THE ROLE OF DROUGHT TOLERANT FOOD CROPS IN FOOD AND NUTRITION SECURITY STATUS AMONG LOW INCOME HOUSEHOLDS IN KASIKEU DIVISION, MAKUENI DISTRICT- KENYA

BY

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DECLARATION

I JOYCE MUMBUA MUE, hereby declare that this dissertation is my original work and has not been presented for a degree in any other university.

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DEDICATION

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Acronyms

ACC	Administrative Committee on Coordination
AEZ	Agro-Ecological Zone
AMREF	Africa Medical Research Foundation
ASALs	Arid and Semi Arid Lands
DANIDA	Danish International Development Agency
DDS	Dietary Diversity Score
G/g	Grams
GDP	Gross Domestic Product
GOK	Government of Kenya
FAO	Food and Agriculture Organization
HA	Height -For-Age
HCDA	Horticultural Crop Development Authority
HH/hh	Household
FANTA	Food and Nutrition Technical Assistance
KARI	Kenya Agricultural Research Institute
KIRDI	Kenya Industrial Research and Development Institute
KDHS	Kenya Demographic and Health Survey
Kg	Kilograms
Km	Kilometers
MOA	Ministry of Agriculture
MOH	Ministry of Health
MoLFD	Ministry of Livestock and Fisheries Development

MoCFD	Ministry of Cooperative and Fisheries Development
NGO	Non Governmental Organizations
NHCS	National Centre of Health Statistics
ODA	Official Development Assistance
RDA	Recommended Daily Allowances
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
SCN	Standing Committee on Nutrition (of United Nations)
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WA	Weight -For-Age
WH	Weight -For-Height
WHO	World Health Organization
WMS	Welfare Monitoring Survey

Operational definitions.

Dietary Diversity -is the sum of the number of different foods or food groups consumed by an individual or household over a specific time period

Food security -When all people at all times have both physical and economic access to sufficient and good quality food to meet their dietary needs for productive and healthy life (USAID, 1992)

Food availability- A condition when sufficient quantities, necessary types of food from domestic production, commercial imports or donors are consistently available to individuals or are within reasonable proximity to them or are within their reach (USAID, 1992)

Food accessibility. A condition when households have adequate incomes or other resources to purchase or barter to obtain appropriate levels of foods needed to maintain consumption of and adequate diet/nutrition level (USAID 1992)

Food poverty incidence -Refers to those whose expenditures on food are insufficient compared to the FAO/WHO recommended daily allowances of 2250 calories per adult as per WMS III.

Chronic food insecurity- continuously inadequate diet caused by the inability to acquire food.

Coping strategy/mechanism- The methods which households employ to deal with food inadequacies in crisis e.g. making greater use of wild foods, selling assets, migration

Consumer unit- It is the nutrient requirement of an individual as a ration of the requirement of an arbitrarily chosen person (nominal adult male) whose requirement is equivalent to one and the rest is expressed as a fraction of it (WHO/FAO/UNU, 1985).

Drought tolerant crops- Crops that can withstand water stress to some degree and relatively produce some yields.

Household- Defined as members of the same family eating from the same pot with the same head and not necessarily blood relatives.

Prevalence- The proportion of the population that has a condition of interest (e.g. stunting) at a specific point in time.

Permanent source of income- steady monthly salaried form of employment or stabilized business

Vulnerability- The extent to which an individual, household, community, socio-economic system is likely to be affected by a foreseeable bad event.

Quantitative data- Numerical observations or measurements

Qualitative data- Observations that are categorical rather than numerical, such as attitudes, intentions and perceptions.

ABSTRACT

Makueni district experiences chronic food insecurity and is ranked the highest in food poverty incidences (71%). Over the past five years, various stakeholders have put some efforts to improve household food security by promoting the growing and utilization of drought tolerant food crops in the district. The purpose of this study was to establish whether growing and utilisation of drought tolerant food crops enhances food and nutrition security in Arid and Semi-Arid Lands.

A descriptive cross-sectional study was carried out among low -income households in Kasikeu division, Makueni district in August and September 2004. The study focused on growing and utilization of cowpeas, pigeon peas, cassava, millets and sorghum because they were the major drought tolerant food crops grown in the area.

Two hundred and sixty (260) low-income households were randomly selected and interviewed. A pre-tested structured questionnaire was used to collect both quantitative and qualitative data. Nutritional status of children aged 6 to 59 months was determined to serve as an outcome indicator of household food security. Qualitative information on growing and utilization of drought tolerant food crops was obtained through focus group discussions. Data on household food consumption was collected using a three–day food list recall method and food frequency questionnaire. Household dietary energy and protein intakes were calculated and compared to the recommended intake per consumer unit.

The study established that 96.2% of the households were food insecure as they did not have adequate food through the year. Nevertheless, the three-day food record showed that 75.8% and 87.2% households met their Daily Recommended Allowance for energy and protein respectively. Though each household grew at least a few of the drought tolerant food crops, the crops did not play a significant role in the household food and nutrition security as they contributed only 8.5% and 21.7% of the caloric and protein intake respectively. However only protein adequacy was positively influenced by amount of calories from drought tolerant food crops among other factors.

The level of malnutrition was high among the children less than five years of age. Stunting was at 26%, underweight 15.1% and wasting 7.5%. Production and consumption of drought tolerant food crops did not show any significant relationship with the nutritional status of the children.

The study concluded that drought tolerant food crops have not played a major role in food and nutrition security in the study area mainly due to low production and utilization. The over dependence on maize than on other crops still remain a challenge in the promotion of drought tolerant food crops. It is therefore recommended that the demand for these crops be created and increased in order to enhance their production. Further research should therefore focus on establishing factors leading to poor adoption, low production and consumption of the drought tolerant crops as well as how to increase utilization of the crops among the poor communities.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The world's population continues to increase at an alarming rate of 85 million per year. The growth is higher in regions characterized by poverty and malnutrition such as south Asia and sub-Sahara Africa where the per capita grain consumption is expected to further increase. Hence the world is faced with a challenge to produce food enough to feed 8 billion people by 2020 (FAO, 2001).

About 815 million people suffer from hunger and undernourishment in the world (FAO, 2001). In 1999-2001, 17% of the people in the developing world were malnourished. Over that period the absolute number of food insecure in the developing world increased from 780 to 798 million people (FAO, 2003) and nearly a half of the population in sub-Sahara Africa is living below the poverty line (FAO, 2001). The problem of food insecurity varies with countries. The largest absolute increases of undernourished are in south Asia and central Africa. The main cause of food insecurity has been recurrent drought, although wars and conflicts, lack of priority in agricultural policies and HIV/AIDS prevalence have also contributed. The rainfall is low, erratic and scattered in the semi-arid areas and this leads to frequent crop failure. To combat drought stresses there is need for production of drought tolerant crops such as sorghum and millets that can withstand water stress and provide food in times of drought (Devereux, 2001).

Most food in the world consists of cereals, followed by root crops, then legumes. About 550 million tonnes of roots and tubers are harvested annually, more than one quarter of

the world's total production of cereals (FAO/WHO, 1992). It is estimated that about 25% of the cereals harvested is lost through poor post-harvest handling, spoilage and pest infestation and 50% perishable fruits, vegetables and roots grown is lost. Hence post-harvest loses also contribute to food insecurity.

Roots provide for more than 1000 million people as staple food in the developing world. However they receive low priority unlike cereals or no priority at all in agricultural plans of developing nations. The most popular roots are cassava, yams and sweet potatoes, all of which are high in carbohydrates, calcium, and Vitamin C though low in protein and the Vitamin B complex. Another advantage of these crops is that they can grow in the tropics even under dry and infertile soil conditions and produce higher yields per unit area than cereals (FAO/WHO, 1992). Root crops also have the potential to provide more dietary energy per unit area than cereals and many other crops except sugarcane (FAO, 1990).

Millets are important cereals in Africa mainly in the semi- arid and sub-tropics. Millet production areas coincide with where most of the poor live in Africa. This has a significant coincidence as it does have socio-economic, food, health and environmental impact on the resource poor people of Africa (FAO, 1988). It also has importance in strategies for responding to needs and welfare of the poor including food security, nutrition and health, poverty alleviation, potential markets and dry environment enhancement.

Agricultural research during the green revolution developed varieties mainly for rice, maize and wheat. These varieties had much higher yields per hectare than the old varieties and took shorter periods between planting and harvesting. However, these varieties required irrigation or a lot of water. The high input use such as fertilizers, pesticides and herbicides is not economically feasible for most poor farmers especially those in marginal areas. Hence agricultural research has attempted to focus attention on the marginal areas, where most of the poor farmers live, and developed some crop varieties suitable to the environmental conditions in those places. Some of the crop varieties developed include sorghum and millet that are drought, salinity, disease and pest tolerant.

1.2 Problem Statement

Makueni district is among the arid and semi-arid lands (ASAL) of Kenya. The district experiences chronic food insecurity, which is mainly associated with unreliable rainfall patterns, declining soil fertility, marketing problems and lack of capital. The district also ranked the highest in the country with food poverty incidence (71%) according to the ranking of districts by food poverty as per WMS III (GOK, 2000) despite many years of efforts by the government and development agencies to promote production and utilization of drought tolerant food crops in ASALs. While the district has high potential for growing drought tolerant food crops such as millets, cassava and sorghum the practice seems abandoned and mainly maize and beans are grown. The drought tolerant crops do well on poor soils and do not require intensive management as compared to the exotic crops.

The majority of the people subsist on a traditional diet primarily consisting of maize. However maize production has declined over the past years following recurrent droughts. Furthermore, a substantial amount of the maize that is produced is lost through post harvest losses associated with pest infestation mainly due to the greater grain borer. In addition, a good portion of the maize produced is sold to provide family income due to lack of alternative cash crops or opportunities for income generation. As a result, many people depend on the government and other organizations for provision of relief food and seeds for planting. This is not a sustainable solution and household food security has persisted in the area.

1.3 Justification of the Study

Development agencies such as Danish International Development Agency (DANIDA), International Fund of Agricultural Development (IFAD) and the Kenya government continue to promote the production and utilization of drought tolerant food crops in ASAL areas of Kenya in the hope that this will reduce household food insecurity. This comes from the premise that production of exotic crops such as maize has substituted the growing of these crops that for a long time were the backbone of household food security.

New food products for such crops as cassava and better ways of processing the drought tolerant food crops have been developed and demonstrated to farmer groups, women groups and school children in the study area. As a result, it is expected that households in this area have adopted production and utilization of traditional food crops such as cassava, millet, sorghum and sweet potato. This adoption should lead to enhanced food security at household level in the households that grow the drought tolerant food crops.

The area of study, Kasikeu Division, has been chosen because it is one of the divisions that most benefited from the promotion of growing of drought tolerant food crops compared to other divisions in the district. This initiative has in the past received considerable funding but evidence of enhanced household food security is scanty. There is therefore need to elucidate information to justify continued efforts by the government and other stakeholders in supporting and promoting the growing and consumption of drought tolerant food crops or to change strategy.

1.4 Objectives

1.4.1 Aim of the study

The aim of the study was to contribute towards improving household food and nutrition security among low-income households in Arid and Semi-Arid Lands (ASALs).

1.4.2 Purpose of the study

To assess the growing and utilization of drought tolerant crops in ASALs where this has been promoted and whether enhances household food and nutrition security.

1.4.3 Main objective

To determine the growing and utilization of drought tolerant food crops and their role in food and nutrition security status among low-income households in Kasikeu division, Makueni district.

1.4.4 Specific objectives

(i) To assess the socio-demographic characteristics of the study households.

(ii) To determine the types and level of production of drought tolerant food crops grown in the study households.

(iii) To determine how drought tolerant food crops are utilized in the study households.

(iv) To determine household food consumption patterns in the study area

(v) To determine household dietary energy and protein adequacy and proportion contributed by the drought tolerant food crops.

(vi) To establish periods of household self-food sufficiency and household coping mechanisms employed during food shortage.

(vii) To determine the nutritional status of children aged 6 to 59 months in the study area.

(viii) To establish the association between production and utilization of drought tolerant food crops, on one hand, and household food self-sufficiency, nutrient adequacy and children's nutritional status, on the other hand.

1.4.5 Hypothesis

Growing and utilization of drought tolerant food crops among low-income households in Kasikeu contributes significantly to their in food and nutrition security.

1.4.6 Research questions

(i) Are the households in Kasikeu growing and utilizing drought tolerant food crops and does this translate to food and nutrition security?

(ii) What is the level of production of the drought tolerant food crops?

(iii) How are the drought tolerant food crops utilized?

(iv) What proportion of household dietary energy and protein intake is contributed by drought tolerant food crops?

(v) What is the role of drought tolerant food crops in houschold food-self sufficiency?

(vi) Is there association between production and utilization of drought tolerant food crops, household food self-sufficiency, nutrient adequacy and nutritional status?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Concept of Food Security

Food security is often defined as access by all people at all times to sufficient good quality food for healthy and active life (USAID, 1992). It is of supreme importance in improving the nutritional status of many millions of people who suffer from persistent hunger and undernutrition. The definition encompasses three main aspects namely availability, accessibility and utilisation of food.

Aggregate food availability means that sufficient quantities of appropriate, necessary types of domestically produced food and commercial imports or food aid are consistently available to individuals. To nourish household members adequately there must be sufficient quantity and variety of food quality and safe food in the household vicinity through the year, and year after year. Hence the need for the household to be able to produce or procure the food its members require for health and active life.

Individuals have access to food when they have adequate incomes or other resources to purchase or barter to obtain levels of appropriate foods needed to maintain an adequate diet (USAID, 1992). Food access depends on the ability of households to obtain food from purchases, gathering, current production, from friends or relatives, government or donors or stocks. A household 's access to food also depends on the resources available to individual household members and steps they may take to utilise those resources.

Adequate food utilisation is achieved when food is properly used, proper food processing and storage techniques are employed, adequate knowledge of nutrition and childcare techniques exits and is applied, and adequate health and sanitation services exist (USAID 1992). Utilisation includes food or dietary intake and health factors that influence the household members' health status. Improved nutritional status affects health and survival of household members' labour productivity and household income earning potential.

Food availability, access and utilisation can be assessed at national, regional, and community, household or individual levels. At national level food security entails adequate food supplies through local production, storage, food imports and food aid. However adequate food availability at the national level does not necessarily imply equitable food distribution across the country or access among all households especially in the drought prone areas. Therefore, the need for attention to be paid to the household level since it is the social unit where most people gain access to food. In drought prone areas there is great need for growing and utilisation of drought tolerant food crops to ensure food security. This would ensure self-sufficiency, which is a natural route towards food security, a strategy through which the poor rural households can ensure food security (FAO, 1999).

Most of the food insecure socio-economic groups include the low-income farmers with limited access to financial resources and farm inputs and mainly live in marginal areas. Growing of drought tolerant food crops would assist them in generating household

income that in return would help them in accessing food to maintain consumption of an adequate diet.

2.2 Global Food Insecurity Status

Poverty and food insecurity are the twin challenge of the 21st Century along other issues such as HIV/AIDS, conflicts and disasters. The first millennium Development goal addresses extreme poverty and chronic hunger (ACC/SCN, 2004). Chronic hunger and poverty are rising in large parts of sub-Sahara Africa. The absolute number of food insecure in the developing countries increased from 780 million to 798 million from mid-1990s to 2000 (SCN, 2004). Many people lack adequate amount of foods that are rich in the nutrients needed for health and a productive life. Chronic under nutrition affected about 603 million people in sub-Saharan Africa between 1999 and 2001 i.e. 33 percent of the population (SCN, 2004). One billion people, approximately 20% of the global population, live in households too poor to obtain food necessary for sustaining normal work. One of every five persons in the developing world is chronically undernourished.

Protein-energy malnutrition (PEM), vitamin A deficiency, iodine deficiency disorders (IDD) and nutritional anemia are the most common serious nutritional problems in almost all countries of Asia, Africa, Latin America and Near East (ACC/SCN, 2004). About 300 million people are affected every year, and a much greater number are at risk of these deficiencies. Malnutrition increases people's vulnerability to infections, causing numerous deaths. The world has a challenge to increase food production supplies with limited natural resources in a manner that protects the soil, water and biotic resource base from which food must come. In the face of this bleak situation, major efforts are required

by national governments and the international community to reduce global food insecurity.

2.3 Food Security Status in Kenya.

Since independence Kenya has undergone a transition of shift from an era of controlled economy to a liberalized economy that has seen the country shift from a food secure to a food insecure nation. Until the late 70s food security was achieved through domestic production facilitated by specific food policies (SCN, 2004).

The Kenya population was estimated to be 30 Million people in 1999 with a growth rate of 3.9% per year (CBS, 2001). This rapidly expanding population has contributed to imbalances between the national demand for food and supply creating dependency on food imports and food aid. About 56% of the population lives below the absolute poverty line, hence not able to meet their daily basic needs such as food, shelter and health. The prevalence and incidence of food insecurity is more severe in the ASALs where people depend mainly on relief aid. It is estimated that the government spends US$ 40-50 million annually on famine relief and the figure is even higher when the support by NGOs is taken into account (MOA / MOLFD, 2004).

In the country about 11.5 million people (37%) were undernourished in 1999 to 2001 (FAO, 2003). The most affected parts were north eastern, coast and eastern parts of Kenya. The Kenyan Government policy on food security is to ensure that all people have access to sufficient and nutritious foods for healthy and productive life as indicated in the sessional paper on National Food Policy (GOK, 1994a).

The Agriculture sector in Kenya contributes about 26% to the Gross Domestic Product (GDP), about two thirds of all exports, and provides livelihoods to over 80% of the population. About 80% of the population lives in the rural areas and depends mainly on agriculture (MOA/MOLFD, 2004). The country's agriculture is predominantly of small-scale farmers found mainly in the high potential areas. Three-fourths of the small-scale farmers have less than two hectares of land and retain substantial amount of their production for home consumption.

Except in years of drought, Kenya has tried to maintain self-sufficiency in most food products through production and sustenance of strategic reserves. Food production especially of the main staple has been declining since late 1980s. This has mainly been due to recurrent droughts (MOA, 2003). Occasionally it has also been due to over dependency on maize and wheat as the main staple and industrial cereals. Generally these crops are drought intolerant and cannot grow well in arid and semi-arid lands within which 80 % of Kenya's land mass falls (KARI, 1998).

Great potential exists to increase food production and sustain self-sufficiency in Kenya. One of the methods is by promoting food crops such as cassava, millets, sorghum and cow peas that are relatively drought tolerant and can be grown widely in the ASALs. The production of these crops has diminished over the years being replaced by maize, which is more dependent on regular rainfall (MOA, 2003).

As a result of declining production and increased demand for food, the national average per capita supply for calorie supply also has declined in the last decade. About 56% of the population live below the absolute poverty line hence not about to meet their daily basic needs (GOK/UN, 2002). It is estimated that 81 % of Kenyans have calorie supply lower than 2960 calories per adult recommended daily allowance (WHO/FAO/UNU, 1985).

2.4 Causes of Food Insecurity

Food security is the product of many agro-ecological, socio-economic and biological factors. The USAID (1992) food security framework (see figure 1) highlights the three elements of food security namely availability, access and utilisation and their relationship to one another. At the apex of the model is food utilisation, which is linked to nutritional status. The framework suggests a hierarchy of causal factors that influence the three pillars of food security and ultimately nutritional status. Adequate food availability at the aggregate level is necessary but insufficient to achieve adequate food access at the household level, which in turn is itself necessary but not sufficient for adequate food consumption at the household level (Bonnard, 2001). Adequate access to food promotes sufficient dietary intake, combined with good health and childcare leading to achieve food security.

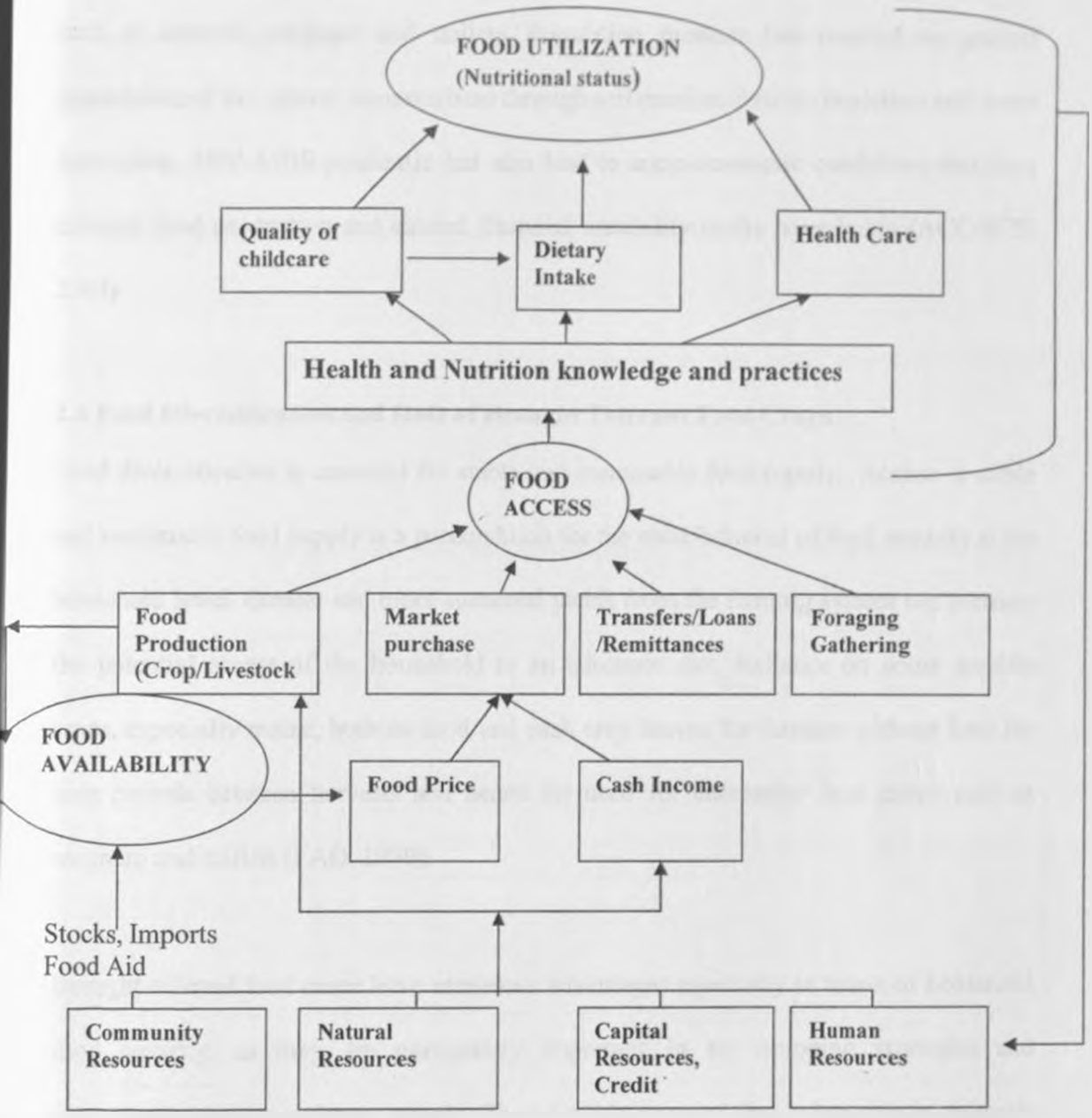


Figure 1. Food Security Conceptual Framework (Source: USAID, 1992)

In Kenya food insecurity has been as a result of: decline in production due to reduced land available for food crops, pricing and marketing inefficiencies, frequent drought and floods, poor governance in key institutions supporting agriculture and little emphasis and

support from government on production and utilization of drought tolerant food crops such as cassava, sorghum and millets. Population pressure has resulted on gradual degradation of the natural resource base through soil erosion, fertility depletion and forest destruction. HIV/AIDS pandemic has also lead to socio-economic conditions that have affected food production and caused financial instability in the households (ACC/SCN, 2004).

2.5 Food Diversification and Role of Drought Tolerant Food Crops

Food diversification is essential for stable and sustainable food supply. Access to stable and sustainable food supply is a precondition for the establishment of food security at the household level. Greater and more sustained yields from the farming system can increase the potential access of the household to an adequate diet. Reliance on some specific crops, especially maize, both as food and cash crop leaves the farmers without food for long periods between harvests and hence the need for alternative food crops such as sorghum and millets (FAO, 1999).

Drought tolerant food crops have numerous advantages especially in terms of household food security, as they are particularly important in the cropping strategies and consumption patterns of poor people. They provide a varied diet, often rich in minerals such as iron and calcium (see table 1), and they can be used to broaden the food base. Studies by KARI in Trans-nzioa have shown that sweet potato is commonly planted as a relay crop after maize and beans inter crop to provide food during periods of shortage mainly in March and May (KARI, 1998).

Some of the drought tolerant crops like cassava are hardy and can adopt to poor soils and different cropping systems. They require less labour, low inputs and yield more calories per unit land than any other crop. Cassava can be grown as a food reserve, left in the ground for up to two years and used as the main source of energy during lean times. Though generally characterized as a subsistence crop it is also a commercial crop as it is a raw material for starch production. This indicates that utilization of drought tolerant crops can improve the regular flow of a variety of different foods into the household throughout the seasons and enhance food security for household members.

Table 1: Energy, protein, calcium and iron content (per 100g) of some cereals, roots and legumes.

TYPE OF FOOD	ENERGY (kcal per 100g)	PROTEIN (g per 100g)	CALCIUM (mg per 100g)	IRON (mg per 100g)
Maize, white	357	9.1	45.8	45.8
Rice, white hulled	359	8.1	166.4	2.01
Millets	336	9.0	245.3	18.7
Sorghum whole grain	306.7	8.3	53.8	14.5
Cowpeas (dry)	333	21.7	146.9	11.8
Green grams	339	20.7	103.0	1.8
Pigeon peas	335	18.3	215.5	19.0
Beans (dry.)	347	17.6	237.5	48.1
Cassava, fresh	134	1.29	33.3	0.90
Sweet potato	131	5.6	35.4	2.7

Source: Sehmi, 1993

Drought tolerant crops can be grown to conserve soil and increase soil fertility, hence improving crop productivity. Grown as rotation crops between successive main crops, they have the advantage of reducing the build up of pests and diseases. When inter-planted, they may act as an ecological barrier to disease. By acting as ground cover,

traditional food plants also help to prevent soil erosion, reduce evaporation and suppress weed growth. The producers, mainly women, can increase their families' consumption and generate income by selling the surplus in local markets. Thus, they make more varieties of foods available to consumers at low cost. Generally, women use this income for improving the nutrition and welfare of their children.

Farmers in drought prone areas can plant different drought tolerant crops or several varieties of the same crop to obtain a more stable output. Hence the rural population can minimize their exposure to the risk of food insecurity by diversification. Diversification can also lead to increased food processing through the establishment and strengthening of small-scale agro-industries, which can contribute to the year-round availability and variety of micronutrient rich foods in rural and urban markets. Therefore strategies for food and dietary diversification at the community and household levels can maximize the availability of adequate amounts and greater variety of nutritious foods.

2.6 Coping Mechanisms of Food Insecurity.

In the ASALs farmers have developed coping strategies of food insecurity such as serial cropping, inter-cropping, mixed cropping, and variety selection and staggered planting dates. A close examination of inter-cropping techniques shows that farmers time their planting and arrange the spacing of crops to create complementarities in growth and canopy cover. In this way a continuous flow of food is produced; some crops are harvested green for early consumption and a crop such as cassava fills unavoidable gaps in food supply since it can be stored in the ground for some time (Devereux, 2001).

Under conditions of extreme food insecurity, households adopt different set of measures, which at times are threatening to their livelihood. In a number of case studies done in Africa, Corbett (1998) discovered a pattern of three discrete stages of strategies adopted by the rural people facing food crisis. First there was insurance mechanisms for example saving, then disposal of productive assets and lastly destination behaviour (distress migration). Strategies that have long last run cost are adopted first such as drawing down saving and calling on remittances. Then strategies with long run costs that are difficult to reverse are adopted later (e.g. selling household assets). Finally survival strategies such as migrating off the land reflect economic stress and failure to cope. People choosing hunger rather than selling key productive assets during famine in Western Sudan has been observed (Devereux, 2001). Other measures include attempting to maintain minimum levels of nutritional intake, reduction of the number of meals eaten, with particularly severe consequences on child nutrition, labour migration and the sale of bigger assets such as livestock and fields. This sequence of responses has been observed to occur in severely drought prone areas. Households facing food shortage are forced to trade off short-term consumption needs against long-term economic viability (See Figure 2).

In Kenya, between December and May, there is usually extreme reduction of food stocks; employment opportunities and income are the lowest. This leads to men mostly, engaging in seasonal migration, to towns, other bigger farms for example tea farms or other centres, where they can find job opportunities (Narayan, et al, 1995). Another means of coping is dependence on relief food, or programmes introduced as interventions in schools, hospitals and at community levels. Other mechanisms may include gathering of

wild fruits, vegetables or insects or sending children to live with their relatives (Devereux, 2001).

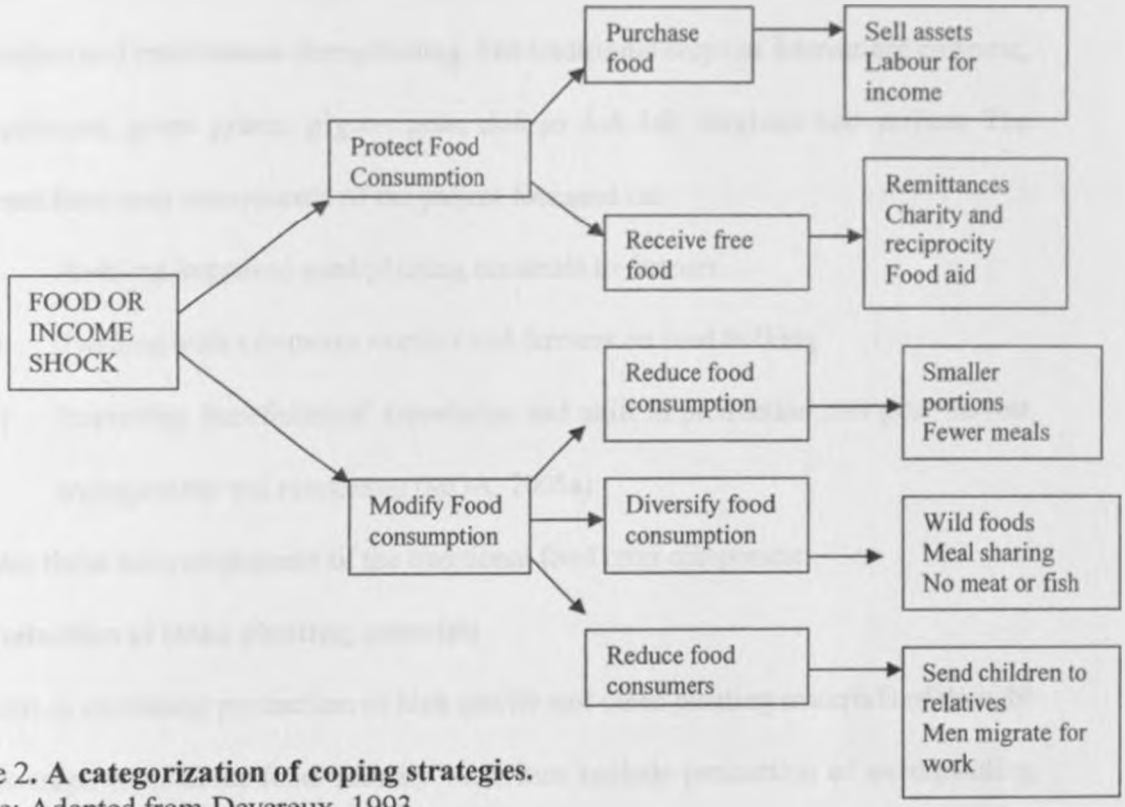


Figure 2. **A categorization of coping strategies.**
Source: Adapted from Devereux, 1993

2.7 Efforts Employed to Promote Drought Tolerant Food Crops.

The government of Kenya, through the ministry of Agriculture in collaboration with Horticultural Crop Development Authority (HCDA), KARI and other NGOs has in the past promoted production and utilization of drought tolerant food crops. An example of such effort is the Eastern Province Horticulture and Food Traditional Food Crops Project that was started in 1996 in Eastern Province within eight districts namely; Machakos, Makueni, Meru South, Meru Central, Meru North, Mbeere, Tharaka and Embu.

The overall goal of the project is to increase the income of smallholder farmers and ensure food security through increased production of smallholder horticulture and drought tolerant food crops. The project consists of five components namely; Horticulture Development, Traditional (drought tolerant) food crops, local initiative fund, project coordination and institutional strengthening. The traditional crops of interest are cowpeas, sweet potatoes, green grams, pigeon peas, *dolicus lab lab*, sorghum and millets. The traditional food crop components of the project focussed on:

(i) Availing improved seed/planting materials to farmers

(ii) Training both extension workers and farmers on seed bulking

(iii) Improving beneficiaries' knowledge and skill in production and post harvest management and marketing (MOA, 2005a).

There are three sub-components of the traditional food crop component:

(a.) Production of clean planting materials

This aims at increasing production of high quality and clean planting materials of drought tolerant crops to enhance food security. Activities include production of seed/planting materials, procurement and distribution of planting materials for bulking purposes, training staff and farmers on agronomic and post harvest practices, setting up and carrying out crop demonstration.

(b.) Support to processing

This aims at assessing existing processing technology to determine appropriateness of small-medium scale food sector processing equipment, liase with the Jua kali/private sector for replication of prototypes and training of staff and/or farmers. Processing equipment for dehulling, milling and grinding cereals, pulses and tubers have been

installed in four districts namely; Tharaka, Makueni, Meru Central and Machakos for demonstration purposes.

(c.) Product promotion

This sub-component is aimed at popularising the products of drought tolerant food crops mainly through trainings and demonstrations either in schools, shows, hotels, farmer groups, women groups or church groups. In the year 2003/2004, 6721 schools, 3635 markets places, 262 women group leaders, 3304 women groups, 73 hotels and 8623 farmers in the province had been reached and trained on product development and utilization of these crops (MOA, 2005b).

In Makueni district, the project is operating in six divisions namely Kibwezi, Mbitini, Kasikeu, Kilungu, Mbooni and Kisau. The target groups are farmers' groups, pupils/students, teachers and entrepreneurs. Achievements to date include staff and farmers training on seed bulking and agronomic practices, distribution of assorted seed/planting materials to farmers, training of trainers and development of recipe manual of traditional food crops (see Tables 2 and 3). In addition, a processing plant (dehuller and miller) was established in Kasikeu division in 2002. Table 4 shows that in the year 2002/2003, over ninety percent of the milling and dehulling was mainly for maize other than for the drought tolerant food crops. It is thought that the main constraints experienced by the project are inadequate harvests leading to consumption of the seed intended for bulking at household level, inadequate low materials for the processing plant, low market prices for these crops and lack of farm inputs.

Table 2: Quantity of seed/ planting material distributed to farmers in the project area, Makueni District

	Amount of seed produced (KG)			
CROP	**1996**	**2001**	**2002**	**2003**
Cowpeas	789	4755	4667	4050
Sorghum	6960	5150	3000	4950
Green grams	426	-	1465	1260
Millets	3278	-	265	-
Sweet potatoes	-	300(cuttings)	-	-
Pigeon peas	95	-	-	540

Source: MOA, 2005a

Table 3: Activities achieved by the project in Makueni District from 1996 to May 2005

Activity	Number of demonstrations/trainings	Number of people reached
Product promotion of drought tolerant food crops in school	81	12,840
Product promotion of drought tolerant food crops in school	231	6840
Market exhibitions of crop products	14	3177
Farmers field days	9	2554
Training of trainers (farmers)	2	38
Staff training of trainers	1	10
Participation in agricultural shows	Every year (District, provincial and national level)	-

Source: MOA, 2005a

Table 4: Percentage of cereals, legumes and roots processed during the year 2003/2004 in the processing plant, Kasikeu Division.

Crop	Percentage milled	Percentage dehulled
Maize	94.0	99.0
Millets	4.0	0.4
Sorghum	1.7	0.3
Cassava	0.3	0
Cowpeas	0	0.2
Green grams	0	0.1

Source: MOA, 2005b

KARI Katumani Agricultural Research Centre has a national mandate for soil and water management for ASALs and a regional mandate for adaptive dry land farming research in five districts, Machakos, Makueni, Kitui, Mwingi and Kajiado. The long-term goal is to ensure complete food security that can only be attained if the region became a net exporter of agriculture and livestock production. Over the years, Katumani research centre has majored on the development of improved crop varieties, development of agronomic packages for each variety, development of post harvest technology to add value to the crops, maintenance of breeder materials and bulking of improved varieties. The knowledge and the technology have been disseminated to extension workers and farmers through trainings and on-farm demonstration trials. Major crops of interest are millets, sorghum, cassava, pigeon peas, sweet potatoes and maize. Various varieties of cassava, sorghum, pigeon peas and sweet potatoes have been developed and released to farmers through the Ministry of Agriculture and other development agencies. The centre has also majored on product development from these crops and dissemination of the same to extension workers and farmers (KARI, 2001).

Over the years other NGOs such as German Agro action, Catholic Relief services, Makueni Agricultural project operating in the district have supported the efforts of the government by assisting farmers in accessing certified seed and planting materials from KARI Katumani centre (see Table 5 below). The seed is distributed to farmers in all the divisions through the Ministry of Agriculture.

Table 5: Amount of seed distributed to farmers in the districts by various development agencies

Year	1997 Amounts (KG)	2000 Amounts (KG)	2001 Amounts (KG)	Total Value (KSh)
1. GOK/Drought Recovery Programme				
Cowpeas	1000	-	2000	300,000/=
Sorghum	4000	-	24000	4,060,000/=
2. World vision				
Sorghum	-	1100	-	159,500/=
Pigeon peas	-	9300	-	930,000/=
Cowpeas	-	1000	1600	160,000/=
Green grams	-	25600	-	3,840,000/=
3. GTZ				
Millets	950	-	-	137,750/=
Sorghum	3150	-	-	452,400/=
Cowpeas	1600	-	-	160,000/=
Green grams	1200	-	-	180,000/=
4. German Agro Action				
Sorghum	25000	7100	-	4,654,500/=
Millets	-	5100	-	739,500/=
Cow peas	-	25,600	-	2,560,000/=
Green grams	-	25,600	-	3,840,000/=
5. Catholic Diocese of Machakos				
Sorghum	-	3000	-	435,000/=
Millets	-	-	-	
Cowpeas	-	6000	-	600,000/=
Green grams	-	-		
Sorghum	-	-		
6. Makueni Agricultural project				
Sorghum	-	382	-	55,390/=
Millets	-	572	-	82,920/=
Pigeon peas	-	586	-	58,600/=
Green grams	-	598	-	89,700/=
Cow peas	-	1145	-	114,500/=
7. AMREF				
Sorghum	-	-	13000	1,885,000/=
Millets	-	-	13000	1,885,000/=
Cowpeas	-	-	13000	1,300,000/=
Green grams	-	-	13000	1,950,000/=
		TOTAL		**30,629,760/=**

Source: MOA, 2003b

2.8 Gaps in Knowledge

As indicated in the previous sections, a lot of work on the promotion of drought tolerant food crops has majored in the development and dissemination of drought tolerant food crop varieties to farmers. New products have also been developed and disseminated to both staff and farmers at various levels with the aim of improving household food and nutrition security. However, little has been done to assess the role of these efforts in household food and nutrition security among the low- income households in ASAL areas.

CHAPTER THREE

3.0 STUDY SETTING AND RESEARCH METHODOLOGY

3.1 Study Setting

3.1.1 Study area and population

Makueni is one of the fourteen districts that form the Eastern Province. The district covers an area estimated to be 7440 km². It is divided into seventeen divisions, 62 locations and 187 sub-locations see the Map 1 (Appendix V).

The population of the district was estimated at 771,545 persons (CBS, 2001) with a growth rate of 3% per year. The average household size is 7-8 persons. More population is found on the high potential areas and in the urban centres. Kasikeu division has three locations and 8 sub locations. The total area of the division is 270.9 sq. kms with total population of 35,719 persons and a total of 6852 households (CBS, 2001).

3.1.2 Topography and climate

The district is generally low lying and rises from about 600 to 1900 meters above sea level. The rainfall received is erratic and ranges from 900 to1200mm per year in the hill-masses while the low-lying areas receive between 200 and 600mm per year. The rainfall pattern is bimodal with the long rain season being in March to May and the short rain season as from October to December. The temperature range is 18-35° C.

The district lies mainly within four Agro-Ecological Zones (AEZ) as shown in Table 2. About 63% of the total area is classified as ASAL and the rest as the hill masses. There are mainly three types of soils, sandy loam, sandy clay and pockets of black cotton soils.

Table 6: Agro-ecological zones of Makueni district.

Agro-ecological zone	Rainfall (mm)	Percentage of District Agricultural area	Main land use activity
Lower highland AEZII	1000-1400	20	Coffee, maize HB 511&512, beans, French beans, cabbages, kale, dairy
Upper midlands AEZIII	600-1000	30	Coffee, maize HB11, beans, cotton, pigeon peas, citrus, mangoes, sorghum, cassava, cowpeas
Lower midlands AEZ IV V	400-600	48	Horticulture, cotton, sorghum, millets, cowpeas, composite maize, citrus, mangoes, cassava, sweet potatoes, sunflower, fruits
Inner lowlands AEZ VI	Less than 400	2	Livestock rearing, maize, sorghum, pigeon peas, beans, cotton, sunflower, forests, cassava

Source: MOA, 1998.

3.1.3 Farming systems

About half of the arable land in the district is used for agricultural production. The average size of the land under cultivation ranges from 5 to 20 hectares in the low potential areas and 0.5 to 1.5 Hectares in the high potential areas (MOA, 2003a). The main farming system in the district is subsistence. Food crops grown include maize that is the main foodstuff, beans, cowpeas, pigeon peas, sorghum, millets, cassava and sweet-potatoes. KARI has developed drought tolerant maize variety 'Pioneer', mainly for drought prone areas such as Kasikeu division. In the hill masses coffee is grown as the main cash crop and zero grazing of cattle is practised. However, in the lower potential areas a number of livestock are kept, mainly indigenous breeds of cattle, sheep, goats, chicken and donkeys. The district has about six irrigation schemes where horticultural crops are grown.

3.1.4 Health and nutrition situation

Makueni district has 60 established health facilities. The most prevalent childhood illness in the district is malaria. Other illnesses include upper respiratory tract infection, skin diseases, intestinal worms, diarrhea, pneumonia and eye infections (GOK, 2002a).

On average the level of chronic malnutrition (stunting) in the district is 30% and infant mortality rate is 45/1000 live births (GOK, 2002a).

3.2 Study Methodology

3.2.1 Study design

A descriptive cross-sectional survey was carried out among 260 households between August and September 2004. The study consisted of a household survey and anthropometric measurements of children between 6 and 59 months of age in the study households. A pre-tested structured questionnaire was used as the survey tool (see Appendix 1).

3.2.2 Sample size determination

The sampling unit was the household. Fischer's formula (Fischer, et al, 1991) was used to calculate the sample size.

$n = z^2 pq / d^2$, where:

n= the desired minimum sample size

z= statistically certainty chosen at 1.96 corresponding to 95 % confidence interval

d= desired accuracy 6% (0.06)

p= estimated prevalence of stunting=32.9% for eastern province (CBS, *et al*, 2004)

q= 1-p

$n = Z^2 pq / d^2$

$n = 1.96^2 * 0.329*0.671/0.06$

$= 236$

10 % Attrition = 24 households

Hence n= 236 house holds + 10% (236)

n=260 households

3.2.3 Sampling procedure

The district of Makueni was selected purposively because it is chronically food insecure and also due to the fact that a number of stakeholders have been involved in the promotion of drought tolerant food crops in the district. Kasikeu division was chosen out of the seventeen divisions in the district because it is one of the divisions where a lot of work on promotion of the drought tolerant food crops had been done.

The division has three locations and Kasikeu location was selected purposively. Kasikeu location has three sub locations out of which three villages were randomly selected from each sub-location. With the help of the headmen of the chosen villages and the research assistants, a list of low-income households with at least a child aged between 6 and 59 months and growing drought tolerant food crops was developed for each village. This formed the sampling frame. Sample size per village was drawn randomly and proportionately from each village sampling frame. The low-income households were households that had no regular source of income or regular employment.

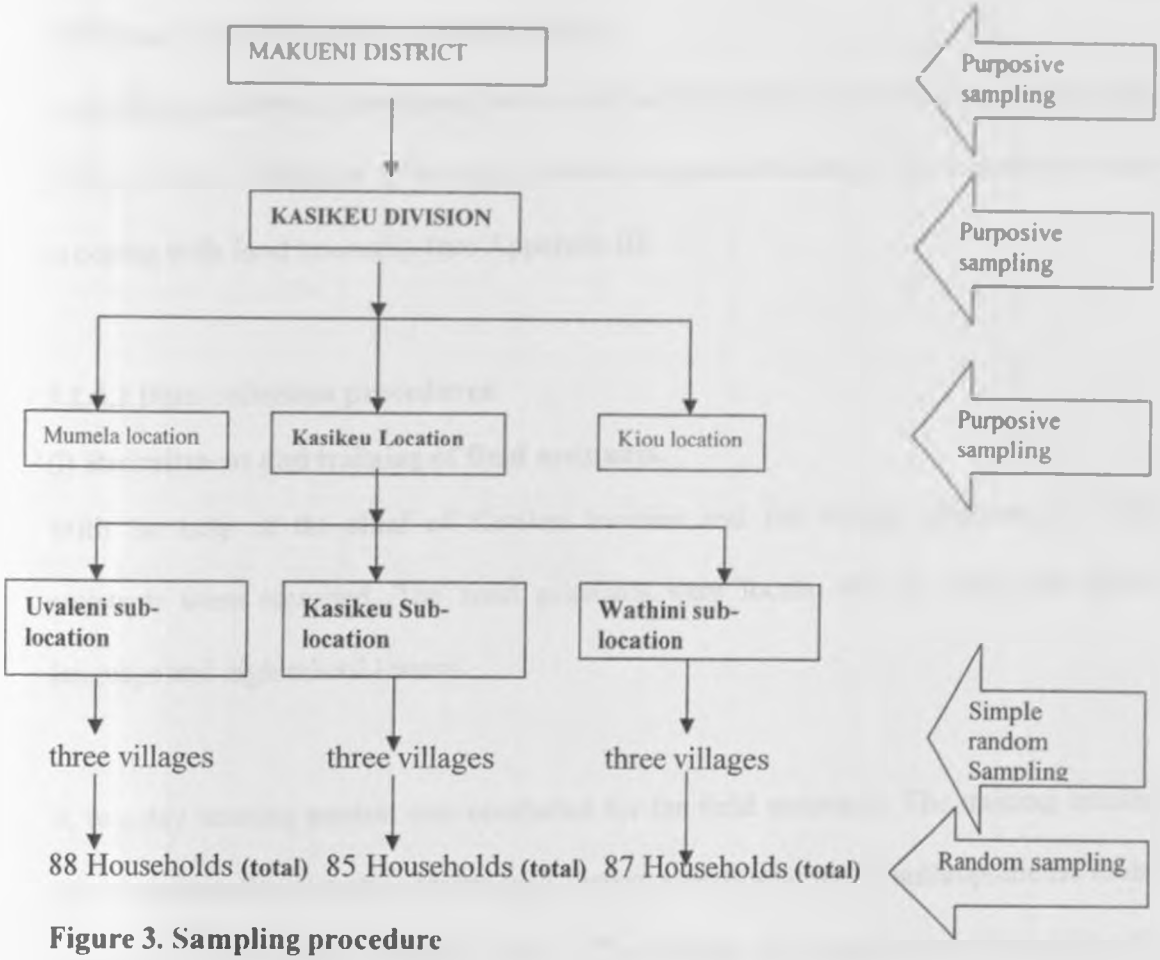


Figure 3. Sampling procedure

3.2.4 Data collection

3.2.4.1 Data collection tools

(i) Structured questionnaire

A structured questionnaire was designed, and pre-tested on 20 households in different households in the same villages and the necessary adjustments made. It was then used to collect both quantitative and qualitative data on demographic, socio-economic status, agricultural production, food consumption patterns and nutritional status of children aged 6 to 59 months (see Appendix I).

(ii) Focus group discussion question guide.

A question guide was developed that helped in collecting qualitative data on the crop production and utilization of drought tolerant crops and challenges the households faced in coping with food insecurity (see Appendix II).

3.2.4.2 Data collection procedures

(i) Recruitment and training of field assistants.

With the help of the chief of Kasikeu location and the village headmen, six field assistants were recruited. The field assistants were locals, able to speak the native language and high school leavers.

A two-day training session was conducted for the field assistants. The training entailed questionnaire administration techniques, dietary assessment, use of anthropometric tools / equipment and general working ethics. The training was also aimed at ensuring the enumerators had a similar understanding of the questionnaire and harmonized the interviewing process.

(ii) Pre-testing of questionnaire

The questionnaire was pre-tested with a small sample size of 20 households in one of the selected villages and the necessary corrections made before the main data collection.

(iii) Demographic and Socio-Economic data

Data on household composition, education level, marital status, occupation and residential status was collected by use of the structured questionnaire (see Appendix I).

Household income was determined by establishing how much was spent on food, school fees, clothing, farm inputs, wages medical care on either weekly, monthly or annual basis.

(iv) Agricultural data

By use of the structured questionnaire respondents provided both qualitative and quantitative data on crop production in terms of acreage under cultivation, yields and utilization of drought tolerant food crops. Secondary data on the same was obtained from the District and Divisional Agricultural offices.

(v) Food consumption data

Tools/equipment used in the collection of food consumption data included a structured questionnaire, weighing scales, cylinders, cups, plates and spoons.

A pre-market survey was conducted in the study area to determine the types of food sold in the area and the local units of measurements, after which a weight conversion table was developed to enable use of metric units (see Appendix IV).

A 3-day food list recall method was used in which the respondent was asked to recall all foods used by the household in the last three days preceding the study in terms of quantity, price and the characteristics of each food. This was used to assess the household energy and protein adequacy. The amounts of ingredients were estimated by use of household measures. The adequacy of the diet in terms of dietary energy and protein intake was calculated using consumer units in reference to adult male of 20-29 years

whose requirement is estimated to be 2960 Kcal and 50 grams of protein per day (WHO/FAO/UNI, 1985).

A food frequency checklist, which consisted of foods commonly eaten in the study area, was developed. The respondent was asked to indicate the typical frequency of consumption of each food item and any other that was not in the list. The food frequency checklist was used to determine the most commonly preferred foods in the study population.

Household dietary diversity score was computed from food items that were consumed three days preceding the study. All the foods consumed were grouped into 12 different food groups namely; cereals, root/tubers, vegetables, fruits, meat/poultry/offal, eggs, fish, pulses/legumes, milk/milk products, oil/fats, sugars and miscellaneous. The cereals group for example included maize, rice, wheat, millet and sorghum products. Each of the food group from which at least one of the food items was consumed was given a score of either "1" or a value of "0" if none of the food items in that food group were consumed in each household. The dietary diversity score per household was obtained by summing the scores of the different food groups consumed. The expected household dietary diversity score range was 0 to 12.

(vii) Nutritional status

The tools/equipment used in the anthromentric data collection included salter scale, plastic hanging pants, sisal ropes, and height/length boards. Athropometric measurements

of children between 6 and 59 months were taken to determine the nutritional status. The measures included weight and height. Dates of birth of the children were recorded for the calculation of age.

Weight measurement

The salter scales used for weighing the children were calibrated every morning by weighing an already weighed 1kg packet of maize flour to ensure validity of the measurements. Weight measurement was taken for one child in each household. Children who were ill on the day of survey were excluded from the exercise. In case of more than one child in the household, measurement of the older child were taken so as to capture the likelihood of the elder child being malnourished because of mothers' negligence due to the presence of a younger child.

Before weighing the child, the mother was requested to remove the child's shoes and heavy clothing leaving only light clothes. The child was placed in the weighing plastic pants that were then suspended from the hook of the salter scale that had already been zeroed with the empty pant. Two readings were taken for each child and the average calculated to the nearest 0.1kg and recorded as the child's weight. Where the two measurement readings had a difference greater than 0.5kg a part, a third reading was done and only the two that were within the 0.5kg difference range were used.

Height/length measurement

Length measurement for children below two years of age was determined by placing the child lying on its back on the measuring board placed in a horizontal position. The foot-rest was placed firmly against the child's feet so that they were perpendicular to the base of the board. The child's knees were pressed down together against the board and the footrest was moved firmly against the sole. With the help of two assistants, the child's head and body were properly positioned against the board. The child's length was read to the nearest 0.1 cm. The process was done twice, two measurements taken and the average of the two readings with a difference not greater than 0.5cm was calculated and recorded as the child's height.

For children above two years the board was used in a standing position. The child was made to stand bare footed on the flat sideboard, with their hands hanging freely, feet parallel to the floor and with heels, buttocks, shoulders and back of the head touching the upright measuring scale. The headpiece of the board was lowered gently such that it touched the crown and the head. The child's height was measured to the nearest 0.1cm. The process was repeated and the average calculated and recorded.

Determination of age of the children

Respondents were requested to produce clinic attendance cards or baptism cards to ascertain the dates of birth and ages of the children.

(viii) Morbidity data

Each respondent was asked whether the child had been sick in the last two weeks prior to the survey. If the child was reported to have been sick the mother was asked to describe the symptoms or type of the illness the child had suffered from, which was recorded.

(ix) Focus group discussion

Two focus group discussions were held. One group consisted of women and the other consisted of the headmen of all the involved villages. Each group consisted of twelve people. In both cases the groups were composed of some of the people growing drought tolerant food crops in large quantities, and others who grew less or few drought tolerant food crops. The discussion went on with the help of a moderator and a question guide. The main issues of the discussion included; major sources of income, crops grown, factors affecting agricultural production and coping strategies during food shortages. The assistant took note of all the proceedings. The results of the focus group discussions have been integrated in relevant sections of this dissertation.

3.3 Ethical and Human Considerations

Research permit was sought before the beginning of the research work. Prior to carrying out the survey, a visit was made to the District commissioner, Divisional officer-Kasikeu division and divisional Agricultural Extension officer (Kasikeu division) respectively to introduce the proposed study and to explain its purpose, objectives and activities.

A chief's "barasa" was held where all the headmen of the villages were informed of the proposed study and its purpose, objectives and activities before the commencement of the study. Consent was given by the administration.

During the data collection verbal consent was sought from the respondents before being interviewed. The respondents were also informed that the information was confidential. Questions raised by the community were also answered.

3.4. Data Quality Control

The researcher closely supervised the field assistants to ensure the data was accurately collected and recorded. The weighing scales were calibrated every morning to ensure accuracy and precision. Cleaning of the questionnaires was done daily which involved checking for any omission or irregular information.

3.5 Data Analysis

After completion of the survey all the open ended questions were coded. The data were entered and cleaned using the statistical package for social sciences (SPSS). Data on all foods consumed, harvested, purchased and received as gifts were translated into kilograms of edible portions and into calories and grams of protein per consumer unit using food composition tables for foods commonly eaten in Kenya (Sehmi, 1993). Consumer units for each household were calculated and expressed as proportion of the daily requirements of 2960 kcal/cu/day and 50 gm/cu/day for calories and protein respectively based on WHO/FAO/UNU (1985) recommendations. Household Diversity Score (DDS) was tabulated as the sum of scores obtained from different food groups consumed in each household in the three days preceding the study. A food group scored

"1" if at least one of the food item in that group was consumed or "0" if none of the food item in that group was consumed. For example if "Ugali" and rice were consumed the score for cereals was "1". The expected highest DDS was 12, while the expected lowest was 0. All variable frequencies were run and tabulated. The variables for each objective were defined and coded for ease of analysing the data. Frequencies, means, standard deviations, percentages were determined.

The children's weight, height and age data were converted into anthropometric indices namely weight-for-age (WA), weight-for-height (WH) and height-for-age (HA) using Epi info (Epi nut.). The National Centre for Health Statistics (NCHS) reference values were used to determine the nutritional status of the children (WHO, 1983). A child was considered underweight, stunted and wasted if WA, HA and WH, Z-scores respectively fell below –2SD. The cut off point for severe under weight, stunting and wasting was –3SD of WA, HA and WH Z-scores respectively.

To determine significant association between variables chi-square and correlation coefficient tests were used. After descriptive and correlation analysis of various variables that gave significant relationships were then entered into the multivariate analysis model (stepwise linear regression analysis) to show the contribution and influence of the selected independent variables on the outcome variables.

CHAPTER 4

4.0 RESULTS

4.1 Demographic Characteristics of the Study Population

4.1.1 Household size

Table 4.1 below shows some selected general characteristics of the study population. In the 260 households studied the total population was 1655 persons. Of these, slightly more than half were men. The household size ranged from 3 to 13 persons with a mean of 6.3 (± 2.2). The household size was clustered around 3 to 9 with few households having more than 9 persons. The dependency ratio of the study population was found to be 1.01.

Table 4:1 Selected general demographic characteristics of the study population.

Characteristics	number	percent
Total population in all the household	1655	100
Sex of household members		
Male	860	52.0
Female	795	48.0
Mean house hold size	6.3	
Mean age of head of household	39.1	
% Female-headed household	27	10.4
% Male-headed household	233	89.6
Marital status of household head		
Married household	225	86.5
Single	12	4.6
Separated	4	1.5
Divorced	2	0.8
Widow(er)	16	6.2
Concubine	1	0.4
% of under five years of age	405	24.5
% of study population less than 15 years of age	807	48.8

4.1.2 Ethnicity and marital status

All the residents of the study households were of Akamba ethnic group. Majority of the household heads were married while the rest were either separated, divorced, single or widowed. Most of the study households were male headed (see Figure 4 below).

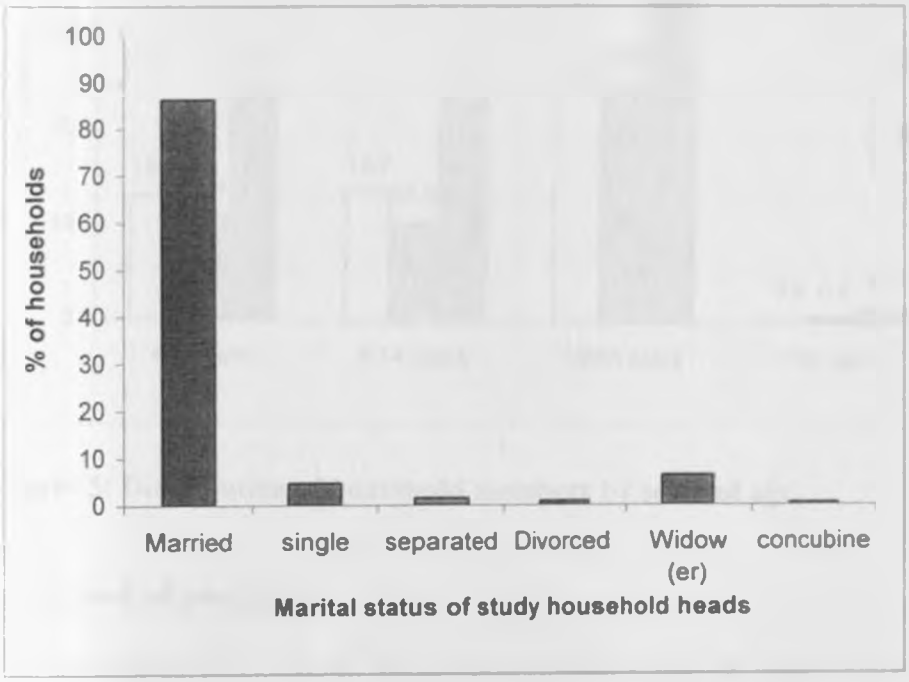


Figure 4: Distribution of study hh heads by marital status.

4.1.3 Age and sex distribution of the study population

Figure 5 below shows the distribution of the household members by age and sex.

The mean age of the study population was 19.8 (±17.0) years and ranged from 1 to 104 years. Nearly a half of the study population was below 15 years of age of which about half were children under fives years (see Table 4.1). The male: female ratio was 1: 0.92 with no great variations in the age categories except in 15-65 years age category where the ratio was 1:1.03 (see Figure 5).

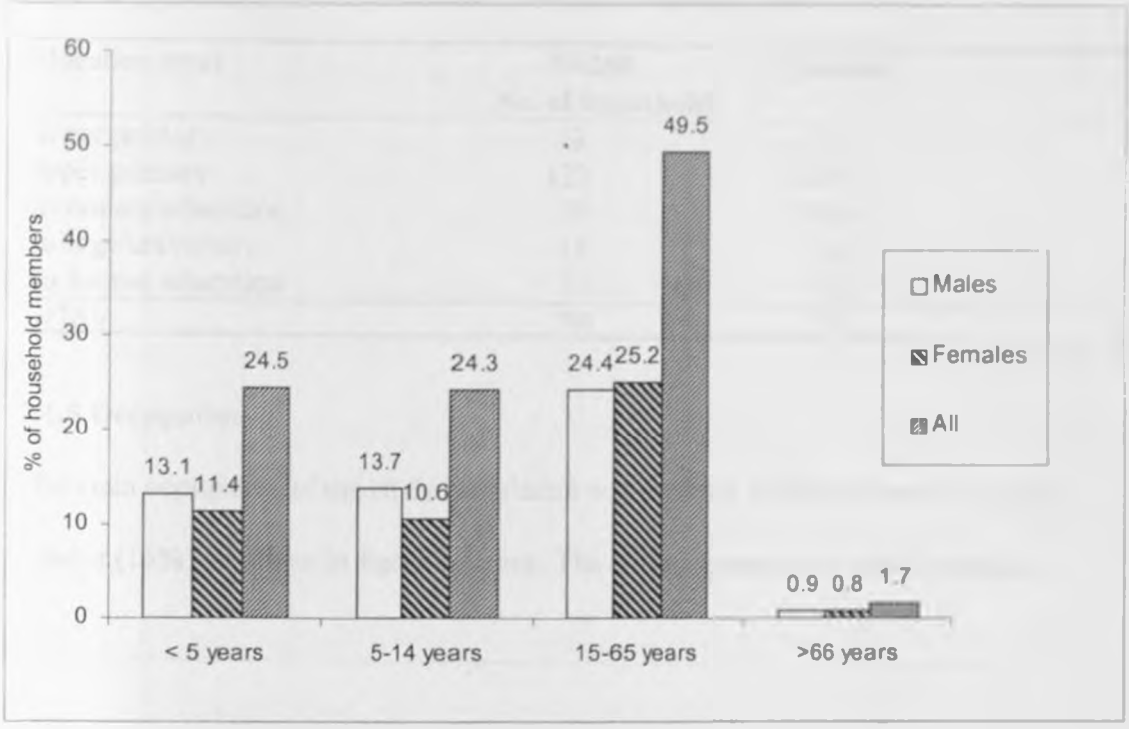


Figure 5: Distribution of household members by sex and age

4.1.4 Level of education

Three quarters (74.7 %) of the study population had at least received some formal education. Those who had not attained school enrolment age were 296 (21.8 %) while those who never attended school were 3.6% (See Table 4.2 below). Table 4.3 shows the distribution of household heads by education level. All, but 11(4.2%) of the heads of the households had received some formal education.

Table 4.2 Distribution of household members by education level

Education level	N=1655 No. of people	percent
Not Applicable	360	21.7
Pre-school	83	5.1
Lower primary	296	17.9
Upper primary	589	35.6
Secondary education	234	14.1
College/university	34	2.1
No formal education	5	3.6

Table 4.3 Distribution of household head by education level

Education level	N=260 No. of households	percent
Lower primary	33	12.7
Upper primary	122	46.9
Secondary education	79	30.4
College/university	15	5.8
No formal education	11	4.2
TOTAL	260	100

4.1.5 Occupation

The main occupation of the study population was farming (18%) followed by casual Labour (15%) as shown in figure 6 below. The student population was the highest.

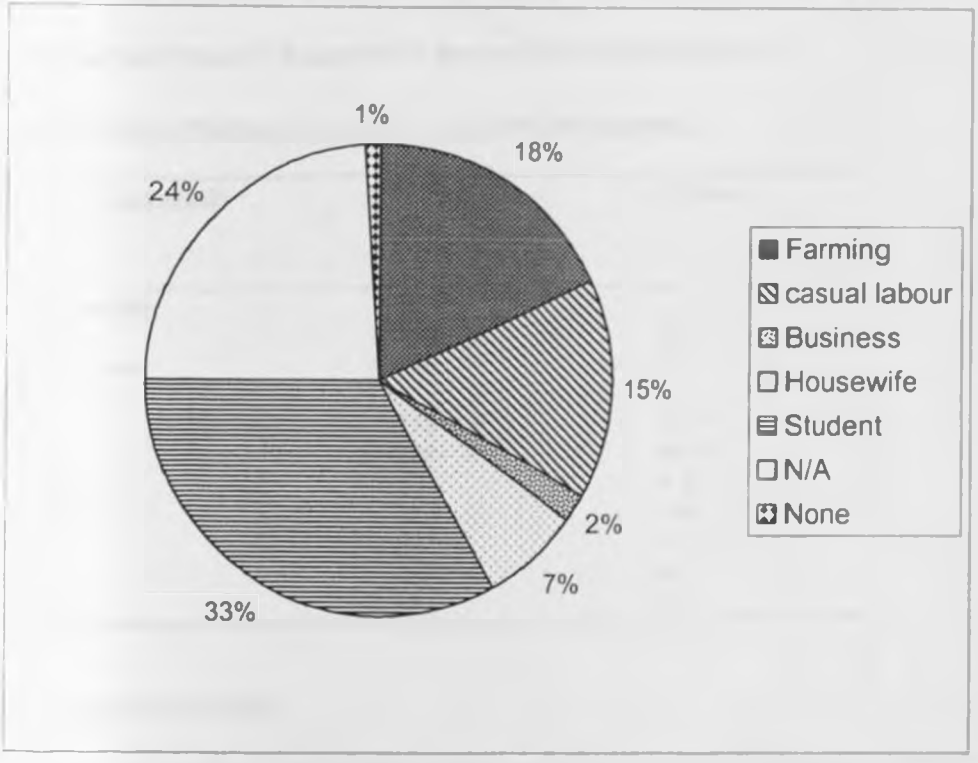


Figure 6: Distribution of the study population by occupational status

4.1.6 Residential status

Majority (91%)of the study population were permanent residents of the study area, while the rest were regular residents (8%) or away (1%) most of the time during the year.

4.2 Socio- Economic Characteristics

4.2.1 Housing

Table 4.4 shows the housing conditions in the study population. More than a half of the households had used corrugated iron sheets while the rest used grass for roofing. Majority of the households had mud wall while bricks was the second most used for making the walls and the rest used either concrete or wood. About two thirds of the households (65%) had earthen/soil floors while the rest had cemented floors.

Table 4.4 Distribution of study households by housing.

Housing materials	Number (N=260)	Percent
Type of roofing		
Iron sheet	150	57.7
Grass thatched	110	42.3
Wall		
Mud	135	51.9
Bricks	108	41.5
Concrete	16	6.2
Wooden	1	0.4
Floor		
Mud	169	65
Concrete	91	35

4.2.2 Land ownership

All the households under study owned land. The land size ranged between 0.5 to 10 acres with a mean land size of 3.0 (±1.91) acres and a mode of 3 acres. Seventy one percent of the households owned between 0.5 and 3.0 acres of land while the rest had more than three acres of land. Majority (91.2 %) of the study households did not rent any

land except for 8.8 % who rented land with a mean size of 1.2 (±0.73) and range of 0.5 to 3.0 acres.

4.2.3 Livestock ownership.

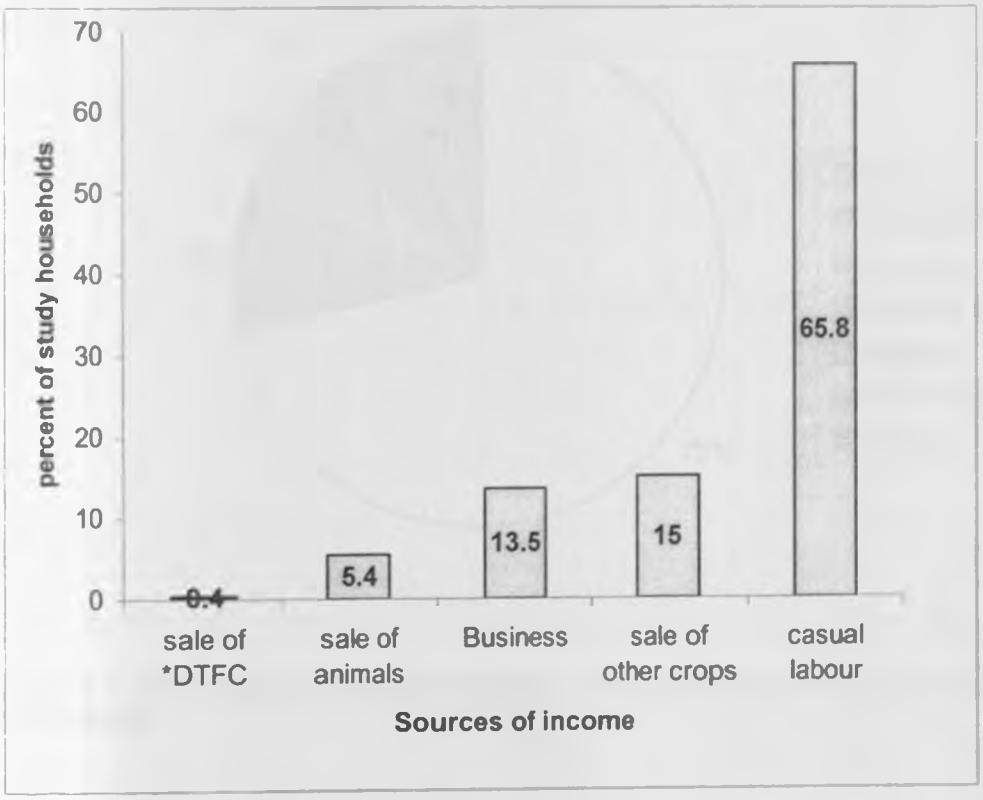
The livestock kept in the study area included cattle, goats, sheep, chicken and donkeys, all of local/indigenous breeds. Most households (98.8%) kept some livestock. Over 40 % of the households kept 1 to 2 cows mainly for milk production for home consumption while one third of the households kept 1 to 2 bulls for tilling land. Majority of the households kept goats mainly for sale and milk production and poultry for home consumption. A few households kept donkeys (see Table 4.5 below).

Table 4. 5 Distribution of study households by livestock ownership

Type of livestock	*Number of livestock*	*Percent of household N=260*
Cows		
None		51.1
1-2 cows	152	43.1
3-4 cows	52	5.8
Bulls		
None		60.5
1-2 bulls	152	35.9
3-6 bulls	35	3.6
Goats		
None		20
1-4 goats	332	47.3
5-8 goats	358	21.5
9-18 goats	318	11.2
Poultry		
None		6.2
10 or less	1153	80.3
11 Or more	570	13.5
Sheep		
None		73.2
1-4 sheep	124	22
5-8 sheep	71	4.4
Donkeys		
None		96.9
1 donkey	8	3.1

4.2.4 Main source of income

Results show that the main source of income in the study population was casual labour (65.8%), followed by sale of crops other than drought tolerant food crops, business, sale of animals and sale of drought tolerant food crops in that order (see Figure 7 below). The sale of the drought tolerant food crops contributed the least to the household income



*DTFC=Drought Tolerant Food Crops

Figure 7: Distribution of study households by sources of income

4.2.4 Income and food expenditure

Figure 8 shows that about three quarters of the monthly income was spent on food, while the rest was spent on school fees, clothing, medical care and wages in that order.

About 60% of the households had a total monthly income of 2000-5000 Kenya shillings, 25% had less than KSh.2000 while 15% earned above KSh. 5000. The mean monthly household income was 3356.30(±1766).

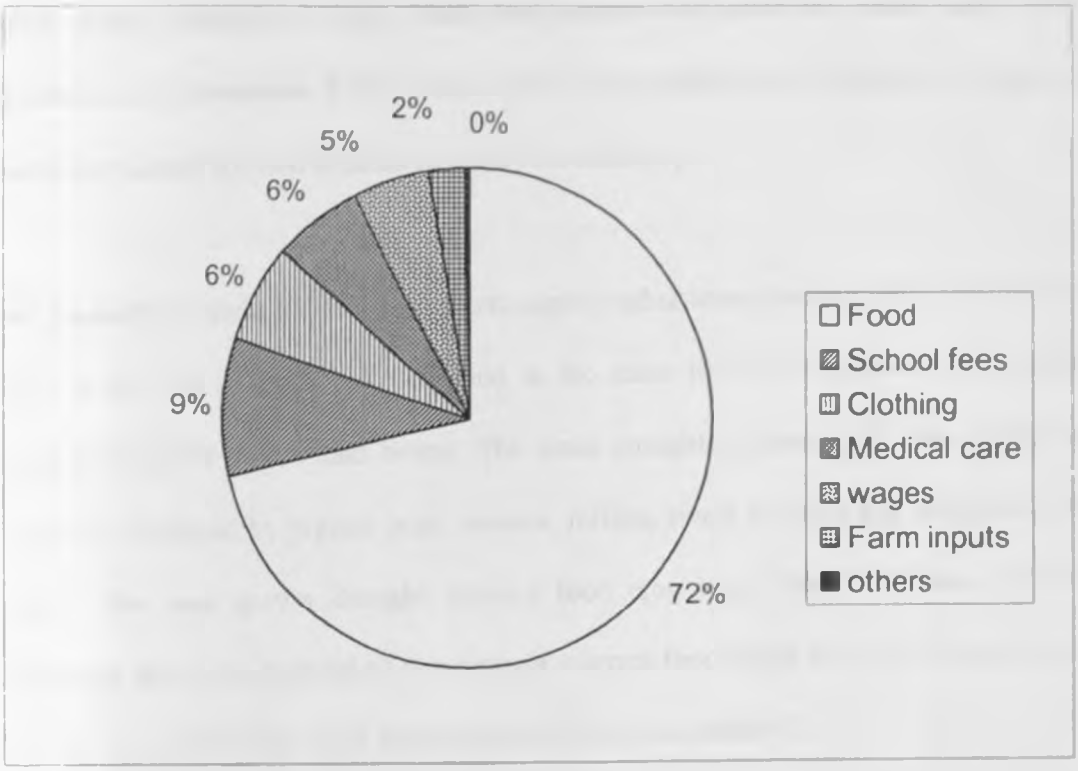


Figure 8: Distribution of household income among various uses in the study households.

4.3 Crop Production and Food Security

4.3.1 Land under cultivation

The total land size under cultivation in the study area was 442 acres with a mean land size of 1.7(±0.96) per household. Eighty five percent of the study households cultivated on a land size less than three acres.

4.3.2 Crop production

Table 4.6 shows the mean annual food crop production by the study population in season one (1) and season two (2) of 2003. Season one represents, the harvest after the long rainy season (March to May 2003) and season two after the short rainy season (November to December 2003). There was a highly significant difference between the mean harvests of the two seasons ($p<0.05$) for each crop.

All the study households practised intercropping subsistence farming where all the crops were grown on a small piece of land at the same time. The majority of the study households grew maize and beans. The main drought tolerant food crop grown was cowpeas, followed by pigeon peas, cassava, millets, sweet potatoes and sorghum in that order. The least grown drought tolerant food crop was "Njahi" (*Dolicus lab lab*). Generally the mean harvest of the drought tolerant food crops was low as compared to the harvest of the other crops like maize and beans (see table 4.6).

Table 4.6 Crop production year 2003

Crop harvested	Season I N=260		Season 2 N=260		t-test (p-value)
	% of h/holds	Mean harvest (kg)	% of h/holds	Mean harvest (kg)	
Maize	99.6	332.2(301.3)	93.5	194.7(269.2)	0.000
Beans	92.0	69.8(98.2)	81.5	33.4(38.9)	0.000
Pigeon peas	60.8	28.8(45.2)	53.8	22.2(31.4)	0.000
Cowpeas	86.5	25.6(28.2)	13.1	14.8(18.8)	0.000
Bean l	20.8	6.3(23.2)	13.1	2.4(8.3)	0.006
Dolicus lab lab	3.1	0.33(2.0)	6.2	0.59(2.3)	0.000
Millets	48.1	12.2(17.3)	42.3	8.3(14.2)	0.000
Sorghum	30.8	8.5(15.4)	32	7.3(15.1)	0.000
Cassava	50.8	106.9(635.3)	40	48.9(175.3)	0.012
Sweet potatoes	38.1	31.4(55.0)	23.8	13.1(26.0)	0.000
Pumpkin	34.6	54(92.7)	27.7	26.8(52.3)	0.000

*figures in parenthesis represent standard deviation

4.3.3 Utilization of crop harvest in the study population.

The Table 4.7 shows that much of the food harvested in the previous year (2003) was mainly used for home consumption. Other uses included selling or used as seeds.

Though the majority of the households grew crops mainly for home consumption, it was further revealed that about 23.3% of the households grew millets and sorghum specifically to provide supplementary food for children. While the harvest of drought tolerant food crops was low, generally a high portion was sold compared to maize and beans (e.g. pigeon peas, *Dolicus lab lab*, cassava etc).

Table 4.7 Utilization of crop harvest

Number of study households (N=260)				
	Mean harvest (Kg)	*Consumed %*	*Sold %*	*Seed %*
Maize	526.9(535.5)	85.2	11.4	3.4
Beans	101.5(122.7)	88.2	5.6	5.3
Pigeon peas	50.4(53.8)	87.5	9.9	2.6
Bean 1	8.8(28.2)	88.6	4.6	6.8
Cowpeas	39.5(43.8)	90.6	8.1	1.3
Dolicus lab lab	0.92(4.3)	54.3	45	0.7
Millets	17.1(25.9)	93.6	1.2	5.2
Sorghum	11.0(24.7)	94.5	1.8	3.7
Cassava	155.8(810.6)	58.3	41.7	0
Sweet potatoes	44.4(81.0)	68.2	31.8	0
Pumpkin	80.7(145.0)	77.4	22 6	0

*figures in parenthesis represent standard deviation

4.3.4 Knowledge of drought tolerant food crops

Majority of the study households (95.4 %) knew about drought tolerant crops, which included cassava, millets, sorghum c owpeas, pigeon peas, sweet potatoes, and "Njahi" (*dolicus lab lab*).

Over three quarters of the households indicated that they grew the drought tolerant food crops for home consumption; while the rest said it was because the crops were drought tolerant hence not prone to crop failure or because they require less inputs (see Figure 9). However, previous results indicate that more of the drought tolerant food crops harvested were sold.

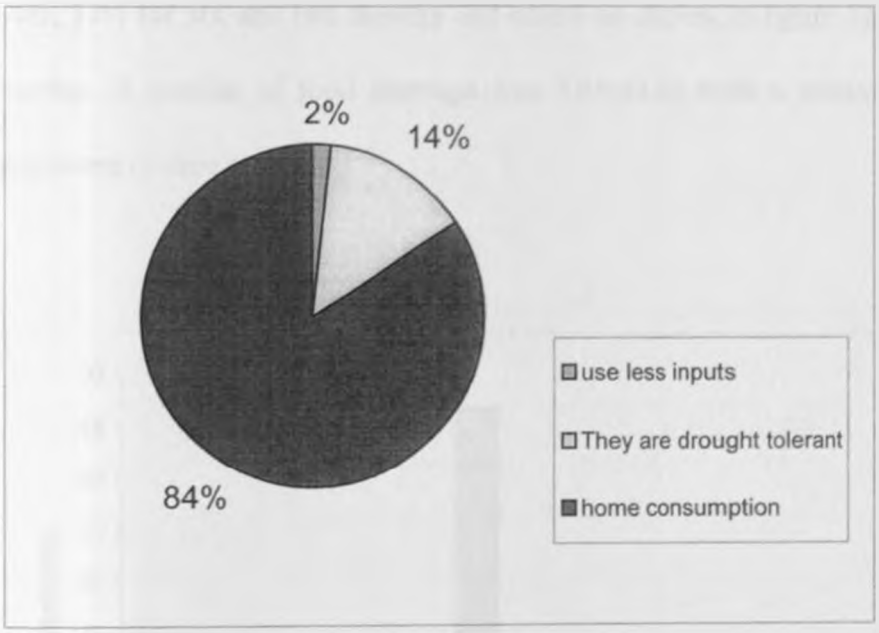


Figure 9: Distribution of study households by reasons for growing drought tolerant food crops

Most households (98.5 %) were found to preserve food after harvest. Majority (87%) preserved legumes and cereals by use of pesticides, 11.9% by drying and 1.2 % by smoking (only maize for seed). Root crops (cassava and sweet-potatoes) were mainly (64.6%) preserved by leaving them in the soil and harvested in piecemeal when needed or (35.4%) sun dried and stored, then ground into flour when needed.

4.3.5 Food availability

The main source of food for the majority (83.5%) of the study households was own production while only 16.5% mainly purchased their food. The vast majority (96.2%) of the study households indicated that they did not normally have enough food. About 47% indicated that they were food insecure for at least five months (September to January) per year, 17% for six and two months and others as shown in figure 11 below. The mean number of months of food shortage was 5.05(±1.8) with a minimum of two and a maximum of nine months.

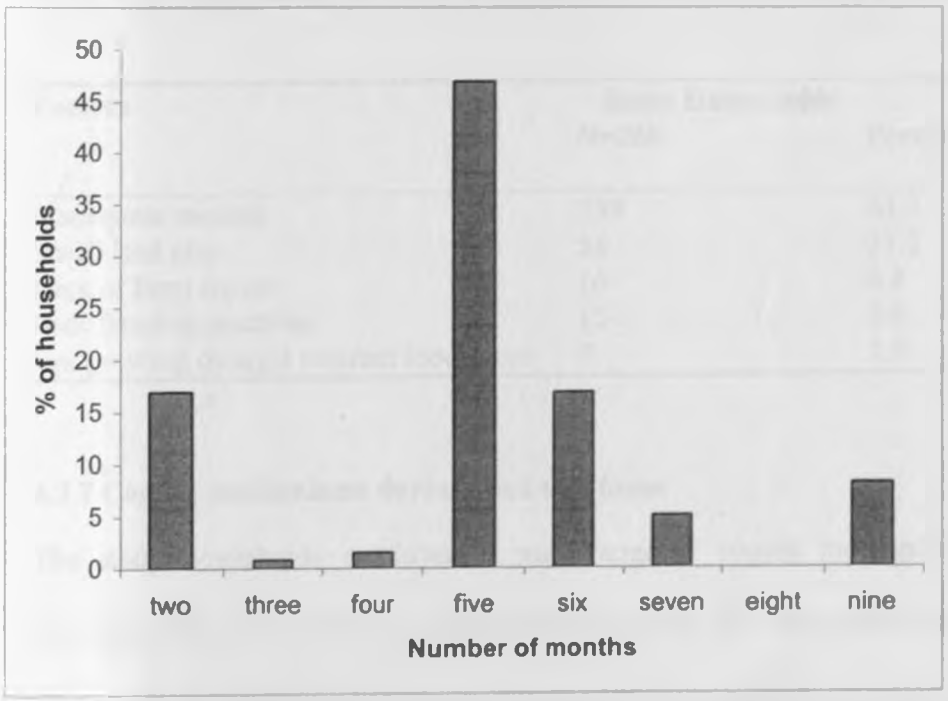


Figure 10: Distribution of study households by period (months) of food insufficiency

4.3.6 Factors affecting food production

Almost two-thirds of the study households attributed low yields to inadequate rainfall. Small land size accounted for 21.2% while a smaller proportion of the households cited lack of inputs, poor farming practices and not growing drought tolerant food crops in that order (see Table 4.8 below). Discussions from the focus groups reviewed the growing the drought tolerant food crops and especially millets was labour intensive hence the low production. In addition the small land size and unpalatable products from most of contributed to the low production.

Table 4. 8: Distribution of study households by factors affecting food production

Factors	Study Households N=260	Percent
Inadequate rainfall	159	61.2
Small land size	55	21.2
Lack of farm inputs	16	6.2
Poor farming practices	15	5.8
Not growing drought tolerant food crops	5	1.9

4.3.7 Coping mechanisms during food shortages.

The study households employed a wide range of coping mechanisms during food shortage. The most common mechanism was opting for cheap food especially starchy foods such as cassava and sorghum, one-quarter of the households reported to reduce the frequency of meals while others migrated to seek employment, sold assets, reduced meal size or bought on credit in that order (see Table 4.9).

Table 4. 9. Strategies employed to cope with food shortage by the study population

Coping Mechanisms	Study Households *n=250*	*Percent*
Opted for cheap foods such as sorghum	86	33.4
Reduce the frequency of meals	66	26.4
Migrate to seek employment	49	19.6
Sale of assets	26	10.4
Reduce meal size	18	7.2
Buy on credit	5	2.0

4.4 Food Consumption

4.4.1 Dietary patterns

Majority of the study households (91.1%) consumed three meals per day and the rest, two meals per day during normal times. While during times of food shortage less than a half of the households consumed three meals per day, and the rest two or one meal per day as shown in Figure 11 below.

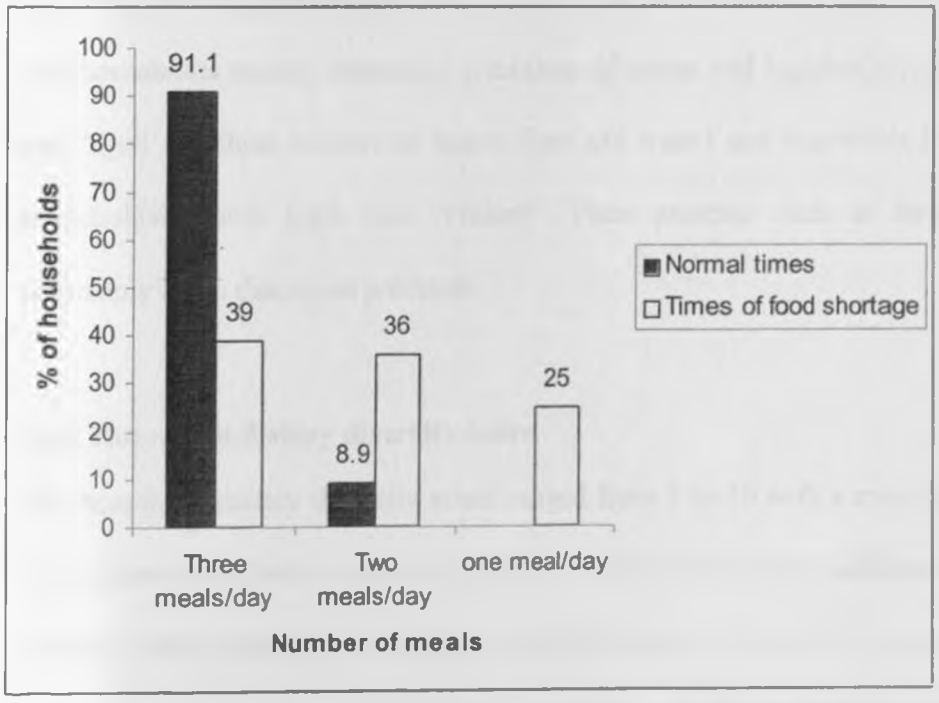


Figure 11: Distribution of study households by meal frequency

There was a significant correlation between the household number of meals taken per day and number of months of food shortage and protein intake (see table 4.10). However there was an association protein and calories from drought tolerant food crops though not significant.

Table 4.10: Correlation between number of meals per day and some variables

	Correlation coefficient with number of meals/day
Caloric intake	0.04(NS)
Protein intake	0.13*
Number of months of food shortage	-0.194**
Household size	0.022(NS)
Expenditure on food	0.02(NS)
Calories from DTFCs	0.299(NS)
Protein from DTFCs	0.253(NS)

* Significant at 1%
** Significant at 5%
NS-Not significant

Tea and leftovers from the previous day were the foods normally consumed for breakfast. The households mainly consumed a mixture of maize and legumes ("githeri") for lunch and "ugali" (a thick mixture of maize flour and water) and vegetables for supper. Most households' stable food was "Githeri". Plant proteins such as beans were more commonly eaten than meat products.

4.4.2 Household dietary diversity score

The household dietary diversity score ranged from 3 to 10 with a mean score of 6.50 (± 1.15). Most households consumed foods from either six or seven different food groups in the three days preceding the study as shown in figure 12 below. The household dietary diversity score had a negative significant correlation with the number of months of food

shortage. However, dietary diversity score had a positive correlation with the production and utilization of drought tolerant crops, though not significant (see table 4.11 below).

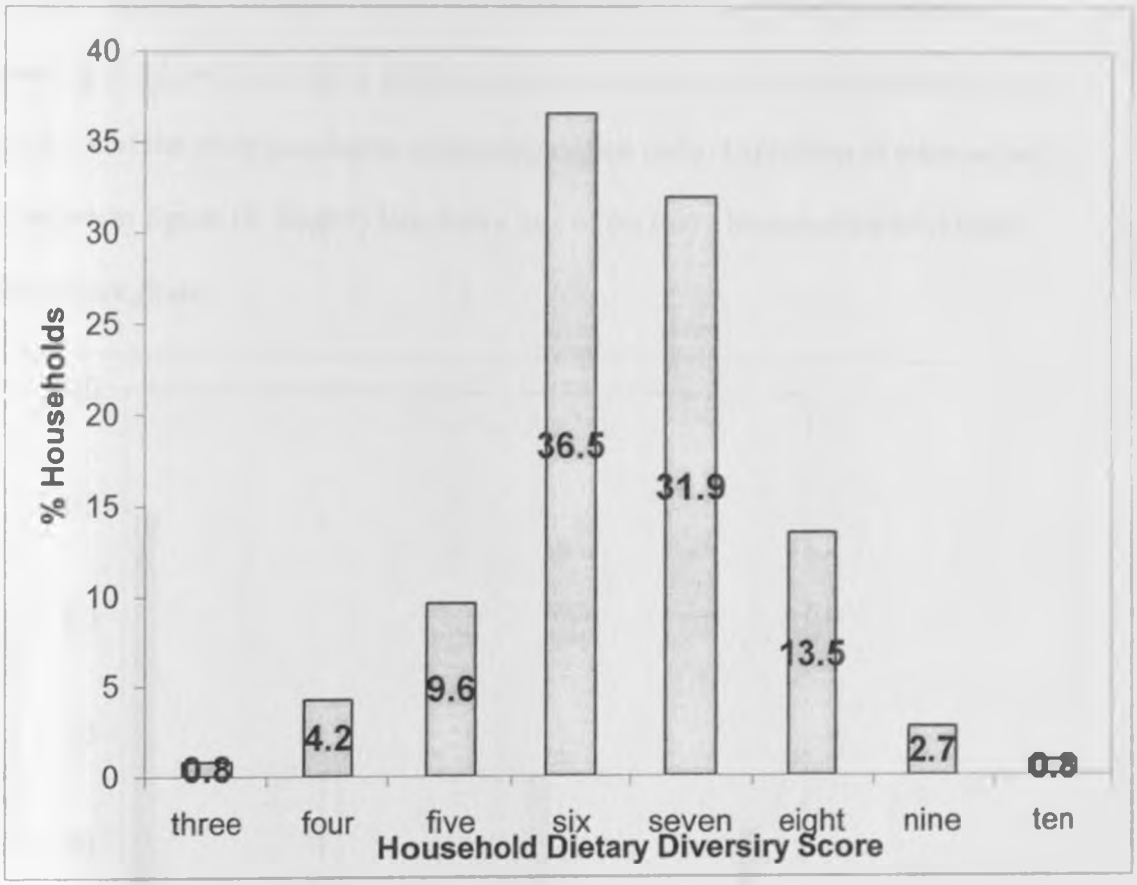


Figure 12: Distribution of households by Dietary diversity score

Table 4.11: Correlation between Household Dietary Score and some variables

	Correlation with Household Dietary Score
Number of months of food shortage	-1.44*
Production of DTFCs	0.804(NS)
Utilization of DTFCs	0.056(NS)
Caloric intake	0.062(NS)
Protein intake	0.929(NS)
Household size	0.111(NS)
Household income	0.982(NS)
Protein intake from DTFCs	0.929(NS)
Caloric intake from DTFCs	0.895(NS)

*Significant at 0.05 level
NS-Not significant
DTFCs-Drought Tolerant food crops

4.4.3 Food consumption frequency

Consumption of cereals

The most commonly consumed cereal was maize, with 98.1% of study households consuming maize products daily. Millet products were the second most consumed cereal with 17.3% of the study population consuming millets daily. Utilization of other cereals is as shown in figure 13. Slightly less than a half of the study households (44%) never consumed sorghum.

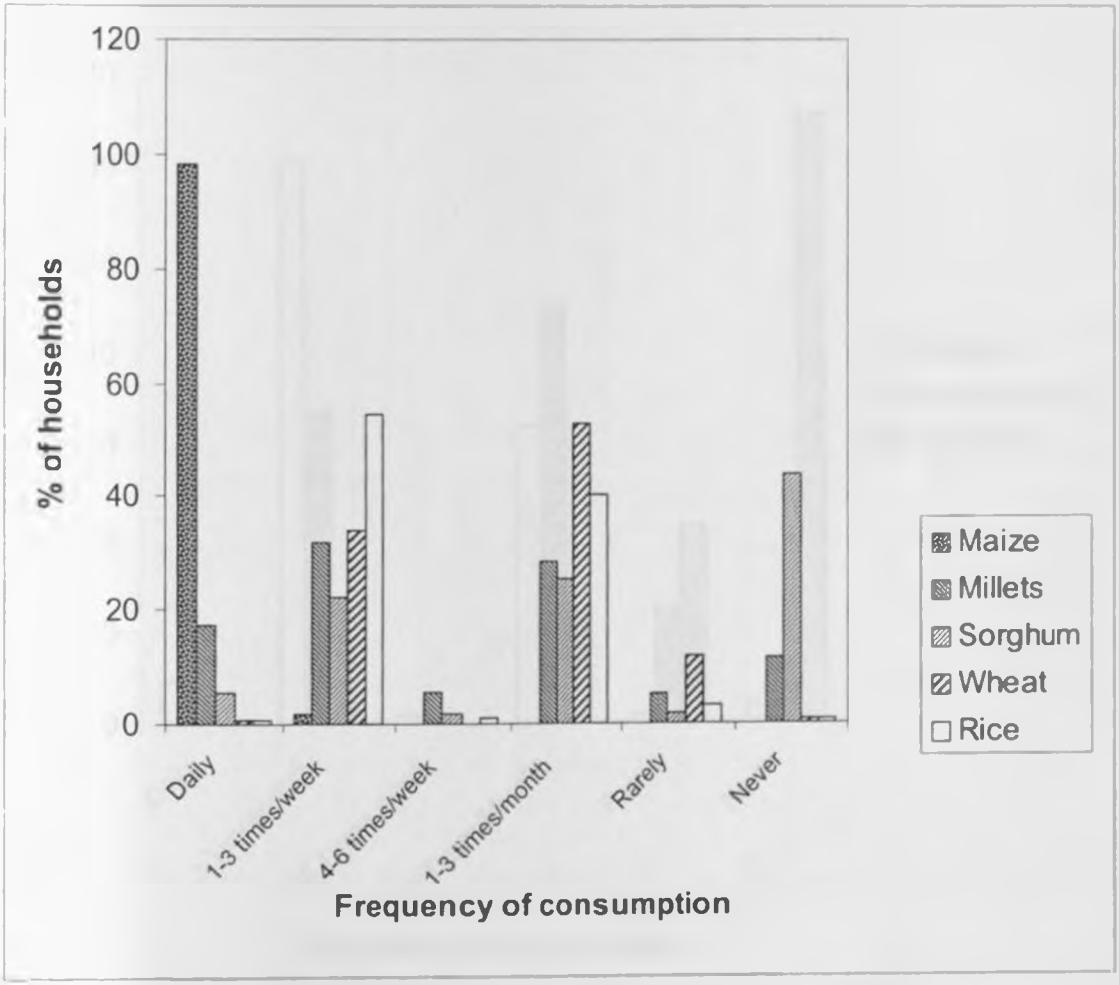


Figure 13: Distribution of study households by frequency of consumption of cereals

Consumption of root crops

The root and tuber crops consumption was relatively low with small portion of study population consuming daily. Cassava was mainly eaten 1 to 3 times per week by 60.4% of study households while 45% f study population mainly consumed sweetpotatoes 1 to 3 times per month. Arrowroots were rarely consumed in the study area (see Figure 14 below).

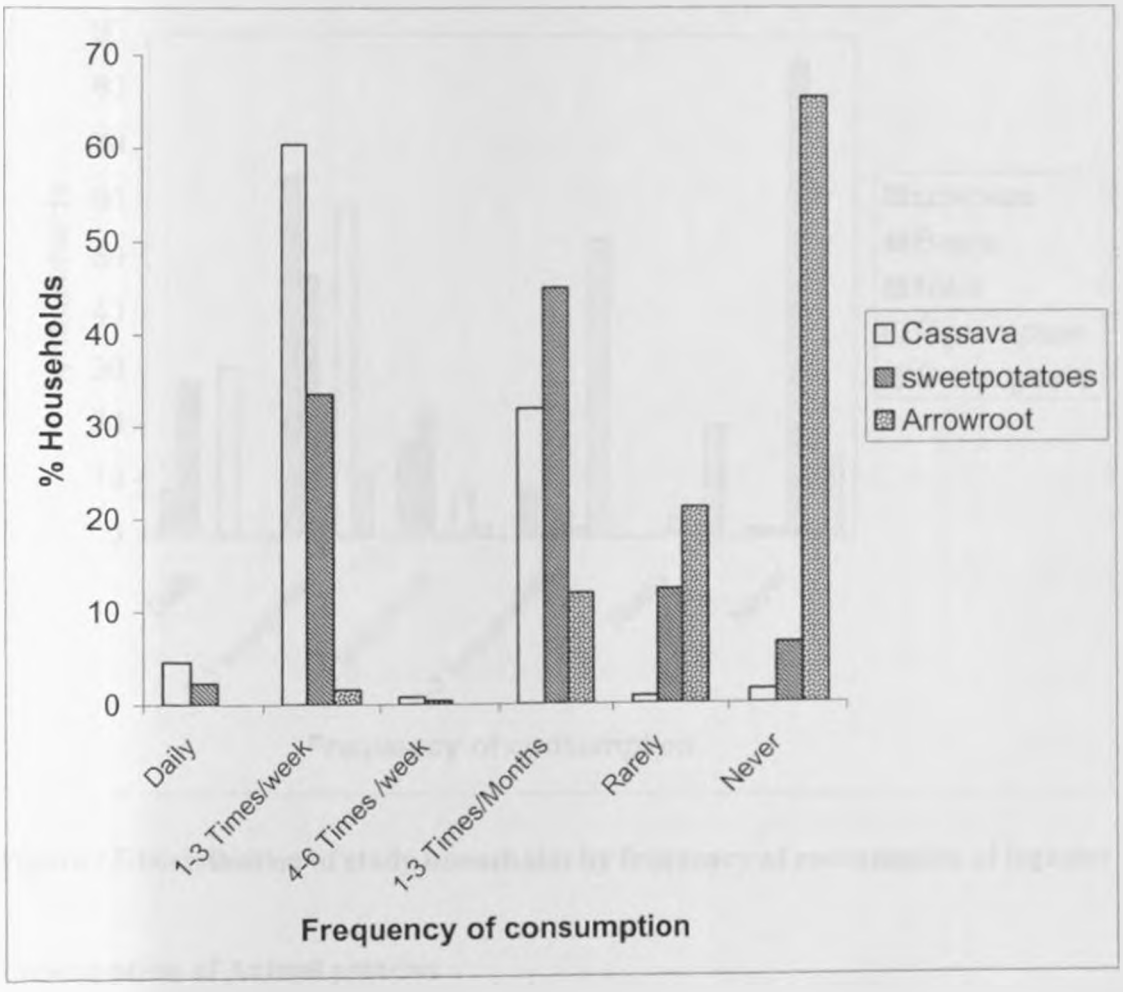


Figure 14: Distribution of study households by frequency consumption of roots and tubers

Consumption of legumes

Figure 15 shows the frequency consumption of legumes by study population. The most commonly consumed legumes were beans, pigeon peas and cowpeas. Slightly above a quarter of the study population consumed beans and pigeon peas daily. About a half of the study population consumed cowpeas and pigeon peas 1 to 3 times a week. Slightly more than a half of the study population consumed green grams 1 to 3 times a month while" Njahi"(*dolicus lab lab*) was rarely consumed.

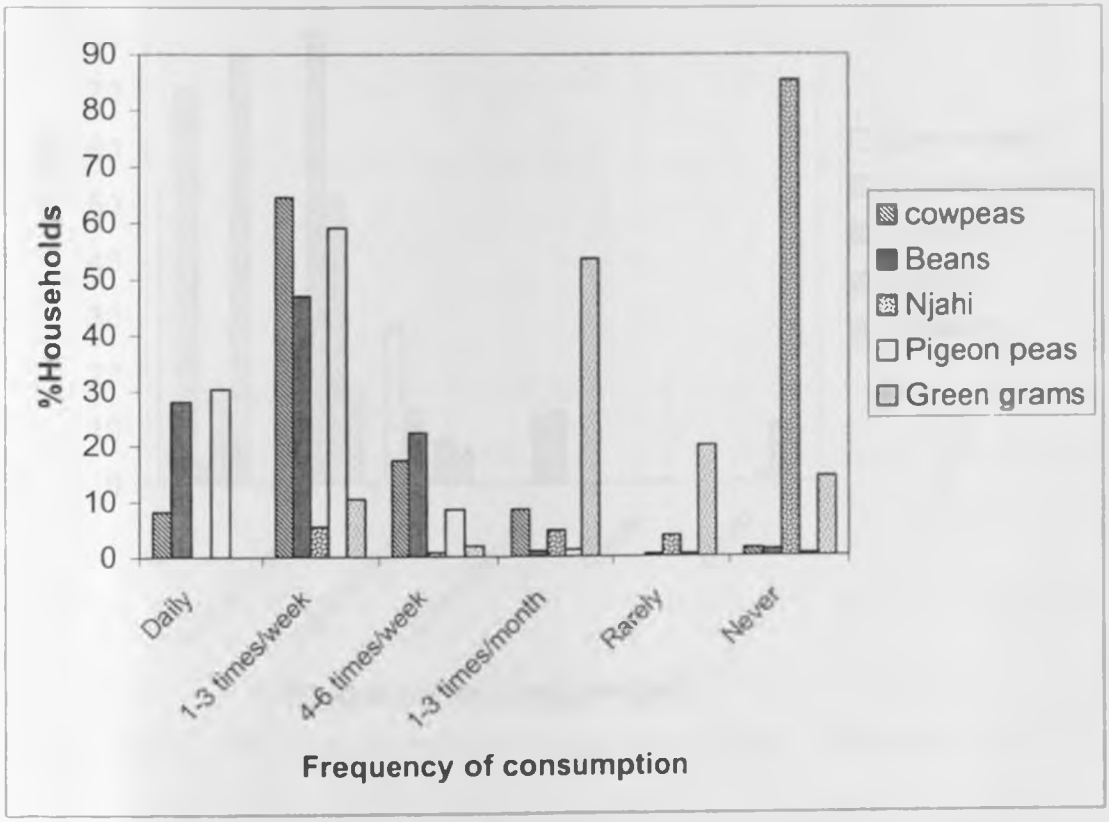


Figure 15:Distribution of study households by frequency of consumption of legumes

Consumption of Animal proteins

Approximately half of the study population consumed beef and chicken once a month. Milk was consumed daily by 80% of the households, while 82.3% never consumed fish.

Consumption of vegetables

The green leafy vegetables consumed by the households were sukuma wiki, cowpea leaves, spinach and cabbage. Most (71%) of the households consumed cowpea leaves daily when in season. Sukuma wiki was consumed daily by more than half of the study households while 81.6% consumed cabbage 1 to 3 times per week. Tomatoes were consumed daily by over three-quarters of the households (see Figure 16).

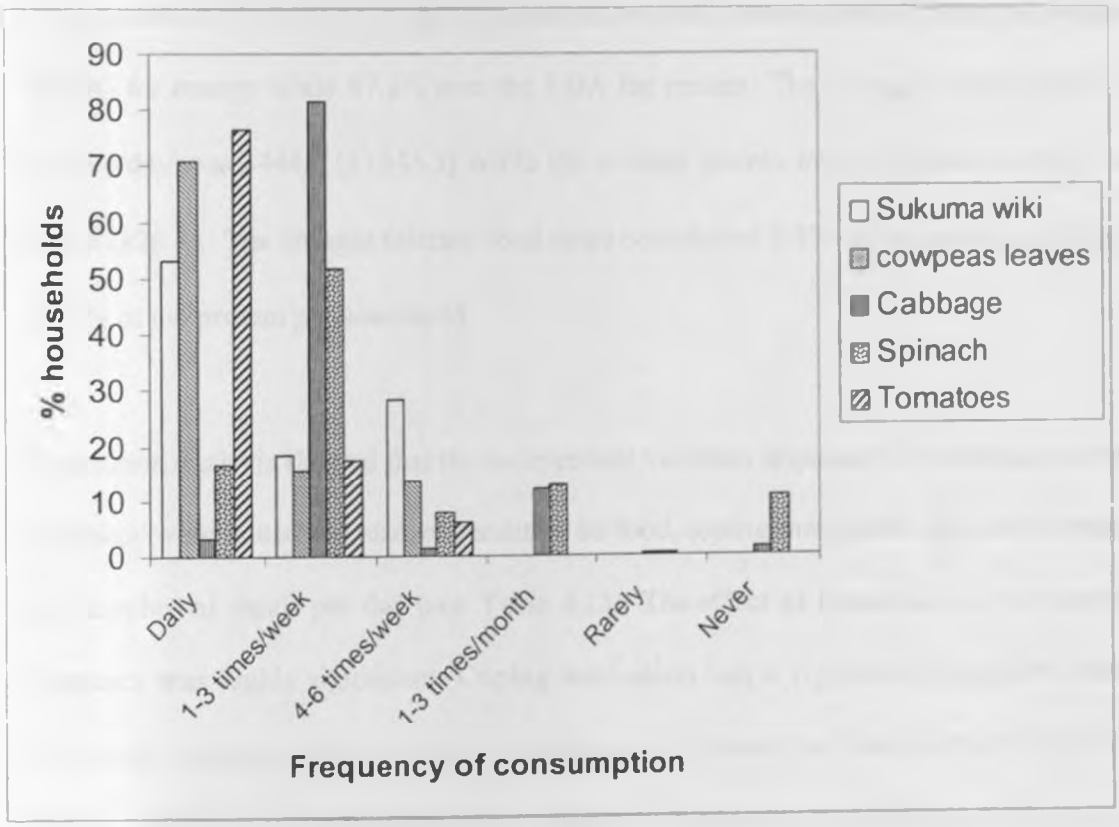


Figure 16: Distribution of study households by frequency of consumption of vegetables

Consumption of fruits

Avocado, paw paw and ripe bananas were consumed once a week by 49.2%, 31.9 % and 65.8% of the households respectively. Oranges were consumed by 40.4% of the households daily most when on season.

4.4.4 Energy and protein intake

Three quarters (75.8 %) of the households met the daily-recommended dietary allowance (RDA) for energy while 87.2% met the RDA for protein. The average energy intake in kcal/cu/day was 3444.2 (±1545.3) while the average protein intake in grams/cu/day was 67.86 (±26.5). The drought tolerant food crops contributed 8.5% of the caloric intake and 21.7% of the protein per household.

Regression analysis showed that the independent variables important in predicting energy adequacy were household size, expenditure on food, coping mechanism for food shortage and number of meals per day (see Table 4.13). The effect of household size on energy adequacy was highly significant. Coping mechanism had a significantly negative effect on energy adequacy. Sale of assets as coping mechanism for food shortage favoured energy adequacy as compared to other strategies. Production and utilization of drought tolerant food crops had no significant association with caloric intake.

Table 4.12: Stepwise regression of energy adequacy and selected variables

Variables	Energy adequacy		
	Beta	t	P-value
Household size	0.532	10.068	0.000***
Expenditure on food	0.143	2.716	0.007**
Coping mechanism of food shortage	-0.151	-2.892	0.004**
Number of meals	0.105	2.011	0.045*
Amount calories from DTFCs	0.045	0.688	0.492(NS)
Regression coefficient	0.347	-	0.045*
Adjusted Regression coefficient	0.336	-	0.045*

***Significant at 0.001 level
**Significant at 0.01 level
*Significant at 0.05 level
DTFCs- Drought Tolerant food crops
NS-Not significant

The independent variables important for predicting protein adequacy were amount of caloric intake per household, consumption of drought tolerant food crops, household income, source of food, land size under cultivation, household size and number of months of food shortage (See Table 4.14). The effect of household caloric intake and utilization of drought tolerant food crops on protein adequacy was highly significant. The number of months of household food insufficiency had a significantly negative effect on protein adequacy.

Table 4.13: Stepwise regression of protein adequacy and selected variables

Variables	Protein adequacy		
	Beta	t	p-value
Household caloric intake	0.512	12.078	0.000***
Consumption of drought tolerant food crops	0.432	11.808	0.000***
Land size under cultivation	0.091	2.357	0.019**
Household income	0.104	2.763	0.006**
Average caloric Months of food shortage	-0.089	-2.378	0.018**
Household size	0.098	2.268	0.024*
Regression coefficient	0.698	-	0.024*

***Significant at 0.001 level
**Significant at 0.01 level
*Significant at 0.05 level

4.5 Nutritional Status of Children 6 to 59 Months

4.5.1 General nutritional status

A total of 260 children were included in the study. The boys were 141 (54.2%) and the girls were 119 (45.8%). The mean age in months was 31.3 (±15.2). Stunting was found to be 26%, under weight 15.1% and wasting 7.5%. More males were malnourished than the females but there was no significant difference (chi-square P>0.05) see the Table 4.11.

Table 4.14 Prevalence of malnutrition by sex

Variable	Moderate malnutrition (<- 2 Z score)		Severe malnutrition (<- 3 Z score)	
	N	%	n	%
Wasting				
Male	13	9.4%	3	2.2%
Female	6	5.2%	1	0.9%
Underweight				
Males	26	18.6%	6	4.3%
Females	13	11.0%	4	3.4%
Stunting				
Males	41	29.7%	14	10.1%
Females	25	21.6%	9	7.8%

Wasting (weight-for-height) was significantly more prevalent in the age group 37-42 months than other age categories (p= 0.021). Stunting (height-for-age) was found to be more prevalent in the age group 19-24 months while underweight (weight-for-age) was higher in the age group 43-48 months compared to the rest of the age group but the differences were not significant (see Figure 17 below).

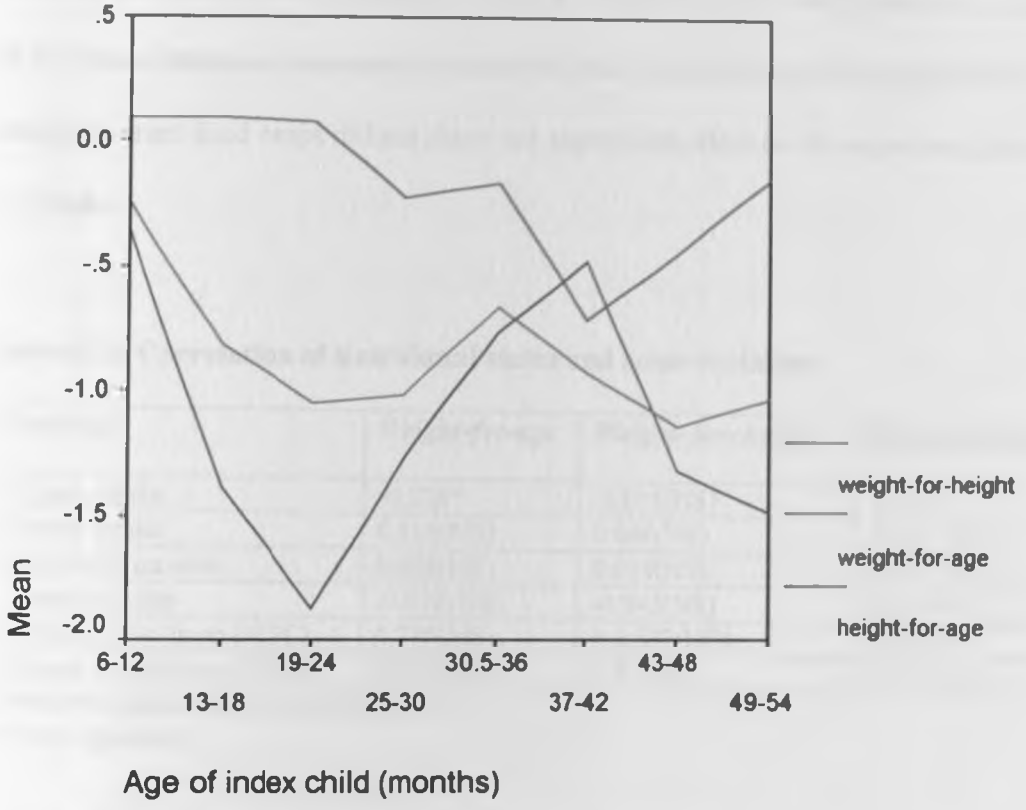


Figure 17: Distribution of prevalence of malnutrition by age

4.5.2 Factors associated with nutritional status.

Correlation analysis revealed that weight-for-age (under weight) and Height-for-age (stunting) were negatively correlated with household caloric intake. The correlation between nutritional status on one hand and protein intake, household income, household size was not significant (see Table 4.12). However there was positive correlation with protein and caloric intake from drought tolerant food crops though not significant

Results showed that the independent variables important in predicting weight-for-height were age, morbidity and sex of the child. The predictors for weight-for-age were age, sex of the child and number of months of food shortage while for Height-for-Age were

source of food and caloric intakes (see Table 4.15 below). Own food production favoured the nutritional status as compared to purchased food. Production and consumption of drought tolerant food crops did not show any significant effect on the nutritional status of the children.

Table 4.15: Correlation of nutritional status and some variables

Variables	*Weight-for-age*	*Weight- for- height*	*Height-for-age*
Caloric intake	-0.138*	-0.015(NS)	-0.151*
Protein intake	0.015(NS)	0.046(NS)	-0.031(NS)
Household income	0.028(NS)	0.019(NS)	-0.051(NS)
Household size	-0.072(NS)	-0.043(NS)	0.036(NS)
Protein intake from DTFCs	0.770(NS)	0.0.537(NS)	0.667(NS)
Caloric intake from DTFCs	0.988(NS)	0.29 (NS)	0.177 (NS)

*Correlation significant at the 0.05 level
NS-Not significant

Table 4.16 Significant factors for the three nutritional indicators.

Stepwise regression- Variables	**Weight for age (Underweight)**			**Height for age (Stunting)**			**Weight for height (Wasting)**		
	Beta	**t**	**p-value**	**Beta**	**T**	**p-value**	**Beta**	**t**	**p-value**
Age	-0.150	-2.438	0.015*	-	-	NS	-0.206	-3.342	0.001**
Number of months food shortage	-0.167	-2.722	0.007**	-	-	NS	-	-	NS
Sex	0.164	2.671	0.008**	-	-	NS	0.127	2.075	0.039'
Morbidity	-	-	NS	-	-	NS	0.182	0.963	0.003**
Sources of food	-	-	NS	-0.173	-2.702	0.007**	-	-	NS
Caloric intake	-	-	NS	-.168	-2.210	0.028*	-	-	NS

NS-Not significant
*Significant at 5%
**Significant at 1%

Approximately a third (31.5%) of the children under study had illness two weeks preceding the interview. Coughing was the most common illness affecting 9.2% of the children, followed by diarrhea/vomiting that accounted for 8.8%. Other illnesses included malaria/fever, ringworms and skin disease/scabies (as shown in the figure 18 below). Although there was no significant difference, results showed more male children (17.7%) reporting to be ill compared to (13.8%) females. Children were more ill in the age group less than 24 months though the difference between the age group was not significant. There was a significant relationship between morbidity and underweight, as well as wasting. (x^2: p=0.003; p=0.004, respectively).

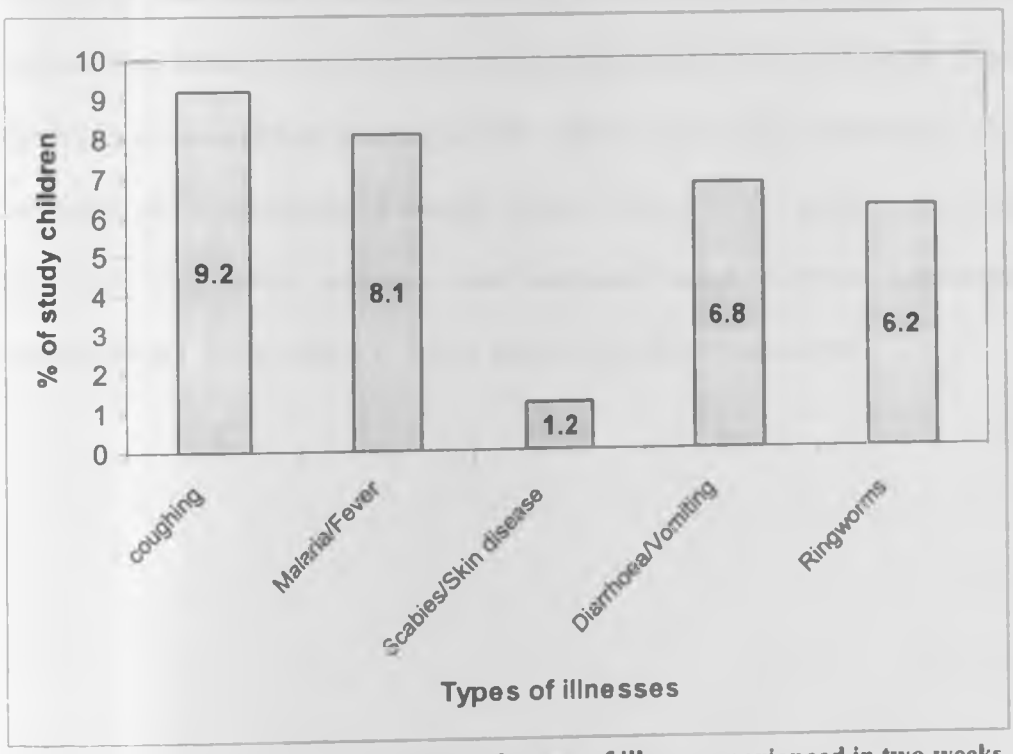


Figure 18: Distribution of study children by type of illness experienced in two weeks preceding study.

4.9 Summary of the main Results

Study population had large average family size of 6.3 persons with a dependency ratio of 1.01. Three quarters of the study population had at least received formal education. The main occupation was farming though the major source of income was casual labour.

There was low production and consumption of drought tolerant food crops in the study area. Most of the drought tolerant food crops grown were mainly for home consumption although a significant quantity was sold. People appear to prefer to produce maize to other crops. A half of study households were food insure for at least five months despite the fact that over three quarters had met their daily recommended dietary allowance for both energy and protein three days preceding the study. Opting for cheap foods such as sorghum was found to be the main coping mechanisms for food shortage. There were high levels of malnutrition; stunting at 26%, under weight 15.1% and wasting 7.5%.

Production and consumption of drought tolerant food crops did not have any significant association with caloric adequacy and nutritional status. However consumption of drought tolerant foods crops was highly associated with protein intake.

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Demographic and Socio-Economic Characteristics

The higher proportion of males than females in the study population is contrary to the general trend of most other populations where females are usually more than males. These results however are in line with the findings of the district's second report on poverty that reported 51.8% males (GOK, 2002b). The proportion of female-headed households in the study is only one third (10.4% compared to 35.8%) of that reported for Eastern province (CBS, et al, 2004) and about half of that reported in the district's second report on poverty (GOK, 2002b). Majority of the household heads are married while a few are single, widowed or divorced. This is the expected in a rural set up where single parenting is considered an unacceptable custom.

The proportion of the population aged below 15 years in the study area is slightly higher than that found in rural areas according to KDHS 2003 (CBS, et al, 2004). However, it compares closely with that reported in the district development plan (GOK, 2002a). Dependency ratio of above one implies that there are more dependants, a scenario that puts economic strain on the households. This is similar to the findings of the Welfare Monitoring Survey for rural areas carried out in 1997 (GOK, 2000). The mean household size of 6.31 persons is higher than that of Eastern province of 4.7 persons according to KDHS 2003 (CBS, et al, 2004). Given that most of the households are low income, large household size impacts negatively on the net per capita food consumption and especially protein food rich foods that are expensive to acquire. Low levels of education, limited

access to family planning services and extended family set up could be contributing to large household size.

Two thirds of the households derive their income from casual labour in farm activities that are also seasonal due to the rainfall pattern experienced. These findings are similar to those of studies done in Embu (Mugo, 1995) where engagement in causal labour was found to be an indicator of food and income insufficiency. Low level of education among the study population could contribute to this form of employment as majority of the able bodied people have no professional qualification required for better jobs.

The mean monthly income per household is relatively low as compared to the findings of Welfare Monitoring Survey III in 1997 that was Ksh 1239 per adult per month (GOK, 2000). This could be due to the fact that their main source of income is low paying casual labour.

The high proportion of monthly household income spent on food implies that the households are not able to produce enough food from their farms. This is further confirmed by the many months of food shortage (5.01 months) in the study area. The percentage of total expenditure on food is an effective measure of vulnerability (Smith, 2002).

Results on housing conditions indicate that most households use local building materials such as grass, iron sheets and bricks. These results are similar to results from other rural

poor areas in Kenya (CBS, 2002). However a few have concrete walls that had been constructed when the household heads had better sources of income.

5.2. Agricultural Production

5.2.1 Agricultural land size

While the main source of food for the study households is from own production, the mean acreage land under cultivation is small. A few households have large pieces of land that are not productive. The land size is much less than that required to produce calories adequate for average household size of 6.3 in the area. As a result, households are not able to produce adequate food for their members throughout the year. At least five acres are required to produce the required calories (FAO, 1986). Land size posses a challenge not only to crop production but also to livestock rearing. Large livestock rearing does not appear to be a major activity in the study area. More than half of the study households do not rear large livestock such as cattle, but prefer small livestock such as poultry. Probably due to the small land size and lack of sufficient pasture. Most of the land is ancestral land that has been inherited over generations and subdivided among the family members, resulting in very small land holdings.

5.2.2 Crop production in relation to drought tolerant food crops

The results clearly indicate that the main crops grown in the study area are maize and beans. The fact that more maize and beans are harvested compared to drought tolerant food crops implies that the household do not prefer to grow these. Hence, they are grown on small pieces of land or planted late after other crops. While, maize and beans, which are most preferred, are given first priority in terms of resource allocation.

The most grown drought tolerant legumes are cowpeas and pigeon peas. Cowpeas are mainly grown for use as a vegetable hence not grown in large quantities. A few households plant sorghum and millets. One of the reasons for not growing much sorghum in the study area is the belief that continued growing of sorghum for over a long period of time hardens the ground thus spoiling their farms. The low selling price of sorghum (Ksh.2/ per Kg) is another factor that limits its production, as farmers would like to grow crops that have high economic returns. In fact sorghum is considered as a cheap food to which households turn to when they suffer food shortage. Limited knowledge on the alternative ways of utilizing these crops also posses a challenge in production. In most cases, millet and sorghum are only used in flour form and only as supplementary and complementary food. Further more, production of millets and sorghum is highly labour intensive and this could contribute to households avoiding production.

The mean yield of the most common food crops in the study area is lower than the average production in the district (MOA, 2003a). The low yields could be attributed to low and unreliable rainfall in the study area. The area depends mainly on rain fed agriculture, thus a shortfall in the overall rain pattern poses a major threat to overall food production. At the time of this study, the area was reported not to have received adequate rains during the previous two rain seasons. Another reason could be that crops are intercropped in small pieces of land with limited use of farm inputs resulting to low production. This is similar to the findings in studies in Colombia (Cock, 1985) where intercropping was found to reduce yields drastically.

5.3 Food Consumption Patterns in relation to drought tolerant food crops

5.3.1 Meal frequency

Majority of the study households consume three meals per day except during times of food shortage. The study revealed that majority of households skip breakfast in times of food shortage depending on the availability of food. During severe times of food shortage, households skip lunch. There is a negative relationship between the number of months of food shortage and number of meals per day. This implies that, as the number of months of food shortage increases, households consume less numbers of meals per day as one of the coping mechanisms. There is a positive association between the number of meals per day and the amount of nutrients from drought tolerant food crops that is not significant. This could be attributed to the little amounts of drought tolerant food crops taken in each meal.

5.3.2 Dietary diversity

Studies have shown that food diversity defined either as the number of different individual food items or food groups, provides an inexpensive and reliable indicator of food accessibility at the household level (FANTA, 2003). The results from this study indicate that the households have a more diversified diet implying that the households have access to variety of foodstuff. This could to due the fact that households had harvested some food three months prior to the study and was still available for consumption during time of the study. It was also observed that during the study period there were plenty of fruits and vegetables mainly paw paw and sukuma wiki, which added to the diet.

The diet diversity score has a positive association with caloric and protein adequacy This implies that, with a more diversified diet the households have a likelihood of meeting their recommended dietary needs for both protein and energy. The diversity score is also correlated to household income implying that households consume a wider variety of foods when their incomes increase. However the association is not significant which could be due to relatively low household income. Production and consumption of drought tolerant food crops has a positive association with dietary diversity which is not significant. This could be due to the fact that there is low production and consumption of these crops in the study area. Months of food shortage has a negative association with diversity score implying that as the months of food shortage increased the study population consumed from few different food groups.

The main cereal consumed in the study population is maize. Majority of the households prefer maize to other cereals as drought tolerant crops such as millets and sorghum. Unlike millets and sorghum that are used mainly in the form of flour, maize is utilized both as grain and flour. This also explains why maize is more preferred to the other cereals. During the focus group discussion, members indicated that sorghum is not palatable except when mixed with other cereals hence not consumed frequently. Nonetheless, sorghum is usually stored and used in times of food scarcity. Millet, which is used to provide complementary food for children, is less utilized. This explains why production of these drought tolerant cereals is low. This underscores the need for the home economists and community nutritionists to look into ways of utilization of these drought tolerant cereals and plant breeds to improve palatability of these cereals.

Beans and pigeon peas are consumed more on daily basis. Beans are however the most preferred legumes compared to the drought tolerant legumes. This could be due to the fact that they are believed to be of more nutritional value than any other legume. Pigeon peas are mainly consumed when green because they are believed to be of more nutritional value than when dry. In the focus group discussions, it was revealed that cowpeas are mainly consumed as legume only in times of food shortage. This is because they are thought to be of low nutritional value hence not grown by many people except as a green leafy vegetable. The study population has little knowledge on the nutritional value of most of these crops. Hence the need to educate the community on the nutritive value and utilization of these legumes.

It is worth noting that there is limited consumption of animal protein. This is an indication of low purchasing power of the study population. In addition the study population keeps very few livestock and are not able to produce enough animal products for self-consumption. The low consumption of animal proteins observed in this study is typical of many poor rural households that have scarce sources of income (Kaluski, et al, 2002). This underscores the need for the community to produce and utilise foods that require low production resources such as the drought tolerant food crops.

Consumption of roots and tubers is relatively low as compared to other food crops in the study area. This could be due to low production and limited knowledge on alternative uses of the produce at household level. Cassava is mainly consumed in the raw form as a snack. Occasionally, a few households boil or mash it with "githeri". Raw cassava cannot

be consumed in large quantities because of the poisoning effect due to cyanogenic toxins present in cassava. Studies have shown that in places where cassava is processed before use, especially in West Africa, the consumption levels are high (Nweke, 1994). Like cassava, sweet potatoes are mainly consumed as a snack. They are either boiled or roasted and taken with tea for breakfast. These ways of preparation of both cassava and sweet potatoes limits the level of their utilization since it does not provide a variety of products. This is mainly due to the community attitude towards these root crops and tubers. Unless the community is sensitised to see value in these food crops it appears like production and utilization will remain low.

5.4 Energy and Protein Adequacy in relation to drought tolerant food crops

In the study population, maize and beans and pigeon peas are the main sources of energy and protein. This is because they are the main crops grown and most preferred. This implies that diversity of foods consumed a factor often considered as an indicator of dietary adequacy (FANTA, 2003), is low. The results however, indicate that most households met their energy and protein requirements during the study period. This could be attributed to the fact that the households had harvested some crops in the previous season, three months preceding the study, some of which were still available for consumption. In addition, data collection was done between August and September a period indicated by households not to experience food shortage as severe food shortage is experienced between October and January.

Female-headed households tend to be poorer than the male-headed households hence have a high chance of not meeting their nutrient requirements. However, this study

showed contradicting results. Most female-headed households have met their nutrient (energy and protein) requirement. This could be because they control the family resources hence provide better nutrition for their families. Studies from Kenya, and Cote d'Ivoire show a positive relationship between improved household nutrition status and increased access to income by women as compared to when resources are controlled by men (Kennedy and Payongayong, 1991, Hoddinott and Haddad, 1991).

The negative effect of household size on nutrient adequacy especially for protein could be attributed to low production of legumes hence low amounts available and especially for the larger families. Low purchasing power among the study households also means that there is higher probability to purchase cereals that are cheaper as compared to the protein sources.

Drought tolerant food crops are found to contribute little in terms of dietary intake, especially of energy. This is because the production and subsequent utilization of these crops, especially of drought tolerant cereals and roots and tubers, is less preferred and low. In addition, these crops are perceived to be of low nutritional value and limited in the ways of utilization besides being considered by most people as not palatable. Contribution of drought tolerant food crops to protein intake is higher than to energy intake. This could be due to more utilization of drought tolerant legumes and due to the fact that little animal protein is consumed.

5.5 Determinants of Nutrient Adequacy

Significant factors predicting energy adequacy are household size, expenditure on food, coping mechanisms and the number of meals per day. The coefficient estimation of expenditure on food indicates a positive effect on energy adequacy. This implies that, increased expenditure on food increases calorie intake. More purchases are done for energy sources that are cheap than protein sources in rural low-income households.

Coping mechanisms applied during food shortage have a negative effect on the energy adequacy. This could be due to the fact that some of the mechanisms result to either reduction of the meal size consumed or reduction of the number of meals and hence households may not be able to meet their nutrient requirement. Sale of assets as a coping mechanism promotes energy adequacy unlike the other strategies in the study population. This however, may result in depletion of household entitlements, leading to increased vulnerability.

Household size has a highly positive effect particularly on energy adequacy. This implies that, there is high caloric intake in larger family unlike the expected. Increased family size may positively contribute to the household income resulting to improved nutrition. Also high labour force to work on land for more production. Number of meals per day has a positive effect on caloric adequacy. As the number of meals per day increases, the higher the possibility that households will meet recommended nutrient requirements. In addition, families consuming more meals per day may imply that they experience little food shortage hence are able to meet their nutrient requirements.

Results indicate that significant factors predicting protein adequacy are amount of caloric intake, amount of calories from drought tolerant food crops, land size, household income, number of months of food shortage and household size. All these factors have a positive effect on protein adequacy except the number of months of food shortage.

The positive effect of land size on protein adequacy could be due to the fact that households with large land sizes are able to grow many different types of crops and also keep livestock. Household income is positively associated with protein adequacy, implying that as household income increases, the higher the likelihood that the households will meet their protein requirement. This is because households with high income are able to access protein sources through purchases to supplement own production, hence meeting their protein requirement.

Number of months of food shortage has a significant negative effect on protein adequacy. This is because longer periods of food shortage tend to lead to households adopting coping mechanisms that are poor nutritionally, such as opting for cheaper starchy foods, reducing the meal sizes e.t.c. which may result to low protein intake. In general protein foods are expensive and long periods of food shortage result in decreased purchasing power, utilization of cheap foods and reduction of intake.

Results on coping strategies show that majority of the study households opt for cheaper starchy foods such as maize or sorghum. Purchase on credit is the most unpopular coping

strategy. During the dry spell when the households are food insecure, there are limited job opportunities in the farms that provide the bulk of casual labour for extra income.

5.6 Nutritional Status of Children

The prevalence of chronic malnutrition manifested as stunting is lower (26.0%) than that for eastern province, of 32.5% (CBS, *et al*, 2004), and also what was found in a study carried out in Kathonzweni division in the same district in the year 2000 (Macharia, 2002). This could be due to the fact Kathonwzeni division is more drier and more food insecure as compared to Kasikeu division. Stunting is especially associated with low economic status that was the case for the study population. The high stunting levels in the study area indicate inadequate dietary intake primarily due to insufficient food consumption for a long period of time. This is so for the area that experiences recurring drought situations, which result to food shortages hence inadequate dietary intake over a long period. In addition, poor feeding practices contribute to this as it is noted that pre-school children in most cases eat from the family pot and no snacks are provided in between the main three meals. The main staple food is "githeri" which is hard for the children to eat sufficient amounts to meet their nutritional requirements.

Prevalence of underweight is found to be lower than the National and Eastern province levels of 20% and 21.4% respectively according to KHDS 2003 (CBS, *et al.*, 2004). However the figures are still high due to inadequate dietary intake as a result of food shortage. Prevalence of underweight is found to increase with age. This could be due to reduced childcare as attention goes to younger siblings.

The prevalence of wasting (7.5%) was significantly higher than the provincial figures (4.2%). Wasting is usually an indicator of recent nutritional status or acute under nutrition. There is high prevalence of wasting despite the fact that results on nutrient adequacy indicate most households meet their nutrient requirement. This could be due to the fact that household nutrient adequacy does not necessarily ensure individual nutrient adequacy. In addition, poor complementary feeding practices, uneven intrahousehold food distribution, and the type of food consumed not suitable for the children could have contributed to this.

Households with larger family size have more malnourished children though the difference is not significant. Households with many children are likely to have high prevalence of malnutrition especially when the resource base is limited.

Regression analysis indicates that numerous factors affect children nutritional status with more effect on weight for height, which leads to wasting, stunting or underweight. The analysis shows that the set of factors that influence weight for age is different from those that affect height for age and weight for height. This is because each of these three indicators measures different types of household food security.

The child's age has a significantly negative effect on both weight-for-age (underweight) and weight-for-height (wasting). These results indicate that wasting and underweight are common in younger children probably due to poor childcare practices in addition to food insecurity. This is similar to what was found in Kathonzweni Division, in the same

district (Macharia, 2002). The child's sex has a significant positive effect on underweight and wasting. The male children are more malnourished than the females though not significantly. This is similar to the findings of KDHS 1998 in Kenya. This could be due to the higher nutrient needs for the male child and food insecurity in the area.

Morbidity has significant positive effect on wasting. This could to be due to the fact that infections and diseases reduce the child's appetite hence reduced food intake. In addition, a lot of nutrients are lost from the body especially in case of diarrhoea/vomiting illness, which is common in the area, resulting to weight loss.

There is a positive significant effect of the number of months of food shortage on underweight. This implies that as the number of months of food shortage increases the level of under weight increases. As the period of food insecurity increases households' food supplies get depleted leading to reliance on other sources of food. In addition households may develop coping strategies that may not nutritionally and adequately provide for the children.

Household caloric intake has a significant negative effect on stunting. This implies that, stunting cases are prevalent in households with low caloric intake that may experience food shortage most of the time. Food shortages often pose the most life-threatening risk to households and affects mainly the most vulnerable especially children under five years of age. In addition sources of food have negative significant effect on stunting. Households that mainly purchase their food have more cases of stunting as compared to

own production. This could be due to limited purchasing power hence inadequate dietary intake.

Production and consumption of drought tolerant food crops has no significant association with nutritional status in the study population. This could be due to the low production leading to low consumption of these crops in the study area and therefore no significant impact.

5.7 Food Security in the Study Area

Households are food secure when they have the ability to reliably acquire their own food for their household members, enough for active life and healthy life throughout the year. Food security may be manifested as adequate dietary intake, as well as optimal nutritional and health status.

There is low food production in the study area implying that the households are not food self sufficient throughout the year. This is demonstrated by the long periods of food shortage that force the households to develop coping strategies that are not nutritionally supportive. Although most of the food harvested is used for home consumption, most households are food insecure, an indicator that the production levels are insufficient. Another indication of insufficient food production in the area is the high level of expenditure of household income on food. The main factors contributing to low production are unreliable and low rainfall and small land size. The rainfall pattern is erratic and generally low leading to low yields or even crop failure. The main crops grown in the study area, maize and beans are not drought tolerant resulting to frequent

crop failure in most times. Hence, the need to promote increased production and utilization of drought tolerant crops in order to improve household food security in the study area. Most of these crops are adaptable to relatively marginal soils and erratic rainfall conditions and have high productivity per unit of land. In addition, they have the possibility of maintaining continuity of supply of food throughout the year. Studies, for example, show that famine rarely occurs in areas where cassava is widely grown (Cock, 1985).

Land size also posses a challenge to agricultural production. In the study area the small land holdings cannot enable households to meet all their food needs through own production especially of non drought tolerant food crops. It has been found that the prevalence of food insecurity tends to be higher among small or landless households who are more dependent on riskier sources of income (Yohannes, 1991).

Households can meet their food needs through earning a stable income with which they can purchase or access the food they need. This is not so in this study area where seasonal casual labour is the main source of income. Drought tolerant food crops can become a major income earner for the households if the production is increased since there is high demand for millets, sorghum, and pigeon peas especially in the urban areas. Cassava in Nigeria has been found to provide the highest proportion of income among the resource poor farmers compared to other crops (Nweke, 1996). Hence these crops have great potential of enhancing household income in the study area.

Although most households appear to meet their nutrient requirement, high levels of malnutrition of the under fives are prevalent. This could be due to uneven intra-household food distribution among the members hence the most vulnerable group suffer. Also the long spell of food shortage could have contributed to this. In addition, the main food consumed is "Githeri" which is usually difficult for the under fives to eat sufficient amounts to satisfy their daily needs. Increased production and utilization of the drought tolerant crops such as sweet potatoes, millets and sorghum can easily provide a variety of nutritious supplementary diet for the under fives.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Results from this study show that the major drought tolerant food crops grown in the area are pigeon peas, cowpeas, cassava, millets and sorghum. However, both the production and consumption levels of these crops that have high potential for improving food security in drought prone areas like Kasikeu are ironically low despite the government's effort to promote their growing and utilization. Hence there is no evidence that the promotion and growing of drought tolerant crops has enhanced household food security in this community. Ironically, production and consumption of drought tolerant food crops High preference for maize as the staple food over the drought tolerant crops by most people remains a major challenge. It is further concluded that the study population has little knowledge on the nutritional value of the drought tolerant crops and therefore place little value in their production and consumption.

In addition and limited growing of drought tolerant crops household food insecurity is also attributed to low crop production as a result of limited land sizes, unreliable rainfall and poor farming practices. With frequent failure of the preferred maize and bean crops, the study community is food insecure and the most vulnerable group are at risk. This is demonstrated by the high malnutrition levels among the under fives and the long spell/periods of inadequate food availability. The most common coping mechanisms for food shortage in the study area is opting for cheap food stuffs.

6.2 RECOMMENDATIONS

In economics, demand will always trigger supply. To enhance production of drought tolerant crops, there is need for increased demand for these crops. Promotion of production without first creating adequate demand is futile. Hence there is need to research on how to increase the usability of these crops. This could be through:

1. Developing and training communities on new recipes.
2. Educating the community on the nutritional values of these crops
3. Innovative processing strategies that will improve the value, appearance and acceptability of the products from these crops.
4. Introduction of incentives in form of subsidies during production or high prices for the drought tolerant food crops to promote more production

There is need for further research to establish the factors behind low production and consumption of drought tolerant crops despite their competitive advantages as promoted by government and development agencies. They should focus on the knowledge, attitude and practices (KAP) of the community in regard to production and utilization of these crops. The government, research institutions, non-governmental organizations, public, and the private sector should put their resources together to establish why communities in ASALs continue to grow maize even when crop failure for maize is higher. Collaboration between food scientists, agriculturists, nutritionists and home economists is necessary for a break through in this area.

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Appendix I.

Questionnaire no.___

Role of drought tolerant food crops in food security status among low-income households in Kasikeu Division, Makueni district.

Circle or fill as appropriate

Interviewer_____Interview Date_____ Household No._____

1.Name of the household head_____ Age____ Sex _____Marital status_____

2. Location_____ Sub-location_____ Village_____

A. **Household composition.**
List the household members indicating their marital status, gender, and relation to hh head, education level, residence and occupation. Use the codes provided below the table.

Serial no.	Name	1.Relation to head of hh	2. Sex	3. Age mths	4 Age Yrs	5. Marital status	6. Education	7. Occupation	8. Residence
1.									
2.									
3.									
4.									
5.									
6.									

Codes

Relation the hh	Sex	Marital status	Education	Occupation	Residence
1.Child	1.Male	1.Married	1.Lower Primary	1.Farmer	1.Rural
2.Paren	2.Female	2.Separated	2. Upper primary	2.Driver	2.Urban
3.Brother/sister		3.Divorced	3.Secondary	3.Business	3. Others,Specify
4.Relatives		4.Single	4.University/College	4.House wife	_____
5.Others, Specify		5. Widow(ed)	5.Pre-unit	5.student/pupil	
		6.Others, Specify	6. Others, Specify	6.others, specify	
_____		_____	_____	_____	
_____		_____	_____	_____	

Questionnaire No._____

B.SOCIO- ECONOMIC STATUS

(i.)HOUSING

9.Type of roofing **[Verify by observation]**

Code: 1-Iron sheet 2-Thatched 3- Others, specify_____

10.Type of wall **[Verify by observation].**

1-Mud 2-wooden 3-Concrete 4-others, specify_____

11.Type of floor **[Verify by observation]**

1.Mud 2.concrete 3.Others,Specify._____

(ii) LAND OWNERSHIP AND CROP PRODUCTION

12.How much land do you own?_____(acreage)

13.Do you rent any land for cultivation? 1.Yes 2.No

14. [If the answer is No go to question 15 .If yes ask]
What is the size of the rented land? _____(Acreage)

15.How much is under cultivation?_____ (Acreage)

16.What food crops do you grow in this household? How much produced per crop in the last year both in the long and short rain season?

16. Food crops	17. Amount produced			18.Area under cultivation (acreage)	
	Long rain Season	Short rain season	Units of measure	Long rain Season / Unit of measure	Short rain season / Unit of measure
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Measures

1. 90 Kgs Sacks
2. 50 Kgs Sacks
3. 18 kg-Debe
4. 2 kg Kasuku
5. Kgs
6. Others, Specify_____

Questionnaire No_____

19 (a.) Do you know of any drought tolerant food crops? 1.Yes 2.No

19(b) **[If the answer Yes Ask]** Which ones? **[List hem]**_____

19(C.) For reasons are they grown? **[Please rank]**

☐Use less in puts ☐They are drought tolerant ☐ Home consumption ☐others specify_____

20.Indicate in order of importance what you do with each of the crops. Use the codes provided below the table.**[use the codes provided below the table]**

CROP	IMPORTANCE (RANK)				
RANKING	1	2	3	4	5
1.Cassava					
2.Millets					
3.Sorghum					
4.Bulrush millets					
5.					
6.					
7.					

Code:
1. Consumed at the hh 2. Sold 3. Fed to livestock 4. Fed to children as weaning diet
5.others specify_____

21.How much was used in each category of utilization (in question 21)?
[Use the codes below or enter the quantity in kilograms. Note indicate the unit of measure in brackets]

19.Drought tolerant crops	(a.).Amount produced	(b.).Amount consumed	(C.).Amount sold	(d).Other uses Specify--------
1.				
2.				
3.				
4.				
5.				
6.				

Codes: Measurements
1.Sacks-90kg 2.Sacks-50kgs 3.Debe-18kgs 4.2Kg Kasuku 5.Others,Specify_____

22(a.) Do you preserve the above food crops that you grow? 1.yes 2.No

22(b) **[If the answer is Yes , Ask]** How they are preserved?

(A)Legumes and cereals _____ (B.) Root crops_____**[Use code below]**

1. smoking 2.Pesticides 3.Drying 4.processed and stored in other forms

5.Others specify

(iv) LIVESTOCK OWNERSHIP

What types of livestock do you own?
[Use the codes below]

23. Type of livestock	24.Number owned	25 Type of product	26.Uses **[Please rank in order of importance]**
1.Cow		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------
2.Bull		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------
3.Goat		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------
4.Sheep		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------
5.Poutry		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------
6.Others, specify ----------		(a)----------	1.---------- 2.----------3.----------
		(b)----------	1.---------- 2.----------3.----------

Codes: uses
1. Home consumption 2. Sell 3.Others, specify_____

(v.) HOUSEHOLD INCOME

27.In order of importance indicate the main sources of income in this household. **[Please rank]**

☐ Sale of drought tolerant food crops ☐Sale of animals ☐ Business

☐ Sale of labour ☐ other ,specify_____

28.How much do you spent on the following items in your household?

	Item	Per day (Ksh)	Per week (Ksh)	Per month (Ksh)	Per year (Ksh)
1	Food				
2	Clothing				
3	Farm inputs				
4	Wages				
5	Medical care				
6	School fees				
7	Others specify				

FOOD SECURITY STATUS

29.What are the main sources of food in order of importance in this house? **[Please rank]**
☐ Own production ☐ Purchases ☐ Food Aid ☐ Others specify_____

30.How many meals do you usually consume per day?

Code:1- One 2 –Two 3 –Three

31. Are there foods you do not eat in this household? 1 Yes 2.No

32. **[If the answer to No.31 is Yes ,Ask]** What are the reasons?

FOOD	REASONS
(a.)	
(b)	
(c)	

Code;

1.medical reasons 2.Food avoidance 3.Social economic reasons
4.Religious/cultural reasons 5.Taboo 6. others, specify_____

33. Do you always have enough food for all the members of your household?

Code: 1 Yes 2 No

34. **[If the answer in No. 33 is NO, ask]** how many months do you usually have scarcity of food in a year?

_____

35. What specific months of food scarcity? _____

36. What measures do you do you take to cope with the food shortage? **[Indicate in order of importance]**

□ Sale of assets □ Reduce the meal size □Reduce the frequency of meals
□Migrate to seek employment □ Others , Specify

37. What do you think contributes to your having/not having enough food?

_____

_____

Questionnaire No_____

FOOD CONSUMPTION

3- DAY LIST RECALL METHOD

38. Indicate what kind of food and amounts have been consumed in the hh in the last 3 days
[Ask systematically for each day]

DAY 1 [3 Days ago]

TYPE OF FOOD	TYPE OF FOOD	INGREDIENTS	AMOUNTS [USE HH MEASURES]	PEOPLE WHO EAT THE FOOD
(a) Breakfast				
(b) Snacks				
(c) Lunch				
(d) Snacks				
(e) Supper				

DAY 2 [2 Days ago]

TYPE OF FOOD	TYPE OF FOOD	INGREDIENTS	AMOUNTS [USE HH MEASURES]	PEOPLE WHO EAT THE FOOD
(a) Breakfast				
(b) Snacks				
(c) Lunch				
(d) Snacks				
(e) Supper				

Questionnaire No._____

DAY 3 [Yesterday]

TYPE OF FOOD	TYPE OF FOOD	INGREDIENTS	AMOUNTS [USE HH MEASURES]	PEOPLE WHO EAT THE FOOD
(a) Breakfast				
(b) Snacks				
(c) Lunch				
(d) Snacks				
(e) Supper				

Questionnaire No._____

FOOD FREQUENCY CHECKLIST

Below is a list of foods, please indicate how many times the food is consumed.

42.Type of food	43.Frequency of consumption per week	44.Freq. of consumption per month	45.Frequency of consumption per 2 month	46.Rarely consumed	47.Never consumed
CEREALS					
Maize products					
Millets products					
Sorghum Products					
Wheat products					
Rice					
Others, specify					
ROOTS AND TUBERS					
Cassava					
Sweetpotatoes					
Arrowroots					
Others , specify					
PLANT PROTEINS					
Beans					
Cow peas					
Pigeon peas					
Green grams					
"Njahi"					
Others , specify					
ANIMAL PROTEINS					
Beef					
Eggs					
Milk					
Fish					
VEGETABLES & FRUITS					
Sukuma wki					
Cowpeas leaves					
Cabbage					
Spinach					
Tomatoes					
Pawpaw					
Oranges					
Ripe bananas					
Others, specify					

Questionnaire No._____

MORBIDITY

Name of the index child_____
Sex_____
Age_____(Months)
Date of birth_____

39. Has the child been sick in the last two weeks? 1 Yes 2. No

40. **[If the answer is yes Ask]** what sickness? [Circle]

1. Coughing
2. Malaria/Fever
3. Skin Disease/scabby
4. Diarrhoea/Vomiting
5. Ringworms
6. Others, Specify_____

ANTHROPOMETRIC MEASUREMENTS

41. [Take the measurements of the child aged 6 to 59 months in the household]

[Take the weight and height for more than 2 years or length for less than 2 years old of the index child in the household]

	FIRST READING	SECOND READING	AVERAGE
HEIGHT (NEAREST O.1CM)			
WEIGHT (NEAREST O.1 KG)			

42.Presence of Edema

1.Yes 2.No

Appendix II

FOCUS GROUP DISCUSSION QUESTION GUIDE

1. What are the main sources of income in your community?

2. What are the factors that affect the crop production in your area?

3. How do you cope with food insecurity?

4. What foods are used in times of scarcity?

5. What can be done to improve food security in your area?

6. What are some of the drought tolerant food crops grown and how are they utilized?

7. What are some of the challenges you face in the growing and utilization of these drought tolerant food crops?

8. Other suggestions.

Appendix III

CONSUMER UNIT

Energy and protein requirements of the various age and sex group expressed in terms of consumer units. One consumer unit is the consumption equivalent in terms of energy and protein respectively of a nominal adult man. Energy requirement of 2960 kcal of adult man (20-29 years) and protein requirement of 50 grams was used (WHO/FAO/UHU, 1985).

	Energy requirements-kcal/cu/day		**Protein requirements-grams/cu/day**	
Age (Years)	Male	Female	Male	Female
<1	0.3	0.3	0.3	0.3
1	0.4	0.4	0.3	0.3
1-2	0.4	0.4	0.3	0.3
3-5	0.5	0.5	0.4	0.4
5-7	0.6	0.6	0.4	0.4
7-10	0.7	0.6	0.6	0.6
10-11	0.8	0.7	0.7	0.7
12-14	0.8	0.7	0.9	0.9
14-16	0.9	0.7	1.1	0.9
16-18	0.9	0.7	1.1	0.9
18-30	1.0	0.7	1.0	0.8
30-60	0.7	0.7	1.0	0.8
>60	0.7	0.7	1.0	0.8

Appendix IV

FOOD CONVERSION TABLE

TYPE OF FOOD	SELLING PRICE	WEIGHT (Edible portion)
Loaf of Bread	-	400g
1 kg Tin of maize	-	820g
1kg Tin of Beans	-	800g
1kg Tin of pigeon peas	-	890g
1 sack of sweet potatoes	-	105kg
1 Sack of cassava	-	115kg
1 sack of pumpkins	-	100kg
Sukuma wiki	5/-	243.5g
Sukuma wiki	10/-	486.4g
Sukuma wiki	15/-	729.6g
Sukuma wiki	20/-	962.8g
Tomatoes	5/-	156.5g
Tomatoes	10/-	313.0g
Irish Potatoes	5/-	210.3g
Irish potatoes	10/-	420.7g
Cabbage	10/-	460.0g
Cabbage	20/-	945.0g
Cassava (Medium)- 1 piece	-	2.5kg
Paw paw (medium)		666g
Ripe bananas	10/-	400g
Pumpkin (Medium)	-	1.85kg
Pumpkin (Large)	-	3.5kg
Fat	5/-	50g
Fat	10/-	100g
1 Egg	-	44g

Appendix V

MAP 1. MAKUENI DISTICT (showing the location of study area)