CROP PRODUCTION FOR HOUSEHOLD CONSUMPTION AND FOOD SECURITY: A CASE STUDY OF MUSOMA RURAL DISTRICT

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study was carried out to assess food crop production for household consumption and food security in Musoma Rural district. A multistage random sampling procedure was employed to select 120 households from Musoma rural district. The study used a Gross Margin (GM) model to test the hypothesis that the selected major food crops production for household consumption is not economically profitable. When the GMs of the major crops were compared it was apparent that maize had the highest gross margin of Tsh 421 352.10 than other crops. In general, the results of this study revealed the existence of considerable economic profitability in producing the major crops. Furthermore the study conducted a comparison of gross margin across different size categories of farms sizes using the Analysis of Variance (ANOVA) technique. The ANOVA indicated the existence of a significant difference in the level of GM for the different farm size categories. Binary Logistic model was estimated to establish factors influencing food security in the study area. The results revealed that 48.3% of the populations were food secure and 51.7% were food insecure. The results indicate that food security was positively influenced by farm size, wealth, off-farm employment, access to credit and market. Furthermore the results revealed that food security was negatively influenced by the household size. However, strategies for sustainable agriculture to enhance food security, like the use of improved inputs and seed and expanding the farm size are recommended. The general conclusion from the research is that policies that would intensify food production and improve off-farm employment would enhance food security in the study area.

DECLARATION

I, Elias Lugane Maijo, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

13/08/2010

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	-	Analysis of Variance
ASDP	-	Agricultural Sector Development Program
BUA	-	Balanced Utilization Approach
CCM	-	Chama Cha Mapinduzi
DADPS	-	District Agriculture Development Plans
DALDO	-	District Agricultural and Livestock Development Officers
FEWSNET	-	Famine Early Warning Systems Network
FPA	-	Focal Point Approach
FAO	-	Food and Agricultural Organization
FSU	-	Food Strategy Unity
GDP	-	Gross Domestic Products
GM	-	Gross Margin
GNP	-	Gross National Product
HBS	-	Household Budget Survey
ICRISAT	-	International Crops Research Institute for the Semi Arid Tropics
IFPRI	-	International Food Policy Research Institute
ILRI	-	International Livestock Research Institute
IU	-	International Unit
LIFDC	-	Low-Income Food Deficit Country
MAFC	-	Ministry of Agriculture, Food and Cooperatives
MKUKUTA	-	Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania
MLE	-	Maximum Likelihood Estimates
MOA	-	Ministry of Agriculture
NBS	-	National Bureau of Statistics

NAEP	-	National Agricultural Extension Project
NFS	-	National Food Strategy
OLS	-	Ordinary Least Squares
PADEP	-	Participatory Agricultural Development and Empowerment Project
PASS	-	Private Agriculture Sector Support
PRA	-	Participatory Rural Appraisal
PRSP		Poverty Reduction Strategy Paper
SGR	-	Strategic Grain Reserve
SPSS	-	Statistical Package for Social Sciences
SSA	-	Sub-Saharan Africa
Tsh	-	Tanzanian shillings
TR	-	Total Revenue
TVC	-	Total Variable Cost
TFNC	-	Tanzania Food and Nutrition Centre
UNICEF	-	United Nations Children's Fund
URT	-	United Republic of Tanzania
WB	-	World Bank
WHO	-	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The agricultural sector remains the largest sector in the economy in Tanzania and hence its performance has a significant effect on output and corresponding income and poverty levels (MAFC, 2006). The sector accounts for just under half of GDP and export, and its importance is amplified through backward and forward linkages (Maliyamkono *et al.*, 2006). The development of agriculture has been a major objective of the government. The focus has been on production of more food to enhance food security and alleviate poverty, with the ultimate goal of becoming self-sufficient in basic food requirements.

Many households continue to face problems of obtaining stable and adequate access to food. Rural people depend continuously on own food production for their livelihood with the unpredictable rainfall being the major obstacle for year round food production (Kavishe and Mushi, 1993). The agricultural sector remains dominated by rainfed production, with only a little over 0.2 of its 5.1 million ha being irrigated. Nonetheless, the total irrigation potential of the country exceeds the total area currently planted. The most frequently irrigated crop is rice, but maize, vegetables, other annual crops, sugar cane and citrus are also produced (URT, 2008). Tanzania's National Irrigation Master Plan (2002) identifies a total irrigation development potential in Tanzania of 29.4 million ha. Of this total area, 2.3 million ha are classified as high potential, 4.8 million ha as medium potential and 22.3 million ha as low potential. However, only 289 245 hectares was under improved irrigated agriculture as of June 2008 (URT, 2008).

The biological nature of most agricultural products is generally dominated by their perishability and lack of storage facilities, which are not available in most rural areas of developing countries. However, most cereal foods are readily available and little is left prior to the next harvest. Generally, the post-harvest period is characterized by high food supply and low prices while the pre-harvest period is dominated by high prices with scarce supply of food (Teokul *et al.*, 1986; Ashimogo, 1995). Food deficit in certain periods of the year causes what is referred to as seasonal food insecurity. Different strategies are applied by different countries aiming at food security which include improvement of agricultural extension services, participatory approach for rural development and development of irrigation systems (Maxwell and Frankenberger, 1992).

Food security is dependent upon people having the resources or skills to grow enough food to eat, coupled with the right weather conditions for food to grow; or enough money to buy the much needed food supplies. Many low income countries are currently unable to produce enough food to feed their own populations. Hence they rely on the importation of food staples such as rice, wheat, corn and soya. Therefore, when global food shortages are high and demand increases, prices also increase meaning that poor people have to spend more of their income on ensuring their families have enough food to eat (Orchard, 2004).

1.2 Food Security

The concept of food security emerged after the United Nations Food and Agricultural Organization (FAO) and World Food Summit in 1974, which aimed at insuring adequate food supply, year to year stability, economic and social accessibility for healthy life. Consequently, it is these factors which formed the basis of the World Bank and FAO's definition of food security (Kavishe, 1993).

Food security is governed by three pillars which are food availability, food access and food utilization. Food availability involves ensuring that sufficient food is available for all people through production and trade (Ehui *et al.*, 2002). The ultimate challenge lies in producing sufficient food in a way that generates income for small scale producers whilst not depleting the natural resources base, and to get this food to markets for sale at prices that consumers can afford. Food access refers to people's ability to get social and economic access to food and it is typically constrained by income, while food utilization refers to an individual's ability to use food consumed for growth, nutrition and health. Ensuring adequate intake and utilization of food means that ensuring good nutritional outcomes. This depends on households' food practices including preservation and storage, selection, preparation and final consumption.

Like in many other countries in the world, food insecurity continues to be a big problem in different parts of Tanzania. However, most of the food insecurity and malnutrition situation in Tanzania is found in rural areas (Mbilinyi and Nyoni, 2000). Rural people tend to be poorer and food insecure because of fewer employment opportunities hence they rely mostly on rain fed agriculture, which is seasonal and precarious. To cope with food insecurity, rural households have developed different strategies including adopting mixed farming as a means of reducing severity of seasonal food shortage (Gill, 1991).

The objective of ensuring food security for every one has been accepted and endorsed at several international conferences from the 1974 World Food Conferences, the 1990 Summit for Children, the 1995 Copenhagen Summit for Social Development, and the 1996 World Food Summit in Rome. The Rome Declaration of the 1996 World Food Summit presented a comprehensive plan of action covering all the important dimensions and principles of food security such as conservation of ecological foundations, investment in

agriculture, importance of technologies, political and economic preconditions for eradicating poverty and inequality, and creation of fair and market-oriented world trading system. Unfortunately, hardly any of these commitments have been implemented (IFPRI, 2002).

1.3 The Role of Food Security in National Development

National development in a developing country like Tanzania depends largely on its human capital. The quality productivity of the human capital is in turn determined by food security. The pace of development of nation is reduced when there is persistent food insecurity (URT, 2003). IFPRI (2002) argues that food security issues need to be given more explicit attention as a core element of poverty reduction strategies.

The population must eat adequate and nutritionally balanced diets to survive and be able to carry out individual activities and participate fully and effectively in community and national development activities. It is the role of the government to ensure that food is available in a sustainable way and that people (especially the vulnerable) have access to it. Food is a basic and essential human right and therefore each citizen is entitled to adequate and nutritionally balanced food or diet. Improved food security (and therefore improved nutritional status) leads to higher agricultural productivity and wages in the labour market. This is necessary for increased total volume of goods and services or Gross National Product (GNP). Food security is therefore one of the important development issues, which has been streamlined in the development agenda of Tanzania (URT, 2003).

1.4 Food Production Situation in Tanzania

Tanzania has been described as a Low-Income Food Deficit Country (LIFDC) (Amani, 2006). There is frequent food insecurity and hunger at household level. According to

2000/2002 Household Budget Survey (HBS) about 19% of Tanzanians live below the poverty line. In the early 1990s, 40% of rural households faced food deficit for 3-4 months before harvesting and 50% of under five children had malnutrition (URT, 2003). Many rural households in Tanzania experience both chronic and transitory food insecurity. One of the major causes of food shortages in the country is poor harvest, a consequence of drought, decline in soil fertility caused by unsustainable land use, lack of capital to buy inputs and insufficient labour availability (Fews NET, 2003).

Tanzania produces approximately 95% of its food requirements and imports the rest to meet its demands. Productivity of food crop in Tanzania is not encouraging. Major cereal productivity has been fluctuating with a general downward trend since 1988/1989 up to 1999/2000 seasons. Between 1988 and 2000, cereal production declined by 25% between, i.e. from 4 494 000 in 1988 to 3 368 000 MT in 2000 (Aman, 2006). After 1999/2000 season, the productivity picked up but was below 200kg/ha, which is an acceptable yield under rain fed conditions. Generally, between 1994/95 and 2000/01 seasons, productivity of cereals was below 2000kg/ha. Among the cereals, paddy productivity has been generally higher than the other cereals throughout the reported season (Fews NET, 2003). Performance of agriculture has been inadequate due to a myriad of reasons like drought, limited access to technology and input, lack of agricultural credit and inadequate agricultural marketing and pricing, causing Tanzania to be classified as a transitory food insecure country, which is just able to meet national food requirements and export surpluses in some years while requiring substantial food imports in other years (Runyoro, 2006).

1.5 Productivity Situation in Agriculture

Currently, Sub-Saharan Africa (SSA) produces less food per person than it did three decades ago. It remains the most malnourished region in the world: one in every three under five children is underweight and about 42% are stunted (Myaka *et al.*, 2003). Runyoro (2006) has noted that food production in Tanzania has remained low and below the available potential due to its consistent inability to: (i) expand areas cultivated under food crops and (ii) increase yield of both crops and livestock. The problem of food insecurity in Tanzania is more of a problem of poor rural households. The overall strategy to reduce food insecurity must be to increase the opportunities available to low income rural households. For many households, this means to assist them produce more of both food and cash crops so that they can feed their families and at the same time provide cash for non food needs (Amani, 2006). It is well known that agricultural growth in Tanzania is increasingly recognized as being central to sustained improvement in economic growth of the country and food security and nutrition for growing population. However, the major contribution of the agricultural output in Tanzania, particularly food crops, is derived from small farming, where the farm production system is mainly traditional and productivity is low (Senkondo, 1999). Amani (2006) reports that progress in reducing food insecurity and malnutrition in Tanzania depends greatly on the performance of the agricultural sector. Therefore, one cannot fail to appreciate the need to reorient the agricultural agenda to focus on sustainable production. Senkondo (1999) has also reported that an increase in small holder agricultural productivity can be achieved in many ways including putting more land into cultivation, increasing production factors or using improved technologies.

1.6 The Profitability of Food Crop Production for Household Consumption

NEPAD (2003) reported that food security can also be secured through improvement of production and recognized that an expansion in agriculture, particularly through increasing

smallholders' output of staple foods, contribute significantly to reducing the incidence of under-nourishment by raising local food availability, especially in poor families. To maximize the contribution of smallholder agriculture to poverty reduction, agricultural productivity must be raised and sustained. Machethe *et al.* (2004) argues that productivity differences in agriculture are increasingly a function of investments in scientific and industrial capacity and in the education of rural people rather than of natural resource endowments. The productivity of smallholder farmers in most African countries is often considered to be low and has been declining during the past two decades. Low smallholder agricultural productivity implies low smallholder agricultural profitability. Agricultural output has also been falling or leveling off in many African countries. For example, yields of most important food grains, tubers and legumes are no higher currently than in 1980 (NEPAD, 2003).

Low productivity of smallholder farmers is one of the most important reasons for the failure of most African countries to achieve food security. Raising agricultural productivity is necessary if African countries are to overcome the problems of poverty and food insecurity. This will require a significant increase in investment in all factors that contribute to agricultural productivity and lifting the constraints thereon (Machethe *et al.*, 2004). The agricultural policies in Tanzania are aimed at transforming the predominantly subsistence agricultural sector into a commercial, favorable agricultural system by providing an enabling environment that is conducive for improving agricultural productivity and profitability, thereby improving farm income, while ensuring food security (Isinika and Ashimogo, 2003).

1.7 Problem Statement and Justification

Despite the effort done by the government to increase crop production, the performance of the agricultural sector has not been impressive. Agricultural GDP has grown at 3.3 percent per year since 1985, the six main food crops at 3.5 percent. For example, in 2002, cereal production dropped by 3.5 percent, roots and tubers increased by only 0.5 percent (Amani, 2006). However, the annual growth rate of food production estimated at 3.9 percent over the last 11 years since 1997 to 2008 (MAFC, 2008) was above the annual 2.9 percent population growth rate though not higher enough to reduce income poverty. For agriculture to have a far-reaching impact on poverty reduction and improve food security, the sector's growth should be as high as 10% by 2010 (Tumbo *et al.*, 2007). This rate of growth of food production is unsatisfactory and this may be one of the reasons why Tanzania is unable to attain food security. The country experienced an intermittent food shortage which has to be met by food imports (Runyoro, 2006) and several help from donors and other programmes. Poverty and human development report on the state of food security in Tanzania indicate that there is food insecurity at household level, largely due to lack of access to food, poor nutritional quality and biases in intra-household food distribution. Current estimate shows that around 42 percent of households regularly have inadequate food (URT, 2001). Several processes, support and activities aimed at improving the state of food security have been implemented in the country. For instance, the support to smallholder farmers programmes initiated by the colonial government such as, the Balanced Utilization Approach (BUA) and the Focal Point Approach (FPA), which aimed at prevention of famine and maintenance of soil fertility.

The efforts to support peasant farmers continued after independence in 1961; with programmes such as National Agricultural Extension Project (NAEP), Participatory Agricultural Development and Empowerment project (PADEP); and the District

Agriculture Development Plans (DADPS) under the Agricultural Sector Development Program (ASDP). These policy reforms are occurring under the umbrella of the National Strategy for Growth and Reduction of Poverty (more commonly referred to as MKUKUTA), which is a second national framework put in place to build upon the PRSP. This longer-term perspective is a more sustained effort toward the reduction of poverty, and aims to widen the scope of development. The framework identifies improving food availability and accessibility as an operational target. Availability of food, both in quantity and quality is an important aspect of human well-being and its absence is manifestation of poverty. Food security is attained through increased per capita production of food crops, having adequate income and ensuring that in times of shocks enough reserves are maintained to minimize vulnerability. Despite all these efforts in the past decades for attaining self food sufficiency and security goal is yet to be achieved on a permanent basis and still about 50% of the population in Tanzania has income under the poverty line (URT, 2005).

Tanzania's agricultural sector, though smallholder dominated, play a significant role in the country's economy. Its importance arises from the fact that over 60% of the Tanzania GDP depends on the performance of the agricultural sector which is heavily dependent on crop productivity. Despite these outstanding contributions to the national economy, the performance of this sector has not been impressive. Although the government has implemented a series of adjustment policies and institutional reforms based on market economic principles, there have been little improvements in agricultural productivity and smallholders livelihoods. It has often been said that poor food crop production contributes to low income, inadequate capital and low marketed food supply. Given the declining per capital food production from 21.6% to 18.7% between 1991/92 and 2000/01, future food availability and security in Tanzania is threatened (Msambichaka, 2006). The solution to

food crisis requires innovations and strategies that are geared towards increasing sustainable food production as well as reducing post-harvest losses.

Musoma district is generally prone to food deficiencies and low crop production whereby households fail to produce enough staple food for home consumption for the whole year. Most households (64%) in the district live below the national poverty line. On the other hand households are faced with different constraints in crop production, producing part of their output for own household consumption or local unrecorded trade. Musoma district has an estimated population of around 330 953. The district's economy is mainly agricultural, and more than 90% of population is employed in agriculture (URT, 2003).

The URT (2005) report indicates that 64% of the Musoma district populations were below the poverty line, while 46% of the relevant households were below the basic needs poverty line. It is significant that the percentage of the rural households owning land for farming is 96% with the mean area for land owned in the district estimated at 8.0 acres per household. Despite of these importance, food crop production and food security data are scarce and characterized by a high degree of uncertainty in Musoma Rural district and other part of Tanzania which make it difficult to undertake sustainable strategies and forecasting future demands. Therefore, given all these facts there is a need to undertake a study at household level with the intention of assessing the food crop production for household consumption and food security. The finding from this study will assist researchers, policy makers, development practitioners and other stakeholders to find appropriate ways, strategies and policies, concerning crop production especially improving major food crops to attain food security.

1.8 Objective

1.8.1 General objective

This study seeks to assess food crop production for household consumption and food security, in order to evaluate the performance and the roles played by the households in agriculture to ensure food security.

1.8.2 Specific Objectives

Specifically the study will:

(i) Investigate the profitability of selected major food crop production for household consumption.

(ii) Identify the factors influencing food security at the household level.

(iii) Explore strategies that would improve the contribution of major crops to households' food adequacy.

1.8.3 Hypotheses

On the basis of the specific objectives, the following hypotheses were put forward for the study:

(i) Selected major food crop production for household consumption is not economically profitable.

(ii) Socio economic characteristics (household size, farm size, off farm work, access to market, wealth and access to credit) have no significant effect on access to food security by households.

1.9 Organization of the Study

This study is organized into five chapters. Chapter one introduces the study while literature pertinent to the study has been reviewed in chapter two. The methodology used is

described in the third chapter and the findings of the research are presented and discussed in chapter four. The last chapter gives the major conclusions and recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The Meaning of Food Security

2.1.1 General definition

The concept of food security is complex and covering wide ranging aspects from global food balance to nutritional adequacy at the individual level. It has a temporal and spatial dimension. In general food security is defined as access by all people at all times to adequate food to be able to lead a healthy life (FAO, 1992). The International Livestock Research Institute (ILRI) defines food security as physical and economic access by all people at all time to sufficient food to meet their dietary requirements for productive and healthy life. Three conditions must be fulfilled to ensure food security. First, food must be available through domestic production and import; secondly, food must be accessible and people must have adequate resources to acquire the appropriate food; and finally, food must be utilized in conjunction with adequate water, sanitation and health to meet nutrition needs (Mkunda, 2006). In this study the concept of food security is generally defined as the condition in which all people at all times have enough food for a healthy and productive life.

Food security involves three components: food availability, food access, and food utilization. Food security does not necessarily imply food self-sufficiency, since a household can be food secure if its income is high and stable enough to purchase its food requirements. In remote areas with poor transportation infrastructure, households may be forced, however, to produce most or their entire food requirement (Lipton, 1983; Haddad, 1997 cited in Gabagambi, 2003).

2.1.2 Food security at regional level

The concept of food security, however, takes different dimensions at various levels. At the regional level, food security is equated with national and regional food balances. But food balances is now considered an inadequate criterion for food security since availability may not guarantee access due to poor distribution or luck of purchasing power. Food security is therefore, defined by a combination of criteria that are not mutually exclusive such as balance between availability and need, and the absence of famine or temporary food insecurity, seasonal or chronic under nutrition, micro nutrient deficiency, especially iron, iodine and vitamin A, and nutrient depleting illness such as malaria, diarrhea and internal parasites (IFPRI, 1994).

2.1.3 Food security at household level

At the household level, food security refers to the ability of the household to secure, either from own production or through purchases, adequate food to meet the dietary needs of its members. In the rural areas, household food security is often determined by food availability and prices, which are commonly related to agricultural production; and incomes which are in turn determined by both on-farm and off-farm employment opportunities. In urban areas, household food security largely depends on the level of income earned by the family. At this level, food security is equated with sufficiency of household food entitlement, which, is either food production resources, income availability for purchases (through employment), and gift or assistance that is sufficient to meet aggregate needs of all the household members. In this case, achieving food security is largely determined by an assumption of minimum nutritional needs, particularly energy (Nyange, 2000).

URT (2003) defines food security at household level as the ability of the household to acquire food either through production, purchase, transfers, and exchange that is adequate in quantity and quality to fulfill the nutritional needs of all members of the household. It is therefore, concerned with intra-household microeconomics. It describes the use of food in the household and the influencing factors such as culture, beliefs, practices and food preparation. Thus, for the household to achieve food security it must have the means to produce (land, production tools and inputs) and/or purchase (job and income) the food that the household need must have the time and knowledge to ensure that the nutritional needs of all family members is met. Food security at the individual level is not often considered, and quite often, at this level it refers to nutritional security that also calls for considerations of the healthy status of individuals (IFPRI, 1994).

2.1.4 The situation of food security in Tanzania

Tanzania is among the countries facing food crisis. Causes of food insecurity have been identified as being due to crop failures, storage deficiencies and sale of food in higher proportions than food security would require (TFNC, 1992). According to URT/UNICEF (1990), and Kavishe and Mushi (1993), it can be argued that in aggregate terms Tanzania has no food shortage. However, some parts of the country often experience food shortage due to drought, floods, market and transport constrains that hinder smooth transfer of food from surplus areas to deficit ones.

Amani (2006) observes that food insecurity continues to be a major problem and a recurrent phenomenon in different parts of Tanzania. Most marginal areas of the country are chronically food insecure. According to Amani (2006), the proportion of households facing inadequate food recently was estimated at 41.8 percent. Furthermore, Amani (2006) has reported that based on recent production figures, it has been established that an

estimated 40 percent of the population lives in food deficit region and according to the World Bank, about 6.6 million people in Tanzania are chronically food insecure. Since the growth of aggregate food production has fallen short of population growth, it has become impossible to meet the nutritional energy requirements of the people.

Tanzania has to set strategies for food security. Several policy declarations have been made and a number of campaigns, programs and reforms have been carried out by the ruling party Chama Cha Mapinduzi (CCM) and the government with the objective of attaining food security. Since the implementation of the National Food Strategy (NFS) in 1984, the government has established a Food Strategy Unity (FSU), which has been charged with the duty of formulating food policy and programs, monitoring their implementation and reviewing them when necessary (Bisheko, 1989). FSU has already prepared drought resistance cereals strategy, with the focus on sorghum and millet, cassava development strategy, rice development program and village level storage program.

The Tanzania food security program has yet to achieve its goal due to a number of constraints. Climatic factors still contribute greatly to food insecurity in Tanzania (TFNC, 1992). The policy goal of the Tanzania food security program are; "ensuring adequacy of food supplies, maintaining safe supply, stability and securing access to available supplies by all consumers according to their nutrition needs" (TFNC, 1992).

2.2 Household Characteristics and Food Security Status

2.2.1 Household income level and food security

In order to categorize a household as poor or otherwise i.e. wealth ranking different results from PRA techniques in various places uses several criteria. For example, a study conducted by Temu (1995) established three ranks; low, medium, and high. The criterion

used was the perception of representative households and their assessment of the economic and social well being of various households in the neighborhood. This approach was also used by Beeandit and Huysman (1999) in Bukoba. These studies further indicate the existence of differences in perceptions about wealth ranks between genders. However, most wealth ranking studies present similar conditions for wealth ranking. The low wealth rank group was viewed as poorest. They were deprived of major farm activities, they had limited off farm income activities; no shops, informal trade or cattle (Huysman *et al.*, 1999). Such household normally, depend on family labour, they produce less food, had poor houses and limited assets like bicycles and radio (Beerlandit and Huysman, 1999).

The medium rank group was manifested by better socio economic status than the low ranked group. In this group, households were better agricultural producers, and though not rich had good houses, depend on family labour but sometimes hire labour or tractors, and possessed some assets like bicycles and radio. The high wealth ranked group members were apparently better off (Temu, 1995). They were good agricultural producers, normally had extra income sources apart from agriculture, normally used to hire labour or tractors, and had comparatively better houses, possessed assets like radio, bicycle and livestock (Huysman *et al.*, 1999). However, what is known is that poor households are generally less resistant to shocks and therefore more vulnerable to food insecurity (Beerlandit and Huysman, 1999).

Rural households are supposed to design different ways to raise income for purchase food. It is reported that in Bukoba, people had to offer labour (work as a casual labourers) in other people's fields and get payment in kind in the form of food or cash (Beerlardit and Huysman, 1999). Apart of selling labour, other strategies for income generating activities identified are selling of dairy cattle products, sale of livestock and sale of local brew.

2.2.2 Household size and food security

Throughout history, larger families have been considered a blessing. However, changes in economic patterns and life style have created a lot of economic hardship to large families, and children are no longer economic assets. Population increase had rendered some rural families to have less land to cultivate, while urban families have faced difficulties in security of income to support large families (Jonsson, 1986). Findings from studies conducted in thirteen surveyed areas in Africa, Asia and Latin America reported that food insecure household tended to be larger, have higher number of dependents and younger age composition (FAO, 1992).

In rural areas people eat what they manage to produce, store and prepare (Jonsson, 1986). The amount of food per meal is closely related to the number of persons sharing a particular meal. Therefore, if the quantity of food prepared is small and is equally shared by many, the family is then likely to be underfed (Mosha, 1990). For example, in Sumbawanga, it was found that families that ran short of maize before harvest were larger households compared to small households, which had maize surplus (Ashimogo, 1995). Although household size affects food security, it is not easy to establish a specific level of household size at which food insecurity starts. However, at the same level of income or food production, larger families are more prone to food shortages than small families (Francois *et al.*, 1982).

2.2.3 Education and household food security

Ignorance and malnutrition are complimentary and any successful effort to reduce one is likely to diminish the other (Maxwell and Frankenberger, 1992). Seenapa (1987) observed that increase in prevalence of malnutrition is to a large extent associated with low education among members of the household. Low education among heads of the

household may lead to low nutritional status due to effects on purchasing power, sanitation, personal hygiene, feeding practices, food selection and budgeting (TFNC, 1988).

Missape (1988) reported that 76% of mothers who had no formal education had undernourished children compared to none of mothers with university education, 61% with primary school education and 28% of mothers with secondary education. However, knowledge in food budgeting and rationing is important for household food security (Njiro, 1997).

2.2.4 Effect of access to credit on food security

Credit is among the important sources of capital which however not yet available to the majority of the small holder farmers. The credit system in Tanzania is not favorable to smallholder although in recent years Tanzania government through its agricultural reform policy (MCM, 2004) have tried to easy credit availability to farmers by providing collateral as the farmer accessing credits but still majority of farmers do not use the opportunity. Lack of credit has been one of the impediments to introduction of new technology. Cash constraints that prevent the adoption of new technology have been the rationale for large credit programmes directed to small farmers. Credit provision by government and other NGOs has been instrumental in boosting agricultural production of smallholders who have limited income to purchase inputs (Madadi, 1998).

For most farmers credit is a problem for both short- and long-term investment. Most formal financial institutions are not very keen on conducting financial intermediation beyond the district level. As a result, farmers are starved of credit and other banking services. Efforts are being made by a few non-governmental institutions and some

development projects to promote Savings and Credit Cooperatives Societies (SACCOs) as a way of encouraging farmer to save, and as a source of credit.(Msambichaka, 2006) Improved access to durable financial intermediation services may facilitate the financing of viable investments, enhancing the productivity of assets, and thereby enable rural people to make better use of existing resources such as land, labour and management skills. (NEPAD, 2003) Farmers require credit, either as a working capital or for long-term investment or both to enhance food security.

Holden and Shiferaw (2004) reported that provision and adoption of credit for fertilizer, although risky in itself, may lead to increased grain production and improved household welfare and food security. Provision of credit may have a negative effect on conservation incentives but this effect may be mitigated by linking a conservation requirement to the provision of credit for fertilizer Furthermore, Sjah *et al.* (2003) reported that agricultural credit enable farmers to implement better husbandry practices, through applying more agricultural inputs (seed, fertilizers, pesticides, crop maintenance) and through timely husbandry application.

Increasing smallholder agricultural productivity requires that smallholder farmers gain access to reliable and good quality farmer support services such as extension, finance and marketing. Increasing smallholder agricultural productivity is particularly important in view of the increasing scarcity of land for cultivation which makes extensification an ineffective response to the demand for increased agricultural production (Machethe *et al.*, 2004). Temu (1998) argues that credit has the potential to act as a force to the development of agriculture sector. Provision of credit to farmer plays an important role to promote agricultural production and the use of modern technologies. Fan and Chan kang (2005) revealed that in Asia farmers play an important role for food security and poverty

alleviation. Furthermore, they found that, in order the small farm to prosper, it is necessary for the governments to help small scale-farmers to have access to credit, marketing and technology.

2.2.5 Effect of access to market on food security

Market access has become a critical determinant of farmers' production system: those who live close to better roads and have more frequent and direct contact with the market are willing to produce more systematically for the market, while those with poor market access have little incentives to produce crops other than those required for domestic consumption (NEPAD, 2003). Currently, smallholder farmers who constitute the biggest proportion of all producers, choose what to produce based either on the previous years or prevailing market prices (Msambichaka, 2006).

Accessing relevant market information will assist in adjusting production and distribution and thus enhance agricultural productivity. This is an important step in alleviating rural poverty and increasing household food security (Owuor, 1999). Market information is viewed as an intermediate good in the production of agricultural commodities. Increasing in the productivity of agriculture through agricultural information and increased market access is growing concern in most of small scale farmers to raise their living standard (Just *et al.*, 2006).

2.3 Crop Production

Most agricultural production is carried out by small-scale farmers, numbering 4.2 million, with landholding of less than 0.2 ha per farmer. Land under medium and large-scale farming is estimated at 1.5 million ha. Livestock keeping is mainly under traditional pastoralists who keep an average of 50 head of cattle. It is estimated that land under

livestock in Tanzania is 24.0 million ha largely comprising of 15.6 million cattle, 10.7 million goats, 3.5 million sheep and 27.0 million poultry (URT, 2001).

Cereals represent a large part of agriculture and an even greater part of the local food supply in many subtropical regions. The production of these crops assures particular significance for these countries. Production of both food and cash crops has fluctuated around low levels, and some have declined over the last decade. It is estimated that 40% of the population in Tanzania live in food deficit regions, that is, regions producing less food than they actually require to feed their population. Another 20% just reach a light balance, leaving only 40% who could be described as self sufficient from own production (TFNC, 1992).

The main food deficit regions are Coast, Dodoma, Kigoma, Lindi, Mara and Tanga with production of less than 90% of their requirements (Makundi, 1996). It should be noted that even in some of the food sufficient region, pockets of food deficit sometimes occur in certain district or part of those districts because of drought, flood and lack of purchasing power.

Percentage change in production of key staple crops (maize, rice, sorghum) by small holder households was 3.5 million tones in 2004/05. A production rate by smallholders growing maize in 2002/03 was 0.73 tons/hectare and sorghum was 0.43 tons/hectare. Production has fluctuated around low levels for most food and cash crops. Major factors contributing to this situation include low levels of education and literacy among smallholder farmers, exposure to variable weather, price shocks, timely access to input, modern and appropriate technology, extension, transport, processing and ineffective marketing organization (URT, 2005).

2.3.1 Maize

Maize is a staple food for the majority of Tanzanians. Although surplus maize is mainly produced in the southern zone regions (i.e. Iringa, Mbeya, Rukwa, and Ruvuma), Arusha, Kilimanjaro, Dodoma, Morogoro, Singida and Tanga regions in a year with good rainfall make significant contribution in producing surplus maize for the market. With the exception of Dar es Salaam and Mtwara regions, the rest of the regions produce more maize than any of the other of the major food crops (World Bank, 1994). According to Amani (2006), the annual growth in maize production was 2.4 percent over the period of between 1985 to 1998 and has been 2.7 percent since 1990. Also, it was observed that maize production has not kept up with population growth, generally assumed to be 2.8 to 3.0 percent. Larsson (2005) reported that both average production and yields of maize over the period 2000 – 2002 were generally low with an overall mean yield of 1.3 t/ha, which almost reached the FAO estimate of 1.2 t/ha for SSA as a whole for the same period. However, Quiñones *et al.* (1992) reported that farmers obtained yield levels of between 3.5 and 5.6 tons/ha in Rukwa region. One of the likely reasons is the fact that farmers in that area consider fertilizer as a necessary farm input, and are of the opinion that maize production is almost impossible without fertilizer application.

2.3.2 Sorghum

Sorghum is a drought resistant crop that offers insurance against crop failure. Coarse grains have a return to labour which is lower compared to most food crops. Despite this low return to labour, farmers prefer to grow coarse grain as a risk management. The problem of marketing, poor storability quality and the unpalatability of coarse grain as food items contribute to this poor response (Mbonde, 1992). Sorghum is grown as a famine crop, particularly in years when rainfall is expected to be below average (Amani, 2006). The average yields based on the survey done by Larsson (2005) stands at 0.9 t/ha, which is

also the FAO estimate for SSA as a whole for the period 2000 – 2002, although there is a pronounced production variation between countries, regions, villages and farm households.

2.3.3 Cassava

Most peasants grow cassava as an insurance crop against failure of other staple crops such as maize and paddy. Cassava production is becoming more important throughout Tanzania due to its drought resistance and storage characteristics. Cassava is also a valuable energy source, and in terms of energy produced per unit of labour and land input, cassava is superior to maize, sorghum and millets (Mbonde, 1992). Cassava is mainly produced for home consumption or marketed locally. Larsson (2005) reported that the average yield of cassava was 5.4 t/ha for the period 2000 – 2002, which was considerable less compared to the corresponding FAO estimate for SSA that stood at 8.9 t/ha as a whole, for the same period.

2.3.4 Sweet potato

Sweet potato is an important secondary food crop grown in almost all agro ecological zones of Tanzania (MAFS, 2002; Kapinga *et al.*, 1995). It is the second most important root and tuber crop in the country after cassava, accounting for 21% of the total area planted with root and tuber crops (Mtunda *et al.*, 2003). The area under sweet potato is 522,300 ha and the average production is 2 tons per hectare. This production per unit area is far below the potential of the crop which is estimated to be 10 – 20 tons/hectare (Mtunda *et al.*, 2003).

The sweet potato crop is considered a food security crop due to many attributed such as: short growing season (3 - 5 months) hence it can avoid long dry season, tolerance to drought, low demand on soil nutrients, capability of providing yields in agro-ecological

zones and seasons where other crops would fail, flexibility in planting and harvesting periods, convenient in ground storability and reduction in soil erosion. The crop is rich in vitamin A (up to 7100 IU) and its leaves are rich in protein and mineral (Carey *et al.*, 1999). The crop is regarded a women crop, however men are actively involved in its production where sweet potato has gained commercial value (Kapinga *et al.*, 1995).

Sweet potatoes are most commonly monocropped in small fragmented plots scattered throughout the farms. The crop is often found in small bits of land which would not otherwise be utilized, around edges of fields or along the roadside. In the dry season, hydromorphic soils which do not dry out, land near water courses or in inland valley or small depressions are planted with sweet potatoes. Sweet potatoes grown in these sites provide food when other crop are scarce and serve as a source of planting material for upland fields when rains begin.

These roles of sweet potatoes are relatively more important for low income households, which are the most vulnerable to crop failure and fluctuations in income (Ewell and Mutuura, 1991). Only a few commercial farmers who have developed links with particular markets plant large fields with good agronomic practices. Many small farmers manage the crop as a food reserve.

2.4 Strategies to Improve Food Security at the Household Level

A range of food security strategies has been adopted to enhance food self-sufficiency at household level (Scoones, 1998; Milich, 1997). Scoones (1998) has identified three broad livelihood strategies: (1) intensification, (2) extensification of existing productive activities and (3) diversification by adopting additional productive activities or migration to develop productive activities elsewhere. For example, in his study in West Africa, Milich (1997)

found that households are able to survive by gradually selling assets as temporal sequence and organization of household responses to food shortages and food security emergencies. But when assets are exhausted, people with no alternative migrate to other areas. He further points out that the initial objective of coping options is to conserve household resources, and the ultimate objective may be the preservation of life. In SSA countries facing rapid population growth and rising scarcity of cultivable land, the extensification path is unsustainable and impracticable (Readon *et al.*, 2001). In Africa, farmers are mainly advised to intensify agricultural production in order to improve food production, and consequently food self-sufficiency. Farmers in these regions are required to invest in land enhancing technologies in addition to labor-enhancing technologies (Mwakalobo *et al.*, 2002).

Amani (2006) has also reported a number of strategies for food security carried out with the Food Security Department under the Ministry of Agriculture and Food Security (MAFS) at national level, these include the building up and managing the Strategic Grain Reserve (SGR). The SGR stock relies more on donor food aid than local purchases by the government. Importation of food by traders is encouraged to overcome food deficit situation in any particular year. However, Amani (2006) also reported specific areas where action can be taken to improve agricultural performance and food security situation which include, improving access to markets, enhancing input use, enhancing productivity, promoting irrigation, institutional development, improving skills of private traders and working towards a long term prevention and food security solution. Furthermore, Amani (2006) noted that Tanzania has a comparative advantage in the production of many crops to ensure sustainable food security.

2.4.1 Enhancing production strategies

For farmers who have resources, particularly land and labour, the challenge is to enhance resource productivity (Amani, 2006). Households own food production is the most important source of food for rural families (Makundi, 1996). TFNC (1992) reported that more than 60% of the food produced in Tanzania is normally retained for home consumption with the remaining, less than 40% reserved for sale and seeds. Rural households have different production strategies to ensure sufficient food supply for their household's consumption. The use of manipulated production technology increases output per unit area as reported by Gill (1991). This is the major production strategy to ensure food sufficiency all year around. Recent adoptions of improved germplasm have been efforts of the smallholder farmers to increase their output per unit area. For example, selections of varieties that mature at a short period reduce the severity of seasonal food insecurity. However, this approach is constrained with the need for extra labour requirement while the food produced may not be enough (Teokul *et al.*, 1986).

2.4.2 Diversification / Mixed farming system

Senkondo (1999) noted that small farmers make their production and/or managerial decisions from season to season. These decisions are made in the face of uncertainty about the agro-ecological condition that will prevail, the incidences of pests and diseases, the prices they will fetch, the performance of new technology, tenure status and the political climate that will prevail. Farm management research in Tanzania has shown that diversification of the cropping system and farming plots are among the most preferred strategies to minimize the variance of expected yield returns (Dercon, 1996). Also, Gill (1991) reported that majority of the rural peoples have established farming systems that will minimize risks of food security. The most adopted system is mixed farming. Rural

households in which crop production is the main activity adopt mixed cropping as their means of reducing severity of seasonal food shortage.

2.4.3 The role of increasing food production in achieving food security

Sustained growth in agricultural production is critical to improvements in food security for two reasons. First, growth in agricultural productivity translates into increased food supplies and lower food prices for consumers. Second, growth in agricultural productivity means higher incomes, and thus improved ability to purchase food and other basic necessities. This can be especially important for many food insecure people who earn their livelihoods through agricultural production (Wiebe, 2001).

FAO (1997) reported that food production is often a path out of poverty for many families, indeed often the only root available. Increase in agricultural growth often result in increases in food production, employment opportunities and a direct improvement in food security for the household (FAO, 1997). The potential future food supply is a function of the household available resources, such as capital (e.g. land), labour and time. It is important to note further that food security for rural households depends on own food production.

Crop Production for the rural people is very important because of food security and cash earnings (Ferris and Malcolm, 2000). While agricultural development is essential for increasing food production, it also has an important role in creating effective demand, that is, the capacity of people to purchase food. According to the WB (1994), average caloric intake per capital in Tanzania is estimated at 206 kcal/capita in 1989, above the 1831 estimated in 1965. A survey by MAC in 1994 indicates that the availability of food varies by farming systems and regions, but the main source of calories for Tanzanians is maize,

which provides 62% of total calories, and rice, the other preferred staple, contributes 8%. The rest calories intake comes from cassava (13%), sorghum (8%) root and bananas (Sarris and van den Brink, 1994 cited in Gabagambi, 2003).

2.5 Determinant of Household Food Security

Food security is affected by factors related to the availability of food, access to food and risk related either to availability or access to food. In this respect, factors associated with food production such as availability of land, access to credit, availability of qualified labour force and agricultural practices also affect stability of the available food such as storage and processing, social sustainability and sustainable environment, can play crucial role on the food security. Important also are the conditions determining food access, which include physical, social and economic accessibility (Hubbard, 1995).

2.6 Food Security Measure

According to Nyborg and Haug (1994), choosing the best indicators of household food security is a difficult task, and many of the conversional indicators used have been shown to be inadequate in giving a true picture of the food security situation. Two of the most commonly used indicators for household food security include nutritional status and agricultural production levels. Food security at the country level can, to some extent, be monitored in terms of demand and supply indicators, that is, the quantities of available food versus needs. Food security at the household level is best measured directly by dietary intake. However, this measures existing situations and not the downside risks that may occur. The level of, and changes in socioeconomic and demographic variables such as real wages rate, employment, price ratios and mitigation properly analyzed can serve as proxies to indicate the status of, and change in food security. Anthropometrics information can be a useful compliment because measurements are taken at the individual level. Yet such

information is the outcome of changes in the above indicators (Anania, 2003). Consequently, there has been a paradigm shift in food security measurement from one based on objective indicators to one based on subjective perception (Maxwell, 1996). One such subjective approach has been to analyze the use of and reliance upon strategies developed by households and sequential responses for dealing with insufficiency of food at the household level as direct indicators. Within the framework of these sequential responses, different sets of indicators are identified by which levels and changes in food stress are monitored, with some indicating early changes prior to the onset of decreased food access while others serving as outcome indicators to the decline of food access (Maxwell and Frankenberger, 1992). In this study, based on the proxy that household is able to produce adequate food and have money to get more food up to the next season harvest is chosen as an indicator that can capture the invulnerability and sustainability elements of food security.

2.7 A conceptual Framework for Analyzing Food Crop Production and Food Security

Fig. 1 shows the conceptual framework for analyzing food crop production and food security. The prime factor that determines household food security is ability to produce or buy food from the market. A household can use its productive resources such as land, labor and available technology to produce food products for own household consumption or sell the surplus. For those who fail to produce food or cash crops and livestock they can perform other off-farm activities and generate cash which will be used to buy food and other household requirements. Therefore, achieving food security requires adequate food availability, access, and use. Agriculture plays a key role in providing food availability, an important source of income to purchase food; and foods with high nutritional status. In order to describe the relationship between resource endowment to produce more food

product and the capacity to maintain food security, the research examines the relative importance of resource endowment: i.e. farm size, technology, livestock holdings, household size, off- farm income, wealth, access to market, farming system and access to credit (independent variables) in determining the value of the dependent variables, namely food security. These socio economic factors influence food crop production, household income and also influence food security. Increase in food crop production lead to a rise in income and food security of the household. In addition, off-farm activities influence food security. Incentives that favor increased food production are the provision of credit and subsidies, and market for food products while storage techniques used by household ensure food availability in their period of scarcity.

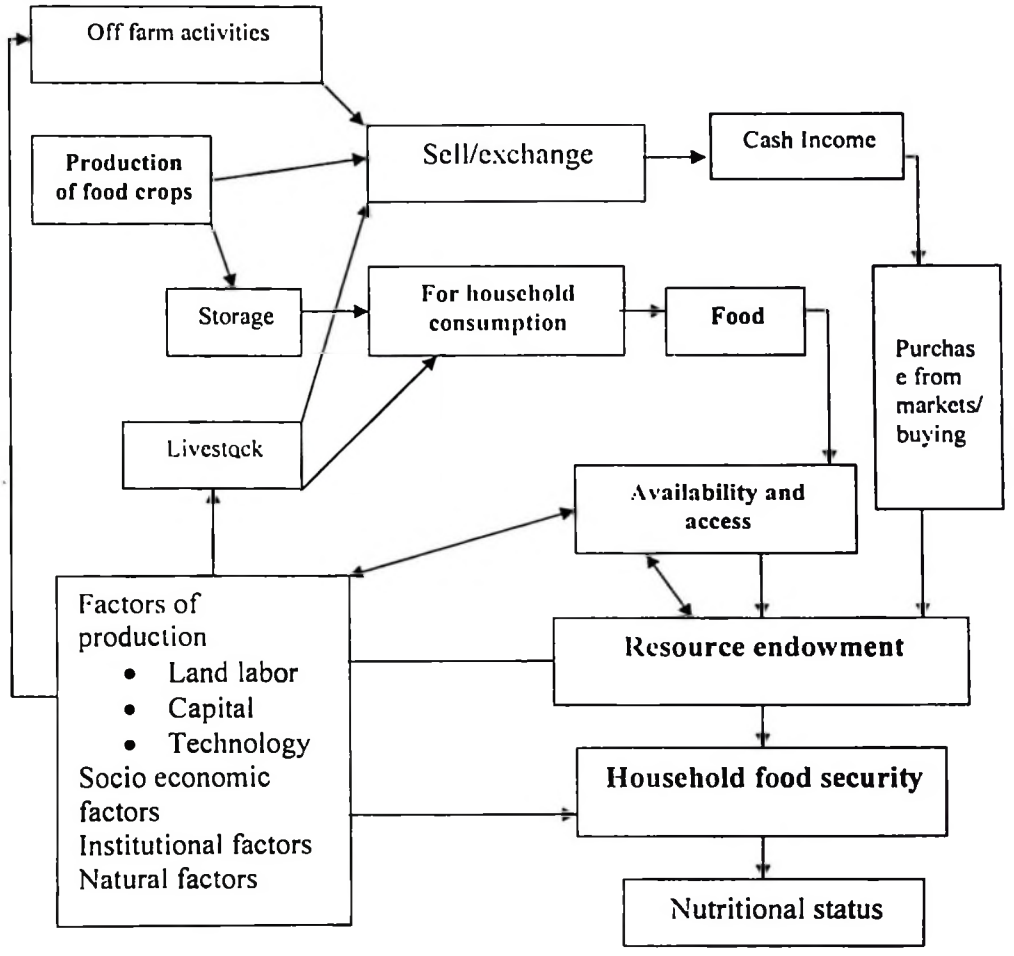


Figure 1: A conceptual framework for analyzing food crop production and food security.

CHAPTER THREE

3.0 STUDY METHODOLOGY

3.1 Overview

This chapter presents the methodology which was used to conduct the study. It begins with a description of the study area followed by the research design, source of data and instrument for data collection, sampling technique and sample size. This is followed by a description of data analysis, empirical model and statistical analysis of data. The last section presents the limitation of the study.

3.2 Location of the Study

The study was conducted in Musoma Rural district in Mara region. It lies between 1°30' and 2°00' latitudes south of the equator and between 32°15' and 30°15' Longitudes East of Greenwich. It is boarded by Tarime district on the North. Serengeti on east, Bunda on the South and Lake Victoria in the West. It covers a total area of 4910 km^2 of which 300 km^2 is covered by Lake Victoria while 4610 km^2 is covered by land. According to the Population and Housing census of 2002, the district had 329 824 people with the natural growth rate of 2.5%. Based on this, it was estimated that the district would have a population of 394 976 in 2008. The district is thought to be ideal for studying agricultural activities due to its high agricultural potential. Administratively, it is sub-divided into 3 divisions, 27 wards, 106 villages and 709 hamlets.

3.3 Research Design

A cross-sectional research design was applied in this study. The design according to Bailey (1994), allows data and information to be collected at a single point in time without repetition from a sample to represent a large population. The design is suitable in

descriptive study and for determination of relationship between and among variables. It is also economical in terms of time and financial resources.

3.4 Types of Sources of Data and Instrument for Data Collection

The process of data collection in this study was organized to be a survey of household farmers. Both primary and secondary data were colleted in this study. Primary data were obtained from the households using a structured questionnaire. A well structured questionnaire with both open ended and closed ended questions was developed to collect quantitative and qualitative data. Prior to the actual survey, the questionnaire was pre-tested under field conditions. The information collected comprised mainly data on crop output, cost of production, land size, assets in terms of number of livestocks, technology adoption, constrains to crop production, credit and market accessibility, availability of inputs, information on food security, strategies to enhance food security, general characteristics of the respondent i.e. age, gender, marital status and socio-economic variables as shown on the empirical models.

The main sources of secondary data for this study were extracted from reports and other documentary materials from relevant institution like DALDO and Ministry of Agriculture, Food Security and Cooperatives (MAFC).

3.5 Sampling Technique and Sample Size

Multistage sampling procedure was used to select, one division, from three divisions, then two wards from the same division and lastly two villages from each selected ward. Assuming that smallholder farmers are homogeneous, selection of the respondents was the last stage. At this stage, a list of household farmers who grow crops was drown in each of selected village, they constituted a sampling frame. The sampled households were

categorized on the basis of farm size. Three logical categories were made; large, medium and small. Small scale category comprises households with farm size area ≤ 5 acres, medium scale 5.1 – 10 acres and large scale > 10 acres. In the first size category, where there are many household farmers only, 60 household were randomly selected (15 household from each village), the second category only 40 household were selected using simple random selection (10 household from each village) and for the last category which had few household 20 were selected using simple random selection technique (5 household from each village). This made a total of 120 respondents. Matata *et al.* (2001) noted that having 80 to 120 respondents is adequate for most socio-economic studies in SSA. A random sampling was appropriate for selecting household for this study because it allows the use of statistical inference tests and avoiding conscious and unconscious biases in selection of the respondent.

3.6 Data Analysis

3.6.1 Data processing

Data from the primary source was verified, coded and analysed using Statistical Package for Social Sciences (SPSS 12.0 for windows) computer software.

3.6.1 Descriptive and quantitative analysis

The descriptive analysis focusing mainly on frequency, cross tabulation, mean, standard deviation and related statistics was employed to describe the characteristics and trends of crop production, and to test whether social economic factors had significant impact on the economic profitability of the major crops grown. Descriptive analysis was also used to identify the constraints that were encountered by household farmers in crop production and the strategies used to enhance food security.

The key quantitative analyses used in this study were the Gross Margin, analysis of variance (ANOVA) and Logistic Regression analysis. Gross margin was used to test the hypotheses that the selected major food crop production for household consumption is not economically profitable. Logistic regression analysis was used to test the hypothesis that Socio economic characteristics (household size, technology, farming system, farm size, off farm work, access to market, wealth and access to credit) have no significant effect on access to food security by the households.

3.6.2 Gross margin analysis

Gross margin analysis was used in this study to establish the economic profitability of major food crops grown by household farmers in the study. Johnson (1985) defines gross margin as the difference between the values of an enterprise gross output and the marginal cost of production.

From each crop, gross margin was calculated based on the following formula:

$$GM_i = \sum TR_i - \sum TVC_i$$

Where;

GM_i = gross margin of i^{th} crop in (Tshs/ha)

$\sum TR_i$ = sum of total revenue from sales of i^{th} crop in (Tshs/ha)

$\sum TVC_i$ = Sum of total variable cost spent on production of i^{th} crop in (Tshs/ha)

In calculating gross margin, a clear distinction between variable and fixed costs was made. Variable costs are costs that increase or decrease as output changes, while fixed costs do not change as output changes (Cramer *et al.*, 2001). The variable costs in crop production include seeds, land preparation, planting and weeding cost, casual labour, transport and storage cost, fertilizers and pesticides. The most important fixed costs in agricultural

production are owned land, farm buildings and farm machinery and implements. The gross margin of farm activity is the difference between the gross income earned and the variable costs incurred (Makeham and Malcolm, 1986). Gross margin analysis is therefore a simple, but in many cases, a sufficiently powerful tool for economic analysis of introduced technologies (Makeham and Malcolm, 1986). It was found useful to compare the gross margin of selected crops to establish the relative economic profitability of the household. Successful studies that employed the gross margin analysis model include Gabagambi (1998), Silomba (2000), Limbu (1998) and O'Neill *et al.* (1999), which was used in their studies on profitability of paddy and cotton, beans, maize and potato farming respectively. Phillip (2001) used the method in the study of medium scale sugar farmers in Morogoro and reported that the GM value were positive for sugarcane, paddy and dairy enterprises, and concluded that medium scale paddy, sugarcane and dairy enterprises were profitable.

3.6.2.1 Advantages and limitations of gross margin

According to Ferris and Malcolm (2000), gross margin analysis has the following limitations:

(i) Gross margin is not a profit figure. Fixed costs have to be covered by the gross margin before arriving at a profit figure.

(ii) Gross margin can vary widely from one year to the next due to differences in market prices, weather conditions and efficiency. Gross margin can also differ considerably from farm to farm as a result of differences in performance levels or differences in the overall system of production or method of record keeping.

(iii) Comparison of average gross margins can be useful, but it should be done over a number of years. However, GM gives the starting point in the assessment of profitability of a farm enterprise.

3.6.3 Logistic regression analysis

The study employed a logistic regression model using maximum likelihood method to examine the influence of households' socio-economic characteristics on crop production to access food security. The choice of the model was based on the assumption that the random component of the response follows a binomial distribution and the logistic distribution of error term (Liao, 1994). Assuming a linear function, we can write the food security equation as

$C_i = \sum \beta_j X_{ij} + \varepsilon_i$.

$C_i \geq 0$ indicates that the household is food secure while $C_i < 0$ indicates that the household is food insecure.

The dependent variable (food security) is measured using a proxy. Based on the proxy that household is able to produce adequate food and has money to get more up to the next season, the household will be food secure. The household observed to be food secure ($Z_i = 1$) is assumed to have $C_i \geq 0$; while the household observed to be food insecure ($Z_i = 0$) is assumed to have $C_i < 0$. Since the dependent variable Z_i is a discrete variable, the food security model can thus be cast as a qualitative response model where φi is the probability of food security, which can be written as

$\varphi_i = \text{Prob}(Z_i = 1) = \text{Prob}\ \beta_j X_{ij} + \varepsilon_i > 0$.

Following Demaris (1992), a logistic regression model of food security can be specified as

$$\ln(\varphi_i / 1 - \varphi_i) = \beta_0 + \sum_{j=1}^{k=6} \beta_j X_{ij} + \varepsilon_i$$

Where φ_i is the conditional probability of food security;

φ_i is the conditional probability of food security;

β_0 is the intercept (constant),

$\beta_1 - \beta_6$ are parameters to be estimated; ε_i is the error term,

X_1 is farm size (ha);

X_2 is household size;

X_3 is wealth (in term of assets or number of livestock the household possess);

X_4 is off-farm work (0 = no off farm job, 1 = otherwise);

X_5 is access to credit facilities (1 = if received credit, 0= if not).

X_6 is access to the market (hrs).

Estimation was done using Maximum likelihood method (MLE). Green (1990) asserts that the maximum likelihood is an efficient estimator compared to the corrected ordinary least squares (COLS). The goodness of fit of the logistic model was then tested using Wald coefficient and T-test. The strength of the logistic model lies in the fact that its dependent variable Yi is assumed to be binary, taking on but two values, say 1 and 0.

The common econometric problems encountered in estimating model from cross-sectional surveys data are multicollinearity, autocorrelation and heteroscedasticity. Excluding some strongly correlated variables from the models and leaving only those that were important and not perfectly correlated minimize Multicollinearity. Heteroscedasticity is associated with inconsistent error term variance in the dependent variable (Yi) (Green, 1990). Heteroscedasticity affects standard errors estimated using OLS methods were the variance becomes large (Gujarat, 2003) leading to small t-ratios, where most of the parameter estimates become insignificant unnecessary. Autocorrelation is associated with the

presence of relation not between two different variables but between successive values of the same variable (Ndunguru, 2007).

In order to observe multicollinearity problems correlation matrix followed by a step wise regression was conducted. This method involves gradual addition of variables (forward selection) to the elementary regression and then their effects observed on the overall R^2 without rendering considerable effects neither on the signs nor on the values of the individual coefficients to be unacceptable in the equation were included. For autocorrelation a Dubin Watson test was done, while the White test was conducted to test for heteroscedasticity.

3.6.3.1 Expected signs from the variables' coefficients

Farm size The increase in size of the farm was expected to reduce the unit of production cost. Therefore as the size of the farm increases, profitability is expected to increase. A positive sign was expected for the parameter attached to this variable.

Household size is measured by the number of family members in the household. Since food requirements increase with the number of persons in a household, the expected sign is negative.

Wealth The wealth status of the household is measured by the number of livestock owned, since livestock is the most important indicator of wealth. A household's level of farm resources (e.g., livestock) can be expected to affect its ability to withstand abrupt changes in production, prices, income, or unforeseen factors that create the need for additional expenditures. When crop failure occurs because of rainfall shortage, the level of one's resources is very important to combat food shortages. The expected sign in this case is positive.

Off-farm work is measured based upon whether or not the household has an off-farm job. A household with no off-farm job takes the value 0 and the household with an off-farm job takes the value 1 where the expected sign is positive.

Access to market is measured by the amount of time (hours) required to reach the nearest local market. The longer it takes to get to the market, the less frequently the farmer visits the market and, hence, the less likely he is to get market information. When there is lack of adequate information about prices, farmers may sell their produce at times when prices are low and buy when prices are high. The expected sign is negative.

Access to credit facilities - It was expected that agricultural enterprises with access to credit service were likely to exploit the benefit of capital expansion than those with no access to credit facilities. A positive sign was expected for this coefficient.

3.7 Limitations of the Data

(i) Using cross-sectional data limits observation over time. This makes it difficult for the study to account for changes due to time differences.

(ii) Prices and costs involved have been limited by the availability of household data. Thus, the results of this research should be taken with caution because most of the farmers do not keep records regarding production and the data provided are based on farmer's memory and some respondents did not remember the actual quantities of products they had produced and they, for example, said to 'estimate..., we got... (amount)'. So, the results are estimates, but of course they were given by respondents themselves. However, figures are proximate indications of the actual situation in Musoma Rural district.

(iii) A case study approach as used in this study limits observation to only one location. Hence, the conclusion reached may not hold for other similar farming activity elsewhere

Inspite of the above limitations, it is expected that the data collected was reliable and adequate to address the objectives set forth for the study.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents results and discussion of the results. This chapter is organized into the following sections: households' socio-demographic characteristics; farm resource. input and crop production; crop produce and consumption; the profitability of selected major food crop production; logistic regression results and strategies to improve the contribution of crops to households' food adequacy.

4.2 Households' Socio-Demographic Characteristics

The households' socio demographic characteristics that were examined in the study included age, gender, marital status, education level of the heads of households and family size of the households. The importance of these characteristics to determine their influence in crop production and food security is discussed in the following sections.

4.2.1 Ages of heads of the households

The age range of heads of households was between 22 years to a maximum of 77 years. The mean age of the sample as a whole is 43.9 years with standard deviation of 13.1, indicating that most households' heads were in the productive age. 29.2% of the heads of households were between the age of 18 and 35 years, 35.8 % between 36 and 45 years, 25.0 % between 46 and 60 years; and 10% above 60 years (Table 1). The results show that no body among the heads of households was of the age of below 18. Only 10% of the households' heads were above 60 years old, a group classified as economically not active. The majority 90% of the respondent were in the economically active age group, and therefore made the study area were considered to be in a good food production situation in

relation to availability of active labour for production of enough food to meet household needs. The results can be supported by Msambichaka (2006) when reported that the biggest proportion (89%) in Tanzania is made up of the 15 – 59 age-bracket, which is meant to be the most active and dynamic group.

Table 1: Ages of heads of household

Age group	Butiama	Masaba	Total	Percent
18 - 35	20.0	15.0	35.0	29.2
36 - 45	23.0	20.0	43.0	35.8
46 - 60	10.0	20.0	30.0	25.0
> 60	7.0	5.0	12.0	10.0
Total	**60.0**	**60.0**	**120.0**	**100.0**

4.2.2 Marital status of the heads of households

It seems that the food production in the surveyed households was mostly done by married couples who were the majority. Survey results indicate that 92.5% of the respondents were married, 5% single, 1.7% divorced or separated and 0.8% were widows (Table 2). Married couples are likely to be more productive than single farmers due to labor reinforcement which enabled them to accomplish both farm and no-farm activities.

Table 2: Marital status of heads of households

Marital status	Butiama		Masaba		Whole sample	
	Frequency	%	Frequency	%	Frequency	%
Married	55.0	91.7	56.0	93.3	111.0	92.5
Single	3.0	5.0	3.0	5.0	6.0	5.0
Divorced	2.0	3.3	0.0	0.0	2.0	1.7
Widow	0.0	0.0	1.0	1.7	1.0	0.8
Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**

4.2.3 The heads of the households by gender of the respondent

For example, out of 60 sampled households in Butiama ward, the majority (91.7%) households were headed by males while female heads of the household were only 8.3

percent. The same result was observed in Masaba ward as shown in Table 3 below, where the majority of the heads of households were males (91.7%) and only 8.3% were females who were either singles, widows, divorced or separated. This shows that most of the households in the study area were headed by males. Usually, heads of households are the decision makers in the households pertaining to the different activities undertaken in production.

Table 3: Gender of the heads of households

Gender	Butiama		Masaba		Whole sample	
	Frequency	%	Frequency	%	Frequency	%
Male	55	91.7	55	91.7	110	91.7
Female	5	8.3	5	8.3	10	8.3
Total	**60**	**100.0**	**60**	**100.0**	**120**	**100.0**

4.2.4 Household size

Survey results indicate that the mean household size for the sampled wards were 8.41 person per household for Butiama ward with standard deviations 4.22 and 9.77 persons per household for Masaba ward with a standard deviation 4.62. The mean of the entire population which formed the study area was 9.09 persons per household. The minimum number of people in the household was 2 while the maximum household size was 24 people (Table 4). Generally, the household size in each of the ward or of the total household sampled in the study area was slightly higher than the national average which stood at 5.0 persons per household in rural areas and the average household size is 4.9 persons (NBS, 2005). This indicates that there is sufficient labour to carry out crop production activities. However, large household size is one of the factors contributing to food insecurity (Lorri & Kavishe, 1990).

Table 4: Family size (number of people)

Standard measure	Butiama	Masaba	Whole sample
Number of household	60.00	60.00	120.00
Mean	8.41	9.77	9.09
Std. Error of the Mean	0.54	0.60	0.41
Std. Deviation	4.22	4.62	4.46
Minimum	2.00	2.00	2.00
Maximum	19.00	24.00	24.00

4.2.5 Education levels of the heads of the households

Results of the education level of the heads of the households reveal that 0.8% of the respondents had no formal education and 5% had attained adult education. Results also show that 76.7% of the heads of the household in the study area had attained primary education. Furthermore, results indicate that 12.5% and 5% of the respondents had attained secondary and college education respectively as shown in Table 5. Education is very important since it increases the farmers' ability to efficiently utilize the advice and information offered by extension services. It was expected that the degree of respondents' education would influence their decision making which would in turn, enhance high production with positive implications to household food security.

Table 5: Education level of the heads of households

Education level	Butiama		Masaba		Whole sample	
	Frequency	%	Frequency	%	Frequency	%
No formal schooling	1.0	1.7	0.0	0.0	1.0	0.8
Adult literacy classes	3.0	5.0	3.0	5.0	6.0	5.0
Primary education	47.0	78.3	45.0	75.0	92.0	76.7
Secondary education	6.0	10.0	9.0	15.0	15.0	12.5
College and above*	3.0	5.0	3.0	5.0	6.0	5.0
Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**

*Above** includes advanced diploma, bachelor's degree and postgraduate diploma/degree.

4.2.6 Type of housing

The results on the distribution by type of houses used by the household in the surveyed area show that most of house floors were built with earth/sand material (52.5%) and 47.5% are finished floor with cement and stone. This actually reflects the typical housing condition of the poor in rural areas in Tanzania. In other words, this implies that earnings from agricultural activities which were the major source of income for the people in the study area were too low to support good quality housing. Furthermore, most of the houses' wall were made of burnt bricks and concrete blocks with plaster (64.2%) and 35.8% with sun dried bricks wall. 68.3% of the houses were roofed with corrugated iron and 31.7% grass roofed. Also, the results show most the material used for doors are wood (77.5%) and (22.5%) were made of corrugated iron sheets (Table 6).

Table 6: Distribution of types of housing

Parts of the house	Type of material used	Butiama		Masaba		Whole sample	
		Frequency	%	Frequency	%	Frequency	%
Floor	Earth/sand	36.0	60.0	27.0	45.0	63.0	52.5
	Finished floor: cement, stone	24.0	40.0	33.0	55.0	57.0	47.5
	Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**
Wall	Sun dried bricks	25.0	41.7	18.0	30.0	43.0	35.8
	Burnt bricks and concrete blocks, plastered	35.0	58.3	42.0	70.0	77.0	64.2
	Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**
Roof	Grass	25.0	41.7	13.0	21.7	38.0	31.7
	Corrugated Iron sheet	35.0	58.3	47.0	78.3	82.0	68.3
	Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**
Door	Wood	48.0	80.0	45.0	75.0	93.0	77.5
	Corrugated Iron sheet	12.0	20.0	15.0	25.0	27.0	22.5
	Total	**60.0**	**100.0**	**60.0**	**100.0**	**120.0**	**100.0**

This is probably because farmers in the surveyed area tend to have low income which results from sales of their crop produces and livestock, limited access to credit facilities and limited off-farm activities. This difference in income was reflected by the type of houses owned by the respondents.

4.3 Farm Resource, Input and Crop Production

4.3.1 Distribution of respondents by land acquisition methods

The study identified four ways of land acquisition in the study area namely: inheritance, given by village government, buying and renting. Results show that the majority of respondents (43.3%) got land through inheritance. This part of land is provided by parents to their sons as part of their inheritance. Furthermore, results indicate that 37.5% of respondents were given land by the village government and 17.5% bought their land (see Table 7). It is obvious from these results that purchasing of land is a common practice in the study area. The other minority (1.7%), acquired land through renting an indication that land in the study area was limited resource to access it freely.

Table 7: Distribution of respondents by land acquisition methods

Mode of land acquisition	Number	Percent
Inherited	52	43.3
Bought	21	17.5
Rent	2	1.7
Given by village government	45	37.5
Total	120	100.0

4.3.2 The mean size of land owned and cultivated

The summary of results of the surveyed area in Table 8 shows that the area owned is higher with mean of 14.73 acres compared to the area cultivated of a mean 7.77 acres. For adequate household food production 2.1 to 5.0 hectares should be cultivated. These finding are supported by Malima (1993) who noted that small plots which are poorly managed,

result in low yields. This results in food insecurity, hunger and poverty. However, according to the classification by ICRISAT (International Crops Research Institute for the Semi Arid Tropics) the mean size of land owned and cultivated in the study area (Table 8) fall under a medium size category. It is reported in Renkow (1990:670) that ICRISAT classifies land areas of between 0.21 to 2.50 ha, as small farms; between 2.5 to 5.25 ha as medium farms and above 5.25 ha as large farms.

Table 8: The mean size of land owned and the size of land cultivated in acres by the household in the sampled area

Parameters	Land owned	Land cultivated
Mean (acres)	14.73	7.77
STd. Error	2.63	0.57
Minimum	1.00	1.00
Maximum	290.0	30.00

As far as agricultural land use is concerned, not all land owned was cultivated in the 2007/08 season. When asked why all the land that was owned by a household was not cultivated, farmers mentioned low technology, lack of capital, drought or unreliable rainfall, labour shortage and low fertility of land to be the major reasons (Table 9). The problem of lack of capital was also exacerbated by inadequate agricultural financing (see also section 4.3.5). Also the problem of drought mentioned by farmers was a consequence of low, erratic and unevenly distributed rainfall.

Table 9: Reasons for not cultivating all the land

Reasons for not cultivating all the land	Frequency	Percent
Low technology	52	43.3
Lack of capital	50	41.7
Drought	34	28.3
Labour shortage	14	11.7
Low fertility	12	10.0

4.3.3 Means of land preparation

The study reveals that the most household use both ox-plough and the hand hoe (87.5%) as means of land preparation, and only 3.3% and 9.2% us ox-plough and the hand hoe respectively. Furthermore, the results indicate that 90.1% of the respondents using hand hoe equipment as their sole means of land preparation and cultivation were food insecure and only 9.9% were food secure, while 50% of the respondents using Ox-plough were food insecure and only 47.6% of the respondents using Ox-plough and hand hoe were food insecure. Results also indicate that 52.4% of the respondents using both ox-plough and hand hoe were food secure (Table 10). The Means for land preparation have a very important influence on the performance of any crop production. These findings seem to suggest that, it is difficult to expand the farm to a considerable size because farmers were using traditional agricultural implements that were labour intensive and hence could not be used in expanding crop acreage. There is therefore a need for more appropriate technology like tractor, plough to be introduced to ease and to reduce drudgery involved in farming operation. It would also reduce the time required to cover a unit area, hence coping better with the cultivation season, which will help households to increase production and improve food security.

Table 10: Means for land preparation and food security

If the household is food security	Type of equipment respondent use in crop production							
	Hand hoe		Ox-plough		Ox-plough and hand hoe		Total	
	Freque.	%	Freque.	%	Freque.	%	Freque.	%
Food security	1	9.9	2	50.0	55	52.4	58	48.3
Food insecurity	10	90.1	2	50.0	50	47.6	62	51.7
Total	**11**	**100.0**	**4**	**100.0**	**105**	**100.0**	**120**	**100.0**

4.3.4 Main crops grown in the sampled households

The respondents were asked to rank the crops grown according to the order of importance. The most important crop was given a score of 4 according to preference and 1 was given to the least important crop. Then the score of all respondents were added together to determine the crop preferred. The majority (88.3%) indicated maize as their first important crop and was ranked the first most important crop which scored 463 than other crops. The second ranked important crop grown by the households was cassava which scored 245. The third important crop considered by the households was beans with a score of 136. The fourth, fifth and sixth crop was sorghum, sweet potatoes and cotton which scored 51, 50 and 47 respectively (Table 11). Therefore the main food crops in the study area were: Maize, cassava, sorghum, bean, sweet potatoes and cotton. The Majority of the respondent in the study area grew Maize in 2007/08 farming season to meet both food security and cash requirements. The fact that maize occupies more land area under cultivation than other crops shows that the crop was more important to the households than other crops. Moreover, the fact that a small number of households grew cotton partly reflects the associated high costs, labour involved in production and low price of cotton. In order to overcome the problem of food insecurity in the study area there is a need of increasing production of maize, cassava, sorghum, beans and sweet potatoes. It is important to point out however that despite the differences in the type of crops grown, household have the general tendency to grow certain types of food crops for household food security. In this respect, root crops such as sweet potatoes and cassava were grown as food security crops in the study area. Cassava and sorghum grown as drought resistance food crops should be emphasized in those villages which experience limited and unreliable rainfall.

Table 11: Main crops grown in the sampled area ranked according to the order of importance

Crops	Total score	Ranking
Maize	463	1
Cassava	245	2
Beans	136	3
Sorghum	51	4
Sweet potatoes	50	5
Cotton	47	6

4.3.5 Credit service and food security

One major constraint in agricultural production in Tanzania is the poor financial status of small scale farmers. The majority of the smallholders cannot finance their production activities on a cash basis particularly at the start of the season. Credit is needed for them to be able to purchase inputs like fertilizers, herbicide and pesticide, and to pay for labour requirement. Among the 120 households interviewed only 5% had access to credit and the rest 95% had no access as indicated in Table 12. These finding are supported by the Agricultural Sample Census of 2002/03 in which only 3% of the total number of agricultural households' accessed credit. Furthermore, the results indicate that 83.3% of the households with credit service were food secure, while only 46.5% of the households without credit were food secure and 53.5% were food insecure. The small percentage of households who had access to credit facilities is probably due to the inaccessibility of credit facilities in the study area because currently access to formal rural finance facilities is limited in Tanzania. The availability of credit will reduce the constraint of production, and consequently facilitating availability of inputs on a timely basis which are expected to increase crop production, thereby improving farm income, while ensuring food security of the households.

Table 12: Distribution of respondents by access to credit and food security

If the household is food security	Access to credit facility					
	Received credit		Does not receive credit		Total	
	Freque	%	Freque	%	Freque	%
Food security	5	83.3	53	46.5	58	48.3
Food insecurity	1	16.7	61	53.5	62	51.7
Total	**6**	**100.0**	**114**	**100.0**	**120**	**100.0**

4.3.6 Access to extension service

Results of the surveyed area show that the majority of the household heads (82.5%) had education level below secondary education (refer section 4.2.5). It is argued that agricultural extension would play a significant role in assisting them by identifying and analysing their production problems and increasing their awareness of opportunities for improvement. Hence, the effectiveness of the other inputs in production partly relies upon the availability of sound agricultural extension services at community levels. However, results from the surveyed area indicate that 35.8% of the households interviewed had access to extension services and 64.2% of the households had limited possibilities of getting extension services (Table 13). The lower percentage of respondents with extension services can be associated to the fact that there are few extension officers or no elaborate extension services at wards or village levels in the study area. hence the limited possibility of getting extension advice. This is supported by Makundi (1996) who observed that limited agricultural extension services contribute to low production and food insecurity.

Table 13: Distribution of respondents by access to extension services

Have access to extension	Number	Percent
Yes	43	35.8
No	77	64.2
Total	120	100.0

4.3.7 Off-Farm Activity

Table 14: Distribution of respondent with off-farm activities

Have off-farm activity	Number	Percent
Yes	25	20.8
No	95	79.2
Total	120	100.0

Results in Table 14 show that the minority of the households (20.8%) had off-farm activities, while 79.2% of the households were not involved in any off-farm activities. Many studies in rural Africa have found positive associations between non-farm diversification and household welfare and, on the basis of these findings, development initiatives to promote off-farm employment in rural areas have gained widespread support. In Tanzania, farming remains the most important livelihood activity among rural households but most households have at least one member involved in off-farm income generation. According to the Agricultural Sample Census 2002/03, 41.6% households had one member engaged in off-farm income-generating activities, 21.2% had two members, and 9.1% had more than two members. However, 28% of households had no off-farm income-generating activities (URT, 2007). Table 15 shows the average weakly income obtained from off-farm activities in the study area. The results indicate that households involved in off-farm activities get an average income of Tshs. 40 833.33 per week with a standard deviation of 40 378.28. The minimum income from off-farm activities was Tshs. 3 000.00 and the maximum was 150 000.00.

Table 15: The average weakly income obtained from off farm

Variable	Number	Mean	Std	Maximum	Minimum
Off farm Income per weak (Tshs)	24	40 833.33	40 378.28	150 000.00	3 000.00

Employment in off-farm and non-farm activities has a paramount significance in the diversification of sources of households' livelihoods. It enables farmers to modernize their production by giving them an opportunity of applying the necessary inputs, and reduces the risks of food shortage during periods of unexpected crop failures by acting as fallback bank insurance.

4.3.8 Livestock

Table 16: Average number of livestock kept by the household

Parameters	Cows	Oxen	Goats	Sheep	Donkey	Total number of Livestock	Poultry
Number	73	73	56	19	17	83	103
Mean	25.23	8.65	10.77	21.31	2.47	29.15	17.09
Std. error of mean	4.12	1.12	1.14	7.66	0.49	4.87	1.53
Std. deviation	35.21	9.55	8.53	33.39	2.03	53.32	15.15
Minimum	1.00	1.00	1.00	3.00	1.00	1.00	1.00
Maximum	250.00	80.00	45.00	150.00	8.00	380.00	100.00

Livestock resources form another important source of livelihood for the studied households. Livestock contribute to the smallholder households' economy in different ways; i.e., as a source of draught power, source of cash income, source of supplementary food, and means of transport. Besides, livestock are considered a means of security and coping methods during crop failure and other calamities. In view of this, an inventory of livestock for the sample households was carried out. Table 16 provides the total number of livestock, the average number per household and their distribution by type.

The average number of livestock was 29.15 heads per household which kept livestock. The average number of cows was 25.23 per household, while 8.65, 10.77, 21.31 and 2.47 was the average number of oxen, goats, sheep and donkeys respectively. The average number of poultry kept by the household was 17.09 with a standard deviation of 15.51. As a result, the farmers have limited capacity to cope with the problem of crop failure. The food insecurity problems experienced in the study communities is a clear manifestation of this dire condition.

Results also show that distribution by type was 87.9% was constituted by cows and oxen, followed by goats that accounted for 67.5% of the livestock. Others include sheep and donkeys which few in quantity. In addition, some 103 households owned poultry.

Farmers, who almost entirely rely on traditional farming methods, possession of oxen would be a critical production factor. The study findings on oxen ownership show that about 39.2% of the households did not own oxen. This means over two-third of the studied households can use these animals to solve the severe problems of traction power. Given these findings, it is not difficult to deduce that crop cultivation in the study area is partly constrained by lack of drought power since the majority the respondent did not own these types of animals.

4.4 Crop Produce and Consumption

4.4.1 Source of food for the households

The availability of food at the household level requires that food be available in the households and in the local or community market to meet consumption needs. Results from Table 17 shows that almost all respondents (80%) produce food for their households, while the rest 19.2% depended on own production and purchase from the market, and the

remaining 0.8% purchased food from the markets. This can be attributed to the low produce obtained due to the small acreages cultivated. These findings are supported by Makundi (1996) who found that households own food is the most important source of food for rural families.

Table 17: Distribution of the main source of daily food for the households

Source	Number	Percent
Own produce	96	80.0
Purchase from the market	1	0.8
Own produce and purchase from the market	23	19.2
Total	120	100.0

4.4.2 Main food crops for household consumption

Food consumption in Tanzania is influenced by its availability, accessibility and cultural preferences. At national level, food availability is determined by domestic production, imports and food aid. The most common staple food in Tanzania is maize. Rice, wheat, sorghum, millets, cassava, bananas, sweet potatoes, and irish potatoes. The results in Table 18 show the main staple food crops for households' consumption in the study area are maize 30.8%, cassava 17.5%, sorghum 11.7%, sweet potatoes 5.8%, maize and beans 10%. This is because these crops contribute to various foods and food groups to household diet. For example the three main contributors to calories are cereals 43.55 percent these are crops like maize and sorghum, starchy roots (like cassava and sweet potatoes) 22.87 percent and fruits and vegetables 15.5 percent. In terms of protein, the cereals dominate even more, accounting for 48.42 percent of total protein in the diet. This is followed by pulses (like Beans) 14.04 percent, vegetables 13.56 percent, fish 6.78 percent, starchy roots 5.21 percent and animal products account for only 4.58 percent. With regard to fats, cereals again lead in their contribution to total fats, accounting for 32.53 percent, vegetable oils

23.66 percent, oil seed 16.40 percent, animal products 13.72 percent, fish 4.3 percent and starchy root 2.69 percent (Mbonde, 1992).

Table 18 : The main food crops used for households consumption

Main crops for household consumption	Frequency	Percent
Maize	37	30.8
Cassava	21	17.5
Sorghum	14	11.7
Sweet potatoes	7	5.8
Maize and Beans	12	10.0
Maize and Cassava	29	24.2
Total	120	100.0

4.4.3 Selling food produce

Results from this study show that 80% of the households sold food produced and meant for households' consumption, while 20% did not sell their food (Table 19). Sale of food crops affects the household food security an observation which has been echoed by Makundi (1996). Consequently, it seems logical to stress increased production to create surplus food that can be sold (Ishengoma, 1998).

Table 19: The distribution of respondents who sold some of the food produced

Sold food produced	Number	Percent
Yes	96	80.0
No	24	20.0
Total	120	100.0

4.4.4 Food storage

Results summarized in Table 20 show that out of the sampled households which store food, only 65% can use their food until the next season and 35% can not store it until next

season. Furthermore, results also indicate that half of the household interviewed store above 10 bags of food produced. Other respondents mentioned storing below 2 (1.7%), 2–4 (14.2%), 5-6 (20%), 7-8 (8.3%) and 9-10 (0.8%) bags, while 4.2% of the households in the study area reported that they did not store food (Table 20). This is probably attributed to the amount of food produced and the family size implying that the harvested food was not enough to feed the entire household in a year. This observation has also been documented by Mamiro (1991) who reported that the proportion of households reporting inadequate harvest to meet food in Mtwara region averaged 67.7% in 1988 and 1989.

Table 20: Amount of food stored by the household

Amount stored in bags	Frequency	Percent	Amount harvested & stored was enough until next season		
			Yes (%)	No (%)	Total (%)
Nil	5	4.2	0.0	4.2	4.2
Below 2	2	1.7	0.8	0.8	1.7
Between 2 - 4	17	14.2	6.7	7.5	14.2
Between 5 - 6	24	20.0	10.0	10.0	20.0
Between 7 - 8	10	8.3	4.2	4.2	8.3
Between 9 - 10	1	0.8	0.0	0.8	0.8
Above 10	61	50.8	43.3	7.5	50.0
Total	120	100.0	65.0	35.0	100.0

4.4.5 Number of meals taken per day

Results in Table 21 show that most of the households (58.3%) in the surveyed area take meals twice per day, while 41.7% take their meal thrice per day, which includes breakfast, lunch and dinner.

Table 21: Distribution of respondents on the number of meals taken per day

Number of meal per day	Frequency	Percent
Once	-	0.0
Twice	70	58.3
Thrice	50	41.7
Total	120	100.0

4.4.6 Food deficit

When asked if the households had ever experienced food deficit since 2005, 62.5% of the households reported having experienced food deficit due to low production caused by erratic rainfall and drought in the study area, while 37.5% of the households reported that they had never experienced that problem (Table 22).

Table 22: Experienced food deficit since 2005

Have experience food deficit since 2005	Frequency	Percent
Yes	75	62.5
No	45	37.5
Total	120	100.0

Furthermore, results in Table 23 also show that 45% of the households reported a high food deficit and 20% reported moderate food deficit. Respondents from the households reported that food shortages of any kind commonly occurred in October – January (70.0%), August – December (18.3%) and October – February (11.7%) respectively.

Table 23: Level of food deficit

Level of food deficit	Frequency	Percent
Highly	54	45.0
Moderate	24	20.0
Not Applicable	42	35.0
Total	120	100.0

4.5 The Profitability of Selected Major Food Crop Production

Gross margin analyses were performed for each crop grown in order to assess the profitability of selected major food crop production. As it was stated earlier that crops grown by the households were meant for home consumption. In cases where agricultural products were consumed at home, revenues of a particular crop accrued to the household were calculated in terms of the relief the household got by consuming the produce instead of using other income to buy the produce. However, crop production involves a number of costs. Table 24 summarises the different variable production costs per crop (the average for all households) incurred in crop production per cropping season. The average cost per crop was obtained by calculating the cost for each item for all the households producing the crop. The total cost obtained was then divided by the total number of households. The estimation of average costs for variable inputs such as seed, fertilizer, pesticide or spray charges, land preparation, hired labour for planting and weeding, harvesting, storage and transport was based on price reported by the household heads.

Table 24: Estimated mean cost used by the household in crop production

Activity	Type of crop					
	Maize	Sorghum	Cassava	Sweet Potatoes	Beans	Cotton
Land preparation (Tsh/ha)	41 825.34	30 481.77	55 301.86	45 028.97	38 235.87	49 219.31
Seeds (Tsh/ha)	26 789.73	16 108.25		24 940.14	42 878.79	11 768.33
Planting (Tsh/ha)	33 896.53	30 252.82	47 254.56	40 363.13	37 386.83	42 515.08
Weeding (Tsh/ha)	48 142.54	35 773.20	82 053.03	59 357.54	50 272.90	73 717.87
Fertilizers (Tsh/bag)	48 541.67					52 600.00
Sprays Cost (Tsh/ha)						31 803.23
Equipment/ tools (Tsh/ha)	13 708.28	7 731.96	22 306.74	21 747.81	17 111.11	17 151.41
Harvesting & bags (Tsh/ha)	23 103.09	19 708.92	34 128.29	55 865.92	24 494.94	33 539.22
Storage Cost (Tsh/bag)	1 024.10	743.64			1 291.77	
Transport Cost (Tsh/bag)	2 043.96	1 083.92	375.04	755.64	1 722.36	1 880.08
Other cost (Tsh/ha)	29 685.98	27 920.97	55 059.52	50 787.21	37 055.56	39 215.69

4.5.1 Average yields for major crops

The yields of different crops in the study area vary from place to place due to variation in weather, rates of farm inputs application among the farmers, soil fertility and also farm management practices. Variation in crop yields and weather are the major reasons for price fluctuations experienced in the district over the years. Table 25 shows the mean yields per hectare of the major crops grown in the study area. Mean yield production of maize was 1 584.08 kg/ha with a standard deviation of 803.38 kg/ha. While the maximum production was 3 968.75 kg/ha and the minimum was 0 kg/ha. This was attributed to drought because maize is one of the crops which are not drought tolerant, low use of fertilizers and improved seeds. Due to this, some of the households producing only maize were forced to sell their assets like livestocks to buy food from the market. Generally, there was low production of maize in the study area based on descriptive analysis on production of maize. This study noted that in respect to yield of maize in the study area the situation was far from satisfactory in comparison with yield levels of between 3.5 and 5.6 tons/ha in the case of maize in Rukwa region reported by Quiñones *et al.* (1992). One of the likely reasons is the fact that farmers in Rukwa region consider fertilizer as a necessary farm input and that maize production is almost impossible without fertilizer application.

Table 25: The mean yields per hectare of the major crops

Parameter	Maize kg/ha	Cassava kg/ha	Sorghum kg/ha	Sweet potatoes kg/ha	Beans kg/ha	Cotton kg/ha
Number	119	85	26	26	57	28
Minimum	0.00	833.33	375.00	950.00	250.00	250.00
Maximum	3 968.75	10000.00	2 875.00	1 2750.00	2 000.00	3 417.50
Standard deviation	803.38	1 879.47	657.43	2 738.61	434.51	702.60
Mean	**1 584.08**	**2 933.54**	**1 101.12**	**3 529.32**	**8 08.28**	**1 147.68**

The mean yield of sweet potatoes was the highest (3 529.32 kg/ha) with a standard deviation of 2 738.61 kg/ha, followed by cassava (2 933.54 kg/ha) with a standard deviation of 1 879.47 kg/ha. The mean sorghum production in the study area was 1 101.12 kg/ha, with a standard deviation of 657.43 kg/ha while that of beans and cotton were 808.28 Kg/ha, with a standard deviation of 434.51 Kg/ha and 1 147.68 kg/ha, with a standard deviation of 702.60 kg/ha respectively. Results in Table 25 show that the number of household growing sweet potatoes and sorghum were too few, possibly because some of the respondents especially male consider sweet potatoes a crop for women only and avoid sorghum due its problem connected with storage which affects quality of these grains, and the unpalatability of these grains as food items contribute. It is also noted that the cases of growing cash crop (cotton) were too few, possibly because most of the respondents in these area grow maize, cassava, sorghum, sweet potatoes and beans as both food and cash crops, which can easily be marketed.

The status of agricultural productivity in any area can be judged from the yield levels of important crops as compared to the ministry of Agricultural and food Security (MAFS) yield level of 2007/08. The survey result revealed that some crops had shown some improvement in yield levels compared to that of MAFS and other crops had had lower yield. It should also noted that survey results on estimated yield per hectare of sampled farmers differ slightly from one provided by MAFS. However, based on world comparison the country's productivity was well below during the last three years (2004-2007). For example cereals such as maize, the productivity achieved was 1.22 tons per hectare, while comparison to the world it was 3.1 tons. Roots and tubers produce such as cassava and potatoes, the achieved productivities achieved were 6.3 and 5.5 tons per hectare respectively. These were well below the Sub-Saharan Africa (7.7 tons) and the world (13 tons) (MAFC, 2008). This implies that there is a chance for the crops that were below

national level to be improved. The improvement could be achieved by undertaking different strategies to improve agricultural production and food security (section 4.7).

Based on the recommendations by Mosha (1990) cited in Ishengoma (1998) that three bags of cereals per person per year are needed to ensure household food security in a year. Due to this observation, it can be concluded that food in the study area was adequate in 2007/08 season. (9.46 bags per person per year) and (3.69 bags per person per year of cereals: maize and sorghum) provided that not a single unit was sold. Although household food security data may seem to be adequate, the household food insecurity problem was due to selling of food crop immediately after harvesting, leaving the household without enough food before the next harvest. As a consequence, household had to buy food for the rest of the year.

4.5.2 Gross Margins by crops based on 2007/08 yield

The average cost per crop used to calculate the gross margin was obtained by calculating figure for each item for all the households producing the crop. In this section, we first consider cash costs per unit of production and gross returns all based on "normal" 2007/08 yields and price; and then computed the difference, which is the gross margin (GM). For crops, gross margins show relative profitability. Therefore, the gross margins were calculated by deducting total variable costs from total revenues per each respondent in 2007/08 growing season. Total revenue from respective crops for the sampled household was obtained by multiplying total output by farm-gate prices for each crop.

It was observed that gross margin for maize was comparatively highest, which had GM of Tsh 421 352.10 followed by beans (Tsh 333 694.70). The two crops have the highest gross margins because of the high prices they fetch in the market thus bringing higher revenues

to farmers compared to other crops. Prices for these crops are high due to the fact that they are staple foods for the majority of the residents in the study area. The gross margins of other crops like sweet potatoes was (Tsh 233 230.80), cassava (Tsh 232 464.70), sorghum (Tsh 68 269.23) and cotton (Tsh 197 485.40) (Table 26). Profitability is therefore found to vary from one crop to another. Profitability of a crop is a pre-requisite for the households in making decision on what to produce. Households on the other hand cannot produce crop which is not profitable. Therefore, major crops are generally found to be profitable if all the principles of production are followed. Therefore, for household to increase level of production which reflects profitability of the crops which leads to food security improvements are needed in crops production to improve their livelihood.

The analysis of survey data also indicate that the average producer price for beans was Tsh 74 663.33 per sack, followed with Maize Tsh 27 377.98 per sack and sorghum Tsh 25 250.00 per sack. The prices of other crops like cassava was Tsh 16 908.96 per sack, sweet potato Tsh 15 064.23 per sack and cotton Tsh 435.79 per kg. The variable cost for producing maize per season was Tsh 324 846.20 higher than other crops followed by cotton Tsh 274 792.90. This probably caused by the high price of input like fertilizer and pesticide. The variable costs of other crops like cassava was Tsh 122 623.50, sorghum Tsh 92 538.46, sweet potatoes Tsh 135 557.70 and beans Tsh 178 735.10. The variable cost for cassava, sweet potatoes, beans and sorghum was low because most of the household used low input or did not use fertilizer and pesticide at all in the production of these crops.

The above results suggest that little is earned from producing crops. These findings are supported by results reported by Shabani (2007) in Kisarawe district, Coast region and PASS (2001) cited in Mashimba (2007) in Kilosa district, Morogoro region, where it was

observed that farmers sometimes earn negative gross margin from crop production. Also Mashiba (2007) also reported that in Iramba district gross margin per hectare of sunflower oil was Tsh 193 485 kg/ha, which was still low relative to production cost leading farmer to complain. The low gross margin from crops in the study area can be explained by several reasons. The price of some crops in the year 2007/08 was relatively low. Secondly, majority of farmers were still using poor technology, cultivated small areas for subsistence and lacked services from the extension sector.

Several studies have looked into farm size in relation to productivity. Example, Fan and Chan (2005) and Hazel (2005) have reported that there is a positive relationship between farm size and productivity. They have also shown that a positive relationship exists between farm size and labour productivity and therefore income. Based on these findings, the problem of low production may partly be solved by intensification or increasing the farm size (see also section 3.5.3).

Table 26: Summary of gross margins per household per growing season

Item	Maize	Cassava	Sorghum	Potatoes	Beans	Cotton
Average Area Cultivated (Acres)	3.95	1.94	1.52	1.79	2.25	2.55
Average total Output (Kg)	2 725.55	2 100.00	636.86	2 448.08	686.32	1 083.75
Average Price in Tsh per sack**	27 377.98	16 908.96	25 250.00	15 064.23	74 663.33	435.79*
Average Total Revenue (Tsh)	746 198.30	355 088.20	160 807.70	368 788.50	512 429.80	472 278.20
Average Total Costs (Tsh.)	324 846.20	122 623.50	92 538.46	135 557.70	178 735.10	274 792.90
Gross margins (GM)	**421 352.10**	**232 464.70**	**68 269.23**	**233 230.80**	**333 694.70**	**197 485.40**

* The average price of cotton is measured in Tsh. per Kilogram (Kg).
** 1 sack = 100 Kg

Table 27 gives the mean Gross Margin for all crops per growing season based on the 2007/08 cropping season. The results show that the mean total revenue, average variable cost and gross margin for all crops were Tsh 1 459 440.75, Tsh 607 429.17 and Tsh 852 011.58 respectively. Furthermore, the results indicate that the minimum and maximum of gross margin per season was Tsh 46 000 and Tsh 6 038 500 respectively.

Table 27: The gross margin of the household

	Minimum	Maximum	Mean
Total Revenue (Tsh)	150 000.00	7 652 000.00	1 459 440.75
Average Variable Cost (Tsh)	46 000.00	2 863 000.00	607 429.17
Gross margin (Tsh)	11 000.00	6 038 500.00	**852 011.58**

4.5.3 Mean separation

The effect of the farm size of the households on its profitability was tested using one way Analysis of Variance (ANOVA). This aimed at comparing the gross margins for the farm size categories. The gross margin was transformed into log 10. The results in Table 28 show that the variation in means separation of gross margin value for the different farm size categories were statistically significant ($p < 0.05$) for all the mean pairs compared. This implies that there is an increase in the GM value with increase in the size of farm size of the households. The difference in GM and in yield suggested by the means separation procedure show the need of the household to expand their farm size to gain the potential of profitability of the major crop grown.

Table 28: The variation in means separation of GM value for the different farm size categories

Farm size	Mean pair comparison	Mean	Std error of the mean
≤ 5 acres	Between 5.1 and 10 acres	- 0.57*	0.08
	≥ 10.1 acres	- 1.07*	0.09
Between 5.1 and 10 acres	≤ 5 acres	0.57*	0.08
	≥ 10.1 acres	- 0.50*	0.10
≥ 10.1 acres	≤ 5 acres	1.07*	0.09
	Between 5.1 and 10 acres	0.50*	0.10

** The Mean difference is significant at the 0.05 level*
** The GM was transformed in log 10*

4.6 Logistic Regression Results

4.6.1 Logistic model characteristics

The analysis to identify the factor influencing food security was conducted through the binary logistic regression procedure (as explained in section 3.6.3 on data analysis). The results of the model show that the model Chi-square = 41.673 statistic is highly significant ($p < 0.001$) with six degrees of freedom, indicating that the log odd of household food security is related to the independent variables. Based on a simple correlation analysis, there were no strong correlations among the independent variables. All of the correlation coefficients were statistically insignificant. With regard to the predictive efficacy of the model, of the 120 sample households included in the model, 87 or 72.5% were correctly predicted. Of the 120 observed households in the sample, 58 were food secure (48.3%) of which 38 or 65.5% were correctly predicted by the model. The other 62 households were food insecure (51.7%) of which 49 or 79% were correctly predicted by the model. Of the six variables considered in the model, four were found to have a significant impact in determining household food security (Table 29). These are farm size, household size, wealth and access to credit.

4.6.2 Parameter estimates of household food security

The result of parameter estimates of the household food security is shown in Table 29. The estimated slope coefficient of household size and access to credit were significant at the $P<0.05$ level. Household size and access to credit were in accordance *priori* expectations. The estimated slope coefficient of farm size and wealth were significant at $P<0.01$. Their estimated slop coefficients were in accordance to *priori* expectations. Furthermore, the results also show that the estimated slope coefficient of off farm work and access to market were not significant but they were in accordance to *priori* expected sign.

Table 29: Parameter estimates of household food security

Variables	Estimates	Wald	Standard error	Exp(B)
Constant	1.156	0.877	1.234	3.177
Farm size (X_1)	0.174***	9.474	0.057	1.190
Household size (X_2)	-0.131**	4.902	0.059	0.877
Wealth (X_3)	0.032***	8.261	0.011	1.033
Off farm work (X_4)	0.245	0.173	0.590	1.278
Access to credit (X_5)	2.345**	4.069	1.163	0.096
Access to market (X_6)	-0.024	0.010	0.236	1.024

The parameters were estimated using maximum likelihood method. They are unweighted.
Number of observation 120
% of correct prediction = 72.5, $\chi^2 = 41.673$*
-2log likelihood value 124.55
*** Statistically significant at $p < 0.01$; ** statistically significant at $p < 0.05$;
* = significant at $p < 0.001$.

Farm size was found to have a significant impact on household food security. Farm size has log odds of 0.174, the higher the farm sizes of the household the greater the odds of food security. In other words, when this log odd is converted to odd ratio it gives a value of 1.190, which means that when the household increase 1 acre of the farm size as the area for

food crop production, the odds that the household could be food secure increases by a factor of 1.190 *ceteris paribus*.

The results reveal that the higher the household size the higher the probability of the household being food insecure. The household size odd ratio was 0.877 which indicates that when the household size increases by one person, the odds that the household could be food insecure decreases by 0.877 *ceteris paribus*. Household size has a negative and significant effect on the probability of food security, implying that the probability of food security decreases with family size. Each additional increase in household size reduces the probability of food security.

Wealth as proxied by livestock number the household possesses was statistically significant, and it is positively related to the probability of food security as anticipated. The odd ratio for wealth was 1.033. Implying that when the household increase one unit of livestock, the odds that household could be food secure increase by a factor of 1.033 *ceteris paribus*.

Off-farm work was not found statistically significant. The insignificance of off-farm work is probably because farmers may prefer to reduce current consumption to save for future capital investments and consumption. The odd ratio for off-farm work was 1.278, and hence was positively related to the probability of food security as anticipated. This means that the chance to be food secure is increased by a factor of 1.278 for the household with off-farm work over a household without off-farm work. This is probably because off-farm work increases income to the household, which can be used to buy inputs for production or food from the market and increase food security.

Access to credit was significant at P<0.01. The positive sign to log odds (2.345) imply that households which have access to credit had greater chance of being food secure by a factor of 0.096 over households who have no access to credit. The positive sign probably shows that with credit households tend to invest and do off - farm activities. Access to credit enable households to implement better husbandry practices, through applying more agricultural inputs (seed, fertilizers, pesticides, crop maintenance) and through timely husbandry application. This may lead to increased crop production and improved household welfare and food security

Access to market as proxied by the time (hours) spent to reach the market has a negative and insignificant effect on food security. Access to market has log odds of -0.024 which indicates that when access to the market increases by one hour, the odds that a household could be food insecure increases by 1.024 *ceteris paribus*. This indicates that the farther the household is from the market place, the less likely it is food secure because the lack of market information causes inefficiency in resource use. This could be attributing to the poor distribution of surplus food produced by households and farmers may sell their produce at times when prices are low.

4.7 Strategies to Improve the Contribution of Crops to Households' Food Adequacy

Results on strategies that would improve the contribution of major crops to the households' food adequacy are presented in Table 30. The results show that most households (70%) suggested the use of input like fertilizers and improved seed variety in order to increase productivity to enhance food availability in the household. Results also show that 59.2%, 24.2% and 24.2% of the households suggested expanding the farm size, the use of improved technology and the use of tractors, respectively. Getting credit was suggested by 30.8% of the households and the use of drought tolerant varieties were suggested by 18.3%

of the household. Results also show that 16.7%. 11.7% and 7.5% of the household suggested the use of improved storage facilities, storage of more food and reduction of the amount of food sold, and education on food storage to minimize losses, respectively. This is due to the fact that households incurred a number of food losses caused by poor storage facilities hence the necessity to improve food storage facilities if household food security is to be assured.

Table 30: Strategies for food security

Strategies	Butiama		Masaba		Whole sample	
	Frequency	%	Frequency	%	Frequency	%
To expand the farm	35.0	60.0	36.0	58.3	71.0	59.2
To use inputs and Improved seed varieties	34.0	56.7	50.0	83.3	84.0	70.0
Use of improved technology and modern agriculture	8.0	13.3	21.0	17.5	29.0	24.2
The use of Tractors	9.0	15.0	20.0	33.3	29.0	24.2
To get credit	12.0	20.0	25.0	41.7	37.0	30.8
The use of drought tolerant varieties	9.0	15.0	13.0	21.7	22.0	18.3
Use of improved storage facilities	7.0	11.7	13.0	21.7	20.0	16.7
Store more stock of food produced and reduce amount sold.	5.0	8.3	9.0	15.0	14.0	11.7
Education on food storage to avoid losses	3.0	5.0	6.0	10.0	9.0	7.5

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This study sought to assess food crop production for household consumption and food security in Musoma Rural district, To achieve this major objectives, the study evaluated the performance and the roles played by households in agriculture to ensure food security and economic development in Tanzania. The gross margin model was used to investigate the profitability of selected major food crop production for household consumption in the study area. The binary logistic model was used to identify the factors influencing food security at the household level. The households' views were deduced based on the observation and discussion to get a qualitative perspective of strategies to improve the contribution of major crops to households' food adequacy. These objectives were based on the fact that while there are adequate resources for food crop production to enhance food security, the study area is prone to food deficit and low crop production whereby households fail to produce enough staple food for home consumption for the whole year. Based on the findings presented and discussed in chapter four, a number of conclusions and recommendations can be drawn. This chapter briefly highlights these conclusions and recommendations.

5.2 Summary of Major Findings and Recommendation

Crop production for the rural people is very important because of food security and cash earnings (Ferris and Malcom, 2000). Findings show that households in the study area have household characteristics typical of rural households similar to other settings in Tanzania.

The findings from this study revealed that crop production plays an important role in the area's economy providing jobs, sustenance and income to rural households growing crops. The results revealed that almost all respondents (80%) produce food for their households, while the rest 19.2% depended on own production and purchase from the market, and the remaining 0.8% purchased food from the markets. Households grow a diversity of crops mostly for household food security. Major crops grown by the households in the study area are maize, cassava, sorghum, sweet potatoes, bean and cotton in order of ascendancy. Majority of the households in the study area grew maize in 2007/08 farming season to meet both food security and cash requirements. Among the root and tuber crops, cassava is the most important grown by about three quarter of the households. Beans are also relatively important and are predominantly grown as a food and cash crop.

The average cultivated area of 7.77 acres per household for crops implies that availability of cultivable land is not a problem to most households. This means that there are households (55%) that have access to land much larger than 7.77 acres but more important there are households (45%) that have access to land of less than 7.77 acres. The impact of the large increase in farming households and increasing land area under production coupled with the small planted area per household is likely to prevent food insecurity. These results in hunger and poverty, and is insufficient to allow households to move beyond the subsistence existence. Land ownership is through customary rights where the majority (43.3%) of the households got land through inheritance, 37.5% and 17.5% of the households was given land by village government, or bought their land, respectively. It is obvious from these results that purchasing of land is a common practice in the study area. The other 1.7% of the respondents acquired land through renting. This revealed that land in the study area is a limited resource that is not accessed freely.

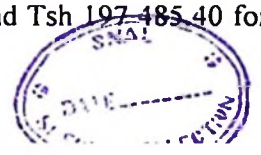
The results revealed that the study area received less extension services. The lower percentage of households with extension services can be associated with the fact that there are few extension officers or there is no elaborate extension service at ward or village level in the study area. thus there was limited possibility of getting extension advice.

The results revealed that only 5% had access to credit and the rest 95% had no access to credit in the study area. There are practically no credit facilities in the rural area surveyed and most households purchased implements through the sale of crop products. The majority of the households cannot finance their production activities on a cash basis particularly at the start of the season. Credit is needed for them to be able to purchase input like fertilizers, herbicide and pesticide, and money to pay for labour costs.

Food was inadequate and the majority (62.5%) of the households had experienced food deficit since 2005 mainly due to inadequate production and early sale of produce. The majority 80% of the respondents sold their produce early in order to obtain cash to purchase household needs.

5.2.1 Profitability of selected main crops

In order to investigate whether the selected major food crops productions for household consumption were profitable or not, it was hypothesized that the selected major food crops production for household consumption were not economically profitable. The null hypothesis was rejected because the gross margin analysis shows that return for all crops were positive. Comparison of gross margins for various crops showed that maize had the highest gross margin of Tsh 421 352.10 followed by beans Tsh 333 694.70. The gross margins for other crops amounted to Tsh 233 230.80 for sweet potatoes, Tsh 232 464.70 for cassava, Tsh 68 269.23 for sorghum, and Tsh 197 485.40 for cotton. Therefore, it was



more profitable to invest in maize production, beans and sweet potatoes and less profitable to invest in cassava and sorghum production. The study found that maize and beans had high selling price per sack. Cassava, which had low gross margin, had the highest yield level per hectare. The low gross margin of cassava may be contributed by lowest price per unit market price.

The results of the study indicated that major crops productions are potential, not only for food security purpose but also for income generation. However, it is evident that households in the study area have not captured the full potential benefits of the major crops produced probably because are grown for subsistence.

The fact that most of the food produced and consumed by the households were obtained from farmers' own production points to the conclusion that food security in the rural areas depend largely on their own sources of crops production. Thus, improving crop production, use of modern technologies and expanding the land size of the household is the key to household food security.

5.2.2 Factors influencing the households to ensure food security

Based on results from tests of the binary logistic model, results show that 48.3% of the households were food secure and 51.7% food insecure. The results revealed that an increase in land area of production leads to increase in household food security at the household level. The positive and significant relationship of farm size with household food security indicates that farm size plays an important role in ensuring household food security, hence the smaller the farm size, the lower the probability of food security. Based on the negative and significant relationship between household size and food security, an increase in family size decreases the probability of food security. Wealth as proxied by

livestock number the household possess was statistically significant, revealing that when the household increases one unit of livestock, it automatically increases the probability of the household to be food secure. The probability of food security increases with the household with off-farm work over household without off-farm work.

The significant relationship of access to credit with food security indicates that access to credit plays an important role in ensuring food security in the households. Nevertheless, field observations showed that the majority of respondents had no access to credit. Furthermore, the positive sign probably shows that with credit households tend to invest and do off - farm activities. Access to credit enable households to implement better husbandry practices, through applying more agricultural inputs (seed, fertilizers, pesticides, crop maintenance) and through timely husbandry application. This may lead to increased crop production and improved household welfare and food security. Access to market as proxied by the time (hours) spent to reach the market had a negative and insignificant effect on food security. The odd ratio of access to market revealed that when access to the market increases by one hour, the odds that a household could be food insecure increases. This indicates that the farther the household is from the market place, the less likely it is food secure because the lack of market information causes inefficiency in resource use. In order to increase food security and in additional to the study findings, it is concluded that increasing farm size and improving socio-economic characteristics such as household size, off farm work, access to market, wealth and acquisition of credit may play an important role in ensuring household food security.

5.2.3 Strategies that would improve the contribution of major crops to households' food adequacy

These finding show that the current and future options for household food security in the rural areas rest on the improvement of the current farming. This is because most of the food consumed is produced locally and very few households bought from the market as shown in the study. However, the existing policy strategies for food security emphasize the enhancement of crop productivity using single cropping and high varieties. High yielding varieties are important. Moreover, high yielding varieties require subsidized inputs. The results revealed that most household (70%) suggested the use of input like fertilizers and improved seed variety in order to increase productivity to enhance food availability in the household. Other strategies were 59.2%, 24.2% and 24.2% of the household suggested expanding the farm size, the use of improved technology and the use of tractors respectively. Getting credit was suggested by 30.8% of the households. Other strategies suggested by the households were the use of drought tolerant varieties (18.3%), while 16.7%, 11.7% and 7.5% of the households suggested the use of improved storage facilities, storage of food and reduction of the amount sold, and education on food storage to minimize losses, respectively.

5.3 Recommendation

Following the study conclusions, the following recommendations are imperative.

(1) It is necessary to improve the production of drought resistant crops such as Sorghum, cassava, and sweet potatoes in the study area. Moreover, maize is grown and preferred for household consumption by most of the households but the crop is susceptible to drought. Therefore, research should be done to provide improved varieties which are

resistant to drought and mature early to enhance food security during the diverse condition.

(2) Household should be encouraged and motivated to grow cotton as a cash crop to increase their income which will enable them to buy non food needs, instead of selling their food produce for household consumption. They should also be discouraged from selling of food crops earlier and encouraged them to store enough food for the next harvest season.

(3) Generally, households experience low productivity in which returns per hectare are too low compared to Sub-Sahara Africa and the World productivity. It is therefore recommended that in order to increase yield per hectare. crop husbandry practices and improved techniques should be adopted along with provisions of adequate and quality extension services, inputs, better product prices and credit facilities.

(4) State of technology in the study area is another constraint contributes to low productivity. Households use hand hoe and poor ox plough facilities as their major tool for land preparation, resulting in small farm size being cultivated. It is therefore recommended that in order to expand acreage cultivated, households should adopt improved technologies, including the use of tractors

(5) Inputs and services should be provided to households at affordable prices. Subsidies /grants should be given to help smallholders change from a subsistence base to profit making economic entities. Steps should be taken to encourage the use of fertilizers especially the use of farm yard manual which is readily available in the study area.

(6)Promoting off-farm and non-farm employment opportunities, through which some proportion of the household could shift from direct reliance on land for their livelihoods, which would in turn enable households to modernize their production since it provides the opportunity of applying the necessary inputs, and reduces the risks of food shortage during periods of unexpected crop failures.

(7) The fact that the climate of the study area is dominantly semi-arid and the existence of a serious problem of frequent crop failure caused by drought and erratic rains clearly suggest that introducing small-scale irrigation can enhance food security at the household level. Therefore, any infrastructural development intervention should give special attention to irrigation development.

(8) Increasing crop production and productivity at the farm level should form an important part of any efforts to improve profitability, household food security and poverty alleviation. In order to raise agricultural productivity it is suggested that farmers switch over from "traditional" to "modern" agriculture in very large numbers, involving the use of high-yielding varieties of seeds, organic manure, chemical fertilizers, insecticides, better implements and animal power. This will raise crop productivity which would enable farmers to produce enough food for the household and the nation and enhance household food security.

(9) The family size of the households has influenced food security negatively. The population in Musoma district is growing faster. To address this issue there needs encouraging people towards family planning and facilitate the establishment of savings and credit societies (SACCOs) to enable households to access both short and long-term investment loans.

REFERENCES

Amani, H. K. R. (2005). Agricultural development and food security in Sub-Saharan Africa. Tanzania country report, Economic and Social Research Foundation (ESRF) Dar es Salaam, Tanzania. [http://www.fao.org/tc/TCA/work05/ Tanzaniappt.ppt] site visited on 4/5/2008.

Amani, H. K. R. (2006). Agricultural development and food security in Sub-Saharan Africa (SSA): Building a Case for more Public Support; The Case of Tanzania. *Policy Assistance Series*. Working Paper No. 06. Rome. FAO. 82pp.

Anania, B. (2003). A Coping Strategies of rural household to food and livelihood insecurity in Semi- Arid area of Tanzania. A Case of Korogwe – Dodoma. A Special Project in Partial Fulfillment for Requirement of the Degree B.Sc H. Eco SUA, Morogoro, Tanzania. 28pp.

Ashimogo, G. C. (1995). Peasant grain storage and marketing in Tanzania: a case study of maize in Sumbawanga District. PhD Thesis Verlag Koster, 369pp.

Bailey, K. D. (1994). *Method of Social Research fourth edition*. Free Press Macmillan Inc., New York. 588pp.

Beerlandit, H. and Huysman, S. (1999). Food Security in Kagera Region: Baseline Description of Different Socio-Economic Systems based on the Results of Participative Group Discussion, with at first list of Indicators and Guidelines For action. KAFOSEC Research Project Report. 92pp.

Bisheko, D. (1989). Tanzania food security issues and challenges for the 1990's. In: *food security policies in the SADCC Regions.* (Edited by Rukuni, M., Mudimu, G. and Jaynne, T.S.) University of Zimbabwe/Michigan State University: Department of Agricultural Economics and Extension. University of Harare, Zimbabwe. pp. 47 – 55.

Carey E. E., Hagenimana, V., Oyunga, M. A., K'osambo, L., Smit, N. E. J. M., Ocitti p'Obwoya, V., Turyamureeba, G. and Low, J. (1999). The role of cassava and sweet potato. In: *Food security and crop diversification in SADC countries; Proceedings of the scientific workshop of Southern Africa Root Crops Research Network.* (Edited by Akoroda, M. O. and Teri, J. M.), 17 – 19 August 1998, Lusaka, Zambia. pp.157 – 168.

Cramer, G. L., Jensen, C. W. and Southgate, D. D. (2001). *Agricultural Economics and Agribusiness 8th edition.* Wiley & Sons. Inc, New York. 925pp.

Demaris, A. (1992). *Logit Modeling: Practical Applications.* International Educational and Professional Publisher, London. 87pp.

Dercon, S. (1996). "Risk, crop choice and savings: Evidence from Tanzania," *Economic Development and Cultural Change* 44(3): 485-513.

Ehui S., Benin S., Williams T. and Meijer S. (2002) Food security in Sub Sahara Africa to 2020. Socio-economics and policy research working paper 49. ILRI, Nairobi, Kenya. 60pp.

Ewell, P. T. and Mutuura, J. (1991). Sweet potato in food systems of Eastern and Southern Africa. In: *Tropical root crops in a developing economy. Proceedings of the Ninth symposium of the International society for Tropical Root Crops.* (Edited by Ofori, F. and Hahn, S.K.), 20 – 26 October, Accra, Ghana. pp. 405 – 421.

Famine Early Warning Systems Network (FEWSNET). (2003). Tanzania food security report, 22 December 2003. [http//www.fews.net] site visited 5/5/2008.

Fan, S. G. and Chan, K. C. (2005). Is small beautiful? Farm size, productivity and poverty in Asian agriculture. *Agricultural Economics Journal* 32 (1):135 -146.

FAO (1992) Major issues for nutrition strategies: Theme paper No. 1: Improving Household Food Security. 12pp.

FAO (1997). Implications of economic policy for food security: A training manual. Rome. FAO. 313pp.

FAO (1998). The state of food insecurity in the world. Rome. FAO. 167pp.

Ferris, A. and Malcolm, B. (2000). *Farm Management Economic Analysis.* University of Melbourne, Parkville Victoria, Australia. 679pp.

Francois, P., Penshe, J. and Kamoum, A. (1982). The effect of household size and income on the probability of energy inadequacy; Tunisian Case Study. *Food and Nutrition Bulletin* 8: 32-39.

Gabagambi, D. M. (1998). Production and Marketing of Paddy and Cotton in Ulanga District of Tanzania. Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 137pp.

Gill, G. J. (1991) Seasonality and Agriculture in the Development World. *A problem of the poor and powerless*. Cambridge University Press, Great Britain. 131pp.

Gujarati, D. N. (2003). *Basic Econometrics*. Fourth Edition. McGraw – Hill Higher Education. West Point, United State Military Academy. 1002pp.

Green, H. (1990). *Econometric Analysis*. Second Edition. Macmillan Publishing company, New York. 791pp.

Hazell, P. B. R. (2005). Is there a future for small farmers? *Agricultural economics Journal* 32(1): 93 – 101.

Holden, S. and Shiferaw, B. (2004). Land degradation, drought and food security in less-favoured area in Ethiopian highlands: a bio-economic model with market imperfections. *Journal of agricultural Economics* 30(1): 31 – 49.

Hubbard, M. (1995). *Improving Food Security. A guide for rural development managers.* International Technology Publication Ltd., London. 151pp.

Huysman, S., Crommelynck, A. and Vanoost, K. (1999). Food Situaiton in Kagera Region, Tanzania KAFOSEC – Research Project, PRA Result Reprot No. 2. 91pp.

International Food Policy Research Institute (1994). A 2020 vision for Food, Agriculture and the Environment 2020 Brief and 29. 1995. IFPRI Washing D. C. [http//www.ifpr.org] site visited 24/5/2008.

International Food Policy Research Institute (2002). *Sustainable Food Security for All by 2020.* A 2020 vision for Food, Agriculture and the Environment. Proceeding of an International Conference, Bonn, Germany, 4 – 6 September, 2001. 281pp.

Ishengoma, C. G. (1998). The Role of Women in Household Food Security in Morogoro Rural and Kilosa Districts. A Thesis Submitted in Fulfillment for the Degree of Doctor of Philosophy at Sokoine University of Agriculture, Morogoro, Tanzania, 371pp.

Isinika, A. C., Ashimogo, G. C. and Mlangwa, J. E. D. (2003). Africa in Transition Macro Study Tanzania. Final Technical Report. Sokoine University of Agriculture, Morogoro, Tanzania. 93 pp.

Johnson, D. T. (1985) *The business of farming. A guide to farm business management in tropics*. Macmillan Publishing Ltd., London. 126pp.

Jonsson, U. (1986). Major Problems of Women and Children in Tanzania paper presented at TFNC regional course on Food and Nutrition Planning, 3 – 15 February, Morogoro, Tanzania. 19pp.

Just, R. D., Wolf, S. T. and Zilberman, D. (2006). Effect of information formats on information services: Analysis of four selected agricultural commodities in USA. *Journal of Agricultural Economics* 35(2): 389 -- 301.

Kapinga, R. E., Ewell, P. T., Jeremia, S. C. and Kileo, R. (1995). Sweet potato in Tanzanian farming and food system: Implications for research. Tanzania national root and tuber, Farming systems Research Programme and International potato Centre. 47 pp.

Kavishe, F. P. (1993). *Nutrition-Relevant Actions in Tanzania.* UN ACC/SCN Country Case Study by UNICEF United Nations Children's Fund. A Case Study for the XV Congress of the International Union of Nutritional Sciences. September 26 to October 1, 1993. Adelaide. 209pp.

Kavishe, F. P and Mushi, S. S. (1993). *Nutrition-Relevant Actions in Tanzania. Monography series* No. I, UN ACC/SCN country case study by UNICEF. A case study for the XV congress of the International Union of Nutrition Sciences, September 26 to October 1, Adelaide. 209pp.

Larsson, R. (2005). Crisis and Potential in Smallholder Food Production – Evidence from Micro Level. In: *The African Food Crisis*: Lessons from the Asian Green Revolution. (Edited by Djurfeldt, G. H., Holmén, M. Jirström and R. Larsson), CABI Publishing, Wallingford, UK. pp. 113 – 137.

Limbu, F. (1998). *Profitable Technologies Ready for Adoption.* Dar es salaam University Press, Tanzania. 145pp.

Liao, T. F. (1994). *Interpreting probability models Logit, Probit, and other Generalized Linear Models. Quantitative Applications in the Social Sciences Series No. 101.* Sage Publication. Inc., London, New Delhi. 87 pp.

Lorri, W. S. M. and Kavishe, F. P. (1990). Household Food Security and Relation to Nutrition. In: *Proceedings of National Workshop on Household Food Security.* TFNC Report No 1277, 11 – 13 June 1990. Dar es Salaam, Tanzania. pp. 7 – 34.

Machethe, C. L., Mollel, N. M., Ayisi, K., Mashatola, M. B., Anim, F. D. K and Vanasche, F. (2004). Smallholder Irrigation and Agricultural Development in the Olifants River Basin of Limpopo Province: Management Transfer, Productivity, Profitability and Food Security Issues. Report to the Water Research Commission on the project entitled "Sustainable Local Management of Smallholder Irrigation". University of the North, School of Agriculture and Environmental Sciences, December 2004 [http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/1050%20web.pdf]. site visited 14 / 07 / 2010.

Madadi, M. (1998). Constraints affecting oil seed crops production and marketing in Tanzania. A case of sunflower in Iramba district, Tanzania. Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 134pp.

Makeham, J. P. and Malcolm, L. R. (1986). *The Economic of Tropical Farm Management.* Cambridge University Press. 968pp.

Makundi, F. (1996). Household Food Security: A Case Study of Moshi Rural District. Dissertation for Award of MSc Degree at Agricultural University of Norway, 139pp.

Malima, V. F. (1993). Agricultural Extension Services for Women Farmers. *The Crucial Role of Women Farmers in Food Security*. Paper presented at the African women farmer workshop, the Mbagala Spiritual Center, 11 - 16 October, 1993. 15pp.

Maliyamkono, T. L. and Mason, H. (2006). *The Promose*. TEMA Publishers Company Ltd., Dar es Salaam, Tanzania. 619 pp.

Mamiro, C. P. (1991). Household Food security in Rural Tanzania. Adequacy Stability and Accessibility: A Case Study of Moshi Rural and Kilosa district. Dissertation for award of Msc Degree at Agricultural University of Norways, Oslo, 85pp.

Mashimba, S. (2007). Evaluation of On-Farm Cassava Processing and its Implication on Marketing and Farmer's Income: A Case of Coast Region. Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 89pp.

Matata, J. B. W., Anandajayasekaram, T. N., Kiriro, E. O., Wandera and J. Dixon (2001). *Farming system approach technology development and transifer*. FARMESA GCP/RAF / 334/ SWE Harare Zimbabwe. 420pp.

Maxwell, D. (1996). Measuring food insecurity: the frequency and severity of "coping strategies." *Food Policy* 21(3): 291–303.

Maxwell, S. A and Frankenberger, T. R. (1992). *Household Food Security: Concepts Indicators and Measurements*. A technical Review. IFAD – UNICEF New york. Rome. 274pp.

Mbilinyi, M. and Nyoni, T. (2000). *Agricultural and Livestock policy*. 1997. Revised based on feedback workshop on policy review process of the Rural Food Security Policy development group (RFS). Tanzania Episcopal Conference (TEC), 2 – 3 May, 2000. 186pp.

Mbonde, J. M. N. (1992). Food Policy in Tanzania in the Last Three Decades: Its Evolution and Performance. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 180pp.

Milich, L. (1997). *Characterizing and relating meridional variability in satellite images of the West African Sudano-Sahel to desertification and food security*. University of Arizona. 86pp.

Ministry of Agriculture, Food Security and Cooperatives (2006). Agriculture sector development programe. [http://www.agriculture.go.tz/mafc-services] site visited on 4/5/2008.

Ministry of Agriculture, Food Security and Cooperatives (2008). Agriculture Sector Review and Public Expenditure Review 2008/09. Final Report. November 2008. [http://www.agriculture.go.tz/publications] site visited on 16/5/2010.

Ministry of Cooperatives and Marketing (2004). *Assessment of Agriculture Marketing Information Needs*. Sokoine University of agriculture, Morogoro, Tanzania. 66pp.

Missape, M. T. S. (1988). Prevalence of Child Malnutrition and factors Associated with it in Morogoro Township. Unpublished Special Project report. Department of Food Science and Technology. Sokoine University of Agriculture. Morogoro. Tanzania. 137pp.

Mkunda, J. J. (2006). Dynamics of Livestock Ownership and Household Food Security in Semi-Arid Tanzania: Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 82pp.

MOA / FAO (1995) Maximum production with optimum inputs. The national special programme. Dar es Salaam. Tanzania. 68pp.

Mosha, A. C. (1990). *Decision Making on Resource Allocation in Rural Households for Food Security*, in Shinyanga Rural District. TFNC Report. 33pp.

Msambichaka, L. A. (2006). Agricultural in Tanzania: Performance and key factor to competitiveness. In: *Globalization and Challenges for Development in Tanzania. (Edited by: Msambichaka, L. A.., Mwamba, N. E. and Mashindano, O. J.)*, Dar es Salaam University Press, Dar es Salaam, Tanzania. pp. 271 – 297.

Mtunda, K. J., Muhanna, M., Masumba, E. A., Msolla, S. N. and Ngereza, A. (2003). Contribution of Sweet potato to the household Food Security in Eastern Tanzania. In: *Towards Food Security Research on production, processing, marketing and utilization. Proceedings of the 2nd Collaborative Research Workshop.*(Edited by Batamuzi, E. K. and Tarimo, A. J. P.). 28 – 29 May 2003, Morogoro, Tanzania. pp. 88 - 96.

Mwakalobo, A. and Shively, G. (June 2002). Food security and natural resource management in developing countries. [http://www.fiuc.org/iaup/sap/] site visited on 9/7/2008.

Myaka, F. A., Chibunda, R. T., Kidunda R. S. and Rwamugira, W. (2003). Factors Limiting Crop Productivity and Their Effect on Household Food Security and Income. In: *Towards Food Security Research on production, processing, marketing and utilization. Proceedings of the 2nd Collaborative Research Workshop.* .(Edited by Batamuzi, E. K. and Tarimo, A. J. P.), 28 – 29 May 2003, Morogoro, Tanzania. pp. 1 -12.

National Bureau of Statistics Tanzania (2005). Tanzania Demographic and Health Survey 2004 – 2005. Dar es salaam, Tanzania, December 2005. 381pp.

Ndunguru, C. (2007). *Econometrics a Science for Non Experimental Data Analysis.* Research, Information and Publication Center, Mzumbe, Morogoro, Tanzania. 239pp.

NEPAD (2003). Comprehensive Africa Agriculture Development Programme. New Partnership for Africa's Development (NEPAD). Midrand, South Africa. 102 pp.

Njiro, E. I. (1997). *Gender and Households Dynamics in Coping with food shortages in Rural Kenya*: A case study of Mbeere a Semi arid district of Eastern Kenya. Mid term research presented during African Social Sciences research Networks (ARSSRN) workshop at Cotonou, Republic of Benin. July 21-26. 57pp.

Nyange, D. A. (2000). The Analysis of Food Insecurity and Malnutrition in Tanzania and its Policy Implications. PhD Thesis, Laboratory of International Rural Development, Kyoto University, 115pp.

Nyborg, I. and Haug, R. (1994). Food Security Indicators for Development activities by Norwegian NGOs in Mali, Ethiopia and Eritrea. A paper of the SSE- Program (Sudano-Sahel Belt of Africa). NORAGRIC. September, 1994. 27pp.

O'Neill, S. and Mathews, A. (1999). *The Rate of Return to public expenditure on agricultural extension in Ireland.* Trinity College, Dublin, Ireland. 116pp.

Orchard, A. (2004). Food crises and food security around the world. Caritas, Australia. [http://www.caritas.org.au/ozspirit/2008/179b.html] site visited 23/5/2008.

Owuor, J. (1999). Determinant of agricultural productivity in Kenya. [http://www.aec.msu.edu/fs2/Kenya/detr_agprod.pdf.] site visited on 5/5/ 2010.

Philip, D. (2001). Economic analysis of Medium Scale Agricultural Enterprises in a Predominantly Smallholder Agriculture Sector. Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 139pp.

Quiñones, M. A., Foster, M .A. and Sicilima, N. P. (1992). The Kilimo/Sasakawa-Global 2000 Agricultural Project in Tanzania. In: *Africa's Agricultural Development in the 1990s Can it be Sustained?*. (Edited by Russell, N. C., Dowswell, C. R.), Mexico, D.F. pp. 26 – 43.

Reardon, T., Barrett, C., Kelly, V. and Savadogo, K. (2001). "Sustainable vs. Unsustainable Agricultural Intensification in Africa: Focus on Policy Reforms and Market Conditions." In: *Tradeoffs or Synergies? Agricultural Intensification, Economic Development, and the Environment*. (Edited by Lee, D. and Barrett, C.), CABI Publishing. pp. 46 – 58.

Renkow, M. (1990). Household inventories and market surplus in semi-subsistance agriculture. *American Journal of Agricultural Economic* 72(3): 664-675.

Runyoro, G. T. (2006). Globalization and food Security in Tanzania. In: *Globalization and Challenges for Development in Tanzania. (Edited by Msambichaka, L. A.., Mwamba, N. E. and Mashindano, O. J.)*, Dar es Salaam University Press, Tanzania. pp. 176 – 406.

Scoones, I. (1998). Sustainable rural livelihoods: a framework for analysis. Institute for Development Studies working paper 72, Brighton, UK. [www.ids.ac.uk/ download.cfm?file=wp72.pdf] site visited on 14/5/2008.

Seenappa, M. (1987). Household Food Security in Tanzania: A Rapid Assessment of Few Village in Shinyanga, Mtwara and Zanzibar. 75pp.

Senkondo, E. M. M. (1999). Risk Attitude and Risk Perception in Agroforestry Decisions: The Case of Babati, Tanzania. Thesis Wageningen University, 208pp.

Shabani, A. (2007). Economic Analysis of Constraints Faced by smallholder Farmers in Crop Production: A Case Study of Kisarawe District, Coast Region, Tanzania. Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 98pp.

Silomba, L. B. (2000). Structure and Performance of Beans Marketing system in Tanzania: A Case of Kigoma Region. Dissertation for the Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 112pp.

Sjah, T., Cameron, D. and Russell, I. (2003). Factors contributing to performance of agricultural credit in Lombok, Indonesia. [http://www.agecon search.umn.edu/bitstream/123456789/11252/1/cp03sj01.pdf] site visited on 4/5/2010.

Temu, A. E. (1995). Rapid Appraisal approaches Versus Conventional Survey Data Collection: A case of smallholder Farmers wealth ranking in Njombe district: In: *Proceedings of the Second Faculty of Agriculture annual Research Conference* held at the Institute of Continuing Education (ICE), 25-27 September 1995, SUA, Morogoro, Tanzania. pp. 292-302.

Temu, A. E. (1998). Financial Institutions and agricultural Development in Tanzania. Dissertation for Award of MSc Degree at the University of Reading. 75pp.

Teokul, W., Payne, P. and Dugdale, A. (1986). Seasonal variation in nutritional status in rural area developing countries. A Review of literature. *Food and nutrition*, 8(4): 7-9. United Republic of Tanzania (2003). National food security policy (draft). 34pp.

TFNC. (1988). "*Uimarishaji wa lishe ya kina mama na watoto*" *Utunzaji wa Matatizo ya Chakula na lishe* 2nd Ed. Wizara ya Elimu na Mafunzo, Dar es Salaam, Tanzania pp. 16-22.

TFNC. (1992). Comprehensive food security programme. Vol.1 .Main report Ministry of Agriculture, Dar es Salaam, Tanzania. pp. 1-25.

Tumbo, S., Mutabazi, K. and Rajabu, K. R. M. (2007). *Rapid appraisal of Policies and Institutional Frameworks for Agricultural Water Management. TANZANIA COUNTRY REPORT.* A Research Report of the Improved Management of Agricultural Water in Eastern and Southern Africa (IMAWESA). (Edited by Mati, B.). November 2007. 51pp.

United Republic of Tanzania (URT), (2001). Agricultural Sector Development Strategy (ASDP), Dar es Salaam. 92pp.

United Republic of Tanzania (2003). National Food Security Policy (Draft). Dar es Salaam, Tanzania. 34pp.

United Republic of Tanzania (2005). Poverty and Human Development Report. Mkuki na Nyota Publishers. Dar es Salaam. Tanzania. 117pp.

United Republic of Tanzania. (2007). Poverty and Human Development Report. REPOA. Dar el Salaam. 128pp.

United republic of Tanzania. (2008). High-Level Conference on: Water for Agriculture and Energy in Africa: the Challenges of Climate Change. National Investment Brief. Sirte, Libyan Arab Jamahiriya, 15-17 December 2008. [http://www.sirtewater and energy.org/docs/reports/Tanzania-Draft2.pdf] site visited on 14/07/2010.

URT and UNICEF (1990). Women and children in Tanzania. A situation analysis, Dar es salaam. 169pp.

Wiebe, K. (2001). Natural resources, agricultural productivity, and food security. Issues in food security. Economic Research Services, United States Department of Agriculture. Agriculture information bulletin 765(3). [http://www.ers.usda.gov/publications/aib765/aib765-3.pdf] site visited on 27/6/2008.

World Bank, (1994). Tanzania Agriculture. World Bank Country study. Washington, Dc. 15pp.

APPENDICES

Appendix 1: Farmers' questionnaire for crop production for household consumption and food security: the case study of Musoma Rural district

A: Background information;
Date of interview..... Name of interviewer .....
Village ..... Ward ..... Division.....
District.....

B: Household identification variables;

1. Name/code number of respondent .....

2. Age..... Gender..... 1= Male 2 = Female ( ).

3. Marital status. 1 = Married 2 = Single 3 =Divorced 4 =Other ( ).

4. Respondent level of education.
   1= No formal schooling, 2= adult literacy classes, 3 = Primary education, 4 = Secondary education, 5 = College and above ( )

5. Are you the head of this household? 1 = Yes, 2 = No.

6. Number of people in the household

Year	**Female**	**Male**
1) Less than 5		
2) 5 -18		
3) Above 18		

7. . How many children do you have .....

8. Are they all schooling; 1 = Yes 2 = No ( )

9. If No explain why? .....

10. If Yes, what is the level of their education and their gender and age?

Children	Age	Gender	Level/ Class
1			
2			
3			
4			
5			

11. How many dependents do you have?.....

C: Household assets;

12. Do you own a house? 1 = Yes 2 = No ( )

13. If Yes how? 1 = Own 2 = Rent 3 = Inherit 4 = Other ( ).

14. What is the material used to build your own house?

Floor	1 = Yes 2 = No	Walls	1 = Yes 2 = No	Roofs	1= Yes 2 = No	Doors	1 =Yes 2 = No
Earth/ sand		Sun-dried bricks		Grass		Wood	
Finished floor: -Cement -Stone		-Burnt bricks -Concrete blocks -Plastered		Corrugated iron sheets		Corrugated iron sheets	
Rudimentary wood planks		Thatched walls		Other		Grass	
Other		Other				Other	

15. What other assets do you own?
    1..... 2.....
    3 ..... 4.....

D: Farm resources and food production

16. Do you own land? 1 = Yes 2 = No ( )
17. If No why?.....
18. If yes, how did you get the land?
    1 = Inherited, 2 = Bought, 3 = Rent, 4 = Other ( ).
19. What is the size of your land?..... ha.

20. Is it possible to obtain more land? 1 = Yes, 2 = No ( ).

21. If No why? .....

22. Do you produce your own food? 1 = Yes, 2 = No.

23. if yes, how many total farm size of land in acres is used for crop farming activities to the household .....
24. What crops are grown? (Rank your crops according to the order of importance).
    Food crops; (in hector) Cash crops; (in hector)
    1..... 1.....
    2..... 2.....
25. Give the criteria for used for the ranking.....
26. Do you cultivate all your area? 1 = Yes, 2 = No. ( )

27. If no why do you not cultivate the rest of the land? 1 = low fertility, 2 = labour shortage, 3 = low technology, 4 = others (specify)

D: Input used information

28. What type of equipment do you use in crop production?
    1 = Hand hoe, 2 = Ox-plough 3 = Tractor 4 = Other ( ).

29. Do you apply any kind of fertilizer? 1 = Yes, 2 = No. ( )

30. If no why fertilizer is not used? 1 = land is fertile, 2 = fertilizer is not available, 3 = expensive, 4 = others (specify) ( )

31. Where do you buy your inputs? 1 = In town , 2 =Private traders , 3 = Cooperative society, 4 = Others. ( )

32. Are the inputs available in time when you need? 1 = Yes, 2 = No ( )

33. If No, why? .....

34. If yes, what is the major means of transport for your farm inputs? .....

35. Do you remember on average how much money did you use in 2007/08 crop season for buying various inputs. T.sh .....

E: Access to credit and extension services.

36. Do you get any extension services? 1 = Yes , 2 = No ( )

37. If yes, what type of extension services and how regular?.....

38. Do you have access to credit facilities? 1 = Yes 2 = No ( )

39. If yes, what are the use of the credit borrowed?.....

40. If No, why? 1 = Lack of credit facilities, 2 = High interest rate 3 = Not aware of credit availability, 4 = High risk 5 = Low income obtained from crop

41. Where do you get the fund for repayment?.....

42. In your own opinion do you think that credit is helpful? 1 = Yes, 2 = No ( )

43. If Yes, why? .....

44. If No, why?.....

F: Crop produced and consumption

45. When do you harvest

Crop	month
Maize	
Sorghum	
Rice	
Cassava	
Sweet potatoes	
Others (specify)	

46. What are the main food crops for home consumption? (list in order of importance). 1- maize, 2- sorghum, 3- cassava, 4- sweet potatoes, 5- others (specify). ( )

47. Did you sell some of your food produce this year? 1 = Yes, 2 = No.( ).

48. If yes, why did you sell some of your food produce? 1 = to obtain cash, 2 = unable to keep crops, 3 = surplus, 4 = lack of storage facilities, 5 = others (specify) ( )

49. Do you purchase any food item? 1 = Yes, 2 = No. ( )

50. If yes, what type of food do you usually purchase?1 = maize, 2 = Rice, 3 = others

51. How much bags did you store last year? (specify which crop) 1 = nill, 2 = below 2 bags, 3 = between 2- 4 bags, 4 = between 5-6 bags, 5 = between 7-8 bags, 6 = between 9-10 bags, 7 = above 10 bags.

52. Was the amount harvested and stored enough for the family until the next harvest? 1 = Yes, 2 = No.( )

53. If no, why? 1 = the storage amount was not enough, 2 = some harvest sold for income, 3 = storage losses, 4 = others (specify) ( )

54. If no, what measure did you take to make sure you have enough food until next season? 1 = buying some food, 2 = casual labour, 3 = aid from government, 4 = others (specify) ( )

55. When did you exhaust your stock? 1) a month after harvesting, 2) 2-4 month after harvesting, 3) 5-7 months after harvesting, 4) above 8 months after harvesting, 5) did not exhaust at all. ( )

56. Do you use any of the grains for brewing? 1 = Yes, 2 = No. ( )

57. If yes, how much per year? ..... bags

58. What is the main source of your daily food? 1 = own produce, 2 =purchase from the market, 3 = own produce and purchase from the market, 4 = others (specify)

G: Off – farm activities

59. Do you perform any off farm activities a part from crop farming?1= Yes,2=No( )

60. If yes, what are these activities performed outside the farm,.....

61. What is the average weakly income from off farm activities above..... Tshs

H: Production cost and Revenue fro crop production.

62. Production cost;

Activity / Item	Type of crop							
	1 Maize	2 paddy	3 sorghum	4 cassava	5 millet	6 potatoes	7 beans	8 others
Land rent								
Land preparation (man/days)								
Seeds								
Planting (man/days)								
Weeding (man/days)								
Fertilizers application								
Sprays cost								
Equipment/tools								
Harvesting & bags								
Storage cost								
Transport cost								
Total								

63. Revenue:

Item	Type of crop							
	1 maize	2 Paddy	3 sorghum	4 cassava	5 millet	6 potatoes	7 beans	8 others
Total output (units produced)								
Units stored / consumed								
Units sold								
Price per unit								
Value								

64. Out of crop produce which one did you sell, amount and at what price in the last two seasons.

Crop	2007 sacks/kg	Price sacks/kg	2008 sacks/kg	Price sacks/kg

I: Marketing of farm products

65. Is the market of your produces feasible? 1 = Yes 2 = No ( )

66. If No, what are the causes? .....

67. Is food available in your market? 1 = Yes, 2 = No ( )

68. Are the prices affordable? 1 = Yes, 2 = No ( )

69. If no why? 1 = expensive, 2 = fluctuating of food prices, 3 = others ( )

70. What has been the price trend of farm produces for the last three years? 1 = Increasing 2 = Decreasing 3 = fluctuating ( )

71. From above, if it is increasing/decreasing, why? 1 =Few/many buyers in the market, 2 = Low supply/high production, 3 = High/low demand, 4 = Others ( )

72. How far is the selling point from your homestead? ..... km

73. How long it take to reach to the market where you sell and buy your product.....hrs

J. LIVESTOCK PRODUCTION

74. Indicate livestock number you own and objective of keeping

Type of livestock	Number	Objectives	Estimated price per head
Cows			
Oxen/ Bull			
Goat			
Sheep			
Pigs			
Donkey			
Poultry			
others			

75. Do livestock help you in case of severe food shortage? 1 = yes 2= No.

76. If yes in what ways 1.....2.....3.....

K. FOOD SECURITY INFORMATION

77. Do your crop harvests or money you get sustain the household to next harvest? 1= yes, 2 = No.

78. If no, what strategy do you use to enhance food availability in your household .....

79. How many times per day do you eat food? 1 =Once 2 = Twice 3 =Thrice 4 = Other ( ).

80. Have you ever experienced food deficit since 2005 to date? 1= yes, 2= No

81. If yes at what level? 1=highly, 2= moderately, 3 = not known.

82. At which time in the year do food shortages of any kind commonly occur?.....

83. How do you compare the nutritional level of under fives/ pre-school age children? 1 = Improved, 2= constant, 3= declined ( )

84. What kind of strategies should be done to improve the contribution of cereal crops to household's food adequacy .....
.....

85. Comment on the general food security of your household.....

L. Miscellaneous:

86. Which of the following do you think causes variations in yields on your farm? 1 = Climate 2 = Price fluctuations of inputs and products 3 = Market feasibility, 4 =Others

87. Who normally controls the earnings from farm activities? 1 = Father 2 = Mother 3 = Both 4 = Other

88. Do women own land? ..... 1 = Yes 2 = No

89. If No, explain why? .....

90. Explain how you spend your money? 1..... 2..... 3..... 4.....

91. Under what conditions can women own land in this area?.....

92. In your opinions, what are the major constraints do you face in your crop production? a). Production (e.g. poor technology) 1..... 2.....3.....4.....

93. What should be done to improve food crop production in your village .....

THANKS VERY MUCH FOR YOUR CO-OPERATION.