Operations in Traditional Processing

Processing of cassava is important in transforming cassava to edible and value adding products. It is essential for marketing as it reduces the bulkiness and transport cost, increases the shelf life of product and reduces postharvest losses. Also, it improves the timing of the marketing and good prices in areas where demand is seasonal and with price fluctuations.

Processing of cassava is mainly done at the household level for home consumption and the surplus obtained is sold to get cash. Studies have revealed that farmers in remote areas with enough labour or / and access to mechanical processing facilities planted relatively more cassava for sale than farmers who had access to market centers (Nweke, 1994; and Temu and Nyange, 2001).

On the average 75% of the total cassava produced in Tanzania is processed and only 25 percent is used in fresh form (COSCA Tanzania, 1996). Processing methods include a combination of several procedures that are performed during specific time periods and in a specific sequence (Nweke *et al.*, 1992). The most common processing procedure for fresh cassava involves peeling, washing, cutting or crushing of the cassava roots into chips, grating and sun drying in open air before pounding or milling into flour (Nweke *et al.*, 1998, Ndunguru *et al.*, 1997). Peeling of cassava roots is one of the labor intensive unit operations in cassava processing.

Peeling requires the equivalent of labour required for ploughing or ridging operation. The labour requirement of peeling cassava roots per averaged yield per hectare was estimated at 20 man-days, it therefore serves as a major source of employment, of women in particular, in rural places, where commercial cassava processing takes place. Usually, crude drying method is used. The method leads to high contamination of the cassava chips. In addition, there is no objective method of measuring the moisture of dried cassava to ascertain level of dryness.

2.7.2 Problems of Traditional Processing Technologies

The major problems of the traditional processing techniques are as explained in this section Heap fermentation, which leads to fungal growth and potential discoloration and aflatoxins contamination. General lack of washing of roots during processing or use of unclean water for washing or soaking and occasional use of processing operations that are inadequate to reduce toxic cyanogenic compounds to safe level.

The last factor is the most serious because it has in the past caused major public health hazards in many cassava consuming villages in Tanzania, particularly in Southern Tanzania, where cases of cyanide- related food poisoning and konzo disease have been repeatedly reported, it has been noted that bitter varieties of cassava produce the best quality of various processed cassava products relative to sweet cassava landraces (Mlingi, 1995). However, households sometimes skip some important operations during processing of the bitter varieties to food.

A rapid survey of konzo affected households in three villages of Mtwara rural in Southern zone (Migombani, Njengwa and Nkunga) in 2007 showed that between October and April every year most households depend on cassava consumption (Mkamilo, 2009b). The most affected households facing acute food shortage adopt a shortcut process for making ' Chinyanya' to prevent hunger and death. The shortcut method involves peeling, pounding, squeezing of the water (omitted in some cases or substituted with roasting) and drying the mashed cassava on the same day of harvesting. The repeated consumption of this improperly processed cassava in those villages during food shortages that occurred in 2003 led to children and women developing several symptoms of konzo and other diseases including weak legs, difficulty in standing , difficulty in speaking (heavy tongue), false noise, headaches followed by sudden paralysis of two legs (konzo). The problem is related to inadequacy in the dewatering which leaves large amounts of of the cyanohydrins and other cyanogens in the food, particularly because the foods are either sundried or roasted and prepared for consumption immediately after pounding without giving sufficient time to the volatile fractions of the toxic cyanogens to volatilize. The method was used even with the extremely high cyanogenic potential (bitter) cassava varieties. The use of this improper processing method led to outbreak of konzo in the villages whereby mostly children and women had weak legs, difficulty in speaking (heavy tongue), false noise, headaches followed by sudden permanent paralysis. The lack of knowledge about the cause of the disease made the community to name it baloka and in other village 'Nandenga' linking it to some traditional beliefs. (Mkamilo, 2009a).

2.8 Modern Cassava Processing Technologies

2.8.1 Improved Cassava Products Processing Technologies in Tanzania

Improved cassava products processing technologies available in Tanzania involve those for the production of chips, pellets and starch. In addition, of cassava is used for the production of foods in Tanzania, Such foods include gari, biscuits, cakes, instant flour, fermented flour and other products exists (Lundquist, 1993).

2.8.2 Chip Production

Chip production involves the simple technique of cutting peeled or unpeeled cassava roots into smaller pieces and allowing the pieces to dry. Sun drying is the most common technique used, while different types of chipping machines or chippers are used.

2.8.3 Pellet Production

Pellet production is stimulated by the need to improve the uniformity in the shape and size of cassava chips required by the users and animal feeds producers. In addition, during transportation, loading and unloading of chips, dust generation causes serious air pollution, placing pressure on the importer in Europe to improve the nature of cassava products handled by ports. Production of pellets involves pressing chips and extrusion through a large die. The heat and moisture in the chips help in the formation of pellet-like shaped product known as soft pellets. Later process development involves grinding of chips followed by steam extrusion. This process produces strong pellets upon cooling. These types of pellets are known as hard pellets (Nweke, 1994).

2.9 Cassava Starch and Flour Production

The production of starch and flour from cassava has been an age long process. The technology for starch production involves peeling and washing of the roots followed by grating or mashing (also called pulverization) and then mixing the resultant mash with water. The suspension is then sieved and the slurry sedimented. Water is decanted and the sedimented starch dried. Different machines are used at the various stages of the process depending on the level of sophistication of production (Sokolov, 2000). Flour production involves peeling and washing the roots. These are then cut into pieces and dried. The dried pieces are then milled and sieved. The resultant flour in this process is the unfermented flour. The fermented flour is produced by fermenting cassava through soaking or steeping the peeled and cut pieces of cassava in water. The fermented pieces are then dried before milling and sieving. Improved technology in the production of fermented cassava flour has led to the production of odourless fufu and instant flour in Nigeria (IITA, 2002).

2.10 Traditional Cassava Products

Cassava roots are processed into different food products. The products vary from one place to another. These product includes *Farinha de Mandioca, gari cassava rice (ladang), kokontse, Chikwangue, tapioca ,fufu, Yakeyake, Casabe, Kibabu.*

2.10.1 Farinha de Mandioca

This type of food from cassava is popular in Brazil and other parts of South America. Asiedu (1999) explained the preparation of farinha de mandioca, which consists of peeling, grating, pressing, mixing, heating and roasting. After grating or rasping cassava, the pulp is packed into *tipiti* (a basket-weave tube). The *tipiti* plate 2-1, is stretched and its internal volume reduces, squeezing juice from the pulp. During this operation, the pulp is subjected to considerable pressure, causing the juice containing cyanogens to drain off. However, the *tipiti* is not used in large scale production practiced in factories.

2.10.2 Gari

Gari is a popular food among the low income groups in West Africa and Nigeria (Meyote, 2004). It is produced by fermenting grated cassava roots, semi-dextrinizing the pulp by heat and then drying the product. The production of gari is a modification of the process for the manufacture of *farinha de mandioca*, but it has a characteristic flavour (Cock, 2001).

Cassava roots are washed, peeled and grated; the resulting pulp is put into cloth bag subjected to pressure by heaping stones and logs on the bag. The juice is squeezed out. The bag is left for about 2-4 days, and the pulp undergoes fermentation. This method is not considered to as effective as the tipiti in squeezing out the juice. Later on the fermented pulp is removed from the bag, sieved and roasted or fried usually with palm oil in shallow metal pans or small pits until dry. The product is then packed into bags and stored. Cassava bacteria (*Corynebacterium manihot*) produce lactic acid and formic acid from starch during fermentation, which causes development of the characteristic flavour of gari. When pH has fallen down to about 4.2, the fungus (*Geotricium candida*) produces more acid and the characteristic aroma.

2.10.3 Cassava Rice (Ladang)

Ladang is a popular food in Philippines and some other parts of South East Asia. According to Asiedu (1999), cassava rice is prepared by shredding the roots and pressing the grated pulp in a cloth to remove the juice. The drained mass is whirled in a winnowing basket and forms pellets. The moisture content and the speed of winnowing determine the size of pellets. Sifting gives pellets of more or less uniform size. They are then steamed or dried. In an alternative way as explained by Meyote (2004) the roots are soaked in water in eathernware jars for five to seven days, until they are soft. Then they are macerated, fibre removed and the mass is air dried and made into pellets.

2.10.4 Kokontse

This product is common in West Africa. Doku (1999) explained kokontse preparation, whereby cassava roots are peeled, cut into pieces and dried in the sun, usually on roofs or along the road side. The dried roots (kokontse) are milled into flour. The flour is usually cooked by adding it to boiling water, and stirring until the correct consistency is obtained (sticky porridge).

2.10.5 Chikwanguc

It is an African type of food popular in Congo. Cassava roots are soaked in water for several days until they become soft, then the roots are peeled and macerated. The fibres are removed and the dough formed is wrapped in banana leaves and boiled (Meyote, 2004).

2.10.6 Tapioca

Tapioca is popular food in South America. This is obtained when starch is allowed to settle from the juice pressed out from grated cassava pulp. The supernatant juice is decanted and the starch is washed, dried and roasted in a pan with continous stirring like gari, but using low fire. The starch grains burst open and partial dextrinization of starch causes particles to adhere to form larger granules of various sizes (Doku, 1999).

2.10.7 Fufu

Fufu is common in Sierra Leone. During its preparation, cassava roots are washed, peeled, grated, sieved and allowed to stand for sometime, However the juice is not squeezed out. Fermentation takes place and at this stage, after which the juice is drained off. The resulting dough is stored and used to prepare *fufu* by putting some dough in a pot of boiling water and stirring continuously to produce a sticky meal (De Bruijin and Fresco, 1991).

2.10.8 Yake yake

This is also common in West Africa. Its preparation involves peeling, washing and grating of cassava roots. The pulp is dried and sieved, then mixed with some salt and moulded into flat small 'cakes', which are steam baked for a few minutes. It is eaten with soup or stew (Fresco, 1982).

2.10.9 Casabe

Casabe is an important cassava food product in the Caribbean island and on the Atlantic coast of Colombia and Venezuela. Cassava is processed in the same way as for the production of farinha, except that the squeezed cassava mash is kneeded into a flat cake and baked (Goosens, 1996).

2.10.10 Kibabu

Is a Tanzanian traditional plain deep fried cassava product prepared from cassava paste. This is only one traditional paste product from Muheza district in Tanga Region that was encountered in a Participatory Rapid Appraisal (PRA) study in the mentioned district. (Silayo *et al.*, 2007).

The product could relate to the Yake yake and Agbeli kaklo. This product looked promising in the broadening the food types of cassava of the Tanzanian community but needed improvement in the processing quality and sensory attributes to improve its acceptability. Plain cassava kibabu was poor in nutrients and rich in energy, but the study was conducted to improve nutrient content and palatability of traditional kibabu, using 80% cassava and other staple mixture including onion and garlic in the formulation. Results showed that use of groundnuts and soyabeans improved the nutritive value while the incorporation of coconut improved palatability of kibabu. (Laswai, *et al.*, 2007). Literature on the use of cassava as a staple based product is scanty. Yake yake is one paste product obtained after peeling, washing, grating, drying and sieving the cassava to obtain a meal that is moulded and steam baked. Agbeli kaklo is a second product encountered in the literature resembling yake yake but instead of steamed baking

2.11 Improved Technologies of Cassava Processing Enterprises; Experience from Established Pilot Sites in Tanzania

During the past three years, four cassava processing sites have been set up in Tanzania as business enterprises in the framework of the SARRNET, livelihood and CFC projects. Three sites were located in Eastern Zone (e.g., Bungu, Mtimbuani and Zogowale villages) and one in Southern zone (Chisegu village) of Tanzania. There was also pilot site supported by DFID and led by NRI in the Lake Zone of Tanzania. These sites process cassava into various products for end use purposes like chips for food and feed consumption (Bungu village and Lake zone); cassava starch for industrial purposes (Mtimbuani village), and high quality cassava flour (Zogowale and Chisegu villages) (Mkamilo, 2009b). The following are brief descriptions of these pilot sites.

2.11.1 Cassava Chips Production Pilot Site at Bungu Village in Rufiji District

The Sululu Farmers' Cooperative group is located at Bungu village in Rufiji district, about 150 km away from Dar-es-Salaam. The area provides better opportunity for income as fresh roots traders offer less attractive prices to farmers at Bungu as compared to farmers near Dar-es-Saalam. The first IITA cassava processing pilot centre was established in 2002 during SARRNET phase II at Bungu village in collaboration with the National Root and Tuber Research program team, where farmers were formed into four processing groups.

The cost of equipment invested was about $1 500 for each group. Farmers were linked to Dar-es-Salaam market to sell high quality cassava chips. In May 2003, the cost price of 1MT of cassava chips delivered to market in Dar-es-Salaam was around $140 whilst the selling price ranged from $190 to $220. This price brought about 300% increases in return per ha of cassava as compared to sale of fresh root to traders. Average sales volume of chips went up to 5MT per week. To date two processing groups are still operational at Bungu village supplying chips to Power Food Limited in Dar-es-salaam. The production steps of cassava chips used at Bungu village include harvesting and transporting fresh cassava roots to the processing site, peeling and washing cassava roots, chipping in a motorized chipper and finally sun drying and bagging (Mkamilo, 2009b).

However, the following are some major bottlenecks of chips production raised at Bungu pilot centre:

i. There is seasonality in supply of cassava raw materials in a processing pilot site. Processing takes place only during main harvest of cassava fresh roots,

ii. There is limited access to water supply. Processors explained that, due to severe drought in some years, good quality water becomes scarce for cassava processing. This calls for strengthening the processing site by ensuring sustainable water supply;

iii. There is inadequate access to market. Currently, the market of high quality chips is available from Power Food Limited based in Dar-es-Salaam that buys chips at farm gate. To make this business competitive and more profitable, there is a need to identify additional market opportunities;

iv. Cassava peeling is labour intensive, as it is done manually by knives. There is a need of motorized cassava peeling machine; and (v). Drying chips is done on the sun making it difficult to process cassava during rainy period. Traders demand constant supply of chips and this point out a need to explore different types of drying technologies at community and SME levels (Mkamilo, 2009b)

2.11.2 Cassava Starch Production Pilot Site at Mtimbuani Village in Muheza District

Mtimbuani village is in Muheza district in Tanga region. It is 18 km from Tanga town or 370 km north of Dar-es-Salaam. The starch processing pilot site was established between November 2003 and June 2004 in collaboration with National Root and Tuber Crops Research Program, TFNC and the Muheza district authority under IITA/CIAT starch project. Total investment in the structure and machines (grater, separation sieves, basins and drying facilities) was about $ 5000-$6000. The starch from the plant was planned to be sold to textile mills and food processors in Tanga and Dar-es-Salaam. While textile mills need large volume of starch (minimum of 12MT starch/month) at about $ 290/MT; processors perceive that little or no gain is made at the estimated cost price of $ 250/MT and the volume required by the industry that is much higher than the production capacity at the small scale processing centre (3MT/month). However, there is market access opportunity in some small scale tie-and dye and food processing enterprises that use small quantities of starch at a time at $ 580/MT. Steps of starch production at Mtimbuani includes harvesting and transporting fresh cassava roots to the processing site, peeling and washing cassava roots, grating in a motorized grater, dilution of grated cassava with potable water, starch extraction and settling of starch, starch rewashing and settling, sun drying milling, sieving, cassava starch. Starch processing group at Mtimbuani raised almost similar constraints as that of chips processing at Bungu village. (Mkamilo, 2009b).

2.11.3 Cassava Flour Production Pilot Site at Zogowale Village in Kibaha District

Zogowale village in Kibaha district has a moderate production of cassava. Although there is substantial demand for both fermented and unfermented cassava flour in the supermarkets in the country, the Zogowale farmers were neither selling flour nor trading in fresh roots. Few months prior to introduction of cassava flour pilot centre, the farmers were selling chips to the animal feed producers in Dar-es-Salaam but the price of Tsh 70/kg of chips offered by the industry was low. The village was selected for pilot project because of availability of good quality water supply, proximity to market in Dar-es-Salaam, there is a good passage of roads and supply of cassava was not considered a problem as cassava can be purchased from neighbouring villages. The pilot centre was established under CFC project in 2004. The cost of equipment (grater, press, pin mill) and water supply was about $ 1200.

The farmers' group (23) is processing cassava roots to flour for sale to a new biscuits factory (Bakers Food International Ltd) and supermarkets in Dar-es-Salaam. The farmers are also milling grains for other villagers for some fees. The steps in technology adopted for production of flour include harvesting and transporting fresh cassava roots to processing site, peeling and washing cassava roots, grating cassava in a motorized grater, rapid dewatering by pressing in polypropylene bag, granulation, sun drying and milling. It should be noted that the constraints encountered at Bungu village are the same as at Zogowale. An additional constraint at the latter site is rapid dewatering by pressing in a polypropylene bag that is labour demanding, as it is done manually. There is a need of motorized dewatering machine (Mkamilo, 2009b).

2.11.4 Cassava Flour Production Pilot Site at Chisegu Village in Masasi District

Chisegu village is in Masasi, South of Tanzania, 600 km from Dar-es-Salaam. Chisegu is one of the most popular cassava producing areas in Masasi district. Cassava is considered as both food and cash crop. The area used to export cassava chips to EU market through the Mtwara port in late 1980s. Cassava is sold in form of dried chips processed in various traditional ways. Although consumption of maize based products is dominant in the area, the village is about 15 km away from Masasi town where incidences of 'konzo' have been reported before. Konzo is a paralytic disease, which results from consumption of improperly processed cassava foods over a long period of time (Mkamilo, 2009b).

In February-May 2004, IITA, TFNC and the National Root and Tuber Crops Research Program introduced the novel cassava processing and marketing technologies under Rural Livelihood project. A pilot processing centre was set up with installed equipment (grater, press and milling machine) for a group of 15 farmers (5 men and 10 women) at a cost of about $ 5000. The farmers' group had access to clean water for processing. IITA, TFNC and the National Root and Tuber Crops Research Program backstop the activities of the farmers in the area. The harvested roots are peeled and grated using motorized grating machines. The grated cassava mash is immediately pressed in order to remove water and the cyanogens in the roots. The pressed cassava cake is granulated and then spread thinly on raised polythene sheets for drying. The dried granules are milled, packed and sold as high quality cassava flour. Constraints of cassava processors at Chisegu are generally the same as in other pilot sites. Also there is regular breakdown of machines especially the mill. (Mkamilo,. 2009a).

2.11.5 Cassava Chips Production Pilot Site in the Lake Zone

A project aimed at developing a small scale cassava chip production in the Lake Zone, which was supported by DFID and led by NRI, was conducted from 2002 to 2005. Key partners in this project were the National Root and Tuber Sub-program in the Lake Zone, TFNC, Vitanda industries in Mwanza whose role was to fabricate cassava chippers and sell to farmer groups in credit/loans. Generally, the technology was preferred but farmer groups reported the following constraints: inadequate market for high quality cassava chips, inadequate supplies of raw materials, machines were expensive and there has been frequent breakdown of the machines (Mkamilo, 2009b).

2.12 Cassava Utilization

The crop is mainly grown as human food, but also it is an important animal feed, and it has several significant industrial uses. Apart from the economic activity inherent in cassava growing itself, the processing and marketing of cassava generate employment and provide opportunities for the development of rural industries. Being one of the cheapest sources of food energy, cassava could play a major role in meeting developing countries, rising consumption of both food and animal feed. (Cock, 2001).

2.12.1 Utilization for Human Food

Cassava is extensively cultivated throughout the tropics for its starchy roots, which form a primary or secondary staple for many people (Coursey, 2000). The crop is an efficient producer of carbohydrate. It is tolerant to drought, it has no precise maturity, and can be left in the ground and harvest nearly any time of the year, thus being good security against famine (Lancaster *et al.*, 1992). In Africa, nearly all cassava is used for human consumption. In Asia, about half of the cassava is produced for human consumption, and the remainder is exported in form of chips and pellets, while in Latin America, the amount of cassava produced for human food is only about 40%. More than half of the eaten cassava is processed into forms such as flour, meals and starch (Cock, 2001). The consumption patterns of cassava differ among regions.

According to Asiedu (1999), in some regions fresh peeled cassava is eaten as a vegetable after boiling or roasting. In Tanzania, cassava root is consumed in the form of stiff porridge locally known as 'ugali', eaten raw, fresh peeled root is eaten after boiling or roasting and also fresh peeled roots are cooked mixed with other food stuffs like sweet potato, beans, pumpkins, fish and meat and sometimes added additives such as tomatoes and onions. Cassava flour is sometimes used to make porridge, while cassava leaves are mostly consumed as vegetable. In West African countries, cassava is boiled and pounded with boiled plantain to form elastic dough called *fufu*, which is consumed with vegetable and meat soups. The roots of the sweetest varieties are sometimes eaten raw as an (inbetween meals) snack or thirst quencher. When cooked, the roots become equivalent to potatoes, but their taste is considerably 'heavier'. In Indonesia, the roots are often wrapped in leaves after covering them with a yeast preparation, and then fermented to produce a soft sand slightly alcoholic side-dish (Meyote, 2004). Peeled cassava roots are also sliced, dried and ground into flour and processed into many different products such as chichili, cake, biscuits, breads, and all other products which can be made from wheat flour (Meyote, 2004).

2.12.2 Cassava as Animal Feed

In most tropical areas, cassava is widely used for feeding pigs, cattle, sheep and poultry. In Brazil and Paraguay, animals are fed on considerable quantities of fresh cassava roots, In Asia, most cassava is dried before being used as animal feed (Cock, 2001). Cassava has become an important animal feed for a long time. A large quantity of cassava chips and pellets are exported to the European community, mainly from Thailand, Malaysia and Indonesia. Cassava roots are an excellent energy source for ruminants, whether dried or, in case of sweet cassava, fresh (Fasae *et al.*, 2009).

2.13 Non Food Uses

Starch is widely used in the textile industry for sizing, cloth finishing and printing. In the paper industry, starch is used mainly to improve the finishing, appearance, strength and printing properties. It also makes papers resistant to scuffing and folding (Whistler and Pascall, 1993). According to Meyote (2004), cassava starch is used as a adhesive. It can be in the form of a roll-dried adhesive or a liquid adhesive. Starch is converted to dextrins by using chemicals, as well as enzymes.

2.14 Industrial Uses

Cassava is also an important raw material in starch production. Starch from different cereals and tubers including cassava, is widely used in the food industries (Cock, 2001). Starch can be used in the form of cooked starch foods, e.g., custard. It can be used as a thickener in soups, baby foods and sauces. This is due to its paste formation properties. Meyote (2004) explained the use of starch as the filler, contributing to solid content of soups and ice cream. Starch can also be used as a binder, especially in sausage and processed meats. This helps to consolidate the mass and stops it from drying out during cooking. Due to its high water-holding capacity, starch can be used as a stabilizer, especially in ice cream. Starch is also used in the manufacture of candies and boiled sweets, in the making gums and pastes, also sprinkled on sweets to prevent them from sticking together. It is widely used in the manufacture of monosodium glutamate (MSG) in far East and Latin America countries. On fermentation by yeast, starch produces alcohol. Cassava contains 30% starch and 5% sugars. When dried, the roots have approximately 80% fermentable substances. Roots are washed, crushed into thin pulp and screened. In alcohol production, sulphuric acid is added to the pulp to allow saccharification, when total reducing sugars reach 15-17% of the content, fermentation by yeast is allowed to take place for about three to four days. Sodium carbonate is used to adjust the pH. Distillation is carried out to separate the alcohol. A tonne of cassava can produce between 70-110 litres of absolute alcohol. This alcohol is mainly used for industrial purposes such as in cosmetics and solvents (Meyote, 2004).

2.14.1 Dextrins

Dextrins are mainly used in the corrugated cardboard industry for the manufacture of cartons, boxes and various packaging materials (Kweon *et al.*, 1994). Starch-based products are used as adhesive for wallpaper and for various domestic uses. Again, starch is very useful in coating and binding sand grains, which are used in moulds in the manufacture of castings for metals.

2.15 Novel Products

2.15.1 Cassava Rava

Rava a term used in Kerala for cassava semolina, is a convenience breakfast food in Asian areas, which is presently made of wheat semolina. Attempts were made at CTCRI to develop a cassava-based rava as a wheat substitute. Conditions for controlled gelatinization of chips for preparation of rava were therefore standardized (Balagopalan *et al.*, 1982).

2.15.2 Fermented products

Fermented products like lactic acid, sorbitol and vitamin C can be obtained from cassava starch. These have wide application in the food industry (Balagopalan *et al.*, 1982).

2.15.3 High-Fructose Syrup (HFS)

A steady increase in the consumption of sugars, due to the population growth and the improvement in the standard of living, is likely to increase the price of acute shortage of industrial and potable ethanol that has prompted research on the feasibility of using cassava starch as a raw material for production of alcohol. Production details for this process have been developed at CTCRI and have been patented (Balagopalan *et al.*, 1982).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Overview

This section deals with the methodological processes which generated data for this study. It includes description of the study area, research design, population, sample size, development and administration of the research instrument, pre-testing, data collection, processing and analysis.

3.2 Description of the Study Area

Mtwara region is comprised of six districts namely Masasi, Nanyumbu, Mtwara Urban, Mtwara Rural, Newala and Tandahimba (Fig. 2 and 3). The main ethnic groups are the Makonde, Mwera, Yao, Makua, Ngindo and Matumbi. The climate features: a hot and humid rainy season November/December to April/May and a cooler less humid dry season June-October. The average temperature is 24.3°C in June/July (coolest period) and 27.5°C in December (hottest months). The mean maximum temperatures are 30.5° and mean minimum is 21.7°C. The average rainfall varies between 810 and 1090mm. The major cash crops are cashew, sesame and groundnuts while the main food crops are maize, cassava, sorghum and rice. The main grain legumes grown are pigeon peas, cowpeas, bambara nuts and greengrams (Katinila *et al.*, 1998).

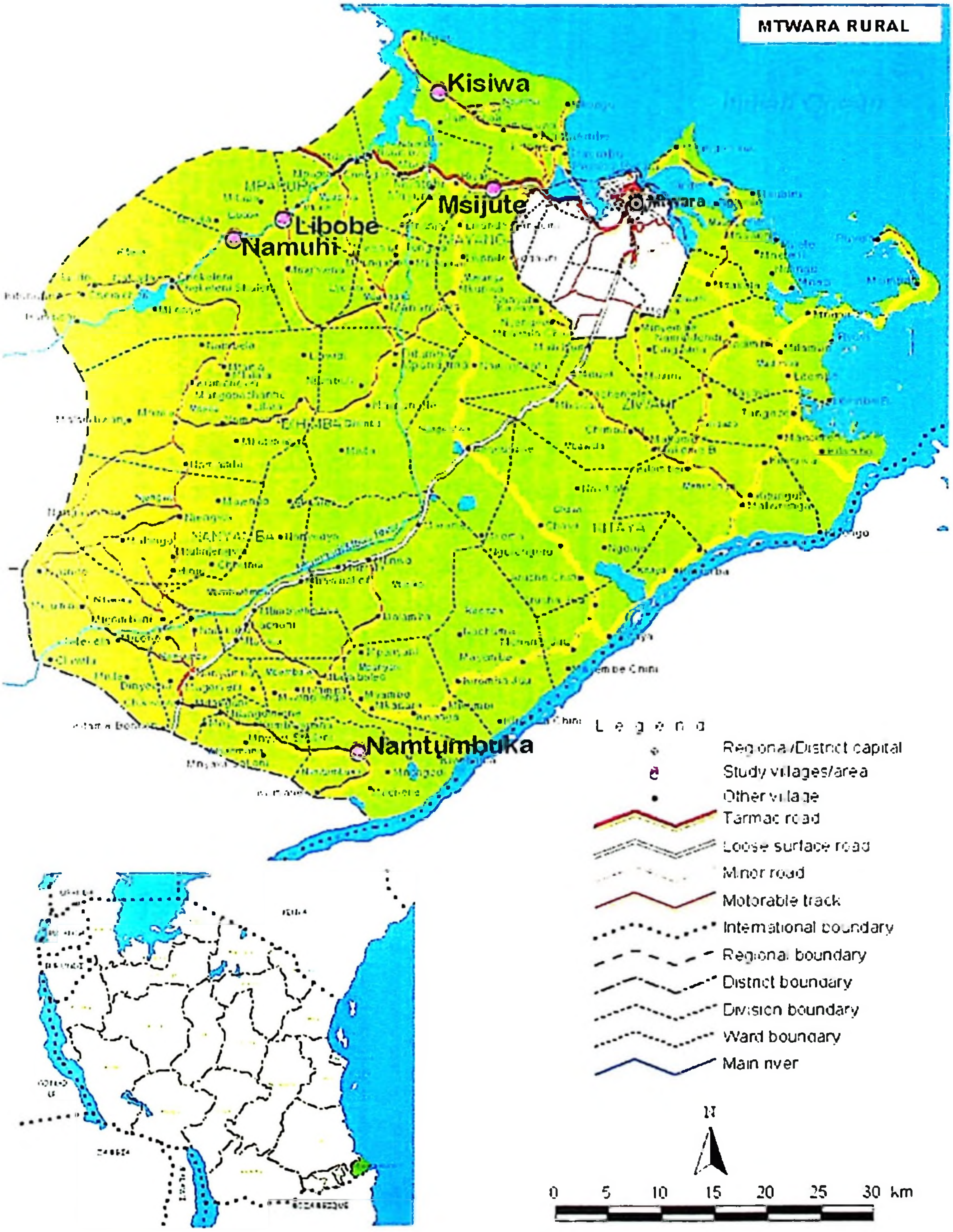

Figure 2 :Map of Mtwara rural district – study areas

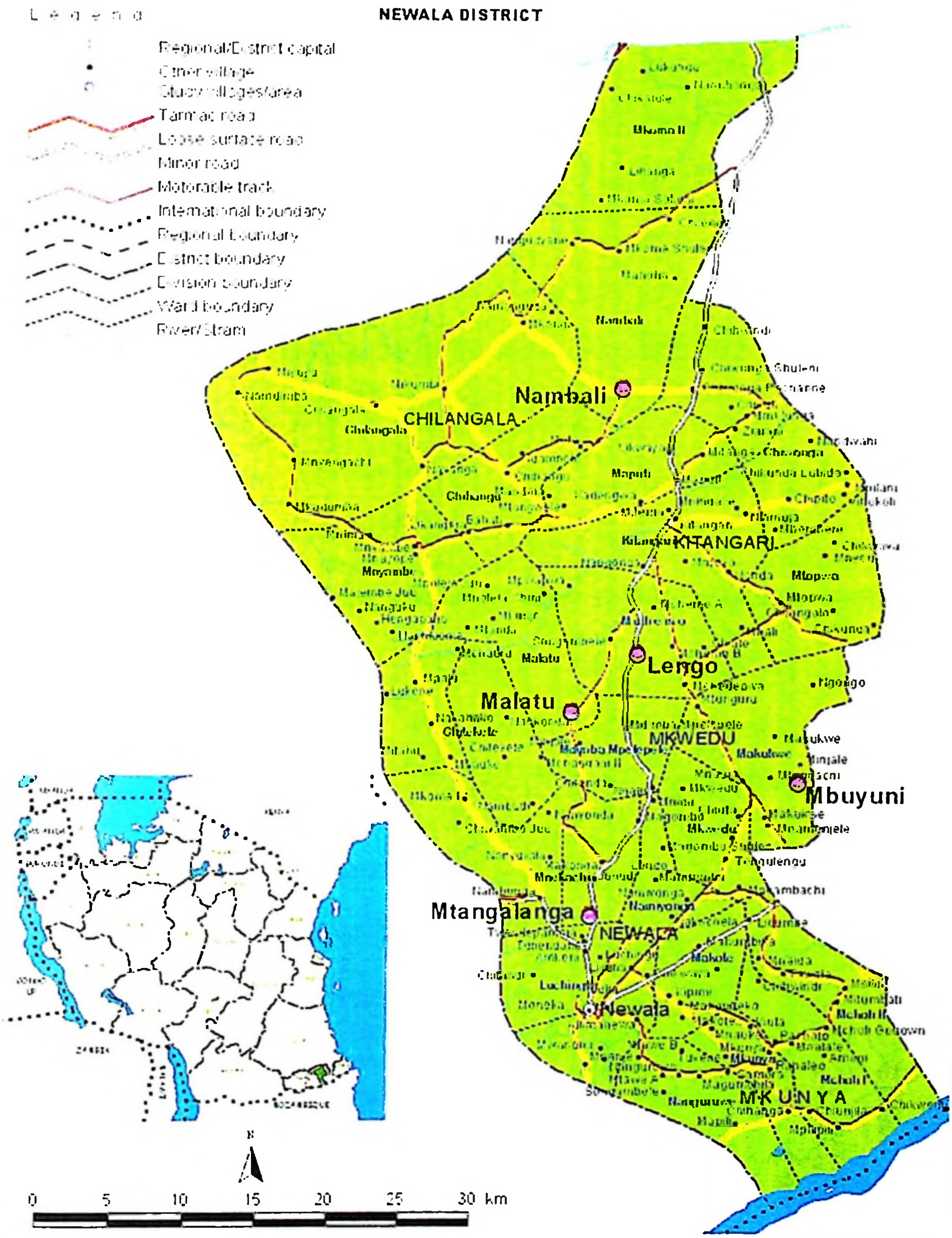

Figure 3: Map of Newala district – Study areas

3.2.1 Newala District

Newala District is located in the southeast of Tanzania between longitude 39^0- 40^0 East and Latitude 10^0 - 11^0 South. The District covers a total land of 2 220 km^2 on the Makonde plateau. It is neighbouring Tandahimba district to the east, Masasi districts to the west, it is bordered by Lindi region in the north and in the south by the Ruvuma river, which is also the border of the United Republic of Tanzania with the Republic of Mozambique. The district experiences a seasonal monsoon rainfall that starts in November and ends in May. The average annual precipitation is 1 000 mm with a poor distribution pattern that is irregular and unreliable rainfall. There is a pronounced dry spell of one or two weeks duration between mid- January and mid- February. The annual mean temperature is 22°C. The district is divided into three agro-ecological zones according to topography of the area located on Makomde plateau, i.e. north Makonde plateau, Central Makonde plateau and Ruvuma River basin.(URT, 2003)

3.2.2 Economic profile of Newala district

Newala District is predominantly a rural district where agriculture/farming is the main occupation of the people. Over 85% of the people in Newala depend on agriculture as the main source of income, Cashewnuts account for over 75% of that income. Other economic activities are animal husbandry, industry, small scale industry and commerce.

a) Animal husbandry – Livestock is kept at a very low scale.

b) Industry – There are 2 cashewnut processing plants.

c) Small scale industries – There are very few small scale industries dealing with cashewnut processing, carpentry, tailoring, cassava processing and mechanics.

d) Commerce – Trade is conducted at domestic level. There are about 7 wholesale shops and 327 retail shops. There arc also many petty businesses taking place in the district.

Newala district has one Commercial Bank, namely The National Microfinance Bank (NMB) Newala Branch located within the district headquarter. It also serves the neighbouring Tandahimba district. The district per capita income is highly sensitive to the seasonal fluctuations in the price of cashewnuts, which is the main source of income. The fluctuation in the price of cashewnuts has appositive correlation with household's income and people's wellbeing. The 2003/2004 cashew buying season started at a price of Tsh 420/kg by the end of December 2003.

The price in the season 2004/2005 started at Tsh 720/kg and remained fairly constant up to December 2004 when it fell gradually down to Tsh 350/kg. In the season 2005/2006 the price started at Tsh 600 and then decreased to Tsh 500/kg. The overall district Gross Domestic Product (DGDP) slightly increased to Tsh 28 992 327 000 in 2004/2005, consequently this raised income per capita to Tsh 157,629 per annum. Generally, a drop in cashew price causes great hardships to most households dependent on the crop in the district (URT, 2003)

3.2.3 Mtwara Rural District

Mtwara Rural district has a total Area of 3 597 sq, km. The district borders Lindi to the north, Indian Ocean to the east and Ruvuma river on the Tanzania / Mozambique border to and the south and to the west is Tandahimba district. The rainfall pattern of the district includes two major seasons, which runs from May to November and the rainy season spreads from December to April. The temperature ranges between 23^0C in the month of June to 30^0C in the month of October (URT, 2003).

3.2.4 Economic Profile of Mtwara Rural District

The district depends on farming as a main source of income, of which contributes about 75% of the total income. Other activities include fishing, petty business and small industries. Food crops grown include cassava, maize, sorghum, millet paddy, legumes, whereas cash crops grown include cashewnuts, groundnuts, simsim and coconut. Mtwara district council is among the poorest districts in Tanzania. It has per capita income of Tsh 160 030. As a result, the Council is characterized by poor service delivery, manifesting in various forms, including high infant mortality, maternal death and illiteracy rates. Among the reasons behind this poverty level is over-reliance on hand hoe poor farming methods, poor infrastructure, inherent anti-development, anti education and traditional and cultural beliefs (URT, 2003).

3.3 Research Design

A cross sectional research design was used in this study. The cross sectional research design allows data to be collected at a single point in time (Bryman, 2004) and is mostly used in social research. The selection of this design was based on the fact that limited resources which include time and fund the researcher had. This design has been recommended by Bernard (1994) and Shank (2006).

3.4 Sampling Procedure

The sampling unit for this study was households in respective villages. Simple random sampling was used to obtain representative sample that was used in the study. Five villages were randomly selected in each district. Random sampling procedure was used to select individual households in the respective villages. The sampling frame was the list of all households in each village. A total of 120 households from the ten selected villages were interviewed. Every village comprised of a sample size of 12 households.

3.5 Data Collection

3.5.1 Primary Data

The primary data was collected using interview schedule by using a structured questionnaire. The questionnaires were pre-tested to ensure validity and relevance of questions so as to enable researcher to make some necessary corrections. Focus Group Discussion (FGD) was used to collect information from key informants, service providers as well as from DALDO's office and members of cassava processing groups.

3.5.2 Secondary Data

Secondary data were used to enrich the primary data. These were obtained from sources such as National Bureau of Statistics, Sokoine National Agricultural Library (SNAL), research reports from various institutions, international organization, and Non-Governmental Organizations dealing with cassava and food security in Tanzania.

3.6 Data Analysis

Descriptive statistics, i.e., statistical mean, standard deviation, range and frequency were used to describe the general characteristics of the data in the study area, which enabled the perception of the situation in the study area. Logistic regression analysis was used to determine the socio-economic factors influencing adoption of improved cassava processing technologies in the study area.

3.6.1 Gross Margin Analysis

Gross margin analysis was used to determine the contribution of cassava processing and utilization technologies on income to small holder farmers. The gross margin was calculated using the formula below;

Gross margin analysis (GM)

GMi = TRi –TVCi -----------(1)

where; GMi = Gross margin per tonne of cassava

TRi = Total revenue from sales of one tonne of cassava

TVCi =Total variable cost spent on one tonne of cassava due to marketing

3.6.2 Binary Logistic Regression Model

The binary logistic regression model using maximum likelihood method was used to determine the socio-economic factors influencing adoption of improved cassava processing and utilization technologies. The model was specified as shown below.

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots\dots\dots + \beta_i X_i + \mu_i \qquad \dots\dots\dots\dots\dots\dots\dots\dots(2)$$

where $\ln\left(\frac{p}{1-p}\right)$ is the dependent variable in the natural log of the probability of use of cassava processing and utilization technologies (p) divided by the probability of not using the cassava processing and utilization technologies and (1-p). It takes a value of 1 for use of cassava processing and utilization technologies and 0 for not using.

α = General mean (intercept constant)

Age (X_1) = Age of respondent (Years)

Occuptn (X_2) = Occupation(X_2 =1 if s/he is a farmer; X_2=0 Otherwise)

Marst (X_3) = Marital status (X_3 =1 for married; X_3= 0 otherwise)

Instsado (X_4) = Access to institution support to cassava processing (X_4 =1 access to institutional support; X_4= 0 no access to institutional support).

β_1 β_2 β_3, β_4 = Parameters to be estimated

μ i = random effect term μ ~ N (0, pi (1-pi))

3.6.3 Conceptual framework

The conceptual framework is narrative outline presentation of variables to be studied and hypothetical relationships between and among variables. The types of variables shown are: background variable such as age, sex, education marital status, occupation and institutional support (Fig. 4). Availability of tools/implements which are machines, press, and technical know how to operate the processing machines, milling machines and farm size. Also, income status of the households, labour and time spent on using the processing machines have effect on the use of the introduced processing and utilization technologies. Therefore, the dependent variable of this study was influenced by background and independent variables.

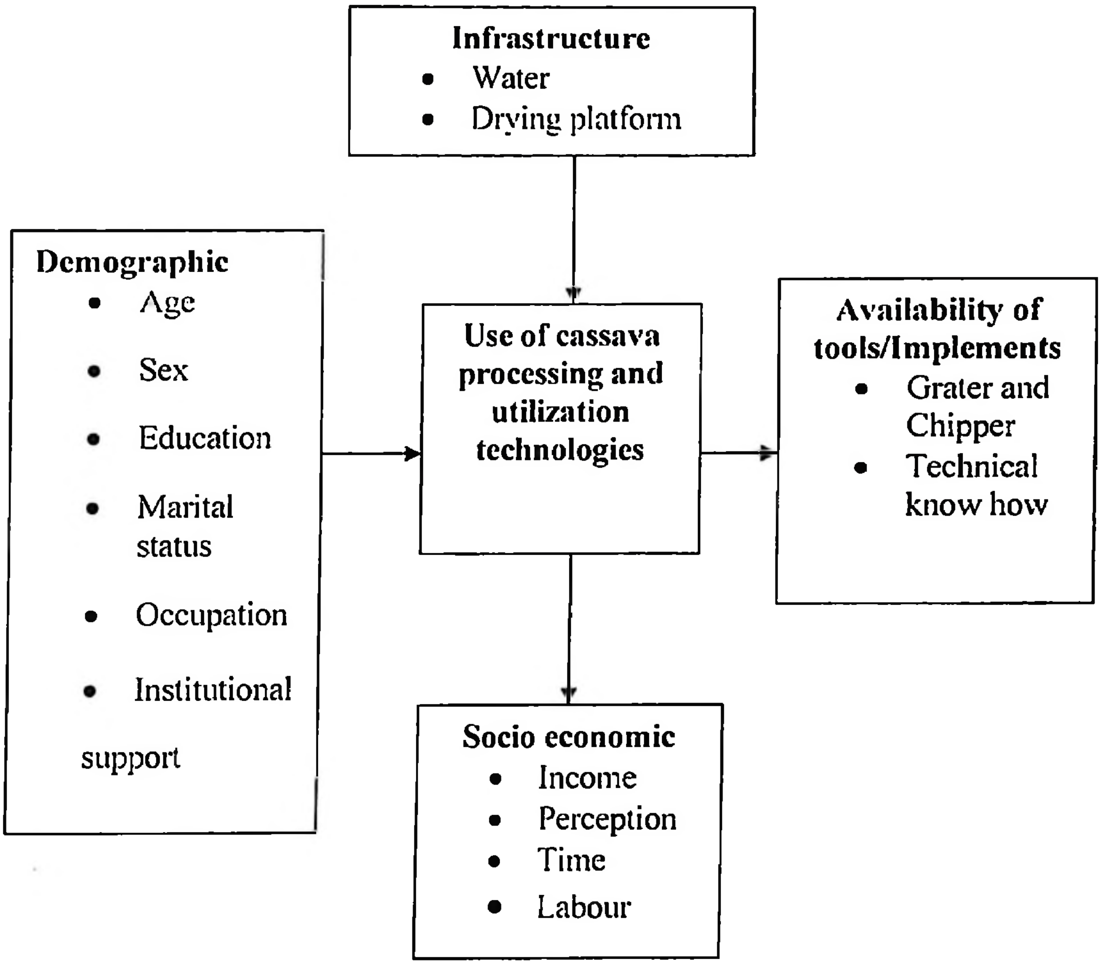

Figure 4: Conceptual framework

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the findings of the study. In the first section socio-demographic characteristics of surveyed households are presented. Section two presents information on cassava production, processing technologies and utilization. Section three presents information on the contribution of modern cassava processing technologies to household income. The last section presents constraints and opportunities faced by small scale farmers in adopting cassava processing technologies.

4.2 Socio-economic Characteristics of Households

Socio-economic characteristics have effect on farmers' production decisions, resources allocation to farm enterprises and decisions for adoption of a certain technology. They determine human potential to produce and capacity to change production practices and technology in this ever-changing social and economic environment (Ngailo, 1993). In this section, socio-economic characteristics of respondents are presented. The variables presented in this section are age, sex, education, marital status, household size and major sources of household income.

4.2.1 Age, Household Size, Farm Size and Allocation to Cassava Production

Table 1 presents a summary of selected socio-economic characteristics of the respondents namely age, household size, land size and amount of land allocated to cassava production during 2008/9 season

Table 1: Socio-economic characteristics of respondents (N = 120)

Household characteristics	Mean	Standard deviation
Age of respondents (yrs)	41.2	12.9
Household size	5.3	2.5
Land size (ha)	2.5	2.7
Size of land cultivated under Cassava 2008/09(ha)	1.0	0.7

Results revealed that the mean age of respondents was 41 years indicating that respondents were in the active age group and could contribute greatly to productive work on the farm. The average household size was five people while the dependency ratio was 40%. The average farm size owned by the respondents was 2.5 ha and the average land size allocated to cassava production for the 2008/9 season was 1 ha per household. However, the land size allocated to cassava production was still low. This finding was similar to that of Temu and Nyange (2001) that cassava production is dominated by smallscale farming with average farm size from 0.8 to 1.2 ha per household. Low production of cassava might be attributed to shortage of labour, low incomes of farmers, high prices of inputs and market related constraints.

4.2.2 Sex of Respondents

Household interview and focus group discussion were used to collect information from respondents. The findings showed that 68% of the respondents interviewed were males (Table 2). This implied that majority of respondents were males. Focus group discussions were mainly conducted to cassava processing group members. In focus group discussion, 57% of the audience was female, due to the reason that food processing activities are mostly done by women.

Table 2: Socio-economic characteristics of respondents (N=120)

Household characteristic	Frequency	Percentage
Sex of respondent		
Male	81	68
Female	39	32
Marital status		
Married	106	88
Single	6	5
Widowed	2	2
Divorced	6	5
Education level		
No formal education	19	16
Primary school education	97	81
Secondary school education and college	4	3
Economic activities		
Farming	117	97
Livestock keeping	73	61
Petty business	30	25
Semi-skilled work	3	3
Civil services	2	2

4.2.3 Marital Status of Respondents

The results revealed that 88% of respondents were married, 5% were single, 5% divorced and 2% widowed (Table 2). This implied that a large number of respondents were married and this might lead to a cohesive and stable community. A stable community can concentrate more on production activities compared to unstable community and thus ensure increased agricultural production. Goosens (1996), reported that, ability of a community or a family to engage in production activities depends mostly on its stability.

4.2.4 Education Level

The findings Table 2 showed that majority of respondents (81%) had standard seven education. Others had no formal education (16%) and secondary school education and college about 3% .The findings showed typical characteristics of literacy common for small holder farmers in rural areas of Tanzania. Education level might influence farmers' decisions of whether or not to adopt a certain technology. However, primary school education might help farmers in seeking and utilizing simple agricultural processing technologies available from different sources.

4.2.5 Major Economic Activities of Respondents

Crop farming (97%) was the first important economic activity (Table 2) followed by livestock keeping (61%) and petty business such as local brewing, retail shops, food vending and charcoal sale (25%). This finding showed that majority of respondents depends mostly on agriculture as a source of food and household income. This result is supported by Rwiza *et al.*, (1998) that agriculture is the major economic activity in many districts of Tanzania. Other economic activities reported include semi-skiled work like primary society staff and labourers in cashew processing industries (3%) and civil services such as primary and secondary school teachers and Village Executive Officers (2%).

4.3 Cassava Production in the Study Area

This section presents information on the status of cassava production. The key information under the section include land ownership and utilization, varieties of cassava cultivated, amount produced, sold, consumed and deteriorated in quantity and monetary values, and also the problems facing small scale farmers in cassava production.

4.3.1 Land Ownership and Amount Allocated to Cassava Production

Land is a major resource in agricultural production. With reference to farm size, the study findings showed that the average farm land owned by the respondents was 2.5 ha. (Table 2). In 2008/2009 season the amount of land allocated to cassava production was 1 ha, which was 40% of the total land owned by the respondents. Relatively large proportion of land was allocated to cassava production due to the environmental factors. Most of the soils in Newala and Mtwara Rural districts are less fertile and also there is usually unfavourable weather condition for production of maize and other related crops. Hence, more land was allocated to cassava production because cassava is the major staple food and also source of household income. However, cassava production is affected by limited access to reliable markets of cassava and its products, causing low production and motivation to increase production and adoption of improved technologies (Mkamilo and Jeremiah, 2001).

4.3.2 Types of Cassava Varieties Grown

Table 3 presents cassava varieties grown in the study area.

Table 3: Most common cassava varieties grown (N=120)

Variety (Makonde names).	Taste	Frequency	Percentage	Rank
Salanga	Bitter	48	40	2
Nanjenjeha	Bitter	20	17	6
Vicent	Sweet	23	19	3
Kigoma	Sweet	71	59	1
Naliekuchumba	Sweet	23	19	4
Lihipukalyene	Bitter	10	8	8
Kalinda	Bitter	22	18	5
Nachinyaya	Sweet	18	15	7

Different cassava varieties were reported to be grown in Newala and Mtwara Rural districts. These included bitter and sweet varieties. The most important cassava varieties grown were Kigoma (sweet) 59% followed by Salanga (bitter) 40%, Vicent (sweet) 19%, Naliekuchumba (sweet) 19% and Kalinda (sweet) 18%. Other varieties include Nanjenjeha (bitter) 17%, Nachinyaya (sweet) 15%, and Lihipukalyene (bitter) 8%. However, there were other varieties reported grown in small quantities. These included Naliendele, Tukuyu, Ndanda, Palichi, Namikonga, Supa, Mbuyu, Binti Mohamedi, Kifuu cha Nazi, Badi, Nakuchima and Albert. All these were sweet varieties. Bitter varieties reported were Sumu ya panya, Magoha, Mussa Saidi and Jodani. Sweet varieties were preferred to bitter due to the fact that they are relatively easy in preparing its roots for consumption, they could be boiled for consumption, they could be chewed when they were fresh and raw, and they were mostly used during the holy month of Ramadan. Also, fresh roots had relatively good prices in the market. Bitter varieties were preferred to sweet varieties due to the reasons that they were high yielding, suffer less attack from vermin and theft and also were used for making *makopa* for food and sale. However, bitter varieties contained higher concentration of toxic cyanogenic glucoside and therefore required special preparation (peeling, soaking for 2 to 3 days, drying and pounding) for safe consumption (Foodnet, 2001). Poor preparation of bitter varieties may result into healthy problems.

4.3.3 Amount of Cassava Produced, Consumed, Sold and Lost per Hectare

Table 4 presents the amount of cassava produced, consumed, sold and lost per ha.

Table 4: Amount of cassava produced, consumed, sold and lost on dry basis (kg/ha)

Variable	Mean	Standard deviation
Amount of cassava harvested	841.9	1145.2
Amount of cassava consumed	574.2	1204.1
Amount of cassava sold	517.4	863.1
Amount of cassava deteriorated	346.0	859.8

The average amount of cassava harvested per hectare per household during 2008/09 season was 841.9 kg. The average amount of cassava lost was 346.0 kg, which was 41% of the total harvest. Cassava loss was attributed to vermin particularly pigs and other pests. The average amount of cassava consumed was 574.2 kg and about 61% (517.4 kg) of the cassava harvested was sold.

4.3.4 Constraints Faced by Farmers in Cassava Production

Results in Table 5 revealed that pests and diseases were the most important problems (71%) in cassava production, followed by inadequate market (31%): vermin (17%) particularly pigs, baboons, monkeys and rodents; inadequate improved planting materials (16%) and lack of inputs such as insecticides .

Table 5: Constraints faced by farmers in cassava production

Constraints	Frequency	Percentage	Rank
Low producer selling price	7	6	9
Inadequate market	37	31	2
Pests and diseases	85	71	1
Vermin	21	17	3
Inadequate knowledge in cassava production	13	11	6
Unreliable rainfall	10	8	7
Shortage of labour	10	8	8
Inadequate improved planting materials	19	16	4
Lack of inputs (insecticides)	17	14	5
Poor road infrastructure	2	2	10
Theft	5	4	10

Other constraints included inadequate knowledge on improved cassava production and management (11%), unreliable rainfall (8%), shortage of labour (8%), low producer selling prices (6%) and poor road infrastructure (2%). This implied that, there are several constraints to cassava production, marketing and utilization in the study area. This included poor working tools and processing technologies, which increased labour in all cassava operations and discourage the expansion of the cassava production by small farmers. Therefore, many studies have emphasized that, efforts in improving production should be well intergrated with efforts in improving the processing technologies (MOAC, 1997).

4.3.5 Farmers' Suggestions on Improving Cassava Production (n = 120)

Table 6 presents farmers' suggestions on ways forward for improving cassava production in the study area.

Table 6: Farmers' suggestions on improving cassava production (n = 120)

Proposed solutions	Frequency	Percentage	Rank
Training of farmers on control strategies of pests and diseases	82	68	1
Developing and dissemination of improved planting materials	20	17	3
Farmers' training on modern cassava management practices	20	17	4
Supply of inputs like insecticides at affordable prices	34	28	2
Supply of farm implements like tractors at affordable prices	1	1	7
Provision of affordable agricultural credit facilities	5	4	5
Government should support marketing of cassava	4	3	6

Training of farmers on control strategies for pests and diseases was the first important suggestion (68%) from farmers. followed by supply of inputs like insecticides at affordable prices (28%) and development and dissemination of improved planting materials to rural farmers (17%). Other suggestions included training of farmers on modern cassava management practices (17%), provision of affordable agricultural credit facilities (4%) since majority of farmers had low incomes and inadequate capital for establishment of agricultural enterprises, government support in marketing of cassava (3%) and lastly supply of farm implements like power tillers and tractors at affordable prices (1%). A number of cassava production and processing constraints have been identified in Tanzania. These constraints are low genetic potential of local varieties. prevalence of diseases and pests. inadequate access to improved planting materials to farmers. poor husbandry practices (e.g.. no fertilizer use in cassava, late planting. weed infestation. small area under cassava cultivation, and poor processing technologies. (Mkamilo. 2009b). Therefore. the government should step up efforts to increase cassava production.

4.4 Cassava Post-harvest Processing

4.4.1 Overview

This section presents reasons for cassava processing. cassava processing technologies used by respondents. storage facilities. cassava products and utilization. perceptions and preferences. contribution of cassava processing technologies to household incomes and opportunities and constraints faced by farmers in adopting cassava processing technologies.

4.4.2 Reasons for Cassava Processing

The results revealed that farmers processed cassava for different reasons (Table 7)

Table 7: Reasons for cassava processing

Reasons	Frequency	Percentage	Rank
For product diversification	39	49	1
To make it palatable	33	27	2
To remove toxicity (cyanide)	30	25	3
Increase cash value	30	25	4
To increase shelf life	23	19	5

The first important reason for cassava processing as reported by farmers was product diversification (49%), and this was followed by increasing palatability (27%), removing toxicity (25%), increasing cash value (25%) and also increasing shelf life of cassava (19%). In order to achieve these, efforts in promoting improved cassava processing technologies are inevitable since removing hydrogen cyanide, product diversification and increasing shelf life might not be achieved without improved processing technologies. Nweke (1994), pointed out that, objectives of cassava processing are to reduce postharvest losses of fresh roots, eliminate or reduce the cyanide contents, improve the taste of cassava products and provide raw materials for cassava based industries.

4.4.3 Cassava Processing Technologies Used by Respondents

The findings showed that both traditional and improved cassava processing technologies were used by respondents (Fig. 5).

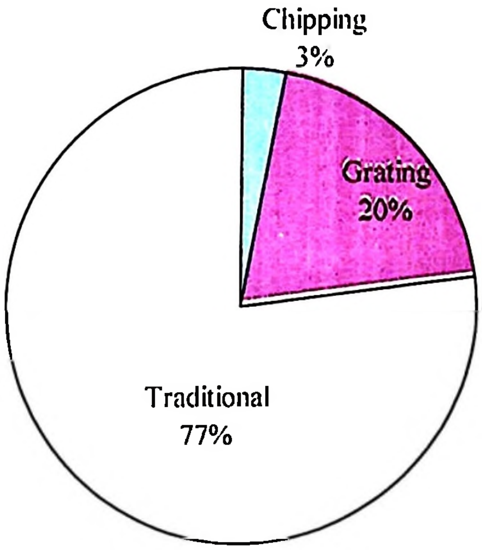

Figure 5: Cassava processing technologies

It was found that 77% of the respondents used traditional cassava processing methods, about 17% used both traditional and improved processing technologies and 6% used improved processing technologies. Traditional processing mainly involved peeling and sun drying of cassava to produce a product locally known as 'makopa'. Modern processing mainly referred to grating and chipping technologies. Grating was used to obtain quality grits while chipping was used to obtain quality chips. Among those who were using modern cassava processing technologies, 20% were using grating technology and 3% chipping technology Majority of farmers were using grating technology due to the fact that most of the varieties used for making 'makopa' and flour were bitter varieties, which contained cyanogen that was harmful to human health. Grating technology performs well in removing hydrogen cyanide from bitter varieties. Chipping technology was mostly used to process sweet varieties.

However, these findings implied that majority of farmers still depend on traditional processing methods. Traditionally, cassava roots are processed by a variety of methods into many different products and used in diverse ways according to local customs and preferences (Hahn, 1989). Many studies have emphasized that efforts on improving production should be well integrated with efforts on improving the processing technologies so as to increase quality of the products, values of the products and also increase market demand for the crop (MOAC, 1997).

4.4.4 Cassava Storage Facilities

Results showed that 77% of the respondents processed cassava using traditional method whereby cassava was peeled and sun dried at the farm to produce a product locally known as 'makopa'. 'Makopa' was stored at the farm until it was properly dried and thereafter was transferred back home and stored again for future use and sale. In the house, 'makopa' was stored on the kitchen ceiling locally known as "dari' until it was needed for food or sale. 'makopa' was stored in the kitchen due to the reason that smoking was used to protect 'makopa' from being damaged by pests. According to Ndunguru *et al.*, (1997), traditional storage methods involving storage of dried chips/makopa on house ceiling are inadequate for preventing further spoilage of 'makopa' by weevil infestation. About 23% of respondents used improved processing technologies. Among four visited processing groups only one group had processing building. other groups were doing their processing activities either under a tree or close to the house. Therefore, cassava grits, chips and flour were packed in sacks and stored on the ground in the house of one member of the group. Generally, storage facilities for processed cassava were still poor. More efforts by the government and other agricultural stakeholders are required to improve the processing structures and storage facilities for increased quality of cassava products. A study by Ayoola (2004) in Benue State (Nigeria), indicated that poor storage facilities were an important limiting factor to production and marketing of cassava.

4.4.5 Cassava Products Awareness and Utilization by Respondents

Table 8 presents cassava products commonly used by respondents in the study area.

Table 8: Cassava products awareness

Cassava products	Frequency	Percentage
Ugali	84	70
Bakery products	71	59
Local brew (Local cassava beer, Liquor)	1	1
Local soft drinks	13	11

The results showed that majority of respondents were aware about stiff porridge locally known as 'ugali'. During focus group discussion it was observed that farmers preferred the traditionally processed flour to modern processed flour in making ugali, because 'Makopa' flour was heavier, so less quantity was used in preparing ugali as compared to modern processed flour, which is very fine and light in weight. About 59% of the respondents were aware about bakery products such as bread, *chichili*, cakes, biscuits, doughnuts, made from cassava flour. However, utilization of these products was still low. This was probably due to inadequate knowledge on how to make the products and also unavailability and high prices of the ingredients required. About 11% were aware of the local soft drinks such as 'togwa' made from cassava and 1% were aware and also used cassava in making local brew. Alternative uses of cassava through value addition have resulted in emergence of wide food recipes from cassava through processing, which involves conversion of edible food into another form more acceptable or more convenient to the consumer (Malcom, 1977). National Root Crops Research Institute (NRCRI) Umudike developed technologies in cassava utilization aimed at diversifying the uses of cassava in Nigeria. Some value added products from cassava include cassava flour, cassava starch, cassava bread, cassava chinchin, cassava chips, cassava flakes, cassava odourless *fufu*, cassava doughnuts, cassava cake, cassava biscuits and cassava salad cream.

4.4.6 Contribution of Cassava Processing Technologies to Households' Income

Table 9 presents information on monetary value earning by households from using traditional and improved technologies.

Table 9: Gross margins for traditional and modern cassava processing based on 2010 market prices (1 tonne of fresh roots as a basis for calculation)

Technology	Gross margin (Tshs/tonne)
Traditional processing	11 774
Modern/improved processing	78 400

Note: Fresh roots processed to flour

The gross margin analysis was used to investigate the contribution of cassava processing technologies to household income. The gross margin analysis was based on one tonne of fresh roots processed to flour stage. The findings showed that improved processing technologies contributed relatively high to households' income with a gross margin of Tshs 78 400 when compared to traditional processing methods with a gross margin of Tshs 11 774 per tonne of fresh roots processed to flour. Relatively high gross margin for improved processing was attributed to premium prices for high quality cassava flour. Traditional processing method had relatively low costs of operations but the selling prices of the final product (makopa flour) were low compared to high quality cassava flour. The value addition technology in cassava possesses enormous potentiality for increasing cassava consumption. diversifying its uses as well as using the same to enhance livelihoods of farm families. This is through providing opportunities for employment. micro agro-enterprises development income and boosting economy of rural households (Ekwe *et al.*, 2008).

4.4.7 Adoption of Cassava Processing Technologies

A logistic regression model was used to analyse socio-economic factors influencing adoption of improved cassava processing technologies at household level.

Table 10: Logistic regression results for adoption of processing technologies

Variable	ß	SE ß	Exp(β)	Wald	df	Sig.
Constant	-4.081	1.263	0.017	10.442	1	0.001**
Age	0.029	0.019	1.029	2.427	1	0.119
Occupation	0.082	0.084	1.085	0.944	1	0.331
Marital status	-0.081	0.350	0.922	0.053	1	0.817
Insitutional support	1.831	0.657	6.240	7.771	1	0.005*

-2 log likelihood = 115.549; Cox & Snell R2 = 0.116; Nagelkerke R2 = 0.176;

Significant at 0.01, 0.05 levels (** and *)

Dependent variable = Adoption of improved processing technologies (1 was if adopted and 0 if not adopted the technology).

Results (Table 10) showed that the independent variables explained 12 and 18% (for Cox & Snell R_2 and Nagelkerke R_2, respectively) of the total variation in adoption of cassava processing technologies.

The -2 log likelihood estimated was 115.5. Results revealed that, institutional support (Instsupt) to farmers was an important factor in adopting improved cassava processing technologies by farmer groups. The coefficient of the institutional support (instsupt) was statistically significant at p=0.05 probability level. The odds ratio (Exp $\{\beta\}$) for institutional support was 6.24. This implies that for those with institutional support, the odds of adopting improved cassava processing technologies are 6.24 times as larger as the odds for those without institutional support. Age of respondents (age), occupation (occuptn) and marital status of respondents (Marst) were not statistically significant. Therefore, in this case adoption of improved cassava processing technologies could be increased if more farmers could have access to institutional support.

4.4.8 Constraints Faced by Farmers in Adopting Improved Cassava Processing Technologies

Table 11 summarizes a list of constraints for adoption of improved cassava processing technologies as identified by the respondents.

Table 11: Constraints faced by farmers on adopting improved cassava processing technologies

Constraints	Frequency	Percentage	Rank
Lack of technical expertise in running processing equipments	20	17	7
Unaffordable prices of processing equipments/tools	41	34	5
Lack of processing and storage shade	29	24	6
Lack of initial capital	62	52	2
Lack of reliable market	67	56	1
Lack of clean water	63	52	3
Lack of cohesion among processing group members	44	37	4
Lack of consistent supply of raw material	11	9	8

It was reported that lack of reliable market (56%) was the most important constraint for adoption of improved cassava processing technologies. Unreliable market was due to seasonality of market. During harvesting season the demand for cassava flour was low due to the presence of other alternative foodstuffs. Palatability and taste of high quality flour was different from traditionally processed flour therefore it took some time to adopt; and low incomes of people in rural areas. Majority of farmers could not afford processing their cassava using modern processing machines and also purchasing high quality flour. According to Mkamilo and Jeremiah (2001), higher production is affected by limited access to reliable markets of cassava and its products, causing low production motivation to produce or to adopt improved technologies. Lack of initial capital (52%) for purchasing the machines and building processing structures was the second important constraint in adoption of improved cassava processing technologies. This was followed by shortage of clean water (52%). lack of cohesion among group members (37%) and unaffordable prices of processing equipment (34%). Other constraints included lack of processing shed (24%). lack of technical expertise in many processing equipment (17%) and also lack of consistent supply of raw materials such as water and fresh roots (9%).

4.4.9 Opportunities Available for Adopting Improved Cassava Processing

The opportunities available for adopting improved cassava processing were, First access to institutional support. like CONCERN Worldwide, NRI, IITA, TFNC, District Agricultural Offices and others are willing and able to provide moral and material support to the processing groups.

Second is the availability of enough fresh cassava roots as raw materials. Third, Cassava is an important staple food in the study area and therefore promotion of high quality cassava flour and products utilization could be easy and hence increased market demand. Presence of good road infrastructure which facilitates easy transportation of cassava products to the district market centre and other external markets, availability of enough land for establishing processing plant, presence of regional Small Industries Development Organization (SIDO). which fabricates the processing machines and sell them at relatively cheap price, presence of farmers group networks which could easily organize themselves and rise capital for cassava processing investment and also availability of extension officers and technical staffs for moral support and advice.

4.5 Access to Extension Services

Extension is known to catalyze awareness, organization, information exchange, and technology adoption among farmers. In this study the results showed that only 66.7% of the respondents had access to extension services. Among those who had access to extension services only 45% received extension advice from extension staffs. This implies that extension services are still inadequate. More extension staffs are needed in rural areas if agricultural development is to be realized.

4.6 Institutional Support to Cassava Processing

Efforts were made to create awareness to large number of farmers, public and private sectors and also other agricultural stakeholders so that they can directly or indirectly contribute to the development of modern cassava processing. Figure 6 presents institutional support to cassava processing received by respondents.

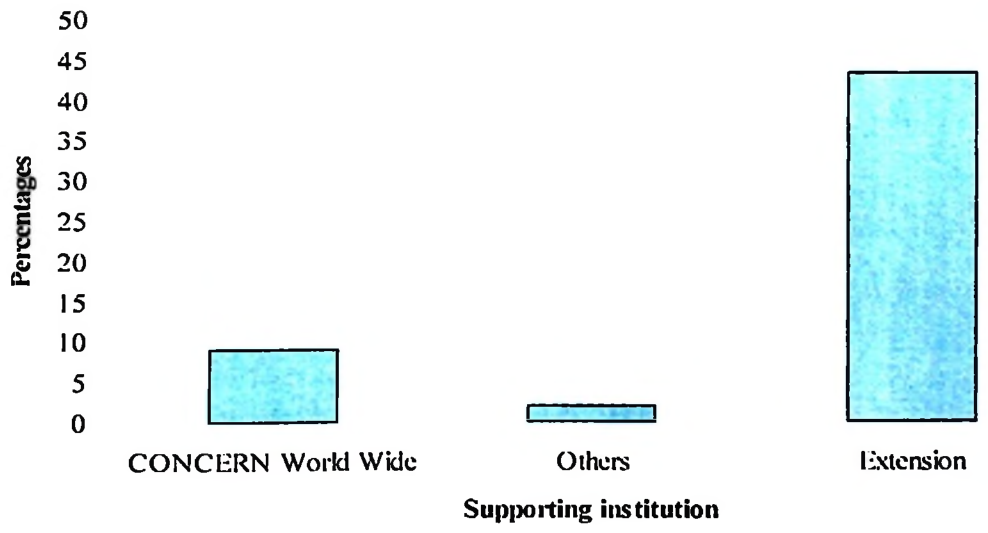

Figure 6: Institutions supporting farmers in cassava processing

In this study the findings revealed that 43% of the respondents received moral and material support from extension officers from district agricultural office District Extension supported farmers in purchasing the machines and also training on the use of the machines. About 9% of the respondents received support from CONCERN Worldwide. This is a Non Governmental Organization, which supported farmers on purchasing of the machines and training in some of the villages, and 2% reported receiving support from other agricultural stakeholders like Tanzania Food and Nutrition Centre (TFNC), Natural Resources Institute (NRI), Naliendele Agricultural Research Institute (NARI), KIMAS and UPT.

4.7 Cassava Marketing

4.7.1 General overview

Cassava marketing section presents information on sources of market information, access and type of market information received by respondents, problems faced by farmers on cassava marketing, farmers' suggestions on improving cassava marketing and farmers' future prospects regarding production and marketing of cassava.

4.7.2 Sources of Market Information for Cassava Products

Market information is important for farmers to know the buying and selling prices of their products and these prices should be from reliable sources. Table 12 presents sources of market information received by respondents.

Table 12: Source of market information received

Source of market information	Frequency	Percentage
Local market	26	22
Traders	38	32
Friends and relatives	38	32
DALDO's office	2	2

The findings showed that traders (32%) and friends and relatives (32%) were the major sources of market information to the respondents. In this case traders had more bargaining power and decisions during price negotiations, and this was especially to those traders who were buying cassava products (grits, chips, flour) from farmers' processing groups. Other sources included local market (22%) and DALDO's office (2%). This implies that there was no reliable source of market information for cassava products; much of the market information reached the farmer by interpersonal sources. The reliance of market information from traders eliminates competition and bargaining power of the smallholder farmers.

4.7.3 Type of market information received by respondents

Market information such as buying and selling prices, source of raw materials and market competition are important for producer's decisions of whether to produce or not to produce. In this study, 77% of the respondents reported that they received information on cassava prices within and outside the village (Table 13).

Table 13: Type of market information received by respondents

Market information received	Frequency	Percentage
Price of cassava	88	77
Price of raw material	14	12
Quality and standards of cassava	12	11

About 12% of the respondents reported that they received information on prices of raw materials. Other market information received by respondents was on quality and standards of cassava products required by traders and ultimate consumers (11%). However, it was found that, still there was uncoordinated and ineffective market information flow in the study area, which limited the realization of market transparency among cassava producers and traders. Therefore, from this study, it is suggested that a system that will ensure effective market information flow should be sought.

4.7.4 Problems Faced by Farmers on Cassava Products Marketing

Results revealed that low prices (71%) was the most important problem in cassava marketing, followed by lack of reliable market (67%) (Table 14).

Table 14: Problems faced by farmers on cassava products marketing

Problems faced by farmers on cassava marketing	Frequency	Percentage	Rank
Low and unstable prices	84	71	1
Lack of reliable market	80	67	2
Poor road infrastructures	8	7	3
Lack of awareness of high quality cassava flour	3	2	4

It was reported that low prices of cassava products (grits, chips, flour) were due to low market demand. Low market demand for cassava products might be attributed to limited number of buyers and users of cassava products, especially in the rural areas. The limited or small number of buyers (traders and individual consumers) reduced competition to the extent that processing groups were disadvantaged. Other problems included lack of awareness of high quality cassava flour (2%) and also poor road infrastructure (7%), especially the feeder roads. Most of the roads connecting villages to ward centers were rough and seasonal. These led to increased marketing costs in terms of time and money spent during transportation.

4.7.5 Farmers' Suggestions on Improving Cassava Marketing

The first important suggestion from farmers was that, government should intervene in cassava marketing (71%) through buying of cassava products like what is done to some of other crops like maize (Table 15).

Table 15: Farmers' Suggestions on Improving Cassava Marketing

Proposed solutions on improving cassava marketing	Frequency	Percentage	Rank
Government should intervene on cassava marketing	73	71	1
Government should find a reliable market for cassava	75	62	2
Government should promote cassava	5	4	4
Promoting the use of high quality cassava flour	4	3	5
Provision of education to consumers on high quality cassava flour	2	2	6
Cassava should also be bought by Co-ops union	6	5	3
Establishing cassava farmers association	3	2	7
Provision of credit facilities to farmers	1	1	8

. The second important suggestion was government to look for reliable market for cassava both within and outside the country (62%). Co-operative unions should buy cassava (5%) and sell it during hunger periods. Other suggestions provided by farmers included promotion of cassava products by the government and other stakeholders (4%) for increased market demand, provision of education to consumers on high quality cassava flour (2%), promotion of use of high quality cassava flour (3%) by district councils and other agricultural stakeholders, establishing cassava farmers' associations (2%) and provision of credit facilities to farmers (1%) so that they increase their capital investment.

4.8 Farmers' Future Prospects Regarding Production and Marketing of Cassava

Table 16: Farmers' future prospects regarding production and marketing of cassava

Farmers' future prospects regarding production and marketing of cassava	Frequency	Percentage	Rank
To increase cassava production	61	51	1
Promoting utilization of cassava products	2	2	3
To have a common market	6	5	2
Finding more market for cassava	2	2	4
Rising capital to sell in large quantities	3	2	5

Majority of farmers (51%) proposed increased cassava production for food security and as source of income due to the fact that cassava is a drought tolerant crop and also grows well in their marginal lands. About (5%) of the respondents proposed a common market; a place where every farmer will be able to sell his/her produce and 2% planned on promoting utilization of cassava products for increased demand. Others planned to find more market for cassava (2%) in the coming seasons and also raise their capital so as to sell cassava in large quantities.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The findings showed that both traditional and modern cassava processing technologies were used by respondents, where 77% used both traditional and improved processing technologies and 6% used improved processing technologies. Among those who were using improved cassava processing technologies. 20% used grating technology and 3% chipping technology. Also, the results showed that majority of the respondents were more aware about stiff porridge locally known as ugali made from cassava flour than other cassava foods. However. during focus group discussion, it was observed that farmers preferred the traditionally processed flour to modern processed flour in making ugali because makopa flour was believed to be heavier, so less quantity was used in preparing ugali as compared to modern processed flour, which was very fine and light. Respondents were aware of bakery products such as bread, chichili, cakes, biscuits and doughnuts made from cassava flour. However, utilization of these products was still low. This was probably due to inadequate knowledge on how to make the products and also unavailability and high prices of the ingredients required. About 11% were aware of the local soft drinks such as togwa made from cassava and 1% used cassava in making local brew.

A logistic regression was estimated to identify socio-economic factors influencing adoption of improved cassava processing technologies in the study area. Results revealed that, institutional support to farmers was an important factor in adopting improved cassava processing technologies by farmer groups. The coefficient of the institutional support was statistically significant ($p< 0.05$). The odds ratio (Exp $\{\beta\}$) for institutional support implied that for those with institutional support, the odds of adopting improved cassava processing technologies were 6.24 times as large as the odds for those without institutional support. Age of respondents. occupation and marital status of respondents were not statistically significant ($p<0.05$). Other factors, such as age of the respondents, occupation and marital status of the respondents were not statistically significant, This showed that they were not all that important in adoption of improved cassava processing technologies by farmer groups.

Gross margin analysis was used to evaluate the contribution of introduced cassava processing technologies and utilization to income of the farmers in the study area. The findings showed that improved cassava processing technologies contributed greatly to household income with a gross margin of Tsh 78 400 when compared to traditional processing methods with a gross margin of Tsh 11 774 per tonne of fresh roots processed to flour. Relatively high gross margin for improved processing was contributed by premium prices for high quality cassava flour.

Also the study identified opportunities and constraints related to improved cassava processing and utilization in the study area. Findings revealed that, lack of initial capital for purchasing the machines and building processing structures and shortage of clean water were the most important constraints for adoption of improved cassava processing technologies. Other constraints included lack of cohesion among group members, unaffordable prices of processing equipments, lack of processing shade, lack of technical expertise in many processing equipment and lack of consistent supply of processing materials such as water and fresh roots.

The opportunities identified for adopting improved cassava processing were access to institutional support like CONCERN worldwide. NRI. IITA. TFNC. and districts agricultural offices. availability in plenty of fresh cassava roots as raw materials, cassava being a staple food in the study area, Therefore. promotion of high quality cassava flour and products utilization could be easy and hence increased market demand, Presence of good roads infrastructure, which facilitates easy transportation of cassava products to the district market centre and other external markets could also increase market demand.

Other opportunities included availability of enough land for establishing processing plant, presence of regional Small Industries Development Organization (SIDO) which could fabricate the processing machines and sell them at relatively low price, Presence of farmers group networks which could easily make than organize themselves and raise capital for cassava processing investment and also availability of extension officers and technical staff for moral support and advice. Looked positive in this cassava marketing.

5.2 Recommendations

Based on the findings of this study, the following recommendations are made.

First, increased efforts on dissemination of improved cassava processing and utilization technologies by government and other stakeholders are recommended, If increased cassava processing and utilization will be realized. Farmer groups dealing with cassava processing need to be provided with entrepreneurship skills. Government and other stakeholders should promote and educate farmers on the importance of improved cassava processing and utilization technologies to human health, food security and poverty alleviation.

District Councils and other stakeholders need to assist in promoting the use of other cassava products such as biscuits, cakes, doughnuts and breads. Increased utilization of these products will lead to increased demand for quality cassava flour and hence increased adoption of improved processing technologies.

In order to improve market of cassava products, there is need to promote and encourage food processing industries to use cassava products as ingredients in some of food products. Food processing industries will increase the demand for cassava products and hence accelerate the adoption of improved cassava processing technologies.

More institutional support to farmers is required if increased adoption of improved cassava processing and utilization technologies should be realized.

Development of small scale industry for cassava flour production will increase the acceptance of cassava products in the country, increase income to the farmers, extend employment opportunities, and decrease the use of imported wheat, and create opportunities for exporting cassava flour, or products containing the flour.

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APPENDICES

Appendix 1: Questionnaire for cassava farmers

Adoption of cassava processing and utilization technologies: A case study of Mtwara Rural and Newala districts, Mtwara region.

Questionnaire No.......................Date of interview.................................

Interviewer name...

Name of respondent...

Ward........................Village.....................................District.............

Module 1 farmer characteristics

Age of the farmer..........................years

Gender of respondent

1. Male 2. Female ☐

Marital status

1. Married 2. Single 3. Widowed 4. Divorced ☐

5. Others (specify)...

Education level of respondent

1. No formal education 2. Primary education 3. Secondary education and above

4. Post secondary education ☐

House hold size (number)..

6. Occupation

7.Main sources of income (more then one answer is possible)

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....

....

....

....

Module 2: Cassava production and processing

Cassava production

8. Do you possess land? 1 =Yes 2= No

9. How big is your land............hectares

10. How much of you total land was cultivated for cassava crops during the last season?

..........hectares

11. What varieties of cassava are you growing?

....

....

....

....

12. Complete the table below about Cassava crop grown during the last season.

Area (ha)	Production (Kgs)	Consumption (Kgs)	Quantity deteriorated (Kgs)	Sold (Kgs)	Price (TSh/Kg)

13. What are the major problems facing cassava production

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....

....

14. What should be done to improve cassava production?

....

....

....

....

....

Cassava Processing

16. Do you process your cassava after harvesting?

1. Yes 2. No.

17. For how long have you been processing cassava ………………year(s)

18. If Yes on Q. 16 above, what type of processing do you use?

1. Traditional

2. Modern processing technologies

19. Why do you process your cassava produce?

1. To make it convenient to use

2. To make it Palatable

3. To remove toxicity (Cyanide)

4. Cash value from processed cassava the raw products

5. Cassava feeds for livestock

6. Others (Specify) ……………………………..

20. Where do you process your cassava produce

1. To small cassava processors in the village

2. I have my own machine

3. Have a group processing machine

4. Others (specify)………………………………

21. If processing from others, how far is the processing machine from home……………..km

22 If using modern processing technologies, what are types of modern cassava processing technologies/tools do you use?

…………………………………………………………………………………

…………………………………………………………………………………

……………………………………………………………………………………..

……………………………………………………………………………………..

23. What are the requirements for some one to have and use the modern cassava processing technologies?

……………………………………………………………………………………..

……………………………………………………………………………………..

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……………………………………………………………………………………..

24. What are the products obtained from processed cassava you know?

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

25. Are there any governmental Institutions, Ngo or CBO supplying the cassava processing technologies?

1. Yes 2. No. ☐

26. If yes, may you mention them?

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

27. Costs and returns from processed cassava

No.	Cassava products	Processing costs/100kg	Return/100 kg	Gross margin/100 kg

Module 3. Opportunities and constraints related to cassava processing and utilization in the study area.

28. Do you have extension agent in your area?

29. Do you get any advice from the extension agent on proper production, processing and marketing of Cassava?

1= Yes 2= No ☐

30. Where do you experience problems most in your cassava business?

1= production 2=Marketing ☐

31. Do you have storage facilities for Cassava Crop?

1= Yes 2 No ☐

32. If yes, what are these storage facilities?

1= ....

2= ....

3= ....

4= ....

5= ....

33. If no, why?

....

....

34. What are criteria used in sorting and grading Cassava crops

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....

35. What do you do to assure that the quality of Cassava produce is maintained?

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36. How do you collect information on cassava market prices?

1= Direct visit to the market place

2= From traders

3= From friends and relatives

4= Radio broadcasting

5=Internet

6=Television

7=others (specify)..

37. What type of market information do you get?

1=Price of the produce

2=Price of input

3=Quality and standards of the produce

4= Export markets

5= Others (specify)..

38. Do you incur any costs in acquiring that information?

1=Yes 2= No

49. If yes, how much.................................TShs

40. What strategies do you set so as to have this information on time?

....

....

....

....

41. Do you usually sell to specific customers?

1= Yes 2= No

42. If yes what is the relationship between you and him/her

1= My relative

2= My friend

3= Officemate

4= Others (specify)

43. Why do you usual sell to him/her?

1= credit advancement

2= trustful person

3= always pay in cash

4= others (specify)

44. Do you have any contractual arrangement with buyers/sellers of cassava produces?

1= Yes 2= No

45. If yes, fill in the following table in terms of condition of sales

Crop	Amount sold	Term of payment 1= on cash 2= on credit 3=others(specify)	How contract is enforced 1= law 2=trustfulness 3=others(specify)	Transaction Cost

46. Do you have any farmers group?

1= Yes 2 No

47. If yes, what is the name of your farmers group...

48. What is the activities of you farmers group?

....

....

....

....

49. Do you usually bulk your produces and sell to customers as farmers group

1= Yes 2= No

50. What are other advantages pf joining to a farmers group?

....

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....

51. What are the problems do you face on marketing cassava produces?

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52. What do you suggest to be done in order to lessen the situation?

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53. What is your future prospect on regarding to marketing of cassava crops?

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……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

Thanks for your cooperation and stay blessed

Appendix 2: Gross margin analysis for traditional cassava processing based on 2010 market prices (1 tone of fresh roots as a basis for calculation)

Item	Unit	Qty	Cost/unit	Tshs
Revenue				
Amount of flour produced	Kg	480		
Average price	Kg	480	400	192000
Gross return				192000
Variable costs				
Cost of fresh roots	Kg	1000	95	95000
Peeling	Kg	1000	20	20000
Constructing drying shade	Drying shade	5	5250	26250
Transport from field	Bag (50 kg)	10	1125	11250
Milling	Kg	482	43	20726
Packaging materials	Sack	20	300	6000
Packing	Sack	20	50	1000
Total Variable Cost				180226
Gross margin/tone of fresh roots				11774

Note: Processing fresh roots to flour stage

Assumptions

No storage cost

Appendix 3: Gross margin analysis for improved cassava processing based on 2010 market prices (1 tone of fresh roots as a basis for calculation)

Item	Unit	Qty	Cost/unit	Tshs
Revenue				
Amount of flour produced	Kg	380		
Average price	Kg	380	650	247000
Gross return				247000
Variable costs				
Cost of fresh roots	Kg	1000	85	85000
Peeling	Bag (50 kg)	20	1000	20000
Washing	Kg	1000	12	12000
Cost of water	Bucket	50	50	2500
Fuel	Ltr	1	2000	2000
Machine Operator	Person	1	1400	1400
Pressing	Bag (50 kg)	20	800	16000
Drying	Day	2	1500	3000
Milling	Kg	382	50	19100
Packaging material	Sack	16	300	4800
Packing	Sack	16	50	800
cleanliness (after processing)	Day	1	2000	2000
Total Variable Cost				168600
Gross margin/tone of fresh roots				78400

Assumptions

No storage cost

No marketing cost

Appendix 4: Participants during Focus Group Discussion at Mkoma I Village

Date: 22.09.2010

District: Newala

Ward: Mnekachi

Village: Mkoma I

Cassava Processing Group Members

Name	Sex	Age
Juma Nakumba	Male	38
Mohamedi Twalibu	Male	45
Shabia Hamisi	Female	38
Sauda Ayoub	Female	38
Zena Kachepe	Female	32
Moza Mkahita	Female	39
Bakari Jeuri	Male	53
Shaibu Mshamu	Male	38
Moza Malove	Female	38
Ashura Saidi	Female	38
Zakia Selemani	Female	38
Karimu Nguya	Male	37
Asha Fikiri	Female	26
Zuhura Nyambi	Female	38
Fatuma Maulidi	Female	38

Appendix 5: Participants during Focus Group Discussion at Mtangalanga Village

Date: 21.09.2010

District: Newala

Ward: Makonga

Village: Mtangalanga

Cassava Processing Group Members

Name	Sex	Age
Ahmedi Khalidi Mtepa	Male	30
Seif S. Jongo	Male	51
Asha M. Chaweka	Female	38
Lukia A. Lukanda	Female	40
Hussein Khalidi	Male	35
Ramadhani A. Malasi	Male	33
Ahmadi S. Mponda	Male	60
Yahya M. Mbaruku	Male	39
Mohamedi M. Nampita	Male	36
Baltaham N. Behabeha	Male	49

Appendix 6: Participants during Focus Group Discussion at Msijute Village

Date:	23.09.2010
District:	Mtwara Rural
Ward:	Mayanga
Village:	Msijute

Cassava Processing Group Members

Name	Sex	Title
Mohamedi Namoto	Male	Member
Asha Chilonda	Female	Village Executive Officer
Mariam R. Mpwesa	Female	Group Chairperson
Asha Mohamedi	Female	Member
Rukia Hassani	Female	Group secretary

Appendix 7: Participants during Focus Group Discussion at Mbawala Village

Date: 22.09.2010

District: Mtwara Rural

Ward: Mbawala

Village: Mbawala

Cassava Processing Group Members

Name	Sex	Age
Ali Salum Nakudabi	Male	65
Zainabu M. Chitowa	Female	40
Zainabu Mpiku Nayumo	Female	35
Asha Msham Namkaka	Female	50
Somoe Mohamedi Namkaha	Female	37
Fatuma Chande Dadi	Female	34
Salum S. Mpeta	Male	28