POPULATION DYNAMICS AND FOOD SECURITY ON THE SLOPES OF MOUNT RUNGWE, MBEYA REGION, TANZANIA

BY

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ABSTRACT

Out-migration from the slopes of Mount Rungwe in Rungwe District to other districts is high despite the district having fertile land. Moreover, food security is not satisfactory; many people of Rungwe buy various food crop products from other districts. Therefore, this study was conducted with the specific objectives to: Record population dynamics in terms of birth, death, in–migration and out–migration rates; Estimate dietary energy consumption (DEC) per adult equivalent per day; Estimate proportions of households below the recommended minimum level of DEC (2,280 Kcal); and Determine associations between the above population dynamics elements and DEC. It was found that the birth rate was 48 births, the death rate was 35 deaths, the in-migration rate was 18 persons, and the out-migration rate was 33 persons, all per 1,000 population. The average DEC was 3,407 Kcal, but 29.7% of households were food insecure. T-test results showed no statistically significant difference ($p > 0.05$) in DEC between households with a newly born member and those without such a member, and between households having in-migrants or out-migrants and those without in-migrants or out-migrants. However, there was statistically significant difference at the 5% level ($p = 0.027$) in DEC between households where at least one member had died and those where there had been no death, and in households that were living at lower and those that were living at higher altitudes ($p = 0.016$). The conclusion is that household food security on the slopes of Mount Rungwe is not much affected by new births and in- or out-migrations, but it is much affected by death of household members and living at higher altitudes of the mountain. To increase food security, it is recommended that, among other things, mortality be checked and people refrain from living at higher altitudes of the mountain.

DECLARATION

I, Sarah Novaty, do hereby declare to the Senate of Sokoine University of Agriculture that the content of this dissertation is my own original work, which has never been submitted for a higher degree award in any other University.

Signature .....Novaty.....

Date .....28 - 10 - 2005.....

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LIST OF ABBREVIATIONS

AAEU	Adjusted Adult Equivalent Units
AE	Adult Equivalent
AEU	Adjusted Equivalent Units
AIDS	Acquired Immuno-deficiency Syndrome
BS	Bureau of Statistics
CBOs	Community-Based Organisations
CSD	Child Survival and Development
DAO	Division Agricultural Officer
DEC	Dietary Energy Consumption
DHS	Demograghic and Health Survey
DR	Death Rate
Dratio	Dependency ratio
DSI	Development Studies Institute
ERS	Economic Research Service
FAO	Food and Agriculture Organization of the United Nations
FBOs	Faith-Based Organisations
FHHs	Female–Headed Households
Ha	Hectare
HHs	Household Heads
GM	Gross Migration
GoT	Government of Tanzania
IFAD	International Fund for Agricultural Development
IR	In-Migration Rate

Kcal	Kilo calories
Kg	Kilogram
Km^2	Square kilometres
m. a. s. l.	Metres Above Sea Level
MAFS	Ministry of Agriculture and Food Security
MHHs	Male–Headed Households
mm	Millimetres
MoA	Ministry of Agriculture
Mt.	Mount
NBS	National Bureau of Statistics
NFAs	Non-farm Activities
NGOs	Non–Governmental Organizations
NM	Net Migration
NR	Net Migration Rate
OR	Out-Migration Rate
PRSP	Poverty Reduction Strategy Paper
PSP	Population Strategy Programme
r	Pearson's Moment Correlation Coefficient
Rev.	Reverend
SACCOs	Savings and Credit Co-operative Society Ltd
SADC	Southern African Development Community
SPSS	Statistical Package for Social Science
SSA	Sub Saharan Africa
SUA	Sokoine University of Agriculture
TDHS	Tanzania Demographic and Health Survey
TRCHS	Tanzania Reproductive and Child Health Survey

Tshs	Tanzania Shillings
U5MR	Under Five Mortality Rate
UN	United Nations
UNICEF	United Nations Children's Fund
URT	United Republic of Tanzania
VALEOs	Village Agricultural and Livestock Development Officers
VEOs	Village Executive Officers
WB	World Bank
WBI	World Bank Institute
WHO	World Health Organization
WPM	World Population Monitoring

CHAPTER ONE

INTRODUCTION

1.1 Background information

Population dynamics and food security are related. For example, when population increases it can lead to the condition whereby people can not get sufficient food either in the household or within the country, i.e. food insecurity. Population dynamics involves changes in population size and structure that is brought about by mortality, migration and fertility (Wilson, 1985). It is otherwise called population change, and embodies three main components, viz. births, deaths, and migration (Haupt and Kane, 2000). Food security is having physical and economic access to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life (FAO 1997, cited by URT, 1999). According to the same source of information, food insecurity is indicated by the proportion of population who are unable to get two meals a day and the proportion of households that are unable to get 270 kg of grains per adult per year. Other indicators are the proportion of villages/wards/districts with food storage facilities, average acreage of cultivated land per household, and the proportion of households using hand hoes, oxen drawn implements, or tractors. However, those are proxy indicators of food security. The actual indicator of food security is dietary energy consumption (DEC) (URT, 1999).

Globally, at the end of 2004, the number of the undernourished was 852 million (FAO, 2004). Since 1969 – 1971, the number of food insecure people in sub-Saharan Africa doubled, reaching 180 million people or around 34 percent of the total population in 1997 – 1999 (WBI, 2001). In the 1990s, food production levels in the majority of countries in the SADC region either declined or remained stagnant while the population growth rate continued to rise (Nyange, 2001). The above-mentioned phenomena have resulted into food

insecurity. Tanzania is one of the countries in Africa South of the Sahara where food insecurity is a threatening problem that needs to be addressed urgently. According to URT (2001a), current estimates are that around 42% of Tanzania's households have inadequate food regularly. Moreover, 27% of the Tanzania's population live in households with expenditures that are insufficient to obtain enough food to meet nutritional requirements (URT, 2000a).

The concept of food security became more apparent in 1974 when, for the first time, there was global concern about food supply (Nyange, 2001). The roots of concern with food security can be traced back to the world food crisis of 1972 – 74, and beyond that to the Universal Declaration of Human Rights in 1948, which recognized the right to food as a core element of an adequate standard of living (UN 1948, cited by Maxwell and Frankenberger, 1992). Existence of chronic food insecurity in a society is a reflection of poverty. Poverty arising from lack of access to sufficient land and capital, unemployment and political instability has resulted into chronic food insecurity in some SADC countries. Chronically food–insecure households constitute the most important risk group that, for policy purposes, should be considered as the primary target group for interventions geared to alleviate food insecurity (Nyange, 2001). The efforts by the Tanzanian government to improve food security include to assure basic food security for the nation, to improve national standards of nutrition by increasing output, quality and availability of food commodities, to increase food crops production through productivity and area expansion, to introduce and develop new technologies which increase the productivity of labour and land, and to improve crop processing technologies (URT, 1997a). Nevertheless, the situation is still worse because Tanzania's agriculture does not depend only on poor tools for most of her farmers but also on rainfall, which is precarious. This makes Tanzania's agriculture vulnerable to weather changes, especially uneven distribution of rainfalls. Household food

insecurity is widespread and chronic in some areas of Tanzania for example Dodoma and Singida, since there seems to be a certain degree of food deficit at one time or another during the year. This is especially true a short time before the harvesting season.

Population growth is one of the most important factors influencing food security. Population growth occurs in various ways globally through high birth rates and moderate death rates, through low birth rates but even lower death rates, and through net migrations (Mtatifikolo, 1996). Population growth rate is the number of persons increasing to or decreasing from a population in a year due to natural increase and decrease (birth and death) and net migration expressed as a percentage of the population at the beginning of the time period (Haupt and Kane, 2000). The former has both positive and negative influences on food security. When the population growth is higher than the agricultural growth, normally the end result is food insecurity, and the vice versa of it is also true, i.e. when agricultural growth is higher than population growth, the population is assured of getting sufficient food and hence food security.

The above mentioned population dynamics elements (births, deaths and migration) may influence food security positively or negatively. For example, if in-migration is higher than out-migration the population may increase to the extent of causing food insecurity in the area or in the household. Similarly, when birth rate is low, and specifically with low fertility rate, it becomes a little bit easier to feed the household members. This results into food secure situation. The role of population is to ensure that agricultural productivity increases to the extent that food is sufficient for all by working hard in their fields. It is important that each household produce sufficient food for its members so as to improve food security situation in the households. It is more likely that if each household manages to work hard and produces sufficient food, even the whole country will be food secure. This is especially

so for the rural populations who are the majority in developing countries and who depend solely on agriculture for their livelihoods.

The Government of Tanzania emphasizes that population size only exacerbates food insecurity situation but it is actually influenced by several factors including poor technology transfer, use of marginal lands for farming, inappropriate land management practices, poor rural infrastructure to support the private sector, participation in marketing and distribution of food; lack of non–farm opportunities, and remoteness (MoA, 1997, cited by PSP, 2003). The World Bank also supports this view (WB, 1990, cited by PSP, 2003).

1.2 Problem statement

Rungwe is one of the districts in Mbeya Region that has land that is suitable for agricultural production. Moreover, the District is one of the" big four regions" of Tanzania that produce a substantial amount of foodstuffs. The other regions are Iringa, Rukwa and Ruvuma. Hence it is supposed to produce a lot of foodstuffs that cannot only suffice the people living within the district but can also be transported to other regions of the country that are producing small amounts of foods. The food crops that are grown in Rungwe District include plantains, sweet potatoes, round potatoes, yams, paddy, maize, beans and groundnuts; and cash crops grown include coffee, tea, cardamom, cocoa and pyrethrum. Rungwe District is the main producer of plantains in the region where it contributes not less than 50% of the total regional production of banana (URT, 1997b). Moreover, on the average it ranks fourth in beans production in the region (URT, 1997b). The district produced 13.0%, 12.3% and 12.8% of the total regional share for years 1992/93, 1993/94 and 1994/95, respectively (URT, 1997b).

Despite the fact that the slopes of Mt Rungwe are endowed with good fertile soils, hence high agricultural potential, out-migration to other districts is still high and the food security situation is unsatisfactory (Oadgaard, 1997). The situation is evidenced by the fact that the people of Rungwe District normally buy maize, rice, round potatoes and other food crop products from other districts of Mbeya Region, especially Mbeya District (maize and round potatoes), Mbozi District (maize and beans), and Kyela District (rice) (URT, 1997b). The fact that the people of Rungwe import food commodities from other districts is an indicator of food insecurity in the area.

One of the reasons for food insecurity is the fact that the District is the most densely populated area in Mbeya Region, with the population density of 139 persons per square kilometre (URT, 2003a). The other reasons for food insecurity in the District include unavailability of land for further expansion, which is caused by overpopulation, use of outdated agricultural methods, employment of inferior agricultural implements and diminishing soil fertility (URT, 1997b). Since Rungwe District and the slopes of Mt Rungwe have much potential for agricultural production and the population growth in the District is low (2.4% against the national population growth rate of 2.9%) (URT, 2003a), the above stated food insecurity would not be expected. Therefore, this study was important to determine what factors actually contribute to food insecurity with respect to population dynamics components and the other factors listed above.

1.3 Justification of the study

Previous studies on food security in mountainous areas in Tanzania have focused on the relationship between population pressure and food security (e.g. Mbonile, 2000). Population pressure is just one element of population dynamics. Little had been done on the major

components of population dynamics and food security, particularly on the slopes of Mount Rungwe. As such, there was information gap on the effects of population dynamics on food security. Therefore, this research was worth doing to fill in the information gap by determining the extent to which population dynamics elements, viz. births, deaths and migration affect food security, and comparing the effects of population dynamics and other factors on food security. The empirical information generated by the research might be useful for development planners, policy makers and development specialists in relevant ministries (especially Ministry of Agriculture and Food Security), NGOs, Rungwe District Council Management, and other institutions interested in improving food security situation in Tanzania. Moreover, the findings from the study will assist in designing new or improving existing food security strategies in Tanzania. In the Poverty Reduction Strategy paper (PRSP) of 2000, the Government plans to reduce by half food insecurity in Tanzania by the year 2010 (URT, 2000a).

1.4 Research objectives and hypotheses

1.4.1 General objective

The main objective of the research was to determine the effects of population dynamics on food security so as to generate empirical information on which the Ministry of Agriculture and Food Security (MAFS), non-governmental organizations (NGOs), community-based organisations (CBOs), faith-based organizations (FBOs) and farming communities might base strategies to improve food security in the area.

1.4.2 Specific objectives

The study intended to achieve the following specific objectives:

(i) Record the rates of birth, death, in- and out-migration;

(ii) Estimate dietary energy consumption in households' routine meals;

(iii) Estimate the proportions of households below the minimum level of dietary energy consumption per adult equivalent; and

(iv) Determine associations between birth rate, death rate and migration on one hand and amounts of dietary energy consumed on the other hand.

1.4.3 Hypotheses

The following null hypotheses were tested:

(i) Dietary energy consumption is not significantly correlated with addition of a person in the household.

(ii) Dietary energy consumption is not significantly correlated with survival of household members.

(iii) Dietary energy consumption is not significantly correlated with migration of household members.

(iv) There is no significant difference in dietary energy consumption between households having lower dependency ratio and those having higher dependency ratio.

(v) Dietary energy consumption does not differ significantly between households producing less and those producing more food.

1.5 Conceptual framework

The conceptual framework is a narrative outline presentation of variables to be studied and hypothetical relationships between and among the variables. The types of variables shown in the conceptual framework for the research are: background variables that include age of household head, sex of household head, marital status of household head, main occupation

of household head, education, non – farm activities done in the household, and household composition. The independent variables include land, income, food production, birth rate, mortality rate, migration, household size, adult equivalent units, dependency ratio and access to productive resources and benefits by gender. These variables influence the dependent variable, which is food security, i.e. dietary energy consumption per adult equivalent. The conceptual framework is shown in Figure 1 and the key variables are defined in Table 1.

Table 1: Operational definitions of key variables

Variable	Definition
• Land	• Acreage under cultivation
• Income	• Net monetary values of products and services by all household members per year
• Food production	• Amount of food crop products harvested per year
• Household size	• The number of persons living in a household
• Dependency ratio	• The ratio of persons in the dependent ages (under age 15 and over 64 years) to those in the economically productive ages (15 to 64 years) in a population
• Adult equivalent units	• Number of household members by age and gender adjusted to be equivalent to adults
• Birth rate	• The number of children born per 1,000 population in a year
• Mortality rate	• The number of deaths per 1,000 population in a year
• Migration	• The number of persons coming in and out of the household
• Access to productive resources and benefits by gender	• Access to productive resources such as land, equipment, skills, credit and technology and benefits by males or females
• Food security	• Dietary energy consumption per adult equivalent (DEC/AE)

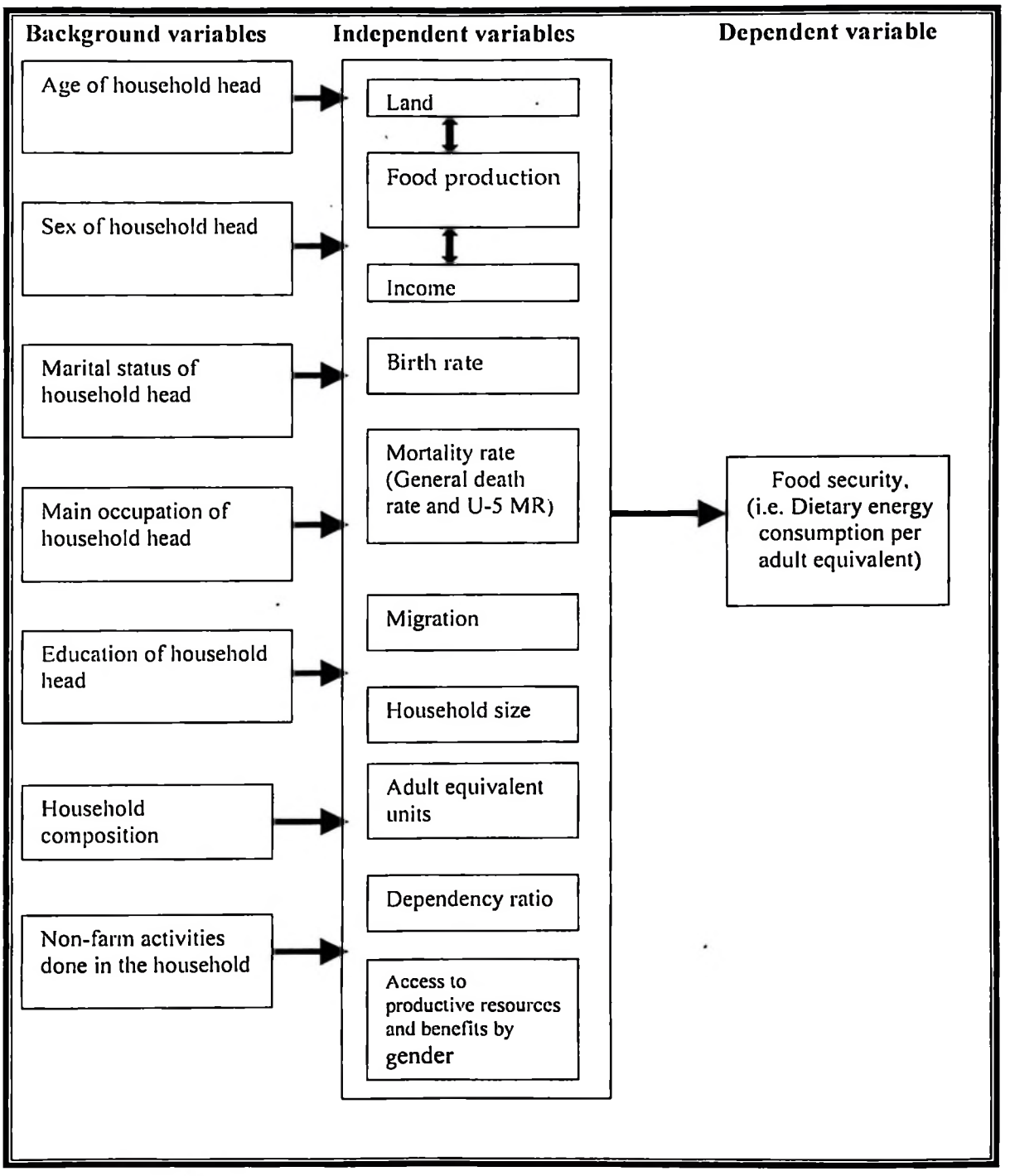

Figure 1: Conceptual framework for the research

CHAPTER TWO

LITERATURE REVIEW

2.1 An overview

In chapter one the background information on population dynamics and food security was provided, whereby also the relationship between the two was described. In this chapter, a review of what is known about population dynamics and food security is discussed. This chapter begins by defining food security at different levels, thereafter the relationship between population and food security is discussed. It is followed by a discussion on the relationship between population dynamics components and food security, and finally other factors influencing food security are discussed.

2.2 The concept of food security

The food security concept has been given different definitions and received varying interest in the past (Rukuni and Eicher, 1987; Yongyout and Sakorn, 1992). In the 1970s food security was mostly concerned with food supply, usually in the form of grain stocks and was being applied at regional or district levels (FAO, 1983, cited by Ishengoma, 1998). In the 1980s, the focus shifted to questions beyond supply, where it also included access to food at household as well as individual levels (Maxwell and Frankenberger, 1992). The authors point out that many definitions and conceptual models all agree that the key defining characteristic of household food security is "secure access at all times to sufficient food" whereby sufficiency, access, security and time are in turn dealt with. However, the World Bank's definition of food security, "access by all people at all times to enough food for an active and healthy life", has been widely accepted (Maxwell, 1990). The author adds that the above definition encompasses two elements, viz. food supply and the access or the ability of a household to acquire food, either through their own production or purchase.

FAO has defined the objective of food security as assuring to all human beings the physical and economic access to the basic foods they need (WBI, 2001). This implies three different aspects: availability, stability and access. The definition is clearly stated in terms of food security for each individual, and it can be argued that it is the most meaningful definition of food security (WBI, 2001). At the national level, food security is defined as a satisfactory balance between food demand and food supply at reasonable prices (WBI, 2001). At the household level, food security is defined as "Physical and economical access to adequate food for all household members without undue risk of losing such access" (WBI, 2001). The household level of food security is probably the most important for the analysis, in so far as the household is the basic economic unit, which determines the level of consumption by the individual (WBI, 2001).

In most analyses, there is a presumption that income comes to the household as a whole, resource allocation decisions are made at the household level and household consumption is divided amongst its members in some relation to the needs of the individuals (WBI, 2001). The source further points out that at this level, households are identified as food secure if their entitlements, or demand for food is greater than their needs, defined as the aggregation of individual requirements. Household food security prevails if the actual food intake of all household members are due to fulfil their dietary requirements is secured in terms of both quantity and quality throughout the year (Lorri and Kavishe, 1990). Food security at the household level is influenced by a variety of factors including food production, cash crop income, non – farm income, household size and composition, access to market and food prices (WBI, 2001). Moreover, it is influenced by an increase in the number of persons living within a household, either by a natural increase (birth) or by in-migration. Food production and income are in turn influenced by farm size and land quality, availability of labour, equipment, access to credit and management skills (WBI, 2001).

At the individual level, an individual is food secure if his or her food consumption is always greater than his/her needs, as defined by physiological requirements. Consumption is determined by the claim the individual has on household food resources. This may be affected by individual earnings and assets as well as by the individuals' positions in the household (WBI, 2001). Local food security focuses on the household and the individual members of households having access to sufficient food for an active and healthy life. But this depends on their income, work, health (linked to nutrition) and distribution of food within the household, as well as on local food supplies and costs of other essential daily consumer items, i.e. water and fuel (Hubbard, 1995).

Food insecurity is the lack of access to enough food (Maxwell, 1990). A household is said to be food insecure when it fails to meet its dietary food intake in terms of quantity and quality (Lorri and Kavishe, 1990; Kajumulo, 1993). Food insecurity exists when there is inadequate food for the people who need it. This situation can arise either due to inadequate food production and problems in distributing this food to the people who need it or because the people cannot afford buying the food that is available (URT, 1992).

The World Bank's perspective of time-frame defined food insecurity as either chronic or transitory. Chronic food insecurity is a persistent lack of a household's ability either to buy or produce enough food (Maxwell, 1990). Transitory food insecurity is a condition that occurs when a household gets a temporary decline in the security of its entitlement as a result of instability in food production and prices or household incomes. The risk of failure to meet food needs is of short duration in transitory food insecurity (Maxwell and Frankenberger, 1992). The worst form of transitory food insecurity is famine (Kavishe, 1993, cited by Ishengoma, 1998). Transitory food insecurity can be divided into temporary and cyclical food insecurity. Temporary food insecurity occurs for a limited time due to

unforeseen and unpredictable circumstances, where cyclical or seasonal food insecurity occurs when there is a regular pattern in the periodicity of inadequate access to food (CIDA 1989, cited by Maxwell and Frankenberger, 1992). Seasonal food insecurity may be brought about by logistical difficulties or prohibitive costs in storing food or borrowing (Maxwell and Frankenberger, 1992).

There is evidence to suggest that household food insecurity is widespread and chronic in some areas since there seems to be a certain degree of food deficit at one time or another during the year. This is especially true for a short time before harvesting season (Mosha *et al.*, 1992, cited by Ishengoma, 1998). Kennes (1990), cited by Maxwell and Frankenberger (1992), argues that a necessary condition for achieving food security is that resources be well used. While the country as a whole may be food secure, different regions may experience varying degrees of food security as a result of natural resource endowments, differences in purchasing power, logistic and infrastructure, access to markets, trade and imports (Bender and Smith, 1997).

2.3 Population and food security

Population growth and food security are negatively correlated in most cases but not always. It is particularly so in poor countries where agricultural intensification is not possible. In rapid population growth normally there are many mouths to feed resulting in food insecurity. Moreover, population pressure has indirect relationship with food security. In high population pressure normally there is imbalance between people and resources. For example, in a very high population pressure normally the land becomes scarce in such away that people do not get enough space to cultivate. Consequently, they get very low yields thereby increasing food insecurity. Household food insecurity affects a wide cross-section of the population in both rural and urban areas. The food insecure socio-economic groups

may include; farmers with limited access to natural resources and inputs, landless people, refugees and displaced persons, immigrants, workers, pastoralists, FHHs, unemployed or underemployed people and the urban poor (FAO, 1992). Increasing the productivity and incomes of these groups requires adopting multiple policy instruments and striking a balance between short-term and long – term benefits (FAO, 1992).

Worldwide, enough food is produced to feed everyone, but the food that is produced and the technology used to produce it do not always reach those in need (Lean *et al.*, 1990). The authors further add that consequently, nearly 1,000 million people do not get enough to eat and over 400 million people are chronically malnourished. Moreover, every year 11 million children under the age of five die from hunger or hunger-related diseases (Lean *et al.*, 1990). In the early 1960s, global food supplies for direct human consumption stood at only 2,300 calories per person per day, and it was very unequally distributed (Lean *et al.*, 1990). The authors further point out that, between the 1960s and the 1990s, the world population more than doubled but agricultural production increased even faster. By 1994, global food supplies for human consumption had climbed to 2,710 calories per person per day, and the percentage of chronically undernourished people in the developing world had been reduced to 20% (Lean *et al.*, 1990).

"World hunger is extensive in spite of sufficient global resources. Therefore increased food production is no solution. The problem is that many people are too poor to buy readily available food. Therefore, measures for solving the poverty problem are required to solve the world hunger problem" (Lean *et al.*, 1990). The authors further contend that people suffer from food insecurity not because the population is growing so fast that the food is becoming scarce, but because people cannot afford buying it. Tanzania produces approximately 97% of its food requirements, and the food production has been increasing at

about 3.5%, while the population growth is about 2.8% per year (Keenja, 2001, cited by PSP, 2003). According to the same source, in "The State of Food Insecurity in the World 2002" by FAO, Tanzania was estimated to have 48% of its total population that are undernourished. Moreover, the Tanzania's food status is insecure, being indicated by the fact that 27% of the population live in households with expenditures that are insufficient to obtain enough food to meet nutritional requirements (URT, 2000a).

Stiles and Brennan (1986) assert that 30 – 35 million people suffered the effects of famine in Africa in 1985 in spite of good rains. The authors add that the main causes of insufficient food production are land degradation and desertification coupled with high population growth. Jallow (2004) asserts that one – third of the African countries are below the recommended calorie intake level of 2,100. The author further points out that two hundred million people are undernourished that is, their access to the minimum amount of calories recommended is inadequate and that is an increase of 20% since 1990. This number represents 27% of the African population and almost 33% of Sub – Saharan Africa (SSA).
In most cases, hypothetical population growth effects on technological change, and more broadly on total productivity, are those of size rather than of other proximate consequences (Nicoll, 1984). It is argued that population size to some extent governs market demand and scale economies in production and can produce similar economies in the provision of infrastructure (Nicoll, 1984). Technologically, there is strong evidence of population induced innovation in some agricultural settings; but there are as well cases where rapid population growth has been accompanied by stagnant productivity or by labour – saving rather than labour – using technical process thereby resulting in food insecurity (Nicoll, 1984).

Population's overall impact on agricultural production per capita is both positive and negative. Which force dominates is an empirical issue that varies from country to country and over time (WPM, 2000). On the one hand, the traditional framework of Malthus emphasizes the negative force of diminishing returns, which holds that, other things equal, population pressing against limited land will eventually result in declining labour productivity and real wages. On the other hand, this negative force can completely or in part be offset, or even dominated by improvements in technology, expansion of the quantity or quality of land or other factors, and realization of internal and external (e.g., transport) economies of scale. Importantly, these positive forces can be and often are directly caused by the pressures of population growth (Boserup, 1965).

Which demographically induced forces dominate, and under which conditions, have been the thrust of the empirical literature of the analysis of food and population linkage (WPM, 2000). According to WPM (2000), to date the outcome has been encouraging. For most of the world's population, diets have improved markedly; consumers have faced declining real food prices over long periods of time, and the incidence of malnutrition has been significantly reduced (WPM, 2000). According to the same source, world food production per capita increased by more than 20% over the period 1961 – 1994. The most rapid increase has been in the developing countries, where population more than doubled and food calories available per person rose from roughly 1,900 to 2,600 kcal per day (for developed countries was 3,000 to 3,200 kcal) (Bender and Smith, 1997). There was considerable regional variation around these averages: growth in production and daily caloric intake was fastest in East Asia and Latin America, and it was slowest in sub-Saharan Africa (WPM, 2000).

Kendall and Pimentel (1994), cited by WPM (2000), assert that there is growing imbalance between the world's population and the resources that support human lives. For example, the per capita availability of world grains, which make up 80% of the world's food, has been declining for the past two decades. The above authors further point out that with a quarter million people being added to the world population every day, the need for grains and all other food types will reach unprecedented levels. Hunger is a familiar companion to millions of people worldwide. United Nations experts estimate that perhaps half a billion of the world's 3.8 billion inhabitants in the late 1970s were hungry everyday (Sobel, 1975). Only the developed nations produce enough food or earn enough money for food to keep the average citizen reasonably well fed. As a result, malnutrition is the fate of most of the people of the developing countries of Asia, Africa and Latin America (Sobel, 1975). The author argues that the explosive growth of world population is widely designated as the dominating factor in the problem of food scarcity. Wortman and Cummings (1978) assert that the world food situation is alarming, but increased food production is only a part of the solution.

Alexandratos (1995) points out that food availabilities worldwide are not equally distributed. At the one extreme, Western Europe's per caput food availabilities stand at some 3,500 Kcal; those of North America at some 3,600 Kcal. At the other extreme they are only 2,100 calories in sub-Saharan Africa and 2,200 calories in India and Bangladesh together. Therefore, the author concludes that, for a large part of the developing world, food availabilities are far from being adequate for all people to have access to sufficient food at all times, for their food security. Table 2 shows that food availabilities worldwide are not equally distributed.

Table 2: Food availability worldwide: calories per caput per day

Region	1983/85	2000
Africa (sub-Saharan)	2050	2190
Near East/N. Africa)	2980	3100
Asia	2380	2610
Latin America	2700	2910
Low-income countries (excluding China)	2130	2350

Source: Alexandratos (1995)

Sobel (1975) points out that in his first Essay on the Principle of Population, published in 1798, the English Cleric and political economist Rev. Thomas Robert Malthus had postulated that, since "population, when unchecked; increases in a geometric ratio" and that "subsistence (food) increases only in an arithmetical ratio", there must be "a strong and constantly operating check on population" or ultimately there would be too many people for the food available. Malthus held that this check was "misery and vice". Malthus's theory has been widely criticized, and he himself revised it in later editions. However, the major aspects of his idea have always enjoyed considerable acceptance. Malthus came to the conclusion that inevitably, therefore, food supplies were going to be insufficient to provide for the population and that hunger and want and starvation were the natural lot of men (Sobel, 1975).

Shortly after Rev. Thomas Robert Malthus wrote, there came some striking developments, the advance of technology and the opening up of the New World, and in the Western World for quite a time. Contrary to Malthus, the food supply ran ahead of the population growth (Sobel, 1975). However, meanwhile, in much of Asia and African continents the Malthus principle is still operating, as many people in these continents suffer from hunger and starvation and consequently they are food insecure. The then U.N. Secretary General Kurt Waldheim, linked excessive population growth to future scarcity of food, energy and raw

materials as well as to poverty and he said all of the problems were "leaping over" national boundaries (Sobel, 1975).

Boserup (1965) asserts that in regions with little or no virgin land, the scope for further intensification may be very high. If population is growing at a rapid rate in such regions normally sufficient food cannot be produced unless agriculture is equipped with modern means of production from industries, and that the additional rural population cannot be employed in agriculture, but must be transferred to urban activities or remain unemployed or under-employed (Boserup, 1965). Boserup (1965) further points out that rural under-employment would emerge when settlement has become so dense that the reserve of virgin cultivable land has been used up much regardless of whether the population is growing rapidly or slowly. Boserup (1965) adds that with rapid population growth, the process of intensification would need to take place much more quickly than with slow population growth. In the former situation the period might be described as the period of agricultural resolution.

In recent years, the sub – Saharan Africa has experienced falling per capita income, food shortage and accelerated environmental degradation (FAO, 1991, cited by Turuka and Kimbi, 2001). The authors add that the cumulative impact of the above factors, reinforced by unregulated demographic pressure, has a destabilizing effect on the overall agricultural productivity leading to food insecurity.

Food shortage is a result of inability of most countries in SSA to produce, purchase and even stock enough food to satisfy demands due to rapid population growth (FAO, 1980; Milich, 1997). For example, in August and September 2002, the United Republic of Tanzania conducted a population census. The total population in 2002 was about 34 million.

Generally, the annual rate of population growth in Tanzania is 2.9% (URT, 2003b). Table 3 shows the increase and projections in population in Tanzania.

Table 3: Population in Tanzania and Projection 1980 – 2010

Year	1980	1985	1990	1995	2000	2005	2010
Population (million)	18.0	20.1	23.8	28.1	32.5	37.4	43.0

Source: Bureau of Statistics (1996, cited by Ishengoma, 1998)

The population is increasing dramatically. Agricultural production has more than kept up with population growth (Table 4), except for 1991 – 1995.

Table 4: Tanzania annual grain production and population growth

Year	Grain production growth (%)	Population growth
1981 – 1990	5.8	3.2
1991 – 1995	2.8	3.0
1996	-	2.5
2002	3.5	2.8

Source: Economic Research Services (2002)

The balance between population size and food supply is the most basic challenge humans face (Bender and Smith, 1997). Tanzania has potential to expand food production. Any increase in the use of inputs, such as fertilizer, could substantially improve production (Bureau of Statistics, 1996, cited by Ishengoma, 1998).

2.4 Relationship between population dynamics and food security

Murphy (1984) argues that despite the decline in the world population growth rate, birth rates continue to greatly exceed death rates. The author further points out that the existing world hunger is due to economic imbalances among and within nations, rather than

biological limits of food production. Almost all of the estimated 500 million undernourished people are in developing countries among which Tanzania is.

Population pressure may result from an increase in the number of people, a decline in the resources (for example, soil depletion), a decline in the demand for labour or a combination of factors. Over population can occur anywhere, in rural or urban areas, in a locality or in a nation or at international and global levels (Maro, 1974). There is an optimistic view which maintains that population increase may, by stimulating transformations in the farming systems, have a favourable impact on economic development (Clark, 1967, cited by Maro, 1974). In a similar way, land degradation, as caused by increased activities on land, e.g. afforestation coupled with increased population, may constitute a threat to provision of food and other basic needs, and inability to counteract it may aggravate the situation (Larrson, 1999).

Madulu (1999) argues that rapid population growth, if not accompanied by agricultural intensification, may be an obstacle to sustainable agriculture. In conditions of poor agricultural management high population growth stimulates deforestation, land degradation and land fragmentation. The above factors have an impact on agricultural productivity and sustainability particularly in the semi-arid zones of central Tanzania, which have the most delicate ecosystem, thus leading to food insecurity (Madulu, 1999).

According to the Boserup hypothesis, increases in population density lead to greater agricultural production and more intensive land use through the unleashing of market forces. Such spontaneous movement toward higher levels of technology and productivity occurred in Europe and Asia (Lele and Stone, 1989). The authors add that in Africa, however, there is evidence that the environmental damage caused by deforestation, reduced

soil fertility, and reliance on subsistence and wage labour overweighs the beneficial impact of autonomous intensification. Large family size has failed to produce social or individual gains for large families at low levels of labour productivity. Though Boserup (1965) argued that an increase in population may stimulate intensification and technological change, evidence from many parts of Tanzania have shown a delayed technology change to cope with population pressure especially in semi – arid rural area of central Tanzania (Madulu, 1996). This delay has actually stimulated land fragmentation, land use conflicts land competition, out – migration and land degradation as observed in the slopes of Mt. Kilimanjaro, Ukara Island and the Kondoa Irangi Hills (Madulu, 2004).

Population will naturally move toward the most productive land in the absence of policies that discriminate against smallholders or constrain population movement, and will migrate outward when land in high potential areas is unavailable (Lele and Stone, 1989). The authors further point out that the population pressure require shifts to higher yielding crops but interventions may be necessary to persuade small farmers to use modern planting materials and methods and to grow higher value crops for increased yields thereby improving food security. Mbonile (1995a) argues that the deepening of the economic crisis coupled with the removal of food subsidies subjected urban and long – distance migrants to food insecurity. Hence as a survival strategy the migrants returned to the area of origin or to neighbouring towns where it was easy to get land to cultivate their own food or get supplementary food from relatives in rural areas (Mbonile, 1995a).

Studies on environment and population growth have been carried out by Maddox, 1996, cited by Liwenga (2003) who found out that by failing to cope with food insecurity under the harsh semi – arid conditions, there has been a history of out – migration of young men leaving particularly women and children behind. Boserup (1985) argues that the experience

of many developing countries has shown that the high rates of population growth are compatible with rapid economic growth over periods. The author adds that area with sparse population and long – fallow systems from which labour migrates in search of employment has sub marginal land or is over populated. The author further points out that when most or all food is produced by women and children, adult men can leave the village in large numbers, not only for seasonal work but for several years. Moreover, a man does not forfeit his right to land assignment by migration, since he can reassert this right when he returns to the village. These features have contributed to the high mobility of Africa's rural male population and the excessively heavy workloads of many African women.

It has been documented by various studies that rural – urban migrants originate from rural areas with rapid population growth, leading to these areas to experience high population pressure and land deterioration (Mbonile, 1994). The problem is aggravated by the dominance of subsistence economy in most rural areas that results in low productivity and consequently failing to satisfy both food and monetary demands of rural population (Mbonile, 1994). It is expected that out – migration will occur in region, with population pressure, hostile climates or depressed economic condition (Mtatifikolo, 1992). The author adds that rural-urban movements during the late 1960s to early 1970s were related to the support for co-operatives and communal, socialist villages.

A study by Madulu *et al.* (1993); which was conducted by using pastoral and agro-pastoral communities such as Barabaig, Maasai and Sukuma; showed that population migration has been a function of both internal and external influence. The internal factors include population increase, food shortages and agricultural expansion into the hinterlands. The external factors include invasion of the pasturelands by small and large – scale farmers, drought and cattle raiding (Madulu *et al.*, 1993). The above factors play the role of push

factors in the push – pull theory of migration. According to another study that was conducted in Makete district by Mbonile in 1992, results showed that population pressure was not a major determinant of migration in the district due to low population growth and high out – migration (Mbonile, 1994).

According to Mbonile (1995b) population movements are not only concerned with seeking employment or new settlement. The author further points out that nevertheless, several studies assume that in most cases out – migration is one of the manifestation of rural population pressure which indicates an imbalance between human beings and resources which support them (Clarke, 1965, cited by Mbonile, 1995b). Usually, as the population increases and requires more from a limited resource base it may lead to environmental deterioration or land use intensification due to technological change. Nevertheless, more often this imbalance causes soil erosion, deforestation, landlessness and population out-migration (Boserup, 1965; Van Donge, 1992, cited by Mbonile, 1995b). However, it is important to note that not all areas with population pressure experience population out – migration. This automatically indicates that there are other factors that influence migration. Most studies on migration indicate that the household composition and division of labour are the most important factors that determine the participation of a household in migration. For example, studies by Gulliver (1955, 1957), cited by Mbonile (1995c) indicate that there is more male labour migration than females because most of the domestic and subsistence household labour is carried out by females.

Mbonile and Mwamfupe (1997) argue that the rising population and land deterioration have put more and more people on a survival margin that is below subsistence level and eventually forcing them to invade other areas. The authors add that the Usangu plains in Mbeya Region is one of the areas of destination which has received several in – migrants

from diversified ecological conditions and their arrival has put more stress on the ecology of the plain.

2.5 Population, income and food security

Sobel (1975) points out that when one considers about income, food is expensive as well as scarce in poor countries (where 70% of the world's population live) but relatively cheap as well as abundant in rich lands. He further points out that the American consumer spends only about 16% of his disposable income on food. By comparison, the proportion of disposable income spent on food is about 25% in Britain, 35% in Japan, 58% in the Soviet Union, 80% in much of Asia and as high as 90% in many developing countries among which Tanzania is. In Tanzania on average, the poor spend 65% of their income on food (NBS, 2002). Dione (2004) argues that food security is an issue of income, either in the form of one's own production of food or income earned from activities that might be related to agriculture or from non – farm activities that is used to gain access to food through the market.

It is recognized that people with inadequate food consumption levels are in that condition because they do not earn sufficient incomes to demand as much food as required to satisfy their needs. One should then be speaking not of food scarcity but rather scarcity of incomes or purchasing power, in short, poverty or lack of entitlements to food (Sen, 1987, cited by Alexandratos, 1995). The level of per caput food production in the countries with high dependence on agriculture for employment and incomes is itself a major determinant of the food entitlements of the poor (Lipton and Ravallion, 1993, cited by Alexandratos, 1995). Alexandratos (1995) asserts that the majority of the world's poor can earn their living by producing food and in most poor countries employment and income earning opportunities in all sectors, not just agriculture, are closely linked to how productive agriculture is.

Income is obtained from not only farm activities but also from non-farm activities (NFAs). The latter are important sources of income for many rural people in most developed and developing countries (Oludimu, 1991). Moreover, rural NFAs contribute much to development of farm activities. For example, activities like tool manufacturing and transportation facilitate tool acquisition and efficient performance of farm activities. Food accessibility component is dependent on the ability to generate income, whether in cash or in kind. The proportion of income that is actually available for consumption purposes also determines access to food.

Food insecurity occurs in situations where food was available but not accessible. According to Sen's Theory (1981), cited by PSP (2003), food access or entitlement means how much food households actually have access to from their own production, income and gathering of wild foods, community support assets and migration. Food availability is another important component of food security. According to PSP (2003) in pure subsistence societies, food availability can be thought to be equal to the food in stock plus what can be picked directly from the fields and gardens as well as from foraging of wild foods. Nevertheless, in more market-integrated societies, the situation is more complex, since food and other crops can be sold and cash income can be used to purchase food available in the market. Deficits in supply of basic foodstuffs in relation to aggregate population requirement manifest in malnutrition or under-nutrition (PSP, 2003).

Food security is closely related to poverty. Lack of food security and nutritional well-being contributes to the perpetuation of poverty. Similarly, poverty can hinder people's ability to access food. Poor families in developing countries spend on average 50% of their income on food and any decrease or lack of sufficient income can seriously compromise their ability to afford food (WBI, 2001).

2.6 Population, land, food production and food security

In Tanzania, the land is owned by the state and the majority of the communities have the right to own land for agricultural production. However, in some parts of the country, productive land is becoming scarce due to increasing population pressure. This is particularly so in areas where they practice permanent agriculture based on perennial crops, like plantains, coffee and tea (Ministry of Agriculture, 1996).

A common and general expression for demographic pressure on land resources is population density, expressed as an average value for administrative or census enumeration units (Maro, 1974). The author continues to argue that population density does not allow for variations in land quality, which can limit the capacity of an area to support people. Social, political and tenurial organizations change under conditions of increasing population pressure. For example, with low population densities, the land belongs to the community as a whole and the ruler supervises its distribution and use. Individuals have the right to cultivate the land but they do not own it (Maro, 1974). The author adds that as population increases, good land becomes scarce and either a feudal lord tenant arrangement or individual ownership results.

Food production cannot be achieved from increased production alone. It is also necessary that the food be distributed and acceptable, that those concerned be given the time and facilities for its preparation, and that it can be converted into good diets (UNICEF, 1985, cited by Ishengoma, 1998; URT, 1992). Most households in Tanzania are engaged in subsistence farming whereby farmers use simple production tools and inputs and depend on unreliable climatic conditions (Wagao, 1991, cited by Ishengoma, 1998). Bantje (1981) argues that laziness and sickness among household members are some of the major causes of food insecurity since those persons do not participate in food production or income generating activities (non – farm activities).

Acquired immunity deficiency syndrome (AIDS) is likely to generate some very significant shocks on productive capacity, purchasing power and per capita food availability. Disruption and even dissolution of family structures because of AIDS is likely to increase food insecurity and malnutrition (Maxwell and Frankenberger, 1992). The authors add that extended families that take in orphans could find their resources spread more thinly. In most African situations, generally the countries are poor, productivity is low, weather is very unpredictable and, therefore, food security is very minimal (Sumaye, 1993, cited by Ishengoma, 1998).

Mtebe *et al.* (1988, cited by Ishengoma, 1998) who did a study on the household food security on Child Survival and Development (CSD) programmes in Morogoro Region, assert that crop acreage for most respondents was between one and three acres. The above acreages cultivated, coupled with inadequate crop management practices currently prevailing in most of the villagers, do not guarantee availability of sufficient food for most households. The data for the above study show that in over 80% of all surveyed respondents, there was sufficient food all across the region over the two seasons (1987/88 and 1988/89). Figures for Morogoro Rural District were almost alarming for which about 73% of the respondents expressed a situation of food inadequacy for the 1988/89 period. Some of the reasons that were mentioned by the respondents as the causes of food inadequacy were selling the produce for the family income, food theft as well as food preference and acceptability (Mtebe *et al.*, 1988, cited by Ishengoma, 1998).

According to the Ministry of Agriculture (1996), one of the factors that causes food insecurity in Tanzania is under-utilization of local foods. Ashimogo (1995) asserts that households are defined as being production insufficient if they report exhausting own produced stocks in a season and hence rendering the household food deficient before the

next crop matures. Moreover, a household can be production deficient, and either food secure or food insecure in any given season, depending on the resources available to buy food, the receipt of transfers, the inter-temporal distribution of consumption that it chooses and the availability of food in the market or community (Reardon and Malton, 1989, cited by Ashimogo, 1995).

2.7 Research gap

Previous studies on food security in Tanzania particularly in mountainous areas have focused on the relationship between population pressure and food security (e.g. Mbonile, 2000) on the slopes of Mount Meru. Population pressure is just one element of population dynamics. Little has been done on the major components of population dynamics i.e. births, deaths and migration and food security. Therefore, there is an information gap on the linkages between population dynamics and food security. This study attempts to fill this gap by finding the differences in DEC among households with different demographic characteristics, including births, deaths and migration.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 An overview

The main aim of this chapter is to provide the details of all the procedures used in research. Its significance is to prepare the whole research process. The chapter is divided into nine sections. Section one presents the location of the research area and justification for its selection. Section two presents definitions of terms used in the research, while section three presents the research design used. Section four presents the sampling procedures that were employed. Section five presents the data collection process, while section six presents the data processing and analysis. Section seven describes about expression of variable values per adult equivalent, while section eight presents how dietary energy consumption was determined. Finally, section nine presents the methodological limitations encountered during the data collection process.

3.2 The research area

The research was conducted in Rungwe district, on the slopes of Mt. Rungwe which are in Ukukwe Division. The district was selected purposefully not only because of its high agricultural potential but also due to the fact that it is the most densely populated district in Mbeya Region. It has the population density of 139 persons per square kilometre (URT, 2003b). Moreover, the slopes of Mt. Rungwe were chosen purposefully because mountainous areas are normally rich in natural resources especially water sources and agro-biodiversity and so they tend to attract many people, leading to population pressure.

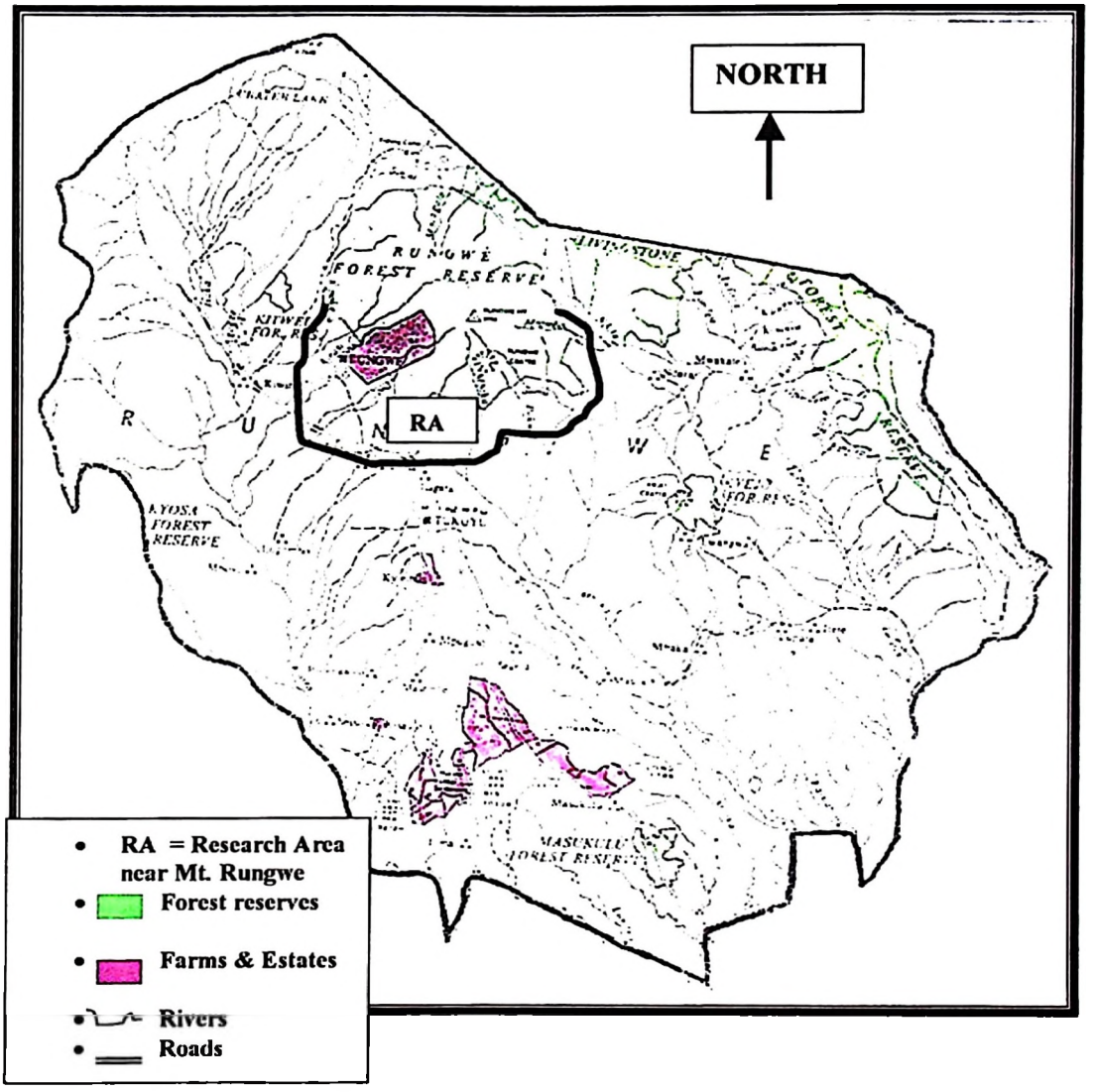

Figure 2: The map of Rungwe District showing the research area

3.2.1 Geographical location

Rungwe District lies between latitudes 8°30' and 9°30 South and longitudes 33° and 34° East. The District shares the border with Kyela District in the South, Ileje District in the West, Makete District in the East and Mbeya Rural District in the North. The District headquarters are situated at Tukuyu, which is about 80 km from Mbeya town along Uyole – Ibonde highway. The District covers a total of 2,211 km^2 of which 1,668 km^2 or 75% of the total area is arable land. The remaining land is covered by 44.5 km^2 of forest and 498.3 km^2 are mountainous and residential areas. Rungwe is one of the smallest districts in the region, covering only 3.5% of the total regional land area (URT, 1997b). The scenery of Rungwe District is evergreen, and Mount Rungwe is visible from the District Headquarters (Tukuyu Town), as seen in Figure 3. The mountain is also seen in Figure 9.

Figure 3: The view of Mount Rungwe as seen from Tukuyu Town

3.2.2 Administrative units

The District is divided into four divisions namely: Ukukwe, Busokelo, Pakati and Tukuyu. The four divisions are sub-divided into 30 wards containing 142 villages. Tukuyu Division that contains two wards constitutes the main town of Tukuyu with an area of 26 – 72 km^2 (URT, 1997b). Busokelo and Pakati divisions are the largest in the District covering an area of 969.4 and 822.13 km^2 respectively. Ukukwe Division where the research was conducted covers an area of 382.95 km^2 (URT, 1997b).

3.2.3 Climate

The District is mountainous with Rungwe and the Livingstone Mountain Ranges rising from an altitude of 770 m to 2,265 m.a.s.l. These mountains have great influence on the climatic conditions of the District making it experience cold and rainy seasons. Average rainfall ranges from 900 mm in the lowland areas to 2,700 mm on the highlands. Temperatures are generally modest and range from 23°C to 25°C all the year round (URT, 1997b). The District is also endowed with numerous rivers and streams flowing from the Rungwe and Livingstone Mountain Ranges. The following rivers pour their waters into Lake Nyasa; Mbaka, Lufilyu, Kiwira and Mwalisi (URT, 1997b).

3.2.4 Agro-ecological zones

According to URT (1997b), the district has three distinctive agro-ecological zones viz.: the highlands zone, the midlands zone and the lowlands zone.

3.2.4.1 The highlands zone

These are a continuation of the Mporoto Mountains from Tembele Ward in Mbeya Rural District. The zone covers the whole area of Isongole Ward. It rises to an altitude of 2,265 m.a.s.l. Generally, this upland zone is cold throughout the year with high rainfall averaging

between 1,500 and 2,700 mm per annum. The area is suitable for agriculture and the main crops cultivated are potatoes and pyrethrum.

3.2.4.2 The midlands zone

The zone covers about 75% of the total land in the district and occupies more of Pakati and Busokelo Divisions. The zone experiences cold weather and receives average annual rainfall of between 800 mm and 2,200 mm. The soils are good for agriculture and livestock development. Main crops cultivated include tea, coffee, cardamom, maize, beans, plantains and groundnuts.

3.2.4.3 The lowlands zone

This lies to the south of the District and covers about 15% of the total land area. It lies at an altitude of 772 m.a.s.l and covers Ilima, Masukulu, Itete, Kambasegela and Kisegere Wards. The weather is generally hot and suitable for cultivation of paddy, maize, beans, cocoa and plantains. The lowlands zone receives average annual rainfall between 900-1,200 mm.

3.3 Definitions of terms used in the research

The following are operational definitions of some of the terms used in the dissertation:

Adult equivalent units (AEU): The number of household members adjusted for composition (by sex and age) and nutrient requirements so that all the members are equivalent to adults. The number is normally smaller than the household size and is even smaller in households with more children, females and the old since these need fewer nutrients than adults, men and relatively younger people, respectively.

Adjusted adult equivalent units (AAEU): Adult equivalent units adjusted for economies of scale, taking into account the fact that larger households may need less resources per person due to sharing some facilities. AAEU is normally smaller than AEU. Values per adult equivalent of a household are obtained by dividing values for a whole household by AAEU of the household.

Female-headed household (FHH): A unit where an adult woman; herself, with children and or other dependants; lives without a male partner and she is in-charge of the household.

Male-headed household (MHH): A unit where an adult man; himself, with his wife, with or without children and or other dependants; lives and he is in-charge of the household.

Household: People whom, at the time of survey, were living together (sleeping under the same roof or in the same compound) including guests who had been there since more than two weeks before (Collier *et al.*, 1990). Where polygamy existed, the husband, wives and their children were taken to constitute one household so long as they were living under the same roof or in the same compound and they were cooking as well as eating together.

Household head (HH): A person living alone, with his wife or her husband, with or without children and or other dependants, living under the same roof or in the same compound in the case of polygamy, is responsible for day – to day decisions regarding activities of the household.

Non-farm activities: All activities excluding crop production, for example beekeeping, carpentry and masonry that are undertaken by household members. In this study even livestock production is regarded as a non-farm activity.

3.4 Research design

The research design that was adopted in this study was a cross-sectional one in which a one – stage survey was conducted. The design was chosen because it is suitable for a study in which data for a single year are considered which was the case of this research (Cooksey and Lokuji, 1995). Moreover, the design was adopted due to limitations of time and funds, as the researcher did not get any sponsor to fund the research. Otherwise, longitudinal design would have been better for the study of this nature on the effects of population dynamics on food security.

3.5 Sampling procedures

3.5.1 The population

The population from which the sample for this research was drawn was all households within the Wards that were on the slopes of Mt. Rungwe. All the wards were in one division of Ukukwe.

3.5.2 The sample

The sampling unit on which measurement of variables was done was the household. The sample size for the research was supposed to be 235 households. But due to shortage of funds only 90% of the expected sample size was taken i.e. 212 households. The sample size for the research was determined by using the following formula recommended by Kothari (1993).

$N = Z^2pq/e^2$, where

N = sample size when population is greater than 10,000 (which is the case for the population for the research).

z = Standard normal deviate, which is about 2.0, corresponding to 95% confidence level.

p = Proportion in the target population estimated to have a Particular characteristic (in this case the population growth rate of Rungwe District, i.e. 2.4%[1] per year was used)

q = 1.0 – P

e = 0.02 (since the estimate should be within 2% of the true value)

Therefore, the sample size was:

$N = Z^2pq/e^2 = (2.00)^2.(0.024) . (1-0.024) /(0.02)^2$

$= 0.093696/0.0004$

$= 234.24 \approx 235$ households

3.5.3 Sampling design

Stratified sampling was the main method of sampling. However, it was preceded by purposive sampling to select the district for the reasons given in Section 3.2. Moreover, the division, wards and villages were selected purposefully, ensuring that they were on the slopes of Mt. Rungwe and accessible by motorcycle, which was the main means of transport for the researcher. Because of rains, the roads were slippery making some other villages inaccessible by motorcycle. One ward, Isongole, which is also on the slopes of Mt. Rungwe, together with its four villages namely Ngumbulu, Ndaga, Unyamwanga and Mtokela were not included in the research because they were not accessible. Other villages that were also not visited for the same reasons included Isebe and Ikama in Suma Ward.

[1] The assumption here is that population dynamics existed in 2.4% of the households.

Stratification involved identifying female-headed households (FHHs) and male-headed household (MHHs) so as to make the research gender sensitive. It also involved identifying smaller (four and fewer members) and larger (more than four members) households. The cut off point between smaller and larger households was based on the fact that the average household size in Rungwe District is 4.0 (URT, 2003b). Sampling smaller and larger households was done in order to get households with different demographic attributes. The lists of names of heads in households belonging to the above four strata were obtained from Village Executive Officers (VEOs). Then, from each stratum proportionate numbers of respondent households were selected systematically until the required sample size of 212 households was attained.

Purposeful sampling was also used to sample Village Executive Officers (VEOs) and Village Agricultural and Livestock Development Officers (VALEOs) from whom supplementary information on population dynamics and food security was obtained through semi-structured interviews. Respondent households were chosen during pre-testing of the questionnaire, which was done prior to the actual survey, to establish the validity of the questionnaire.

3.6 Data collection

3.6.1 Instruments for data collection

The main instrument that was used to collect data in this study was a structured questionnaire that contained tabular, open and closed -ended questions. In every sampled household, only heads of households were interviewed to represent other members of the households. The instrument was supplemented with a guide for semi-structured interviews with VEOs and VALEOs so as to obtain more information on population dynamics and

food security. The questionnaires were translated into Kiswahili so as to facilitate the interviews, which were conducted in Kiswahili. The instruments were pilot tested in Kiwira Ward of Rungwe District by interviewing 10 household heads and one VEO, in October 2004. The purpose of the pre-testing was to check the validity of the instruments. Based on the results of the pre-testing, the questionnaires were amended and duplicated to get final versions (Appendix 1), which were used, in actual data collection.

3.6.2 Data collection

Data were collected in one division of Rungwe District, called Ukukwe, on the slopes of Mt. Rungwe. The data were collected in five wards: Suma, Kiwira, Kyimo, Katumba and Nkunga. The list of the villages in which data were collected is given in Appendix 3. The Division Agricultural Officer (DAO), who served two purposes, accompanied the researcher. Firstly, he was the researcher's assistant in data collection and secondly he was an interpreter of the local language (Kinyakyusa) where necessary. The household questionnaire copy was used to interview household heads; the interview guide was used for semi-structured interview with VEOs and VALEOs. Data collection was done in October and November 2004.

3.7 Data processing and analysis

The data were coded, summarized and entered into a spreadsheet manually before they were entered into a computer. Moreover, before analysis, the data were cleaned and verified. The data analysis was done using the Statistical Package for Social Sciences (SPSS) computer software at the Computer Laboratory of the Development Studies Institute (DSI) of Sokoine University of Agriculture (SUA). Both qualitative and quantitative data analysis were done. Univariate analysis (i.e. determining descriptive statistics) included measures of central tendency including means, mode and percentages of individual variables. Moreover,

measures of dispersion were determined during descriptive analysis. These included standard deviation, minimum and maximum values. Bivariate analysis involved the use of correlation to determine associations among pairs of variables recorded at the ratio level. Differences in amounts of DEC in households with different demographic characteristics were determined by using independent samples t-test. Moreover, the latter was used to confirm the results of linear correlations and hence to test the overall hypotheses of the research. For any hypothesis whose p-value was greater than 0.05 (i.e. 5% level of significance), the alternative hypothesis was rejected and the null hypothesis was accepted.

3.8 Expression of variable values per adult equivalent

In the analysis of household food security, standardisation or scaling is necessary in order to account for differences in household size and age. Since adult equivalent scales for Tanzania have not been estimated for any one who may need to use them, in this study they were estimated following Collier *et al.'s* (1990) procedure in their study in Tanzania. The two–step procedure was done by combining nutritional requirements approach and Deaton–and–Muellbauer's approach, using the figures in Table 5 and Table 6. In the first step each household member was assigned an appropriate adult equivalent unit, and all the weights for all the members of the household were summed up to get household sizes in adult equivalent units (AEU). This step was done to adjust for household composition owing to the fact that children, women and old people need less nutrients than adults, men and young people, respectively. In the second step the AEUs were multiplied by the average cost factor for a household with the corresponding number of adults to get the adjusted adult equivalent units (AAEUs) of each household. This second step was important to take into account economies of scale since large houscholds need less resource per person due to sharing

some facilities. Dietary energy consumed by each household was divided by its own AAEU to get corresponding values of DEC per adult equivalent.

Table 5: Calorie requirements by age and sex for East Africa

	Sex	
Age group	Male	Female
0 – 2	0.40	0.40
3 – 4	0.48	0.48
5 – 6	0.56	0.56
7 – 8	0.64	0.64
9 – 10	0.76	0.76
11 – 12	0.80	0.88
13 – 14	1.00	1.00
15 – 18	1.20	1.00
19 – 59	1.00	0.88
Above 60+	0.88	0.78

Source: Latham (1965), cited by Collier *et al.* (1990)

Table 6: Household economics of scale

Household size (Number of adults)	Marginal cost	Average cost
1	1.000	1.000
2	0.892	0.946
3	0.798	0.897
4	0.713	0.851
5	0.632	0.807
6	0.632	0.778
7	0.632	0.757
8	0.632	0.741
9	0.632	0.729
Above 10+	0.632	0.719

Source: Deaton (1980), cited by Collier *et al.* (1990)

Example:

Finding the adult equivalent total annual income of Household Number One of the research (Table 7), given the following composition and a total annual income of Tshs. 221,750/= for the whole household, the following procedure is used.

Table 7: Household composition (example)

Household members	Sex	Age	Individual No.
a) Household head	Male	38	1
b) Wife	Female	29	2
c) Children			
1.	Male	14	3
2.	Male	12	4
3.	Female	7	5
4.	Female	6	6
5	Female	4	7
d) Other members			
1.	Female	60	8
Total	-	-	**8**

First step: Finding adult equivalent units

Adult equivalent units (AEUs) = $1.00_{(1)} + 0.88_{(2)} + 1.00_{(3)} + 0.80_{(4)} + 0.64_{(5)} + 0.56_{(6)} + 0.48_{(7)} + 0.72_{(8)} = 6.08$ AEU.

Second step: Adjusting the adult equivalent units for economies of scale

Adjusted adult equivalent units (AAEUs) are equal to the number of adult equivalent units (AEUs) times the average cost factor. The average cost factor corresponding to 6 AEU is 0.778. Therefore, for this household, AAEU = 6.08 x 0.778 = 4.73. Since the total annual income for the whole household is Tshs 221,750/=, the total annual income per adult equivalent is Tshs. 221,750/= ÷ 4.73, which is equal to Tshs 46,881/=. This procedure was

done for each of the 212 households of the research to get various values per adult equivalent.

3.9 Determination of dietary energy consumption

To determine the consumption of cereals in the survey area, a number of assumptions are necessary. Ideally, calorie intake estimation should be based on the nutrient content of each food, adjusted for edible portion (Rogers and Lowdermilk, 1991, cited by Ashimogo, 1995). Food availability should, in turn, be measured by the daily dietary energy and protein intake levels, adjusted for household size, age and gender composition as recommended by the FAO/WHO/UNU expert consultation group (FAO – WHO – UNU, 1985, cited by Ashimogo, 1995). However, in Rungwe District no nutritional studies for accurate estimation of share of different food groups in total energy supply by age and gender were available. According to Seshamani (1981), cited by Ashimogo (1995), in Tanzania foods other than cereals contribute about 20% of energy in the diet. Therefore, in this research, it was assumed that cereals supply 80% of energy in diets of the people of Rungwe district.

The food crops that are grown in Rungwe District include plantains, sweet potatoes, round potatoes, yams, paddy, maize, beans and groundnuts. Although banana is much grown in Rungwe District, it was found that it was more for sale rather than for home consumption. Maize and rice are the staple foods. While maize is the most important staple food in the area, rice is eaten only in small quantities, as the majority cannot afford buying it due to low incomes and higher prices. Therefore, food security was determined based on maize and rice, which were the main food. Energy content for white maize, which is eaten in Rungwe, like elsewhere in Tanzania, is 357 calories per 100 grams edible portion of maize (FAO, 1968, cited by Ashimogo, 1995). According to West *et al.* (1988), maize to flour conversion

ratio is 60 – 80% extraction. For the sake of this research the average of the above two figures (60 – 80), i.e. 70% was taken.

The average daily calorie requirement for a moderately active adult equivalent (AE) is 2,850 Kcal/day (FAO – WHO – UNU, 1985, cited by Ashimogo, 1995). According to the World Health Organization (WHO), a safe minimum daily intake should not fall below 80% of the above calorie requirement, which means that the minimum intake should be 2,280 Kcal/AE/day. To obtain such kilocalories, an adult has to consume 568 grams of maize per day, which is equivalent to 207.3 kg of maize (or any grain or cassava expressed in maize equivalents) per year (Ashimogo, 1995). Therefore, the following equation was used to get dietary energy consumption:

$$X = \frac{\text{Grains actually consumed per AE per day (kg)} \times 2{,}280 \text{ Kcal/AE/day}}{0.568 \text{ kg}}$$

Where:

X	=	Dietary energy consumption
2,280 Kcal/AE/day	=	Minimum grain and grain – equivalent consumed per day

Since it was assumed that 30% of the grains (maize or rice) was lost during processing and cooking, that is according to West *et al.* (1988) the amount of maize and rice consumed in the household was multiplied by 100/70 to get grains actually consumed per day (kg). Then the above formula was used to calculate the dietary energy consumption (DEC). The amount of dietary energy consumed that was obtained in the above formula was multiplied by 100/80, in order to cater for 20% of energy consumed in foods other than grains.

3.10 Limitations of the study

In most cases retrospective data have problems of recall. The data on the numbers of children born, people who migrated in and out of the households and people who died was based on a period of one year prior to the survey. Thus, the results obtained were probably the minimum and they should be taken as estimates and should not reflect the real situation that existed in the research area, but only in the sample.

The research/data collection process was conducted during the period when registration of voters for 2005 general elections of national leaders in October 2005 was going on in the Southern highlands regions. Hence, the researcher faced the problem of contacting most VEOs and VALEOs who could have provided more information on population dynamics and food security in their villages, because most of them were involved in the registration exercise. Other respondents had problems in recalling amounts of different foodstuffs consumed in their households per month. Thus, the estimates were taken, making some of the data to be just estimates and not the actual ones.

Some respondents were reluctant to be interviewed, as they said that they were tired of being interviewed every now and then as most of the researches that have been done do not help them at all. Such respondents were discarded, i.e. they were not interviewed resulting in wastage of time and resources for the researcher and her assistant. In some cases, due to time limit and communication problems that were beyond the researcher's ability, the respondents given appointments went back home or in their field plots after the time they were promised elapsed. This resulted in missing respondents on some other days and hence wastage of time and resources for the researcher and her assistant.

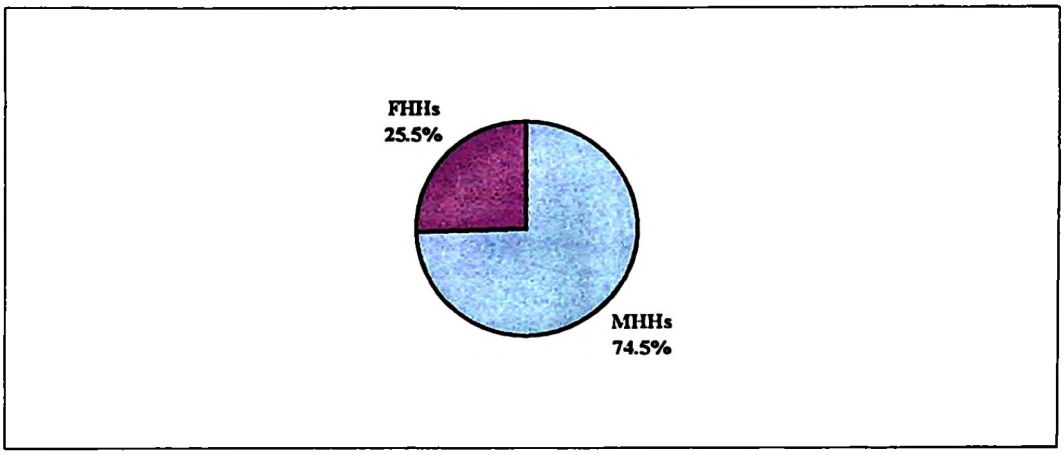

Figure 4: Proportions of Male- and Female-headed households interviewed

Among the surveyed households, female–headed households (FHHs) were 54 (25.5%), while male – headed households (MHHs) were 158 (74.5%). According to Due *et al.* (1997), FHHs among smallholder farm households in Tanzania are almost 30%. The 1996 Tanzania Demographic and Health Survey (TDHS) results show that in rural areas female head 21.3% of the households (Sichona, 2001). But World Bank (1998), cited by Sichona (2001), reports that in rural Tanzania FHHs are only 5.8%. The above contradictory information implies that the number of FHHs in this research may have been either over- or under – represented. The percentage of the interviewed FHHs (25.6%) was almost the average of the percentages reported by other researchers, as seen above. This proportion of FHHs was arrived at with the aim to have a good number of them so as to make the research gender sensitive for meaningful statistical computations.

4.2.2 Marital status of household heads

Married couples are likely to be more productive than single ones due to labour reinforcement (synergy) in accomplishing farm and non –farm activities; hence the former are more likely to be in a food secure situation. Households with widowed, separated and

divorced household heads are normally characterized by more dependants than married ones. Most of the widowed households in the study area were old and had a burden of dependants who were mostly their grand children. This category of dependants normally cannot participate either in agricultural production or in other IGAs, resulting into a food insecure situation in households with many dependants. The results show that 70.8% of the interviewed households were married (Table 8).

Table 8: Marital status of household heads (n = 212)

Marital status	Number of respondents	%
Married	150	70.8
Widowed	46	21.7
Separated	7	3.3
Not married	7	3.3
Divorced	2	0.9
Total	212	100.0

4.2.3 Main occupations of household heads

The occupation of most household heads was agriculture denoted as crop production. In this research crop production or agriculture did not include livestock production as many researchers do. The finding indicates that the majority of respondents (94.2%) were involved in crop production (Table 9). That implies that the land that is scarce to the people living on the slopes of Mt. Rungwe is a very important resource for their livelihoods. This is due to the fact that the majority depends on agriculture, so that they can get food as well as income for buying non – food items. Furthermore, they rely on agriculture even in the period of food shortages. For example during food shortages, they sell plantains and cash crops such as tea to obtain money for buying maize their staple food. The "others" category, with less than 2% of the respondents included radio repairing/electrical works, tailoring, carpentry, bicycle repairing, religious leadership, salaried job and livestock keeping.

Table 9: Main occupations of household heads (n = 212)

Main occupation	Number of respondents	%
Crop production	200	94.3
Trading	5	2.4
Others	7	3.3
Total	212	100.0

4.2.4 Age – sex composition of household heads and household members

Age has influence on productivity as well as on food consumption. Age of the household head influences decision-making and provision of labour by itself. There is difference in food consumption among household members. Moreover, energy requirements among household members differ. For example, children need less food than adults and females need less food than males (Collier *et al.*, 1990). Furthermore, children, women and old people need less nutrients than adults, men and young people respectively (Collier *et al.*, 1990; World Bank, 1993; and 1996). Therefore, age composition of the household members was considered to be an important factor in this study. Ages of household heads were treated on an individual basis. Furthermore, ages of household heads together with those of household members were treated on a group wise basis so as to facilitate the computation of the dependency ratio. The highest age of respondents was 86 years and the lowest was 19 years, with more than half of household heads (52.4%) having the ages ranging from 30 – 49 years. However, the standard deviation was high (15.1) indicating that the ages of household heads were quite dispersed.

Table 10: Age – sex composition of household heads (n=212)

Age group	Men		Women		Total	
	No.	%	No.	%	No.	%
15 –19	1	0.6	0	0.0	1	0.5
20 - 24	5	3.2	3	5.5	8	3.7
25 – 29	11	7.0	2	3.7	13	6.1
30 – 34	24	15.2	4	7.4	28	13.2
35 – 39	30	19.0	6	11.1	36	17.0
40 – 44	18	11.4	7	13.0	25	11.8
45 – 49	15	9.5	7	13.0	22	10.4
50 – 54	14	8.9	3	5.5	17	8.0
55 – 59	7	4.4	5	9.3	12	5.7
60 – 64	13	8.2	2	3.7	15	7.1
65 – 69	10	6.3	6	11.1	16	7.5
70 – 74	7	4.4	4	7.4	11	5.2
75 – 79	2	1.3	3	5.6	5	2.4
80+	1	0.6	2	3.7	3	1.4
Total	158	100.0	54	100.0	212	100.0

Table 10 shows that a greater proportion of household heads aged over 64 years are women. This is because women have higher life expectancy than men; hence are more numerous than men at very old ages. Table 11 further explains this by showing that from 70 to 74 years, 75 to 79 years, and 80 and above years men were fewer than women. Men were 1.4%, 0.4%, and 0.2% while women were 1.5%, 1.4%, and 1.2%, respectively.

Table 11: Population by age and sex in the surveyed area (n=1,071)

Age range	Male		Female		Total	
	No.	%	No.	%	No.	%
00 - 04	73	15.0	88	15.1	161	15.0
05 – 09	90	18.5	88	15.1	178	16.6
10 – 14	69	14.1	87	15.0	156	14.6
15 – 19	56	11.5	53	9.1	109	10.2
20 - 24	23	4.7	41	7.0	64	6.0
25 – 29	21	4.3	55	9.4	76	7.1
30 – 34	30	6.1	40	6.9	70	6.6
35 – 39	32	6.6	21	3.6	53	4.9
40 – 44	20	4.1	24	4.1	44	4.1
45 – 49	16	3.3	14	2.4	30	2.8
50 – 54	17	3.5	8	1.4	25	2.3
55 – 59	7	1.4	14	2.4	21	2.0
60 – 64	14	2.9	16	2.7	30	2.8
65 – 69	10	2.0	10	1.7	20	1.9
70 – 74	7	1.4	9	1.5	16	1.5
75 – 79	2	0.4	8	1.4	10	0.9
80+	1	0.2	7	1.2	8	0.7
Total	488	100.0	583	100.0	1,071	100.0

4.2.5 Population pyramid

The population pyramid for the surveyed households is given in Figure 5. According to Haupt and Kane (2000), a population pyramid is a graphical representation of a population's age and sex composition. In the pyramid, horizontal bars represent the numbers or proportions of males and females in each age group and the sum of all the age sex groups equals 100% of the population.

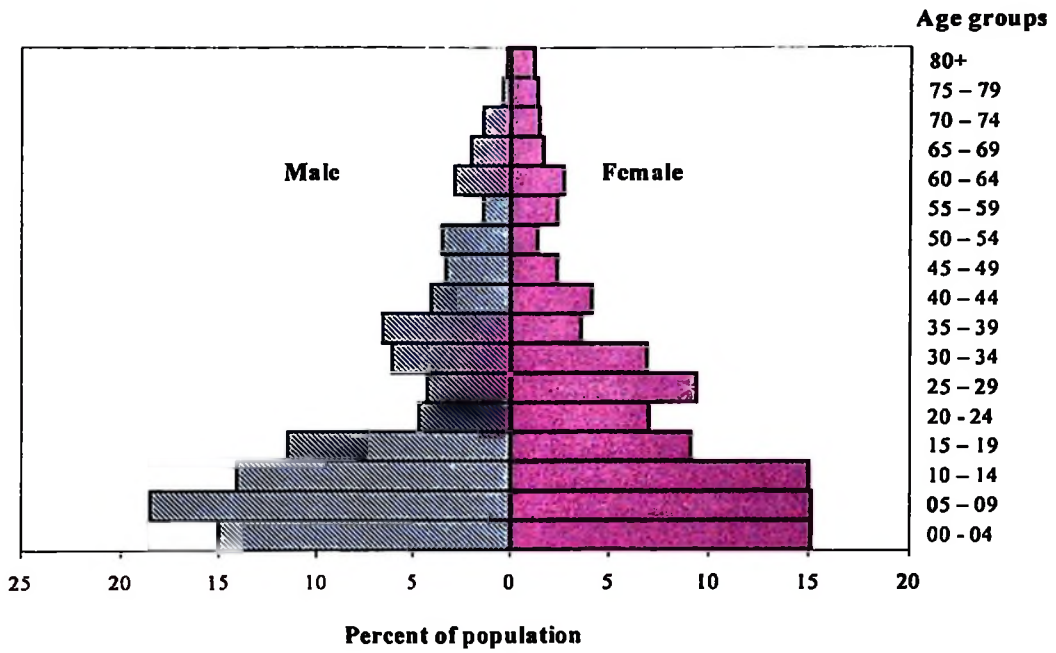

Figure 5: Population pyramid for the surveyed households

The pyramid (Figure 5) begins with a large percentage in the first age group (0–4) of each sex (15.0% and 15.1%) of male and female children, respectively. Then in the age group of 5 – 9 there is an abrupt increase in the percentage of boys to 18.5%, and the same percentage of girls as in the first age group (0 – 4) that is 15.1%. The population continues to decrease in percentage for both males and females up to age group 20 – 24. Thereafter, there is an abrupt increase in the percentage of females in the age group 25 – 29 but with a decrease in the percentage of their male counterparts. The plausible explanation for that might be due to the fact that most out – migrants are males in that particular age group, leaving females at home.

Then the population percentage continues to decrease and increase in subsequent age groups until finally the number of old people become smaller and smaller. In most age groups the number of females is a bit higher than that of males, the reason being that normally the

females are more numerous than males in most countries. Moreover, the females form the substantial majority in the oldest age groups. According to Haupt and Kane (2000) in most countries worldwide, normally females outlive males.

Like the pyramid of the surveyed area, that of Rungwe (Rural) District has a broad base; it begins with a large number in the first age group (0 –4) of each sex category (Figure 6). However, unlike that of the surveyed area, the pyramid of Rungwe (Rural) District has a large percentage of males in the first four quinquennial age groups, i. e. from 0 –4 up to 15 – 19 age groups. Then it is followed by a large percentage of females for the age groups 20 - 24 up to 30 –34. Thereafter, the subsequent age groups continue to decrease in percentages in both sexes until finally the number becomes smaller and smaller. Where males predominate in the first few quinquennial age grouped, the pyramid follows a normal age structure derived from a complete and relatively accurate census enumeration typical pattern (URT, 2003a). Unlike the pyramid of the surveyed area, females are more numerous in the old age groups (50-69), but in the oldest age groups, i.e. from 70-79 and above 80 years, males and females are more or less equal in numbers.

Table 12: Population by age and sex in Rungwe (Rural) District (n= 283,798)

Age range	Male		Female		Total	
	No.	%	No.	%	No.	%
00 - 04	20,455	15.2	21,222	14.2	41,677	14.7
05 – 09	19,884	14.8	20,186	13.5	40,070	14.1
10 – 14	18,897	14.1	18,733	12.6	37,630	13.3
15 – 19	14,658	10.9	14,532	9.7	29,190	10.3
20 - 24	10,252	7.6	13,357	8.9	23,609	8.3
25 – 29	9,011	6.7	11,594	7.8	20,605	7.3
30 – 34	7,682	5.7	8,606	5.8	16,288	5.7
35 – 39	6,023	4.5	6,733	4.5	12,756	4.5
40 – 44	5,349	4.0	5,628	3.8	10,977	3.9
45 – 49	3,891	2.9	5,056	3.4	8,947	3.1
50 – 54	3,542	2.6	5,112	3.4	8,654	3.0
55 – 59	2,922	2.2	4,189	2.8	7,111	2.5
60 – 64	3,420	2.5	4,823	3.2	8,243	2.9
65 – 69	2,818	2.1	3,608	2.4	6,426	2.3
70 – 74	2,588	1.9	2,819	1.9	5,407	1.9
75 – 79	1,540	1.1	1,463	1.0	3,003	1.1
80+	1,551	1.2	1,654	1.1	3,205	1.1
Total	134,483	100.0	149,315	100.0	283,798	100.0

Source: URT (2003a)

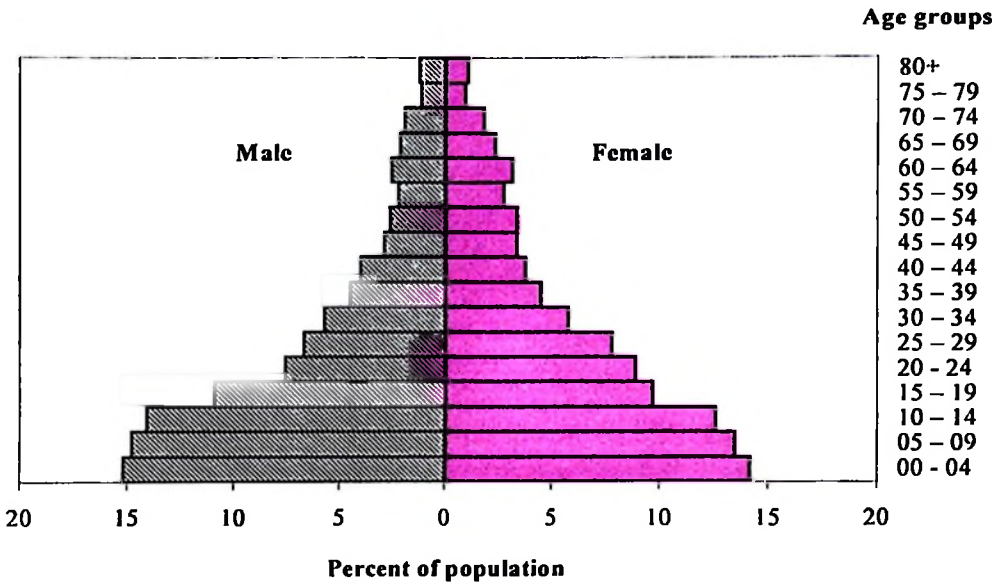

Figure 6: Population pyramid for Rungwe (Rural) District

Table 13: Percentage distribution in broad age groups (Surveyed area)

Age	Males		Females		Total	
	No.	%	No.	%	No.	%
0 – 14	232	47.6	263	45.2	495	46.2
15 – 64	236	48.4	286	49.0	522	48.8
65 and over	20	4	34	5.8	54	5.0
Total	488	100.0	583	100.0	1071	100.0

According to Table 13, the proportion of children in the 0 – 14 age group was 46.2%. Normally the proportion in this age group ranges between 43 and 48% for all the African countries (URT, 2003a). In 2002 population census the proportion in this age group was found to be 44% in Tanzania (URT 2003a). The proportion of the working population, i.e. from age group 15 – 64 was 48.8% in the surveyed area. The figure is a little bit lower than the national figure of the same age group that was found to be 52% (URT, 2003a). The proportion of old people ranges between 2 and 6% for all African countries (URT, 2003a).

In the surveyed area it was found to be 5%. According to URT (2003a), the 2002 census revealed the proportion in that category (65 and over) to be 4%.

4.2.6 Years of schooling of household heads

A person with higher education level is expected to have more knowledge than a counterpart with lower education. Normally, through formal education one gets more knowledge and skills that can enhance one's ability to effectively produce, get higher returns and make one to be food secure. Furthermore, farmers' education is very important for their ability to efficiently utilize the advice and information offered by the extension service and development agents (Ragnar *et al.*, 2002).

The levels of education of household heads were obtained by asking respondents to state the number of years they had spent on formal and non-formal learning, as opposed to informal learning. The results show that about half of the respondents (49.2%) had primary school education, and 7.5% of respondents had more than standard seven education. More than a quarter of respondents (26.8%) had education level of below standard seven. However, 35 respondents (16.5%) had not attended school at all (Table 14). It is impressive that the majority of respondents had some formal education that could enable them to read leaflets of newly introduced technologies and hence be able to use them. Nevertheless, it is important that the illiterate group be given special attention when information is being disseminated.

Table 14: Household heads' years of schooling (n = 212)

Years of Schooling	No.	%
0	35	16.5
1	6	2.8
2	6	2.8
3	12	5.6
4	20	9.4
5	8	3.7
6	5	2.4
7	104	49.0
8	4	1.9
9	1	0.5
10	1	0.5
11	6	2.8
13	2	0.9
14	1	0.5
16	1	1.0
Total	212	100.0

4.2.7 Household size of surveyed households

Taking into account that the size of household may affect the food security situation within a household, the numbers of household members were recorded. The results show that the average household size among the surveyed households was 5.1. This figure differs from the documented household size of Rungwe District of 4.0 (URT, 2003b). The reason for the discrepancy is the fact that rural households normally have bigger household sizes than urban ones, whereas the documented household size of 4.0 includes also urban households whose sizes are normally smaller. The findings revealed that household size was negatively correlated with food security (-0.234) (See Table 47), implying that the smaller the household size, the more food secure the household was and vice versa.

The surveyed households were grouped into two groups of smaller (four and less members) and larger (more than four members) households (as given in section 3.5.3). Results of this grouping show that smaller and larger households were 45.3% and 54.7% respectively. They imply that more than half of the respondents had more than four members in their households. A photograph of one of the larger households surveyed is given in Figure 7. The household had 10 members; Mr. Charles Mwakyambiki was the household head. He had two wives and 6 children, and his mother was one of the household members.

Figure 7: A photograph of one of the larger households surveyed

4.2.8 Non-farm activities

Non-farm activities (NFAs) have influence on food security, as they are sometimes the sources of income for buying food. It is particularly so during the period of food deficit when stored crop products have been exhausted. Moreover, NFAs are very important sources of income for the rural people as they help in getting money for buying non-food items, for example clothes that are among the basic needs for human beings. Therefore,

respondents were asked to state non-farm activities that were being done by all household members in their households. Many NFAs were found (Table 15). The results show that the majority (42.9%) were involved in livestock keeping while 21.7% of households had no activities other than crop production that were being done in their households (Table 15). That figure is below the one obtained by Kayunze (1998) in Rungwe District who found that 30.7% of the households had no NFA. Moreover, the figure is above the one obtained by the same author (14.0% of households) in Ileje District. Nevertheless, since the majority of the respondents had NFAs, it implies that NFAs were very important sources of income for both food and non – food items for the people living on the slopes of Mt. Rungwe.

The category of 'others' that had less than 2% included religious activities, tailoring, local birth attendant, luggage haulage, house renting, beekeeping, fish keeping, radio repairing, hair plaiting, bicycle repairing and electrical works. Some households had more than one non-farm activities.

Table 15: Non-farm activities (NFAs) (n=212)

NFAs undertaken	No.	%
Livestock keeping	91	42.9
None	46	21.7
Petty trade (trading)	36	17.0
Charcoal selling	23	10.8
Timber selling	21	9.9
Local brew making selling	15	7.0
Casual agricultural labour	14	6.6
Salaried job	11	5.2
Mat making	9	4.2
Carpentry	6	2.8
Masonry	6	2.8
Pancake making	5	2.4
Others	16	7.7

NB: The percentages do not add to 100 due to multiple responses

4.3 Food security (Dietary energy consumption per adult equivalent)

Food security was a dependent variable in this research. It was defined as dietary energy consumption per adult equivalent. It was hypothesised to be influenced by the independent variables discussed in Section 4.4. There are many indicators of food insecurity, for example the proportion of population who are unable to get 2 meals a day (FAO, 1997, cited by URT, 1999). That indicator and others that have not been mentioned are just proxy indicators of food security, but the actual indicator of food security is dietary energy consumption (URT, 1999).

Respondents were asked to mention the number of meals that adult members as well as the under-five children members of their households ate per day. Furthermore, they were asked what their staple foods were and how many meals composed of the staple foods they were eating per day. Results show that 86.3% of the respondents said that their adult members were eating three meals per day. For the households that had the under-five children members, 54.8% said that they were eating three meals per day. That means they were eating at the same time when adult members were eating. A few respondents (35.6%) said that the under-five members ate more than three meals per day (Table 16). The plausible explanation why adult members ate three meals the same as the under five children is that many people cannot afford more than three meals due to low income. Moreover, because what they produce does not suffice until the following season, they are forced to buy from the market so as to cover for the food deficits (See Table 29).

Table 16: Number of meals per day per household

Number of meals	Households with adult members (n = 212)			Households with under five children members (n = 115)		
	Two	Three	Four	Two	Three	Four/five
Number of households	25	183	4	11	63	41
%	11.8	86.3	1.9	9.6	54.8	35.6

On the staple food, 93.9% of respondents said that stiff porridge (*ugali*) that comes from maize was the staple food and 13.2% said that plantains were eaten as a staple food (Table 17). However, a few respondents said that both plantains and stiff porridge were eaten as staple foods. On the number of meals composed of the staple foods, the findings reveal that about four-fifths (79.7%) said two meals composed of the staple foods. This means that the staple foods were being eaten for lunch and dinner.

Table 17: Staple food (n = 212)

Foodstuff	No.	%
Ugali	199	93.9
Plantains	28	13.2
Both	13	6.1

NB: The percentages do not add to 100 due to multiple responses

The respondents were asked to mention the composition of their breakfast, lunch and dinner, i.e. what food types were being eaten in the mentioned meals. Moreover, they were asked to state how much of the foodstuffs they consumed per month in their households. In the composition of breakfast, the findings show that the majority of respondents and their members ate sweet potatoes and plantains for their breakfast 64.2%. and 63.7%, respectively. The minority (5.7%) ate bread for their breakfast. The results were as they appear in Table 18.

Table 18: Foods eaten for breakfast (n = 212)

Food type	Frequency	%
Sweet potatoes	136	64.2
Banana	135	63.7
Yams	131	61.8
Rice	65	30.7
Stiff porridge	56	26.4
Round potatoes	50	23.6
Pancakes	45	21.2
Cassava	36	17.0
Bread	12	5.7
None	20	9.4

NB: The percentages do not add to 100 due to multiple responses.

Table 19: Foods eaten for lunch (n = 212)

Food type	Frequency	%
Stiff porridge	202	95.3
Plantains	180	84.9
Yams	122	57.5
Sweet potatoes	99	46.7
Round potatoes	50	23.6
Rice	37	17.5
Cassava	35	16.5
Mixture of maize & beans (*kande*)	25	11.8

NB: The percentages do not add to 100 due to multiple responses.

In the composition of lunch, the results show that the majority of respondents (95.3%) said that they ate stiff porridge (*ugali)* for their lunch. The minority (11.8%) ate a mixture of maize and beans locally known as *kande*. The results were as seen in Table 19. In the composition of dinner, the results show that the majority of respondents (95.8%) said that stiff porridge (*ugali)* was mainly eaten for their dinner. A few of respondents (11.3%) said a

mixture of maize and beans (*kande*) and cassava were eaten for dinner, respectively. The results were as they appear in Table 20.

Table 20: Foods eaten for dinner (n = 212)

Food type	Frequency	%
Stiff porridge	203	95.8
Rice	183	86.3
Plantains	173	81.6
Yams	87	41.0
Sweet potatoes	67	31.6
Round potatoes	49	23.1
Cassava	24	11.3
Mixture of maize and beans *(kande)*	24	11.3

NB: The percentages do not add to 100 due to multiple responses.

The majority of the respondents ate plantains and sweet potatoes for their breakfast because not only that they were available either in their fields or in the market throughout the year but also they were cheaper and affordable than foodstuffs like rice or bread. The same reasons apply for the plantains that were eaten by the majority for lunch and dinner. Rice was preferred by most respondents to other foodstuffs for their dinner, even though it was more expensive than the other foodstuffs, probably because most people in rural and urban areas of Tanzania have the habit of eating rice for their dinner. The same applies to stiff porridge which many people have the habit of eating for their lunch.

The few respondents that did not take anything for their breakfast (9.4%) were the ones who did not have plantains, yams and sweet potatoes in their fields and who could not afford buying them from the market (See Table 18). On how much of the foodstuffs they consumed per month, results show that respondents and their household members ate an

average of 35.8 kg of maize per month in the form of stiff porridge (*ugali*), which is the main staple food. The least amount of foodstuff that was consumed by household members was cassava, with the average of 2.9 kg per month. The results were as shown in Table 21. The plausible explanation for the little amount of rice that was being eaten per month (9.1 kg) is that the rice that was eaten for their breakfast was the amount left in previous nights for their dinner (*kiporo*) and was not cooked fresh in the morning.

Table 21: Average foodstuffs eaten per month (n = 212)

Food type	Amount eaten (kg)
Maize	35.8
Yams	29.9
Sweet potatoes	25.9
Round potatoes	12.0
Rice	9.1
Bananas (bunches)	5.6
Cassava	2.9

NB: The percentages do not add to 100 due to multiple responses.

Based on the method described in Section 3.9, the results show that the average dietary energy consumption per adult equivalent per day in surveyed households' routine meals was 3,407 Kcal. That figure is impressive because it is above the safe minimum daily intake that was suggested by WHO i.e. 2280 kcal/AE/day (FAO – WHO – UNU, 1985, cited by Ashimogo, 1995). It is even higher than the average daily calorie requirement for a moderately active adult equivalent i.e. 2850 Kcal/day/AE. However, the method of using energy from cereals to calculate DEC in areas where cereals are less produced tends to underestimate DEC.

One of the research objectives was to estimate the proportions of households below the minimum level of dietary energy consumption per adult equivalent. In this study, households which consumed kilocalories below 2,280 Kcal/AE/day were considered to be food insecure and those who consumed amounts that were equal or more than the above kilocalories were considered to be food secure. Results show that 63 households (29.7%) were below the minimum level of dietary energy consumption per adult equivalent, meaning that they were food insecure. Further, the findings indicate that the majority of households in the surveyed area, i.e. 70.3% were food secure, implying that the majority of the people who were living on the slopes of Mt. Rungwe ate the foods that contained the calories that were above the recommended minimum level of DEC/AE (Figure 8). Sex-wise, the results (Table 22 and Figure 8) show that male-headed households were more food secure than female-headed households. The plausible explanation for that is as explained in Section 4.2.1.

Table 22: Food security and food insecurity sex-wise (n = 212)

Food security	MHHs		FHHs		All	
	No.	%	No.	%	No.	%
Food secure	114	72.1	35	64.8	149	70.3
Food insecure	44	27.9	19	35.2	63	29.7
Total	158	100.0	54	100.0	212	100.0

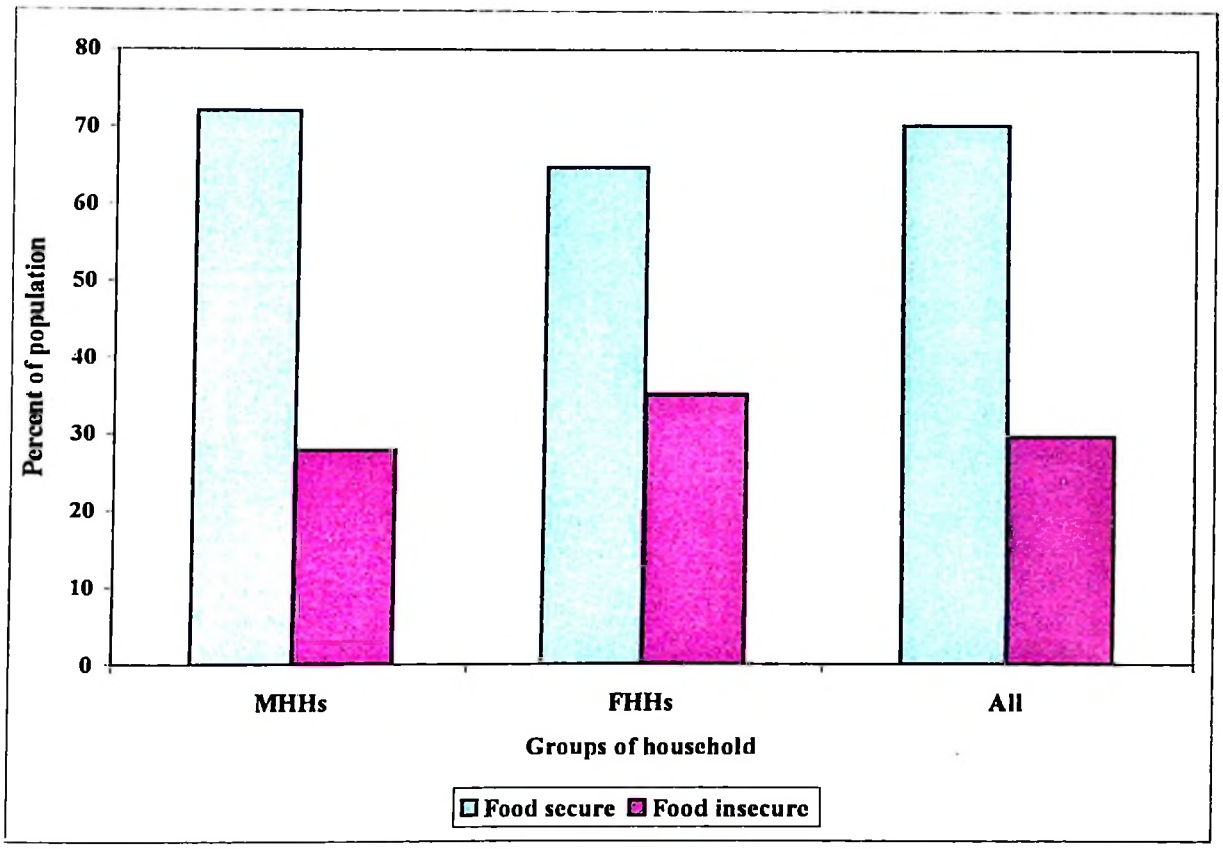

Figure 8: Proportions of food secure and food insecure households

4.4 Factors affecting food security

There are many factors that affect food security at the individual, household and national levels. In this study only some of the factors affecting food security at the household level are discussed. These were also the independent variables of the research that affected the dependent variable i.e. DEC/AE. The factors include land, food production, income, and access to productive resources and benefits by gender.

4.4.1 Access to land

Land is one of the principal means of agricultural production. Access to land enables a farmer to produce either for subsistence (to get food for consumption) or for cash so as to

get an income for non-food items for example soap and clothes. Moreover, cash income serves as a source of money for buying foodstuffs, particularly during the period of food deficit. Respondents were asked to state whether they owned land or not and if yes how much land they owned. Besides, they were asked to state how much of the land was used for farm activities in the 2003/04 agricultural season. Moreover, they were asked whether they borrowed land or not and if yes how much land was borrowed in the 2003/04 agricultural season and how much of the borrowed land was used for farm activities in the 2003/04 agricultural season. Results show that only 2.8% of surveyed households had no land at all, meaning that they did not own their own land (Table 23).

Table 23: Land ownership (n = 212)

Category	No.	%
Yes	206	97.2
No	6	2.8
Total	212	100.0

The maximum land size owned by respondent households was 16.2 ha, with the average of .1.1 ha (Table 24). That figure (1.1 ha) is below the one pointed out by Ashimogo (1995), who asserts that on average smallholder farmers own farm sizes of about 2.0 ha.

Table 24: Land size owned by the respondents (n=206)

Land size owned	No.	%
< 1ha	135	65.5
1.0 - 2.0 ha	45	21.8
2.1 - 3.0 ha	14	6.8
3.1 - 4.0 ha	3	1.5
> 4.0 ha	9	4.4
Total	206	100.0

4.4.2 Food production

The slopes of Mt. Rungwe in Rungwe District have conducive agro-climatic factors for various food crops as well as cash crops production. Food crops that were being produced by the respondents and their members included maize, sweet potatoes, round potatoes, yams, cassava, bananas, beans and groundnuts. The main cash crop was tea. However, the study did not focus on cash crops. While Figure 3; besides showing Mount Rungwe, shows plantains as a major crop; Figure 9 shows maize, which is another major crop, man-made forests and Mount Rungwe.

The quantity of harvested crop products in households is another important factor that cannot only influence food security at the household level but also at the national level. This is due to the fact that crop products are usually transported from areas of surplus production to areas that have food deficit problems. Nonetheless, the quantity of harvested crop products will have no meaning if all the harvested crop products are sold, without keeping some of them to be consumed during periods of food deficit.

The respondents were asked to state how much of crop products they harvested during the 2003/04 agricultural season and whether the harvested crop products were enough to feed their families until the following season or not. Results show that maize, which the majority of respondents said was the staple food, on average respondents produced 130.4 kg per adult equivalent in 2003/04 agricultural season. The above finding reveals that there was maize deficit from own production, leave alone other sources of getting maize for instance purchases from the market, in kind transfers and gifts. This implies that for the majority of the farmers, own produced maize was not sufficient for household consumption.

Figure 9: An on-site view of Mount Rungwe slopes showing a maize field

Normally, maize supplies are adequate during the harvest season. Food maize needed thereafter for the family is usually stored. However, the quantity stored may or may not last up to the next harvest, either due to small amounts stored or due to the use of stored maize for purposes other than family consumption for example for brewing alcohol or selling to those who brew alcohol (Ashimogo, 1995).

According to a study that was done in Sumbawanga by Ashimogo (1995), carry-over maize was preferred in brewing alcohol to fresh maize, presumably because it had relatively less moisture content and hence better germination quality, an important characteristic for fermentation. The results show that 74.5% of respondents said that the harvested crop products were not enough to feed their household members until the next harvest (Table 26).

Table 26: Food sufficiency until next season (n = 212)

Category	No.	%
No	158	74.5
Yes	54	25.5
Total	212	100.0

For those who said the harvested crop products were not enough, the reasons for insufficient harvested crop products were asked for (Table 27). Moreover, the respondents were asked to state where they got food in case the harvested crop products were not enough until the following season. Various reasons that caused food shortages for the respondents were mentioned.

Although the area has fertile land, there are some crops like maize and beans that need supplementation of fertilizers for high yields. Low yield was due to soil exhaustion after frequent and permanent cultivation without the use of fertilizers. The majority (78.3%) of the respondents who replied negatively said that high costs of agricultural inputs especially fertilizers was the major cause of insufficient harvests. This implies that the majority did not afford buying fertilizers due to low income. The category of "others" that had less than 1.9% included the following reasons: too big household size and poor weed control. The results were as shown in Table 27.

Table 27: Main reasons that caused food shortage (n = 158)

Reasons	Frequency	%
High costs of agricultural inputs	123	78.3
Small plot/shortage of land	35	22.3
Low capital/income	21	13.4
Plant diseases and pests	12	11.5
Too old to cultivate	12	7.6
Shortage of labour	10	6.4
Lack of extension officers	7	4.5
Caring for sick relatives	5	3.2
Exhausted land	4	2.5
Traditional agriculture	4	2.5
Household head being disabled	3	1.9
Death of spouse/relative	3	1.9
Lack of improved seeds	3	1.9
Weather condition/drought	3	1.9
Others	2	1.2

NB: The percentages do not add to 100 due to multiple responses.

The respondents who said food was not sufficient until the next harvest stated where they got food to feed their household members. The majority (75.5%) said that they bought food either in kind or from the market. Although about a quarter (24.5%) said that the harvested crop products would suffice until the next harvest, the findings reveal that the harvested crop products would be enough until the next harvest for only 8.0% of the interviewed households (Table 28). Otherwise the amount would not be sufficient if one calculated the amount each household consumed per month, unless the household members consumed other food products such as yams and plantains that are normally obtained throughout the year in the fields.

For those who said harvested crop products were enough to feed their families until the following season, they were asked to mention how much was sold, consumed and stored.

Results show that on average each household stored 709.1 kg of maize. Moreover, results show that each household sold an average of 122.6 kg of maize in the previous season. This has an implication that the majority of households used to store big amounts of harvested products even though what they harvested in general could not suffice until the next harvest.

Table 28: Households with food remaining in store until the following season (n = 212)

Category	No.	%
No	195	92.0
Yes	17	8.0
Total	212	100.0

All the respondents (whether they harvested enough food or not) were asked to state what actions (coping strategies) they took to ensure that they had sufficient food for their families throughout the year. The findings show that 29.7% said that they were applying fertilizers in their fields to ensure that they harvested enough food throughout the year (Table 29). Although respondents said that they were using fertilizers in their field crops as one of the coping strategies, according to researcher's observations, in actual sense most of them were not using fertilizers as seen in Table 27. However, other respondents gave more than one action. The category of "others" that had less than 2.0% included the following reasons: ensuring surplus food production, increasing hours of work on the farm, using more capital for agricultural production, using insecticides to control insects, getting food from sons/daughters, borrowing land, doing good land preparation and being active in farmers groups. Results were as they appear in Table 29. Farm households used different strategies to cope with food insufficiency. Other studies (e.g. Corbett, 1988; Webb and Reardon, 1992, cited by Ashimogo, 1995) have indicated that strategies are carefully planned to cope with food insecurity. Food purchases (leave alone using fertilizers that was an indirect

strategy) was by far the most important coping strategy for households with food deficit (27.8%).

The use of money either from crop selling or non-farm activities imply that since maize is used as staple food in the surveyed villages, it is sold soon after harvest just to be bought back in the lean season. It seems, therefore, that most of the farmers who sell maize at harvest time run out of it later in the season and are forced to buy it back from the market (See Table 29). Thus, early crop sales do not mean that people have always enough to eat; rather it underlines the farmers' need for cash soon after harvest.

Table 29: Actions taken to ensure food availability throughout the year (n = 212)

Action	Frequency	%
Using fertilizer	62	29.7
Buying food	59	27.8
Storing harvested crop products	45	21.2
Cultivating bigger land	26	12.3
Taking no action	25	11.8
Cultivating other food crops like yams	19	9.0
Buying land	9	4.2
Using improved seeds	6	2.8
Following advices from extension officer	5	2.4
Planting on time	5	2.4
Using modern techniques of farming	5	2.4
Others	18	8.4

NB: The percentages do not add to 100 due to multiple responses

In order to know whether lack of agricultural extension services was a contributing factor to the quantity of harvested crop products or not, the respondents were asked to say whether they were getting advice from agricultural extension workers or not. Agricultural extension services can help rural people increase their productivity through dissemination of improved

farm knowledge and skills by the village Agricultural and Livestock Extension Officers (VALEO). The knowledge and skills they impart can enable the farmers to produce more farm products per unit of input. On whether respondents got advice from extension workers or not, the findings reveal that 72.6% of respondents said that they were not getting advice from extension staff. One of the reasons is that the district has very few extension workers, thus, making some villages to have no extension workers to serve the farmers, like it was the case of the villages that surround Mt. Rungwe. Other reasons might be because the villages surrounding Mt. Rungwe are in hilly topography, making the job difficult especially due to transport problems and long distances from the villagers to the residential places of extension staff.

4.4.3 Income

Income is one of the important aspects of food security due to the fact that it assists in buying foodstuffs particularly during the period of food deficit. Lack of insufficient income can hinder one's ability to afford buying food, rendering him/her to be food insecure. Income is even more important to rural people who are engaged in other activities than farming, for example carpenters, as well as to urban people who depend solely to income obtained, for buying all kinds of foodstuffs.

The findings show that in the majority of interviewed household heads whether FHHs or MHHs, the head of the household was the major income earner in his/her family i.e. 90.1% of households. Respondents were asked to state major sources of income during the period of food deficit. The majority of households (29.7%) had no sources of getting money at the period of food deficit (Table 30). Probably they consumed whatever was available from the fields such as yams, plantains and cassava. To them food deficit implied that maize (the staple crop) was not available in their stocks.

Moreover, food deficit period to them was defined as a period of the year when members of households felt that they ate less than they normally would and that what they ate was not what they regarded as a good diet. The findings also show that a few of households had various sources of income during the period of food deficit as seen in Table 30. However, for those who had sources, the major source of getting money during the period of food deficit was selling agricultural products such as plantains and vegetables (15.6%) of households. The category of "others" that had less than 2.0% included the following sources: house painting, selling grass for thatching, honey selling, luggage haulage, house renting, and allowances for religious leadership.

Table 30: Sources of income during periods of food deficit (n = 212)

Source of income	No. of respondents	%
None	63	29.7
Selling agricultural products	33	15.6
Does not buy; consumes yams and banana	19	9.0
Trading	17	8.0
Charcoal selling	14	6.6
Casual agricultural labour	13	6.1
Livestock selling/keeping	13	6.1
Lumbering	10	4.7
Timber selling	6	2.8
Given by sons/daughters	6	2.8
Salaried job	6	2.8
Local brew making and selling	5	2.4
Carpentry	3	2.4
Hair plaiting and mat selling	3	2.4
Masonry	3	2.4
Others	6	3.0

NB: The percentages do not add to 100 due to multiple responses

Respondents were asked to estimate the amount of money they got from different sources of income in a twelve months' time (one year) prior to survey and whether the amount they got was sufficient for buying foodstuffs till the next harvest or not. If the money they got was not sufficient, other sources of getting money for buying foods were mentioned. Results show that the average total income from different sources for the sampled households was Tshs 311,126/= per year, which is an average of Tshs 852/= per day per household. The average total income per adult equivalent per year was Tshs. 93,822/=, with an average of Tshs 257/= per day per adult equivalent (Table 31). This amount is slightly below the basic needs poverty line of Tshs. 259/= per adult per day documented in the Household Budget Survey Report of 2000/2001 (NBS, 2002). The annual incomes for the interviewed households were as they appear in Table 32. Respondents who earned high income had more than one NFAs where as those who earned low income had either one NFA or had no NFA at all.

Table 31: Annual income per adult equivalent per year (n = 212)

Statistics	Categories of respondents		
	MHHs	FHHs	All
Mean (Tshs)	108,130	529,78	93,822
Median	63,226	36,630	50,982
Mode	1550	4,098	6,250
Std. Deviation	162,763	70,845	146,486
Minimum	1,460,950	418,720	1,460,950
Maximum	1,462,500	422,819	1,462,500

Table 32: Annual income categories per adult equivalent per year (n = 212)

Income range (Tshs)	Male		Female		All	
	No.	%	No.	%	No.	%
1,550 – 20,000	26	16.5	14	25.9	40	18.9
20,001 – 40,000	27	17.1	16	29.7	43	20.3
40,001 – 65,000	29	18.4	14	25.9	43	20.3
65,001 – 125,000	38	24.0	10	18.5	44	20.7
125,001 – 1,462,500	38	24.0	0	0.0	42	19.8
Total	158	100.0	54	100.0	212	100.0

Income per adult equivalent per year was grouped into five groups as given in Table 32. Assuming that lower annual income is Tshs 65, 000/= and below, Table 32 shows that the proportions of female-headed (FHHs) households getting lower income are higher than those of male-headed households (MHHs) getting lower income, and vice versa. Therefore, since most MHHs have more income, they are likely to be more food secure than FHHs.

On whether the money they got was sufficient until the next season or not, results reveal that 69.3% of respondent households said that the money they got was not sufficient and the remaining 30.7% said the money was sufficient for buying food items until the next season (Table 33).

Table 33: Income adequacy up to next season (n = 212)

Category	No.	%
No	147	69.3
Yes	65	30.7
Total	212	100.0

The major source of income for buying food for those who had insufficient income was from loans from friends or relatives (25.2%), followed by those who got money by doing

casual agricultural labour 17.0% (Table 34). However, the findings reveal that more than half of the respondents (52%) and their household members ate bananas (*mbaraga*), sweet potatoes (*mbatata*), cassava and yams in periods of food deficit regardless of whether the income was sufficient or not, even though they regarded them as not good diets. The main reason is that the above-mentioned foodstuffs were available almost throughout the year for most of respondents even though their staple food was *ugali*. Those who had insufficient income bought food using various sources of income that are summarized in Table 34. The category of "others" included getting money from mat selling, pancake selling, house renting, doing masonry and given money by aunt/uncle.

Table 34: Sources of money for buying food where income was insufficient (n = 147)

Source of money	No	%
Loan from friends/relatives	37	25.2
Casual agricultural labour	25	17.0
Trading	18	12.2
Selling agricultural products	18	12.2
Given by children	17	11.6
Given by relative	15	10.2
Charcoal selling	12	8.2
Local brew selling	8	5.4
Timber selling	7	4.8
Salaried job	7	4.8
Lumbering	6	4.1
Given by parents	6	4.1
Selling livestock/livestock products	4	2.7
Loan from SACCOs	3	2.0
Pan cake selling	3	2.0
Others	8	5.4

NB: The percentages do not add to 100 due to multiple responses.

In order to know the amount of money each household spent per day on food, respondents were asked to mention their expenditures on food items for breakfast, lunch, dinner and other foods. Besides, they were asked to state which food types specifically they bought. The answers for the latter question could enable the researcher to know whether the respondents produced or harvested enough food or not. The estimates of expenditures per day did not only mean cash money produced but also they included the monetary values of food consumed. The results obtained reveal that the average monetary values per household per day for breakfast, lunch and dinner were Tshs. 472/=, 908/= and 1050/=, respectively. Because the standard deviations for the monetary values were very high (i.e. 358.0, 633.0 and 1595.1, respectively) they indicate that the monetary values among households were quite dispersed.

Table 35: Breakfast monetary values (n = 212)

Monetary values (Tshs)	No.	%
50 – 500	146	68.9
550 – 1000	56	26.4
1050 – 1500	6	2.8
1550 – 2000	4	1.9
Total	212	100.0

Table 36: Lunch monetary values (n = 212)

Monetary values (Tshs)	No.	%
100 – 500	73	34.4
600 – 1000	74	34.9
1200 – 1600	49	23.1
2000 – 2500	13	6.1
3000 – 5000	3	1.5
Total	212	100.0

Results show that for breakfast the majority (68.9%) of households spent 50 – 500 Tshs (Table 35), and 34.9% of households spent 600 – 1000 Tshs for lunch and dinner respectively (Tables 36 and 37). This implies that most of the people in the surveyed area did not earn much money. Another plausible explanation could be because what they ate normally had low prices in the market due to the fact that in rural areas foodstuffs are much cheaper than in urban areas.

Table 37: Dinner monetary values (n = 212)

Monetary values (Tshs)	No.	%
100 – 500	73	34.4
600 – 1000	74	34.9
1100 – 1600	41	19.3
1700 – 2600	19	9.0
3000 – 10,000	5	2.4
Total	212	100.0

On food bought as shown in Table 38, the findings reveal that rice was the food item that most respondents bought (95.8%). The reason is that paddy was not cultivated in the surveyed area because soil type and weather were not conducive for the paddy crop. Rice buying was followed by maize. *Ugali* that is obtained from maize is the staple food for the majority of Rungwe people, particularly in the surveyed area. The fact that about two thirds of households (66.0%) bought maize indicates that the majority of people living on the slopes of Mt. Rungwe were not able to produce enough food for consumption either due to land scarcity or due to traditional farming that involved the use of hand hoes as well as not using agro-chemicals like fertilizers and insecticides in their fields.

Table 38: Food bought by respondents (n = 212)

Food item bought	Number	%
Rice	203	95.8
Maize	140	66.0
Beans	120	56.6
Round potatoes	81	38.2
Sweet potatoes	45	21.2
Garden peas	43	20.3
Yams	38	17.9
Cassava	38	17.9
Groundnuts	37	17.5

NB: The percentages do not add to 100 due to multiple responses.

4.4.4 Access to productive resources and benefits by gender

Access to productive resources is of major importance as far as food security is concerned as it can influence food security at the household level. Productive resources include land and farm implements such as oxen ploughs. Benefits to household members by males or females include things like education (training), credit availability and decision on how to use the income obtained in the household. Land is one of the major means of agricultural production. Access to land as a means of production is of major importance as without it, one can neither cultivate nor plant. Land availability to smallholder farmers is a contributing factor to food security at the individual level as well as at the household level.

Therefore, respondents were asked to state whether they owned and controlled the land in the household. Besides, they were asked if female members of the households had equal rights as male members in inheriting the land as well as in using farm implements like oxen ploughs and others. The findings show that 85.4% of the respondents said that female members had equal rights in inheriting land. A study by Kayunze (1998), in Rungwe and Ileje Districts found that FHHs had less access to land ownership. Nevertheless, it seems

that after people of Rungwe got education and advice on equal rights between males and females in resources and other things such as equal education, they have understood the importance of land inheritance among male and female members. That's why according to observation during the research many respondents replied that both their sons and daughters had equal rights in land inheritance. Furthermore, the majority of respondents (95.8%) said that female members had equal rights as males on the use of farm implements. Those who said no mentioned the reason for the females not inheriting land as they were being married (4.2%).

In the case of training, results show that nearly a quarter of households (23.1%) had members who got training on various fields (Table 39). In the proportion of those who got training, about one third was females (32.7%) (Table 39). In the case of credit, unfortunately, in the surveyed area only 6.6% of the respondents had received credit for various activities (Table 40). In that proportion of those who received credit 28.6% were female members and the rest (71.4%) were male members (Table 40).

Table 39: Households that got training and sex of members trained

Household characteristics	Categories	No.	%
Households having members trained (n =212)	No	163	76.9
	Yes	49	23.1
	Total	212	100.0
Sex of household members trained (n = 39)	Male	23	67.3
	Female	16	32.7
	Total	39	100.0

NB: In each household only one member got training

Table 40: Households that got credit and sex of members who got credit

Household characteristics	Categories	No.	%
Households with members who got credit (n =212)	No	198	93.4
	Yes	14	6.6
	Total	212	100.0
Sex of household members who got credit (n = 14)	Male	10	71.4
	Female	4	28.6
	Total	14	100.0

NB: In each household only one member got credit

Results on the sex of the members of households who got training and credit imply that females had no equal access to such resources (32.7% and 28.6% respectively) as compared to their male counterparts. This may have contributed to food insecurity in FHHs. Nevertheless, the finding reveals that two thirds of respondents (66.7%) said that all members of the respective households shared the benefits from obtained credits and training. On who made major decisions on the use of income obtained in households, results indicate that 42.9% of respondents said that decisions were made by the males, 25.0% (a quarter) said by females, 30.7% by both males and females (couples) and 1.4% of respondents said decisions were made by all members of the household (Table.41).

Table 41: Decision maker on the use of income obtained in the household (n = 212)

Decision maker	No.	%
Father	91	42.9
Both	65	30.7
Mother	53	25.0
All members	3	1.4
Total	212	100.0

Nonetheless, on who benefited from income in households, results show that more than four fifths (82.5%) of respondents said that all members of households benefited from income of

the households. Results from interviewed VEOs and VALEOs show that women and men had equal rights in access to resources and benefits (62.5% of VEOs and VALEOs). However, they said that it was so after intervention by the government and that in general the conditions were not so good particularly to the widows who were married in polygamous marriage arrangements, because normally after the deaths of spouses the widows are chased away, meaning that they are deprived of access to resources like land and others.

4.5 Population dynamics components

The term population dynamics is sometimes used more generally to indicate any demographic process susceptible to change. The main components of population dynamics are births, deaths and migration (Haupt and Kane, 2000). As people are born, die or move; their total numbers in an area change. Other elements of population dynamics include population growth, population pressure, population density and age dependency ratio (Dratio). In this study the numbers of children born, people who migrated in and out of the households and people who died were recorded. Moreover, different rates and ratios were calculated, for example birth rate, death rate, in and out migration rates and Dratio, just to mention a few.

4.5.1 Birth rate

Birth rate (BR) is one of the important elements of population dynamics. Thus, it cannot be avoided in this study. It is defined as the number of live births per 1,000 population in a given year (Haupt and Kane, 2000). In this study the number of children who had been born in twelve months' time prior to the survey was recorded. Results show that 51 children were born in 23.1% of surveyed households. The reasons for recording the number of children

who were born one year prior to the survey was based on the fact that all the data for the research were collected for a single year and because the study adopts the "with and without approach" whereby the levels of food security are being compared in households where there was population change and where there was no population change.

According to Haupt and Kane (2000) mathematically BR can be calculated as follows:

$$BR = \frac{\text{Number of births}}{\text{Total population}} xk$$

Where k is a constant and in this case 1,000

$$BR = 51/1.071x1{,}000 = 47.62 \approx 48$$

The results show that there were 48 births per 1,000 population in the surveyed area. According to PSP (2003) crude birth rates range from 10 births per 1,000 in developed countries to 50 births per 1,000 in developing countries among which Tanzania is. That is a very high birth rate. The BR is higher than the national figure of 41 live births per 1,000 population (BS and DHS, 1997). The high birth rates that dominate in developing countries may be due to the fact that many people, especially in the rural areas take into consideration the high value of children, consequently they do not practice family planning methods.

Moreover, it may be due to the fact that most couples prefer many children to a few in their families. This is because children in rural societies are considered to contribute much in family labour and also compensate for those who may die. Because of high infant-mortality rates in most developing countries, women need more pregnancies and births so as to achieve the necessary family size. Children provide labour for meagre family income. In Bangladesh, one study showed that even by the age of six a boy provides labour and/or income for the family, and by the age of twelve, he contributes more than he consumes (Lean *et al.*, 1990). In some people female children are preferred to boys as when they

mature, they might get married and hence parents will get money or livestock such as cattle as a dowry price. Therefore, in general, particularly in rural areas, having many children is considered as a prestige and a sign of wealth. Furthermore, in rural areas the age at first marriage is a major determinant of fertility rate. In most cases, the earlier the girls have their first marriage, the more the number of children they are to bear in their life time and vice versa. In rural areas most of the girls are married at the adolescent ages, hence resulting in high fertility rates.

4.5.2 Death rate

Death rate (DR) is another important component of population change. Death rate is defined as the number of deaths per 1,000 population in a given year (Haupt and Kane, 2000). Like birth rate, the number of persons who died in twelve months' time prior to the survey was recorded in every sampled household. In this study the deaths of the under five children was also considered i.e. the under five mortality rate (U5MR). This age group was considered because the mortality of under-five differs considerably from adult mortality. Usually under normal conditions there is a higher probability of dying at the age below five years. The reasons for recording the number of deaths for the last twelve months (one year) prior to the survey are the same as they have been mentioned for recording the number of children born. According to Haupt and Kane (2000) mathematically, DR can be calculated as follows:

$$DR = \frac{\text{Number of deaths}}{\text{Total population}} xk$$

Where k is a constant, i.e. 1,000 in this case.
Therefore: DR = 38/1,071 x1,000 = 35.48 ≈35.

The results show that the death rate in the surveyed area was 35 per 1,000 population. This death rate is also high. Haupt and Kane (2000) argue that "crude death rates are affected by many characteristics, particularly age structure", and hence it is important when comparing

death rates between countries to adjust for differences in age composition. For example populations that have comparatively large numbers of old people are expected to have more deaths and fewer births than will a population of equal size that is largely composed of young families. This is when other factors are held constant.

Under Five Mortality Rate (U5MR) is mortality that occurs to children between age 0 to age four years (PSP, 2003). The measure is computed as follows:

$$\text{U5MR} = \frac{\text{Deaths of children under 5 years}}{\text{Total live births in that year}} x1000$$

$$= 10/51x1{,}000 = 196.07 = 196$$

The results show that there were 196 deaths of the under five children per 1,000 live births per year, i.e. November 2003 up to October, 2004. The under five mortality in Tanzania is 137 per 1000 live births (BS and DHS, 1997). According to URT (2000b), U5MR was found to be 147 per 1,000 live births. In 2000, there were 165 deaths per 1,000 live births for the under-five children (URT, 2001b). The U5MR found in the research area is on the higher side as compared to the national figures. Madulu (1996) argues that the levels and trends of infant and child mortality of most countries in SSA are high, ranging between 80 and 170 deaths per every thousand live births as compared, for example, to 33 and 32 in Sri–Lanka and China, respectively (Ross *et al.*, 1998 cited by Madulu, 1996). The author further points out that there is strong evidence to suggest that the levels of infant and child mortality have been declining in many countries. However, in Tanzania as indicated by the data above the U5MR is increasing. The figures obtained in birth and death rates in this study are just approximate ones because the mid-year population could have been used in calculating the above rates. Unfortunately, the data for the mid – year population were not available. Moreover, because of confusion with respect to the reference period (the previous 12 months, i.e. November 2003 to October 2004), it is possible that some respondents

reported deaths that had occurred prior to November 2003. Likewise, others might have forgotten to report deaths that occurred during the reference period.

4.5.3 Migration

Migration is defined as a form of geographical or spatial mobility that involves a permanent or semi permanent change of usual residence between clearly defined geographical units (PSP, 2003). The main forms of internal migration are the rural - rural migration and rural - urban migration. Under the former are the villagization schemes of the 1960s and 1970s and the resettlement of people from rural high population density areas to those rural areas that are sparsely populated (Mtatifikolo, 1997).

According to Mabogunje (1970), cited by Mbonile (1997), migration varies in volume, distance and duration and is divided into two main types viz.: internal and international. The former applies to movements within a country or a particular region; the latter applies to movements involving crossing international boundaries. As stated by Gold and Prothero, "in internal migration there are four major types of migration, and these are: rural – rural, rural – urban, urban – urban and urban – rural (counter urbanization)" (Mbonile, 1997). Migration is an important component in population dynamics since it has an influence on the size and composition of a population, especially at the local level (Shryock and Siegel, 1976 cited by Mbonile, 1997). Moreover, it is one of the determinants of population growth.

Migration that includes out-migration and in-migration is one of the major elements of population dynamics. It is an important factor in this study as it determines an increase or a decrease of population in the research area, and in this case in a household. Therefore, the numbers of persons who migrated in and out of the households were recorded in the surveyed households. Furthermore, other measures of migration were computed and

discussed. The measures include net migration, gross migration, in/out migration ratio, in – migration rate, out – migration rate and net migration rate.

4.5.3.1 Out-migration

Out - migration is movement out of an area within the same country i.e. internal migration (PSP, 2003). Respondents were asked to state the number of persons who had migrated out of their households within a period of 12 months, if any. The findings obtained from the interviewed household heads indicate that the majority of people who had migrated out of their households, had migrated to not only villages of Rungwe District but also within the districts of Mbeya Region. For example, they had migrated to Mbeya, Ileje and Kyela, with the majority who migrated to Mbeya (22.2%). Results were as they appear in Table 42. The category of 'other places' each with one out-migrant included out-migration to Usangu, Ileje, Kyela, Songwe, Tukuyu, Mpandapanda, Isyonje, Morogoro, Ibililo, Isongole, Njombe, Lindi, Mpanda and Igurusi.

Table 42: Out - migration from the households (n = 36)

Place	No.	%
Mbeya	8	22.2
Dar es Salaam	4	11.1
Kiwira	4	11.1
Sumbawanga	2	5.5
Uyole	2	5.5
Tukuyu	2	5.5
Other places	14	39.1
Total	36	100.0

Respondents mentioned various reasons for out-migration, as seen in Table 43. However, those who had moved out of their households because they were married were the majority

(22.2%). The rest had other reasons as they appear in Table 43. The weakness is that the mentioned reasons might not be the actual ones as the researcher did not ask those who migrated out.

Table 43: Reasons for out-migration (n = 36)

Reasons	No.	%
Getting married	8	22.2
Getting treatment	5	13.9
Following his/her father	5	13.9
Joining school/college	4	11.2
Absconding from agricultural activities	3	8.3
Finding an employment opportunity	2	5.5
Finding better life	2	5.5
Attending a tailoring course	2	5.5
Separation from spouse	1	2.8
Joining the army	1	2.8
Trading	1	2.8
Following her son/daughter	1	2.8
Got a job	1	2.8
Total	36	100.0

4.5.3.2 In-migration

In-migration is movement to an area within the same country, i.e. internal migration (PSP, 2003). It is also important in this study as it determines an increase or a decrease of population in an area, in this case in the household. Results show that like out – migration, the majority of persons who had moved to the respondents' households were from surrounding villages and also from among the districts of Mbeya Region. Most of in-migrants had come from Ileje District (26.3%). Those who had moved from within the districts of Mbeya Region were from Mbalizi, Kyela, Mbozi, Mbeya and Ileje while those who had moved from villages of Rungwe District were from Kituli, Ilolo, Isange, Ilundo, Kyimo and Syukula (Table 44).

Table 44: In - migration to the households (n=19)

Place	No.	%
Ileje	5	26.3
Mbozi	2	10.5
Kyela	2	10.5
Mbalizi	2	10.5
Other places	8	42.2
Total	19	100.0

The category of "other places" each with one in-migrant included in-migration from Dar-es-salaam, Kituli, Ilolo, Isange, Mbeya, Ilundo, Kyimo and Syukula.

Respondents were asked to mention the reasons that had made them to move to the households. The majority (32.0%) were the ones who were employed by the host families either as housemaids/houseboys or as livestock attendants (Table 45).

Table 45: Reasons for in-migration (n=19)

Reasons	No.	%
Employed by the host family	6	32.0
Joined grand parents	3	15.8
Death of Parents	2	10.5
Joined their relatives	2	10.5
Coming to mourn deceased relatives	1	5.2
His/Her mother married by another man	1	5.2
Loss of capital in trade	1	5.2
Being closer to the treatment place	1	5.2
Joined his/her friend	1	5.2
Separation from spouse	1	5.2
Total	19	100.0

4.5.3.3 Net migration (NM)

According to PSP (2003), mathematically, NM is calculated as follows:

NM = In-migration – out-migration

= 19 – 36 = -17

The results show that NM in the surveyed area was -17. They imply that out-migration was higher than in – migration. The plausible explanation for this is as explained in net migration rate (Section 4.5.3.8).

4.5.3.4 Gross Migration (GM)

Gross migration is the sum of in – migration and out –migration. Sometimes this measure is called a turnover (PSP, 2003).

GM = In- migration + out- migration

= 19 + 36 = 55

The results show that the GM in the surveyed area was 55 persons i.e. the total of in and out – migrants. The GM reveals that there were more out-migrants than in-migrants in the study area.

4.5.3.5 In/out migration Ratio

According to PSP (2003) in/out migration ratio can be calculated mathematically as follows:

$$\frac{\text{In - migration}}{\text{Out - migration}} x100$$

19/36 x 100 = 52.78 ≈ 53

The results show that there were 53 in – migrants per 100 out – migrants in the surveyed area. The ratio of in – migration to out – migration shows the magnitude of in – migration and out – migration. They imply that the out migration was very high in the surveyed area.

4.5.3.6 In–migration rate (IR)

The in-migration rate is the number of in-migrants arriving at a destination per 1,000 population at that destination in a given year (Haupt and Kane, 2000). According to Wilson (1985), mathematically IR can be calculated as follows:-

$$IR = I/P \times k = 19/1{,}071 \times 1{,}000 = 17.74 \approx 18.$$

Where: I = number of migrants into an area

P = area's population

K = a constant, often 1,000.

The results show that the IR was 18 in-migrants per 1,000 population in the surveyed area per year.

4.5.3.7 Out-migration rate (OR)

The out-migration rate is the number of out-migrants departing from an area of origin per 1,000 population at that area of origin in a given year (Haupt and Kane, 2000). According to Wilson (1985), mathematically OR can be calculated as follows:

$$OR = O/P \times k = 36/1{,}071 \times 1{,}000 = 33.61 \approx 33.$$

Where: O = the number of out - migrants

P = the area's population

K = a constant, often 1,000.

The results show that the OR was 33 out-migrants per 1,000 population in the surveyed area. They imply that the out-migration rate was high in the surveyed area The plausible explanations for that are the same as explained in net migration rate (Section 4.5.3.8).

4.5.3.8 Net migration rate (NR)

According to Wilson (1985), mathematically NR can be calculated as follows:

$$NR = (I - O)/P \times k = (19 - 36)/1{,}071 \times 1{,}000 = -14.61 \approx -14$$

Where I, O, P and k are as defined in Sections 4.5.3.6 and 4.5.3.7.

The results of NR imply that the number of out – migrants was higher than that of in – migrants. The plausible explanation for this is that people migrate to other places in order to find better life that includes things like employment, bigger land for cultivation and to be sure of food security throughout the year, just to mention a few. According to Mbonile (1994) the major underlying determinant of migration is subsistence economy followed by household division of labour, lack of non – agricultural employment opportunities, lack of higher education institutions, proximity to the main sources of commodities and environmental factors like poor soils and forest.

4.5.4 Summary of population dynamics

The components of population dynamics, including births and deaths, natural increase (births minus deaths), numbers of in- and out- migrants, and net migration (in-migrants minus out-migrants) in the research area are summarised in Table 46 and Figure 10. Based on the balanced equation of population change, it was found that the population in the research area had decreased by four persons.

Table 46: Summary of population dynamics

Number of births	Number of deaths	Natural increase	Number of in-migrants	Number of out-migrants	Net migration
51	38	13	19	36	-17

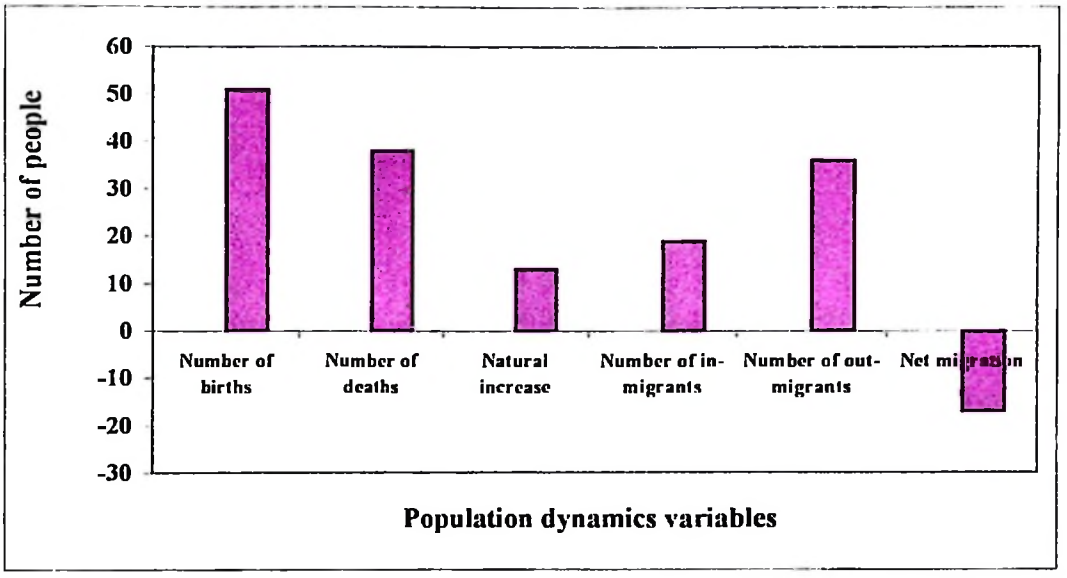

Figure 10: Population dynamics in the sample

4.5.5 Dependency ratio (Dratio)

The dependency ratio (Dratio) also called age dependency ratio is defined as "the ratio of the combined child population (under 15 years) and aged population (65 years and over) to adults aged 15 to 64 years" (PSP, 2003). Haupt and Kane (2000) define dependency ratio as the ratio of persons in the ages defined as dependent (under 15 years and over 64 years) to persons in the age defined as economically productive (15 – 64 years) in population. From the labour force point of view, the economically active population refers to the total number of persons available for the production of economic goods and services, and includes persons working and looking for jobs (Mtatifikolo, 1996). The Dratio takes into account the variation in the proportions of children, aged persons (i.e. dependent ages) and persons of working ages (i.e. productive ages). According to PSP (2003), mathematically, dependency ratio is defined as follows:

$$Dratio = \frac{P_{0\text{-}14} + P_{65}}{P_{15\text{-}64}} \times 100$$

Dratio = dependency ratio

P_{0-14} = population under 15 years

P_{65+} = population aged 65 years and over

P_{15-64} = population aged 15 – 64 years

Therefore, according to the above formula, Dratio = 495 + 54/522 x 100 = 105.17 ≈ 105 persons, i.e. Dratio = $^{105}/_{100}$.

The Dratio of 105/100 means that there were 105 persons in the dependent ages for every 100 persons in the working ages. The results obtained are more or less the same as the national figure (106/100) obtained in 1996 in Tanzania Demographic and Household Budget Survey (BS and DHS, 1997). According to Haupt and Kane (2000), the age dependency ratio is often used as an indicator of the economic burden the productive portion of a population must carry. The Dratio measure has some limitations. Some persons that are defined as "dependent" are producers, i.e. they may be productive in the actual sense and they are strong enough to perform productive activities. Moreover, others who are defined as "productive" may as well be dependent, i.e. are economically dependent, hence unable to perform productive activities. Countries with very high birth rates usually have the highest age – dependency ratio because of the large proportion of children in the population (Haupt and Kane, 2000). Results on how the Dratio was associated with food security, i.e. DEC, are indicated in correlation and t-test results in Sections 4.6 and 4.7, respectively.

4.6 Correlation results

Pearson's moment correlation coefficients (Pearson's r) between some individual independent variables and the dependent variable are given in Table 47, so are their levels of significance. According to Cohen and Holliday (1982), cited by Bryman and Cramer (1992), correlation coefficients (irrespective of sign) are interpreted as follows: below 0.19

is very low, 0.20 to 0.39 is low, 0.40 to 0.69 is modest, 0.70 to 0.89 is high and 0.90 to 1.00 is very high. Accordingly, the number of children born was negatively correlated with the DEC/AE, with the correlation coefficient of –0.102 but the correlation was not statistically significant at the 5% level. People who died in the households had a low negative correlation with DEC/AE. The correlation coefficient between them was – 0.246 and was statistically not significant at the 5% level. People who migrated into the households varied inversely proportionally with the amount of DEC/AE. The coefficient between them was – 0.281 but the correlation was not statistically significant at the 5% level. Likewise, people who migrated out of their households varied inversely proportionally with the amount of DEC/AE. The person's r between them was –0.130 but the correlation was not statistically significant at the 5% level.

Both household size and adjusted adult equivalent units had negative correlation with DEC/AE. The correlation coefficients between household size and adjusted adult equivalents units on one hand and dietary energy consumption on the other hand were – 0.234 and –0.254, respectively. The correlations were significant at the 0.1% level. The findings imply that smaller households and those with few adults tend to consume more DEC/AE than larger households. This is because some members of large households may be children, women and the old who need less food and hence less energy than adults, young people and men.

Dependency ratio had negative correlation with DEC/AE. The Pearson's r between them was – 0.052, and the correlation was not statistically significant at the 5% level. Age of household head had a very low positive correlation with DEC/AE. The correlation coefficient between them was + 0.040 but it was not statistically significant at the 5% level.

Amount of income earned per adult equivalent had a low but positive correlation with DEC/AE, with a correlation coefficient of +0.196 at the 1% level. This indicates that the amount of income within households is an important factor in raising the amount of dietary energy to be consumed. However, since the correlation is low, it implies that income is a less important determinant of food security in rural areas where people eat a good amount of food harvested from their own farms. The monetary value of food eaten per day per adult equivalent varied directly proportionally with DEC/AE, with Pearson's r of +0.164 at the 1% level. The finding implies that the higher the monetary values of foods eaten per day per adult equivalent, the higher the amount of dietary energy will be consumed per day and vice versa. Household heads' years of schooling had very low negative correlation with DEC/AE, with the correlation of -0.013. But the correlation was not statistically significant at the 5% level.

The amount of maize harvested in kilograms per adult equivalent had a positive correlation with DEC/AE, with a correlation coefficient of +0.220 at 0.1% level. This implies that harvesting large quantities of maize in the households is associated with the amount of dietary energy to be consumed in the households, meaning that the higher the quantities harvested, the more the dietary energy will be consumed in households. The same is for the amount in kilograms of beans and groundnuts harvested per adult equivalent. The amount of beans and groundnuts harvested per adult equivalent varied directly proportionally with DEC/AE. Pearson's r between each of them and DEC/AE was +0.343, and the correlations were significant at the 0.1% level ($p = 0.000$). The amount of tubers in kilograms harvested per adult equivalent had a positive correlation with DEC/AE, with a correlation coefficient of +0.284, which was significant at the 1% level ($p = 0.002$). The finding implies that the amount of tubers harvested per adult equivalent had influence on the amount of dietary

energy consumed in households. This means that as more tubers are harvested within the households, it is more likely that the amount of dietary energy consumed will also increase. That is particularly so during the period of food shortages because most households eat tubers that are normally available throughout the area as they don't have a specific season as cereals. Moreover, because households that have very low income in such a way that they cannot afford buying maize and rice, normally survive by eating tubers from their fields.

Table 47: Independent variables correlation with the dependent variable[2] (n = 212)

Variable characteristics (Independent variables)	Correlation coefficients (r)	Level of significance (p–value)
Demographic variables		
Children born (n = 51)	-0.102	0.246
People who died (n = 32)	-0.246	0.087
People who migrated in (n = 19)	-0.281	0.146
People who migrated out (n = 36)	-0.130	0.239
Household size (n = 212)	-0.234	0.000
Adjusted adult equivalent units (n = 212)	-0.254	0.000
Dependency ratio (n = 183)	-0.052	0.244
Age of household head (n = 212)	+0.040	0.282
Socio-economic variables		
Income per adult equivalent (n = 212)	+0.196	0.002
Monetary value of food eaten per day AE[3] (n = 212)	+0.016	0.008
Household heads' years of schooling (n = 212)	-0.013	0.426
Production variables		
Kg of maize harvested per AE (n = 202)	+0.220	0.001
Kg of beans harvested per AE (n = 191)	+0.343	0.000
Kg of groundnuts harvested per AE (n = 35)	+0.343	0.000
Kg of tubers harvested per AE (n = 101)	+0.284	0.002
Bunches of plantains harvested per AE (n = 167)	+0.026	0.367
Hectares of land cultivated per AE (n = 206)	+0.263	0.000

NB: n-values differ because households' characteristics also differed. For example, not all households grew all the crops, and some households had no children born.

[2] The dependent variable is dietary energy consumption (DEC) per adult equivalent
[3] AE means Adult Equivalent

Bunches of banana harvested per adult equivalent had a positive correlation coefficient with DEC/AE. The Person's r was +0.026 but the correlation was not significant at the 5% level. However, since the coefficient is very low, it indicates that the amount of plantains harvested per adult equivalent has very low influence on DEC/AE. The plausible explanation for this is probably the fact that normally plantains are eaten rarely in the surveyed area; maize is the staple food in the area, and plantains are not regarded as good diet. Furthermore, it may be because it is more for sale rather than for consumption.

Hectares of land cultivated per adult equivalent had a low positive correlation with dietary energy consumption per adult equivalent (DEC/AE). Pearson's r between them was + 0.263 and the correlation was significant at the 0.1% level. That finding implies that the acreage under cultivation has a low significant influence on increased DEC/AE.

4.7 T-test results for the independent variables and the dependent variable

In order to confirm the above results of linear correlations, and test the overall hypotheses of this research, independent samples t-tests for unrelated means were carried out to ascertain whether means of dietary energy consumed were significantly different between:

(a) Households with a newly born member and those without a newly born member;

(b) Households where at least one member had migrated out and those where no member had migrated out;

(c) Households where at least one member had migrated in and those where no member had migrated in;

(d) Households where at least one member had died and those where no member had died;

(e) Households with dependency ratio of 100 and less and those with dependency ratio of more than 100;

(f) Households with more than 8 ha of land and those with less than 8 ha;

(g) Households with income equal to and more than 50,633 Tshs and those with less than 50,633 Tshs;

(h) Households which harvested 84 and more kg of maize per adult equivalent and those which harvested less than 84kg of maize per AE;

(i) Households which harvested 15 and more bunches of plantains per AE and those which harvested less than 15 bunches of plantains per AE;

(j) Households which harvested 33 and more kg of tubers per AE and those which harvested less than 33 kg of tubers per AE;

(k) Larger households with five members and more and smaller households with less than five members;

(l) Households that lived at higher altitudes and those that lived at lower altitudes; and

(m) Male headed households and female headed households.

The t-test results are presented in Table 48. Households with a newly born member consumed less dietary energy per adult equivalent (3,192 Kcal) than those without a newly born member (3,470 Kcal). But they did not differ significantly at the 5% level. Although there was no significant difference this means that addition of a person results in a decrease in the DEC/AE. This relationship was also shown by correlation results (Table 47) that the number of children born was negatively correlated with the DEC/AE. But the relationship was not statistically significant. Therefore, on the basis of the sample of this research, there is sufficient evidence to accept the first null hypothesis of section 1.4.3 that dietary energy consumption is not significantly associated with addition of a person in the household.

Households where at least one member had died consumed less dietary energy per adult equivalent (2,875 kcal) than those where no member had died (3,502kcal). The means were significantly different at the 5% ($p = 0.027$). This supports the correlation results in Table 47, which shows that people who died in the household were negatively correlated with DEC/AE. The reason for this correlation was given earlier in correlation results discussed. Therefore, there is sufficient evidence to reject the second null hypothesis of section 1.4.3 and confirm the alternative hypothesis that dietary energy consumption is significantly correlated with survival of household members.

Households where at least one member had migrated out and those where no member had migrated in consumed less dietary energy per adult equivalent (3,292 and 3,355 Kcal), respectively, than those where no member had migrated out (3,425 Kcal) and those where at least one member had migrated in (4,001 Kcal). However, they did not differ significantly at the 5% level, meaning that as a person migrates into a household, the DEC/AE increases and as a person migrates out of a household the DEC/AE decreases and vice versa. This relationship was also shown by correlation results (Table 47) that people who migrated into households and those who migrated out of the households varied inversely proportionally with the amount of DEC/AE. The correlation was not statistically significant ($p = 0.000$) between the people who migrated into the households with the amount of DEC/AE. Therefore, there is sufficient evidence to accept the third null hypothesis of section 1.4.3 that dietary energy consumption is not significantly correlated with migration of household members.

Table 48: T-test results for independent variables and the dependent variable (n = 212)

Groups compared	Mean DEC/AE	t-value	p-value
Households which harvested more maize per AE[4] (n = 102)	3,941	+3.924	0.000
Households which harvested less maize per AE (n = 100)	2,923		
Larger households (5 and above) (n = 116)	3,053	-3.005	0.002
Smaller households (less than 5) (n = 96)	3,835		
Households which harvested more beans per AE (n = 97)	3,823	+2.922	0.002
Households which harvested less beans per AE (n = 95)	3,027		
Households with larger acreage (n = 104)	3,777	+2.686	0.004
Household with smaller acreage (n = 102)	3,074		
Households with higher income per AE (n = 106)	3,737	+2.561	0.006
Household with lower income per AE (n = 106)	3,077		
Households that lived at higher altitude (n = 114)	3,144	-2.178	0.016
Households that lived at lower altitude (n = 98)	3,713		
Households which harvested more plantains per AE (n = 80)	3,721	+2.063	+0.021
Households which harvested less plantains per AE (n = 88)	3,094		
Households whose members died (n = 32)	2,875	-1.985	0.027
Households whose members didn't die (n = 180)	3,502		
Households which harvested more groundnuts per AE (n = 16)	4,188	+1.840	0.039
Households which harvested less groundnuts per AE (n=13)	3,428		
Households which harvested more tubers per AE (n = 51)	3,196	+1.319	0.095
Households which harvested less tubers per AE (n = 51)	2,797		
Households whose members migrated in (n=17)	4,001	+1.016	0.162
Households whose members didn't migrate in (n = 195)	3,355		
Household with lower dependency ratio (less than 100) (n = 72)	3,473	+0.758	0.225
Households with higher dependency ratio (>100) (n = 127)	3,264		
Households with a newly born member (n = 48)	3,192	-0.921	0.180
Households without a newly born member (n = 164)	3,470		
Male headed households (n = 158)	3,470	+0.574	0.284
Female headed households (n = 54)	3,283		
Households whose members migrated out (n = 29)	4,001	-0.307	0.381
Households whose members didn't migrate out (n = 183)	3,425		

NB: n-values differ because households had different characteristics. For example types of crops grown and households that had children born.

[4] AE means Adult Equivalent

Households with lower dependency ratio consumed more dietary energy per adult equivalent (3,473 kcal) than those with higher dependency ratio (3,264 kcal). But they did not differ significantly at 5%. Although they did not differ significantly, it implies that the more the dependants the less the dietary energy will be consumed in the households. This supports the correlation results in Table 47, which show that dependency ratio is negatively correlated with DEC/AE. Therefore, there is sufficient evidence to accept the fourth null hypothesis of Section 1.4.3 that says that there is no significant difference in dietary energy consumption between households having lower and those having higher dependency ratios.

Households with larger acreage, those that that had harvested more maize per adult equivalent (AE), those that had harvested more beans per AE, and those with higher income per AE consumed more dietary energy per adult equivalent (3,777, 3,941, 3,223 and 3,737 kcal) than those with smaller acreage (3,074 kcal), those that had harvested less maize per AE (2,923 Kcal), those that had harvested less beans per AE (3,027 Kcal) and those with lower income per adult equivalent (3,077 kcal). They were significantly different at the 1% ($p = 0.004$), 0.1% ($p = 0.000$), 1% ($p = 0.002$) and 1% ($p = 0.006$) level of significance. This relationship was also shown by correlation results (Table 47) that acreage of land cultivated, the quantity of maize and beans harvested (kg), and the amount of income earned per adult equivalent was positively correlated with DEC/AE, and the correlation was significant. Therefore, the area under cultivation, amount of maize and beans harvested and amount of income earned are very important in increasing the dietary energy to be consumed.

Households that had harvested more groundnuts per AE, more plantains per AE and more tubers per AE consumed more dietary energy per AE (4,188, 3,721 and 3,196 kcal), respectively, than those that had harvested less groundnuts, plantains and tubers per AE (3,428 Kcal, 3,094 Kcal and 2,797 Kcal, respectively). The differences for the means of

DEC for groundnuts and plantains harvested were significant at the 5% level, respectively, and for tubers harvested the difference was not statistically significant at the 5% level. The t-test results supported the correlation results in Table 47, which show that the quantities of groundnuts, plantains and tubers harvested were positively correlated with the amount of DEC/AE. But the correlation between means for less and more quantities of plantains harvested per AE was not statistically significant at the 5% level. Generally, households that had harvested more food per adult equivalent consumed more dietary energy per AE than those that had harvested less food. The differences among the means were significant, except for plantains. The relationships were also shown by correlation results that the quantities of food harvested were positively correlated with the amount of DEC/AE. Therefore, on the basis of the sample of the research, there is sufficient evidence to reject the fifth and last null hypothesis of Section 1.4.3 and confirm the alternative hypothesis that dietary energy consumption differs significantly between households producing less and those producing more food.

Larger households and those that lived at higher altitudes consumed less dietary energy per adult equivalent (3,053 and 3,144 Kcal), respectively, than smaller households (3,835 Kcal) and those that lived at lower altitudes (3,713 Kcal). They were significantly different at the 1% ($p = 0.002$) and the 5% level ($p = 0.016$) level of significance. The relationship for the former was also shown by correlation results (Table 47) that household size was negatively correlated with DEC/AE. The coefficient between them was –0.234 and the correlation between them were significant at the 0.1% level. The finding implies that smaller households tend to consume more DEC/AE than larger households. The plausible explanation for the latter is that since those at higher altitudes had fewer IGAs than those at the lower altitudes, they could not manage to buy enough food for their members. Hence, they consumed less dietary energy per adult equivalent.

MHHs consumed more dietary energy per adult equivalent (3,450 Kcal) than FHHs (3,283 Kcal). But the difference was not statistically significant at the 5% level. Nonetheless, it means that households that are headed by females consume less amounts of DEC, probably because most of the FHHs are headed by old women and tend to have more dependants hence unable to feed them properly.

The correlation results presented have shown associations between the independent variables and the dependent variable for the research, i.e. DEC/AE. The t-test results presented also have shown how DEC/AE differed among households with different characteristics.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 An overview

In the previous chapter, results and discussion of the findings of the research were presented. This chapter presents the summary of the research findings, conclusion, recommendations and areas for further research.

5.2 Summary of findings

5.2.1 Socio-demographic characteristics of respondents

Of all the household heads (HHs) that were interviewed, FHHs were 25.5% while MHHs were 74.5%. The findings show that 27.9% of MHHs were food insecure and 35.2% of FHHs were food insecure, implying that MHHs were more food secure than FHHs.

Households with married household heads were 70.8% while those without unmarried household heads were 29.2%. The latter included widowed, separated, not married, and divorced household heads. Households with married heads were more likely to be in a food secure situation due to labour reinforcement from spouses.

About the main occupations of HHs, the finding showed that the majority of respondents (94.2%) were involved in crop production. A few were involved in trading, radio repairing, electrical works, tailoring, carpentry, bicycle repairing, religious leadership, salaried jobs, and livestock keeping.

On the ages of respondents, the highest age was 86 years and the lowest was 19 years, with more than half of HHs (52.4%) having the ages ranging from 30-49 years. On broad age groups of both the HHs and their members, the results revealed 46.2% of 0 –14 age group, 48.8% of 15 –64 age group and 5.0% of 65 and above age group. They imply that the economically active group of 15-64 years were higher in numbers than other broad groups.

On years of schooling of HHs, the results show that about half of HHs (49.2%) had primary education; whereas 16.5% of HHs had not attended school at all. On household size the results show that the average household size was 5.1. The findings revealed that household size was negatively correlated with food security (-0.234), implying that the smaller the household size the more food secure the household was, and vice versa.

On NFAs, the results show that the majority of respondents (42.9%) were involved in livestock keeping while 21.7% of households had no activities other than crop production that were being done in their households. Other NFAs that were being done by household members included trading, charcoal and timber selling, casual agricultural labour and salaried job, just to mention a few.

5.2.2 The rates of birth, death, in - and out - migration

Based on the findings, it was found that the birth rate for the people who are living on the slopes of Mt. Rungwe was 48 births per 1,000 population and the death rate was 35 persons per 1,000 population per year. The in-migration rate was 18 persons per 1,000 population and the out-migration rate was 33 persons per 1,000 population per year. Moreover, the findings showed that there were 105 persons in the dependence ages for every 100 persons in the working ages.

5.2.3 Dietary energy consumption in households' routine meals

The respondents were asked to mention the composition of foods they ate everyday. Based on that composition, the DEC/AE was calculated. The findings showed that the average dietary energy consumption per adult equivalent per day in households' routine meals was 3,407 kcal. This value is impressive because it is above the minimum daily intake of 2,280 Kcal that was calculated in Section 3.9.

5.2.4 Proportions of households below the minimum level of DEC/AE

Based on the calculated DEC/AE per day for each household, the findings showed that 29.7% of households were below the minimum level of DEC/AE, meaning that they were food insecure and 70.3% of households were above the minimum level of DEC/AE, implying that they were food secure. The above figure (29.7%) indicates that the prevalence of food insecurity in the study area is on the high side.

5.2.5 Association between population dynamics and dietary energy consumption

T-test results showed that there was no statistically significant difference in DEC between households with a newly born member and those without a newly born member ($P > 0.05$). T-test results also showed that there was no statistically significant difference in DEC between households whose members had migrated in and out of the households and those whose members had not migrated ($P > 0.05$). Moreover, t-test results showed that there was statistically significant difference at the 5% level ($P = 0.027$) in DEC between households where at least one member had died and those where no member had died. There was also statistically significant difference in DEC between households that were living at lower altitudes and those that were living at higher altitudes of Mount Rungwe. The latter had less DEC, hence they were more food insecure.

5.3 Conclusion

Food insecurity is likely to persist unless appropriate technologies are used to increase food production to meet high population food requirements on the slopes of Mt. Rungwe. Negative attitude towards consuming cooked banana and tubers as staple foods is another explanation for food insecurity on the slopes of Mt. Rungwe. Such foods, if well planned for diets in combination with grains and various types of relish, could substantially improve the amounts of DEC.

The prevalence of food insecurity (29.7%) found on the slopes of Mt. Rungwe in this research is on the higher side, especially based on the fact that Rungwe District is a good producer of various food crops. One of the plausible explanations for that is relatively high population whereby the average household size is 5.1, while household size was negatively correlated with food security in terms of DEC.

The average land size owned (1.1 ha) by households is very small indicating that there is land scarcity in the surveyed area. Therefore, land size or acreage under cultivation is associated with food security.

The study found that out-migration from the area is not very high probably because mountainous areas are very rich in natural resources like water and biodiversity so they tend to attract many people. This leads to population pressure and also high population density.

Non-farm activities, which are otherwise called IGAs, are very important to the people of Rungwe, as they are the sources of income for buying food, especially during the period of food deficit, particularly a short period before the next crop matures. Non-farm IGAs are an important strategy for coping with food insecurity on the slopes of Mount Rungwe.

If the use of hand tools goes on dominating agricultural production activities, production will not be enough to solve the problem of food insecurity, taking into account that there was a relatively high population that was shown by the average household size of 5.1 in the surveyed area.

High numbers of dependants in the household contribute to household food insecurity. That is due to the fact that the dependants cannot participate fully in agricultural activities as well as in IGAs that can help people earn money and buy food.

On access to productive resources by gender, at least nowadays the condition is improving as female members of households in the surveyed area have equitable rights with their male counterparts in inheriting assets such as land. That is after they have been educated and also after intervention by the government by reforming the Land Laws in 1999 to increase women's access to it, among other objectives of the reform.. However, in some few cases, especially among women who are married in polygamous marriage structures, that right is not there as they are chased away immediately after the death of their spouses.

Death is one of the important components of population dynamics. From the results of this research it was is concluded that somehow population dynamics relates to food security but not always. For example, the findings show that the food security situation was not good in the households where at least one household member had died. However, the findings revealed that food security was not necessarily affected in households where there was increase in terms of child birth and an increase or a decrease in terms of in and out – migration, respectively.

Households that were living at higher altitudes were less food secure than those that were living at lower altitudes. The former consumed 3,144 Kcal per adult equivalent per day while the latter consumed 3,713 Kcal because the latter had more non-farm activities, hence more income to buy food.

5.4 Recommendations

Based on the above conclusions of the research, the researcher gives the following recommendations so as to improve the food security situation in the research area, with respect to population dynamics.

5.4.1 Policy makers/Government

Since most of the farmers in the area cannot afford buying fertilizers, the government should not only provide subsidy to the transporters of fertilizers, but also should provide subsidy to smallholder farmers, so that they can afford buying fertilizers and improve or increase yields. In that way they will be able to increase food security in their households.

Since the majority of the farmers in the surveyed area do not have contacts with VALEOs, while extension services are still under the Government, the Government especially the Ministry of Agriculture and Food Security, should employ more VALEOs. This will help many farmers to access the services and get improved technologies as well as advice that will help them to improve and increase agricultural productivity and hence improve food security in the surveyed area as well as in other areas of Tanzania.

Because the dependency ratio is on the higher side, the Ministry of Health should educate and provide counselling to the people in the research area or in Rungwe district as a whole on birth control and family planning. This will help them to reduce the fertility rates. In so doing the dependency ratio will decrease because most of the dependants were the children

under 15 years of age rather than the old ones (above 64 years of age), and therefore the food security situation in the area will improve.

People should be advised and/or educated to change the societal norms of family size through the media like radio and newspapers. This will help them to reproduce a smaller number of children, which will impact positively on food security.

Since death of some members of households was significantly and negatively correlated with food security, the Government, particularly the Ministry of Health, is urged to increase efforts to check not only mortality but also morbidity in order to improve food security.

5.4.2 NGOs

NGOs that are involved in credit provision should provide credits to smallholder farmers that will help them buy fertilizers and hence increase the yields. In order to improve food security the government and NGOs should conduct nutritional education campaigns about the values of banana and tubers and how better they should be combined with grains and different types of relish for better nutrition.

5.4.3 Community level

Farmers should be encouraged to store large quantities of crop products after harvest; that will help them during the period of food shortage. In order to increase food security it is recommended that appropriate technologies be used especially the use of improved cultural practices, agrochemicals and agricultural extension officers to ensure production of sufficient food for the population of Mt. Rungwe.

5.4.4 Household level

Since most farmers do not afford buying artificial fertilizers, they should use farmyard manure that is locally available to increase crop yields and hence reduce food insecurity.

Because most farmers do not produce sufficient food crop products for the members of their households throughout the year, the little amount they produce should be stored to be used during periods of foods shortage.

Since most farmers use local seeds and that is one of the reasons for low harvests and hence food insecurity, they should use improved seeds so as to increase production per unit area thereby increasing food security.

Because most farmers use hand hoes in most agricultural production activities, which also leads to small acreage under cultivation and hence low harvests, they should organize themselves to form farmers' groups whereby they can buy draft animals and oxen ploughs to be shared. That will facilitate production activities and increase area under cultivation thereby increasing food security.

Taking into account the finding that the dependency ratio is on the higher side, with most of dependants being children under 15 years of age, the people living on the slopes of Mt. Rungwe should be informed of the advantages of small families and should as well use family planning methods to reduce the number of children born. Those who cannot afford paying for modern methods of contraception should use natural or traditional methods of birth control. Decreasing the dependency ratio will contribute to improvement in household food security, since dependency ratio was negatively correlated with the amount of dietary energy consumption.

In order to increase household food security, apart from increasing the use of technologies as recommended above, people are urged to refrain from living at higher altitudes of Mountain Rungwe because of fewer income generating activities and spatial isolation at higher altitudes.

5.5 Areas for further research

The negative attitude towards consuming bananas and tubers as staple foods is one of the reasons for food insecurity in the surveyed area. There is a need to carryout a study as to why bananas and tubers are not regarded as good foodstuffs although they are available almost all the year round.

Since the interviewees were people who had not migrated out of their households, there is a need to carryout a study on determinants of out-migration for the out-migrants in the areas of destination.

One of the obvious reasons for out-migration is finding better life by improving the standard of living. One of the criteria for improvement of standard of living is assurance of food security throughout the year. Therefore, I recommend that a research on food security situation for the out-migrants in the areas of destination be conducted.

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APPENDICES

Appendix I: Household questionnaire for the research

POPULATION DYNAMICS AND FOOD SECURITY ON THE SLOPES OF MOUNT RUNGWE, TANZANIA

A: GENERAL INFORMATION

1. Name of the Village .....
2. Name of the Ward .....
3. Name of the Division .....
4. Name of interviewer .....
5. Date of interview .....

B: BACKGROUND VARIABLES

6. Sex of household head: 1. Male 2. Female
7. Marital status of household head:

   (1) Married (2) Widowed (3) Divorced (4) Separated

   (5).Not yet married
8. Main occupation of household head .....

9. Household composition:

Household Members		Sex Male/female)	Age	Years of schooling
Household Head				
Wife/wives	1. 2. 3.			
Children:	1. 2. 3. 4. 5.. 6.			
Other members of the family	1. 2. 3.			

10. What are the activities other than agriculture/farming that are done in this household? .....

.....

C: FACTORS OF PRODUCTION AND POPULATION DYNAMICS COMPONENTS

(i) Land

11. (a) Does your household own any farmland? 1 = Yes 2 = No

(b) If yes, how much land do you own? .....acres/ha

(c) How much of the land was used for farm activities in 2003/2004? ..... acres/ha.

(d) Does your household borrow land? 1= Yes 2= No

(e) If Yes, how much land was borrowed in 2003? ..... acres/ha

(f) How much of the borrowed land was used for farm/agricultural activities in 2003/2004?..... acres/ha.

(ii) Income

12. Who is the major income earner in the family?.....

13. What was the major source of income in seasons of food shortage?.....

14. Estimate your income from different sources

Activities/sources	Amount of income Tshs
1. Main source	
2.Other sources	
a	
b	
c	
Total	

15. Was the income obtained adequate for your family requirements up to the next season? 1. Yes 2 No

16. If no, where did you get money for buying food?

Source of money for buying food	Yes	No
Sons/daughters		
Father/mother		
Uncle/Aunt		
Relatives		
Friends		
Borrowing from any of the above		
Borrowing from SACCOS		
Other sources (Specify)		

17. Please estimate your household expenditure per day on:

18. What food items specifically did you buy? .....

Breakfast .....

Lunch.....

Dinner.....

(iii)Food production

19. How much food crop products did your household harvest in 2003/2004?

Crop	Quantity harvested
Maize	Kg
Paddy	Kg
Beans	Kg
Plantains	Bunches
Others (specify)	Kg

20. Was the amount harvested enough to feed your family until the next season?

1. Yes 2. No

21. If no, where did you get food to meet your requirements?

22. What are the reasons that caused shortage of food in your family?

23. If yes, how much food did you store in 2003/2004 and how much was sold?

Food crop	Sold	Consumed	Stored
Maize			
Paddy			
Beans			
Plantains			
Others (specify)			

24. Which types of food and quantities remained from the previous season in the store when you started harvesting this season

Food type	Quantity remained
1.	
2.	
3.	
4.	
5.	

25. What do you do to make sure that there is enough food for your family throughout the year?

    .....

26. Did you get any advice from extension agents on better ways of food production? 1 Yes 2 No

(iv) Migration

27. How many persons in your household for the past 12 months have moved/migrated to other places?
28. Where did they migrate to? .....

    .....

29. What were the reasons for their migration out of the household?

    .....

    .....

30. How many persons for the past 12 months have come to live with your family?

    .....

31. Where did they migrate from? .....

32. What were the reasons that made them to come to live in your household?.....

.....

(v) Birth rate

33. How many children were born for the last 12 months?.....

(vi) Death rate

34. How many members of the household have passed away in the last 12 months?

1. Under 5 years old .....
2. 5 to 14 years old .....
3. Between 15 – 64 years old .....
4. 65 and above .....

(viii) Access to productive resources and benefits by gender

35. Who owns the land in your household?

1. Father 2. Mother 3. Both
4. All members of the family 5. Others (specify)

36. Who controls the land in your household? .....

2. Father 2. Mother 3. Both
4. All members of the family 5. Others (specify)

37. Does female members of the household have the rights to inherit the land?

1. Yes 2. No

38. Do female members of the household have equal rights in using farm equipment like oxen plough and others? 1. Yes 2. No

39. If No, What are the reasons? .....

.....

40. Is there any member of the household who has received any training on better farming methods or in any other field? 1. Yes 2. No

41. If yes, who got training? 1. Male member 2. Female member

42. Is there any one in your household who has ever got credit to improve your farm or non farm activities? 1. Yes 2. No

43. If yes, who got credit? 1. Male member 2.Female member

44. Who benefits from the credit? 1. Father 2. Mother 3. Both
4. All members of the family 5. Others

45. In your household who makes major decisions on the use of income obtained?
1. Father 2. Mother 3. Both
4. All members of the family 5. Others (specify)

D: FOOD SECURITY INDICATORS

46. How many meals do adult members of your household eat per day?
.....

47. How many meals do the under five children members of your household eat per day? .....

48. What is you staple food?
.....

49. How many meals compose of staple food per day?
.....

50. What is the composition of your
1. Breakfast .....
2. Lunch .....
3. Dinner.....

51. How much of the following foodstuffs do you consume per month in your household?
Rice.....kg
Maize.....kg
Round potatoes.....kg
Sweet potatoes.....kg
Yams.....kg
Plantains.....bunches
Beans.....kg
Others (specify).....kg

THANK YOU FOR GIVING ME IMPORTANT INFORMATION

Appendix 2: Checklist for VEOs/VALEOs

GENERAL INFORMATION

1. Village.....
2. Ward.....
3. Division.....
4. Does this village have food insecurity problems?
5. If yes, in what season/period of the year?
6. What are the main causes of food insecurity in your village/area?
7. What strategies do farmers take to cope with food insecurity in your village/area?
8. What strategies are taken by the village government to cope with the problem?
9. What are your suggestions on how to cope with food insecurity in your area?
10. Is there any person in this village/area who has died of hunger? When was it?
11. In what aspects do you think farmers need technical assistance to improve food security in your village/area?
12. Do you normally give farmers advice on how to improve food production?
13. If yes, how often?
14. How many villages do you attend?
15. How many households on average do you attend?

MAIN ACTIVITIES

16. What are the main activities of this village?

FOOD SECURITY

17. What is the staple food in this village?
18. How many meals on average do adult members of your village/area eat per day?
19. How many meals on average do the under five members of your village/area eat per day?

FACTORS OF PRODUCTION AND POPULATION DYNAMICS COMPONENTS

LAND

20. Do villagers own land for farm activities?
21. How much land on average does a villager own?
22. How much land on average does a villager cultivate?

FOOD PRODUCTION

23. Do most farmers store their crop products after harvesting?
24. What percentage of farmers stores their crop products after harvesting?
25. Do you emphasize on the importance of storing harvested crop products?

MIGRATION

26. Is out-migration a problem in your village/area?
27. If yes, how?
28. How about in-migration?
29. Where do many villagers migrate? (Other districts of Mbeya, outside the region)
30. From where do many people migrate? (Other districts of Mbeya, outside the region)

ACCESS TO RESOURCES AND BENEFITS BY GENDER

31. Would you say women and men have equal rights in access to resources and benefits?

INCOME

32. What are the main sources of income for the villagers in your village/area?

Appendix 3: Villages in which data were collected

Ward	Village	Location
1. Katumba	1. Katumba	High land
2. Kiwira	2. Ilolo	High and low land
	3. Ilundo	High and low land
	4. Mpandapanda	Low land
3. Kyimo	5. Kibisi	High land
	6. Syukula	High and low land
4. Nkunga	7. Nkunga	Low land
5. Suma	8. Ibumba	High and low land
	9. Kabale	High land
	10. Nditu	Low land
	11. Suma	Low

Source: Rungwe District Administrative Secretary's Office (2004).