HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF CHILDREN AGED 6-59 MONTHS IN MWEA-TEBERE RICE IRRIGATION SCHEME, KENYA.

BY

JAMES NJIRU KANYUIRA

(BSc. Food Science and Technology (UoN))

A Dissertation submitted in partial fulfillment of the requirements for the Degree of Master of Science in Applied Human Nutrition in the Department of Food Science, Nutrition and Technology, Faculty of Agriculture, University of Nairobi

September, 2010

DECLARATION

I hereby declare that this dissertation is my original work and has not been presented for a degree in any other University.

Signed---------- Date----14/09/2010----

James Njiru Kanyuira

This dissertation has been submitted for examination with our approval as University Supervisors

Signed---------- Date----14/09/2010----

Dr. Mwangi Alice Mboganie (PhD)

Department of Food Science, Nutrition and Technology.

Signed---------- Date----14/9/2010----

Prof. Karuri, E.G.

Department of Food Science, Nutrition and Technology.

DEDICATION

I feel privileged to dedicate this work to my late parents, Mr. and Mrs. Kanyuira who lovingly brought me up and taught me three important pillars in life: hard work, patience and pursuance. The ember you lit in me is still burning. I miss you. Thank you and may the Almighty God rest your souls in eternal peace.

ACKNOWLEDGEMENTS

First and foremost I am grateful to Almighty God for His abundant grace and love that has put me where I am today. Thank you Lord.

I am greatly thankful to my supervisor Dr. Mwangi Alice Mboganie that despite her busy schedule, she always found time to assist me during the entire period of this study. I appreciate her dedication and commitment she demonstrated in guiding me in accomplishing this study and also throughout the course work. May Almighty God bless her and give her more strength. I am also deeply indebted to Prof. Edward G. Karuri as my supervisor, for his guidance and encouragement he accorded me. I appreciate his commitment in ensuring that I remained focused to my objectives and time frame. I also owe special thanks to Prof. Wambui Kogi-Makau for her commitment in teaching an introductory course to this study. I extend my appreciation to Joseph Mugo for his assistance during the study particularly in software application. My thanks also go to Joan Waluvengo (ANP secretary/librarian) for her unlimited support in the many occasions I needed help in the library. Thank you very much and God bless you all.

I am highly grateful to the Government of Kenya, Ministry of Public Health and Sanitation (MoPHS) for offering me study leave to pursue MSc. degree at University of Nairobi. Special thanks to Ms Terry Wefwafwa, Head of Nutrition Division, MoPHS for her support through that process. I also appreciate the help of George Ndichu (PNO, Central province), Immaculate Onyango (PNO Nairobi province) and Festus Mutua

(DNO, Kirinyaga district) for assisting me with the anthropometric tools and equipment that were used for data collection for this study.

I want also to thank the field assistants; John Kago, Samuel Waithaka, James Mwangi, Peter Murimi and Kenedy Goiyo for their excellent work during data collection. Were it not for you, this work would not have been successful. I am very grateful to the community members of Tebere location particularly men and women who accepted to be interviewed and provided the required information. Once again I have wondered whether you would regret reading this report.

Special thanks go to my wife, Sabinnah for her support and encouragement throughout the period I was away for studies. On top of her many commitments, social obligations and care for the children, she always found the moral resources to encourage and support me. Without her guiding influence it would have been very hard for me to pursue this endeavour all the way through to its successful conclusion. I love you very much and God bless you.

Last but not least, I wish to express my gratitude to my classmates from ANP for their companionship during my stay at the university. You made my life and study easy. Also I thank any other person who directly or indirectly contributed to the success of this study. God bless you all.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMES AND ABBREVIATIONS

AE	Adult Equivalent
ANOVA	Analysis Of Variance
BCG	Bacillus Calmette-Guérin
CBS	Central Bureau of Statistics
CI	Confidence Interval
CU	Consumer Unit
DC	District Commissioner
DMOH	District Medical Officer of Health
DPT	Diphtheria, Pertussis, Tetanus
ENA for SMART:	Emergency Nutrition Assessment for the Standardized Monitoring and Assessment of Relief and Transitions.
EPI-ENA	Epidemiological Emergency Nutrition Assessment
EPZ	Export Processing Zones Authority
FANTA	Food And Nutrition Technical Assistance
FAO	Food and Agriculture Organization
FAs	Field Assistants
FCS	Food Coping Strategies
FGD	Focused Group Discussion
FIC	Fully Immunized Child
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
GAM	Global Acute Malnutrition
H/A	Height-for-Age

HAZ	Height – for – Age z-score
HDDS	Household Dietary Diversity Score
HHs	Households
IMAWESA	Improved Management of Agricultural Water in Eastern & Southern Africa
IRRI	International Rice Research Institute
IYCF	Infant and Young Child Feeding
KCSE	Kenya Certificate of Secondary Education
KDHS	Kenya Demographic and Health Survey
KES	Kenya Shillings
MoA	Ministry of Agriculture
MOH	Ministry of Health
MTIS	Mwea-Tebere Irrigation Scheme
MUAC	Mid-Upper Arm Circumference
NAR	Net attendance Ratio
NCHS	National Centre for Health statistics
NIB	National Irrigation Board
OPV	Oral Polio Vaccine
OR	Odds Ratio
RDA	Recommended Daily Allowance
SAM	Severe Acute Malnutrition
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children's Fund

W/A	Weight-for-Age
W/H	Weight-for-Height
WAZ	Weight- for - Age z- score
WHO	World Health Organization
WHZ	Weight -for- Height z- score
WUA	Water User Association

OPERATIONAL DEFINITIONS

Adult Equivalent: The nutrient requirement of an individual expressed as a ratio of the requirement of an arbitrarily chosen person (e.g. nominal adult male) whose requirements is equivalent to one and the rest expressed as a fraction of it (Gibson, 2005). Also see Consumer Unit

Consumer unit: The nutrient requirement of an individual expressed as a ratio of the requirement of an arbitrary chosen person (e.g. nominal adult male) whose requirements is equivalent to one and the rest expressed as a fraction of it (Gibson, 2005).

Dietary Diversity: The number of different food groups consumed over a given period of time (FSAU, 2005).

Food security: A situation that exists when all people, at all times have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active healthy life (FSAU, 2005).

Household Dietary Diversity Score: Points created by summing the number of individual foods or food groups consumed in a household over a reference period. The household dietary diversity score is meant to reflect, in a snapshot form, the economic ability of a household to consume a variety of foods (FAO, 2008).

Household food access: The ability to acquire sufficient quality and quantity of food to meet all household members' nutritional requirements for productive lives (Swindale and Bilinsky, 2006).

Household: People living together and eating from the same pot at the time of study (FSAU, 2005).

Improved EPI method: An Epidemiological method of sampling where every household is given an equal chance of being selected into the sample.

Livelihood: Comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Chambers and Conway (1992).

Stunted: Height-for-age below -2 Z-score or below 80% of median height for age for reference population (WHO, 2006)

Underweight: Weight-for-age below -2 Z-score or below 80% of median weight for reference population (WHO, 2006).

Wasted: Weight-for-height below -2 Z-score or below 80% of median weight for height for reference population (WHO, 2006).

ABSTRACT

Freedom from hunger is the most fundamental human right that can be obtained if an individual is food secure. Nearly 1.02 billion people are food insecure and one-third of pre-school children in developing countries are malnourished. It's assumed that increasing household income and/or agricultural production would consequently improve food security and nutritional status yet malnutrition in irrigation schemes have consistently remained high since the 1960's. Factors influencing food security and nutritional status in Mwea-Tebere Irrigation Scheme have received little attention.

The objective of this study was to assess household food security and nutrition situation and associated factors in Mwea-Tebere Irrigation Scheme. A cross-sectional study was conducted in 200 households with a child aged 6-59 months. Data was collected through qualitative and quantitative approaches using pretested structured, semi-structured questionnaires and focused group discussion guides. Household food security indicators included food production , socio-economic status, household three-day food record (food availability), household dietary diversity and food coping strategies while underweight, stunting and wasting for children aged 6-59 months were used to assess nutritional status. Random sampling and improved EPI method were used to sample households. Nutritional status was analyzed using weight-for-age, weight-for-height and height-for-age z-scores of WHO (2006) and mid-upper arm circumference. Food coping strategies and socio-economic status were analyzed using weighted scoring index developed through focused group discussions. Energy and protein availability was assessed through adult equivalents at household level. Results were analyzed by descriptive statistics,

ANOVA, bivariate and partial correlations and regression analysis. SPSS v. 16, Excel 2007, Nutrisurvey 2007, ENA for SMART 2008 softwares were used for data analysis.

The mean household size was 4.5±1.6 with male to female ratio of 0.9. Male-headed households were 80%. The main source of household income was casual labour and 75% of that income was spent on food. About 72% of households lived below one dollar per capita income per day. The mean household dietary diversity score was 6.2(SD=0.9) with 98% of households consuming more than 4 food groups. Global and severe acute malnutrition prevalence were 5.1 % (CI: 2.3-10.8) and 0.5% (CI: 0.1-4.9) respectively. Underweight and stunting prevalence were 14.2% (CI: 9.1-21.5) and 32.5% (CI: 21.7-45.7) respectively. Majority of the households used unsafe water. Children were more likely to experience diarrhoea for drinking untreated water (Odds ratio: 1.13, 0.53-2.41). Morbidity experiences were high (64%) with acute respiratory infections being most prevalent followed by febrile illness and diarrhoea. A sick child was more likely to be wasted than a well child (Odds ratio: 1.75, CI: 0.46-6.7). Household income and proportion of income spent on food positively correlated with household caloric and protein availability (r^2=0.056, $p<0.05$) but not with nutritional status of children under five years old. Increase in income was associated with increase in household dietary diversity ($p<0.05$) as well as household protein ($p<0.01$) and energy ($p<0.05$) availability per consumer unit. Larger households were more food insecure than smaller households ($p<0.01$). Household dietary diversity correlated with nutrient intake of household members (r^2=0.033, $p=0.01$).

No individual measure suffices to capture all dimensions of food security and a suite of indicators are used to cover the different dimensions of food security. Although the dietary diversity in Mwea-Tebere Irrigation Scheme is high, it does not translate into adequate nutrient intake in the households probably because the amounts are inadequate. Thus the cosmopolitan nature of the area contributes to high dietary diversity that does not necessarily result into adequate dietary intake. Hence, household dietary diversity is not a good measure of food security in monocropping communities. Using 3-day food record, majority of the households are food insecure while acute and chronic malnutrition is at alert and serious levels respectively. There is no direct relationship between food security and nutritional status. Furthermore, food security and economic growth do not necessarily translate to improved nutrition. Therefore, a multisectoral approach that will address household dynamics, health and sanitation is necessary to improve nutritional status in Mwea-Tebere rice irrigation scheme and in other monocropping agricultural projects.

CHAPTER 1: INTRODUCTION

1.1 Background

Freedom from hunger is the most fundamental human right that can be obtained if an individual is food secure. Nearly 1.02 billion people are food insecure and one-third of pre-school children in developing countries are malnourished (FAO, 2009). Hunger and poverty are two sides of the same coin. Those who are poor are generally hungry, and those who are hungry are undoubtedly poor. Although household food insecurity may not encapsulate all dimensions of poverty, the inability of households to obtain access to enough food for an active, healthy life is surely an important component of their poverty (Hoddinott and Yohannes, 2002). Households become food insecure when their livelihood systems (i.e. capabilities, assets and activities required for a means of living) change or fail to adapt to the challenges and shocks from the external environment (Lindenberg, 2002 as cited by Kruger et al., 2008).

According to Kenya Food Security Steering Group's (KFSSG) Long Rains Assessment Report of 2008, the food security outcomes contrasted sharply, across and within livelihoods. It was estimated that about 1.38 million people in rural areas were highly food insecure and were not able to meet their minimum food requirements in the subsequent six months, if external support was not granted. Seasonality is now recognized as being a constraint to agricultural production and to household food security in many countries within the tropical region of the world. The coincidences of food shortage and heavy workloads witnessed in Mwea-Tebere Irrigation Scheme (MTIS) paddy fields creates competing demands on the allocation of scarce energy resources and

is likely to have an impact on the energy turnover in the scheme households (Kigutha, 1994).

Operationalising the concept of household food security requires a series of assumptions about household structure and organization in order to identify the activities, relationships and processes essential to improving food security and to maintaining adequate nutritional status. Children, pregnant and lactating women are often identified as priority vulnerable groups, implying a disaggregation of the household (Wendy et al., 2001).

Available data indicate that household food insecurity is one of the underlying causes of malnutrition and death (American Dietetic Association, 2006 as cited by Kruger et al., 2008 and UNICF, 1990). Nutritional status is the result of complex interactions between food consumption and the overall status of health and care practices. Poor nutritional status is one of the most important health and welfare problems facing Kenya today and afflicts the most vulnerable groups; women and children (CBS, 2004) as indicated in the UNICEF's conceptual framework for causes of malnutrition (UNICEF, 1990). It is considered as an outcome indicator for food security among dietary diversity, individual dietary intakes, and household caloric acquisition and indices of household coping strategies (Hoddinott and Yohannes, 2002).

Over the short term, irrigation projects often negatively influence the nutrition and health of target populations through factors which are either directly or indirectly related to the development process of the project (Mwadime et al., 1996; Niemeijer et al., 1985). Nutritional status at some of the large schemes, notably Mwea and Ahero, have on

several occasions given rise to concern and have received publicity in the national press. Studies on nutritional state of the population conducted at Mwea (Mwadime et al., 1996, Ngare and Mutunga, 1999) indicated a high prevalence with at least twice as many severely malnourished children compared to the national average. This necessitated establishment of a community based nutrition centre (referred to as family life home) in early 1980's.

Frequently mentioned factors for high malnutrition levels are low income levels realized by tenants, poor health as a result of diseases associated with stagnant water, unbalanced diets as a result of mono cropping and finally unbalanced spending of budgets by households not used to purchasing food (Niemeijer et al., 1985). Since 1996, information on food security and nutritional status of populations in mono cropping schemes especially MTIS is not available. Given that the indicators were grave more than twelve years ago, this study attempts to elucidate changes that might have taken place since then.

1.2 Problem statement

About 1.38 million people are highly food insecure in Kenya especially in rural areas (KFSSG, 2008). The greatest impact of food insecurity is observed in children who are the most nutritionally vulnerable group of the population. Prevalence of malnutrition for children under five years in Central province in which the Mwea- Tebere Irrigation Scheme (MTIS) is located, were estimated at 5.5% Global Acute Malnutrition (GAM), 1.1% Severe Acute Malnutrition (SAM), 27% stunting and 14.6% underweight (CBS, 2004). The GAM prevalence fell under alert (5-9.9%) while chronic malnutrition

(stunting, 27%) was under serious status according to WHO classification (FSAU, 2005). While these were averages for the province, it is possible that the irrigation scheme had worse malnutrition prevalence for children less than five years. Mwadime (1996) and Niemeijer et al. (1988) indicated higher malnutrition prevalence of children under five years among scheme residents than non- scheme residents.

1.3 Aim

This study aimed at contributing to the improvement of nutrition and health status of populations in small scale mono cropping schemes.

1.4 Purpose

The purpose of this study was to generate information that could be used as the basis for improvement of livelihoods, health and nutritional status of households in Mwea-Tebere Irrigation Scheme.

1.5 Justification

At the time of this survey, Kenya was among the countries affected by the economic recession and failure of rainfall due to climatic changes. This culminated in poor purchasing power and food shortages nationally and globally (FAO, 2009 and KFSSG, 2009). The government of Kenya tried to intervene by introducing "cheap maize meal for the poor" but this failed. It was therefore possible that food insecurity, morbidity and malnutrition had exacerbated among vulnerable groups.

Furthermore, rice production had deteriorated due to fungal disease (rice blast) and water shortage at that time (N.I.B., 2008). That had negatively affected majority of Mwea residents who relied on rice growing as a main source of livelihood and probably worsened their food security situation.

Overcrowding due to population growth in the settlement (which was designed for original tenants and not including their children) might have resulted in poor hygiene and sanitation and polluted water systems that had exacerbated malnutrition, morbidity and mortality.

Due to those factors, Mwea-Tebere Irrigation Scheme could be a hot spot that needed emergency attention.

1.6 Overall objective

The objective of the study was to assess household food security and nutritional status of children aged 6-59 months and the associated factors in MTIS.

1.6.1 Sub-objectives

1. To determine demographic, socio-economic and livelihood characteristics of the population.
2. To establish the nutritional status of children 6-59 months old in MTIS.
3. To establish the household food status, dietary diversity score and coping strategies during food shortage.
4. To establish the morbidity experience and mortality of children 6-59 months old in MTIS.

5. To establish water availability, hygiene and sanitation status of households in MTIS.
6. To determine the relationship between household food security, morbidity, demographic, socio-economic, dietary diversity and nutritional status of 6-59 months in MTIS.

1.7 Research questions

1. What is the food security situation of households in MTIS?
2. What is the nutritional and morbidity status of children under five years old in MTIS?
3. What is the hygiene, water and sanitation situation of households in MTIS?
4. Is there a relationship between household food security indicators, socio-economic characteristics, morbidity, water, hygiene and sanitation practices and nutritional status in MTIS?

1.8 Hypothesis

1. More than 75% of the households in MTIS are food secure.
2. The GAM prevalence of children 6-59 months old in MTIS is below 5% (the alert level).
3. The dietary diversity of households in MTIS is above 4 points.
4. The under five mortality rate in MTIS is <1/10,000/day.

   There is no relationship between household food security indicators, morbidity and nutritional status of children 6-59 months old.

CHAPTER 2: LITERATURE REVIEW

2.1 Historical background

In many developing countries the rural sector accounts for the majority of the population and an even greater proportion of those falling below the poverty line and have grossly inadequate access to basic services such as water and sanitation, health and education. Small scale farmers have been reported to be basically the majority of the working population within the rural sector in these countries (FAO, 1990, 2009). Land is the basis for the production of food and other raw materials. It is also the source of income, employment and economic security of most rural people.

The commencement of the Mwea-Tebere Irrigation Scheme dates back to the 1950s when Kenya was a British Colony. During this time, the colonial government set up internment camps in this area to house captured Mau Mau freedom fighters that were then forced to grow rice. After independence in 1963, the government resettled many landless peasants alongside the Mau Mau freedom fighters and took over the rice irrigation scheme. Today, former Mau Mau freedom fighters and their children still work the rice fields, side by side with the people settled after independence. MTIS was considered successful in settling the landless and improving food security of the tenants. Subsequently in the 1960s and 1970s, the government of Kenya initiated several other large rice irrigation schemes for the cultivation of rice. These included Ahero and West Kano schemes in Nyanza Province and Bunyala irrigation scheme in Western Province. Mwea Irrigation Scheme in Central Province still remains the largest.

2.2 Food production in Kenya

In recent years, agricultural production has not kept pace with population growth rate in Kenya and the country has become a net importer of its foods including maize, wheat and rice. Seasonality is recognized as being a constraint to agricultural production and to household food security in many countries within the tropical region of the world. The duration and severity of food shortage are mainly related to the rainfall pattern, whether unimodal or bimodal (Kigutha, 1994).

While Kenya has witnessed significant economic recovery over the last five years resulting from implementation of farmer-oriented and other wide-ranging policies, a significant and growing proportion of the population suffers chronic and acute food insecurity. According to Kenya Food Security Steering Group's (KFSSG) Long Rains Assessment Report of 2008, the food security outcomes contrasted sharply, across and within livelihoods. It was estimated that about 1.38 million people in rural areas were highly food insecure and were not able to meet their minimum food requirements in the subsequent six months, if external support was not granted. In addition, urban populations who depend almost entirely on food purchases in the context of increasingly rising food and non-food prices amidst declining incomes were not spared either, particularly in urban slums. Maize is the overwhelming staple across all livelihoods in the country. Its production pattern, which is synonymous with food insecurity, was estimated to fall by 12% of the previous year's production. This had consequently reduced the carryover of the National Strategic Grain Reserve. Production of other staples like beans, wheat, rice, sorghum, millet and stem and root tubers has also significantly declined. This

has prompted increased cross border imports of maize from South Africa in an attempt by the government to bridge the gap.

Globally, rice is one of the most important food crops in the fight against hunger. The total annual world production of milled rice currently stands at 400 million tons which compares favourably well with maize and wheat. Unlike maize and wheat (that are consumed as human and livestock feed) rice remains the most favoured grain globally for human consumption (Ito, 2002 as cited by MoA, 2008). Rice is an important staple food for more than 50% of the world's population (Wanjogu and Mugambi, 2001). In Kenya, it is the third most important cereal crop after maize and wheat. It is the major part of the diet for the urban populations and it is gaining popularity in the rural areas. The annual consumption is increasing at a rate of 12% as compared to 4% for wheat and 1% for maize. This is attributed to changing eating habits (Walela, 2010 and MoA, 2008).

The impact of agricultural projects on the timing of income raises two important issues, the risks associated with monocropping and the effect of lumpy forms of income on household spending patterns. Agricultural projects may decrease the spread over time of income if they introduce monocropping or if the crops introduced are all sold at the same time of the year. This exposes peasants to two kinds of risk, production loss and market failure. If the farmer, for technical reasons, loses the crop or if, for marketing reasons, he is unable to sell the produce, farm income is lost (Benjelloun, 2003). Due to economic pressures, most farmers may not be able to hold their produce for the market to stabilize thus sell off their produce immediately after harvest at low prices which has a damaging effect on food security and nutrition.

2.2.1 Rice cultivation in Mwea

Rice cultivation was introduced in Kenya in 1907 from Asia. About 80-95 % of the rice grown in Kenya is under irrigation paddy schemes established and managed by the government through the National Irrigation Board (NIB) while the remaining 5-20% per cent is produced under rain fed conditions (EPZ, 2005 and MoA, 2008). Most of the rain fed rice is grown in Kwale, Kilifi, and Tana River districts in the Coast Province, and Bunyala and Teso districts in Western Kenya. Kenya's rice production comes from cultivated rice (*Oryzae sativa*) and meets only 60% of the demand (NIB, 2008). Kenya uses only 10% of her potential irrigation to produce rice. This should be increased in order to reduce overdependence and the pressure put on other food crops like maize (IRRI, 2009). Rice produced in Kenya is hardly enough for local consumption. The national rice consumption is estimated at 300,000 metric tons compared to an annual production range of 45,000 to 80,000 metric tons. The deficit is met through imports which were valued at KES 7 billion in 2008 (MoA, 2008).

In Mwea, the beginning of each cropping cycle is scheduled according to the water availability through the irrigation water distribution scheme. The schedule of individual rice husbandry also differs within the water availability time limits from one group of rice fields to another. Most fields are cultivated once a year, although some farmers cultivate a second crop. The typical cultivation cycle includes a sowing–transplanting period (July–August), a growing period (August- November) and a post-harvest period (November–December). The second crop is cultivated prior to the long rainy period

between January and May. The duration of the rice cycle varies between 120 and 150 days, depending on the rice variety.

2.3 Nutrition

Nutrition is influenced by many factors beside food security e.g. public health and the social care environment for women and children. Malnutrition and, by inference poor nutrition is presented as an outcome of adverse conditions with immediate, underlying and basic causes (UNICEF, 1998). Child survival, growth, participation and development are the outcomes of child's individual nutritional and health status (immediate determinants). The underlying determinants include household food security, care for women and children, and adequate health services and healthy environment. These causes of malnutrition are further influenced by basic determinants that include adequate education, formal and non-formal institutions, political and ideological super structure, socio-economic structure and importantly the potential resources.

Nutritional status at some of the large schemes, notably Mwea and Ahero, have on several occasions given rise to concern and have received publicity in the national press. Studies on nutritional state of the population conducted at Mwea (Wanjohi, 1978, Mwadime et al., 1996) indicated a high prevalence with at least twice as many severely malnourished children compared to the national average. The coincidences of food shortage and heavy workloads in the wet paddy rice fields creates competing demands on the allocation of scarce energy resources and is likely to have an impact on the energy turnover in Mwea households.

The frequently mentioned factors for this are low income levels realized by tenants, poor health as a result of diseases associated with stagnant water, hardly diversified and unbalanced diets as a result of mono cropping and finally unbalanced spending of budgets by households not used to purchasing alternative foods (Niemeijer et al., 1985).

Intra-household food distribution and diet adequacy in a context of inadequate food access is a factor of household size. Small households are more likely to have adequate food compared to large households (Kigutha, 1994).

2.4 Food insecurity

Food insecurity is defined as a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life (FSAU, 2005). Hence the concept of food insecurity includes not only unavailability, inaccessibility, poor utilization, inappropriate use of food (e.g. food preparation and intra-households food distribution) and insufficient purchasing power but also perceptions (e.g. that food is insufficient, inadequate, unacceptable, uncertain and unsustainable) (Wendy et al., 2001).

Food insecurity affects dietary intake of individuals. Hence, dietary intake can be used to assess food insecurity using some aspects such as caloric insufficiency and nutrient inadequacy. However these do not assess the cognitive and affective components of uncertainty (expressed as anxiety), unacceptability or unsustainability. For example, current intakes may be adequate, but food insecurity may still be experienced because of

concern over future intakes. Alternatively, intakes may be inadequate, but only temporarily to protect supplies and prevent future food insecurity (Wendy et al., 2001).

Consequently, coping strategies resulting from the impact of food insecurity have been used as early indicators of future food insecurity. However, presence or absence of particular management strategies is not indicative of food security and neither do they assess important aspects of the experience of food insecurity (Maxwell, 1996; Maxwell et al., 1999). Growth status has also been used as an indicator of food insecurity, but again does not assess most of the components of food insecurity because it is an indirect outcome of food security and depends on factors such as health and child care (Maxwell and Frankenberger, 1992). Precursors such as income or total expenditure are correlated with caloric sufficiency, but they only capture the access component of food insecurity and are quite indirect in others.

Food insecurity is experienced differently at household and individual adult and child levels; adults buffer the effect of food insecurity on children. Food insecurity has four components, two related directly to food (quantity and quality of food), and two psychological and social in nature (certainty, which is related to worry about food, and acceptability, which is related to how food is acquired); and hunger is the most extreme consequence of the progression of food insecurity (Wendy et al., 2001). The experience of food insecurity therefore, can be measured subjectively by assessing not only the aspects of availability, access and utilization of food, but also how people think about it, (e.g. perceptions or social acceptability).

At the beginning of irrigation settlements and up to now, households were expected to supplement their food security and hence dietary diversity through the returns they fetch from the sales of rice produce. However, this largely depends on whether the rice growers are able to fetch adequate returns to purchase an appropriate diversity of foods.

2.4.1 Assessment and measurement of indicators of food security

There is no individual measure that suffices to capture all aspects of food insecurity, a suit of indicators are needed to cover the different dimensions of food insecurity (FAO/FIVIMS, 2003 as cited by Coates et al., 2003).

Household food security can be assessed through process indicators; those that describe food supply and food access, and outcome indicators, those that describe food consumption (i.e. individual food intakes, household caloric acquisition, household dietary diversity and indices of household coping strategies). Process indicators are imprecise due to confounding factors, are time consuming and expensive (Hoddinott and Yohannes, 2002).

2.4.1.1 Food availability

Food availability is a factor of production capacity, amount of imports and amount that is normally used at a given period and of the availability of storage. Food availability is also influenced by the availability of seeds, pest infestation/attack, weather conditions, availability of pasture, land acreage under cultivation, labour availability and insecurity issues. The amount of food used by households, traded or stored, all influence food availability at the household level (FSAU, 2005). In this study, household crop production was assessed for household food availability.

2.4.1.2 Food access

Many factors affect people's access to food. These include:

- Cultural factors (when women and children are not allowed to eat certain foods).
- Reduced purchasing power (where households can't afford the food in shops/markets).
- Logistical/geographic obstacles to markets (rivers and roads become impassable)
- Insecurity (food may be in the market but the market may be inaccessible because of fighting).
- Seasonal patterns especially for households that rely on agriculture as a sole source of livelihood as may be the case for MTIS residents (FSAU, 2005, Kigutha, 1994).

Efforts towards assessing food access through perceptions and social acceptability of food have been undertaken through the development of Household Food Insecurity Access Scale (HFIAS).

This tool (HFIAS) is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale. These responses are dependent on income levels e.g. what is referred to as severe in a low-income household may be different from one in a well-off household. Hence using the scale for the two households may be misleading. Care should be taken to categorize the population (Coates et al, 2007). Furthermore, validation of this tool has yielded contradicting results and its utility is still in question. In this study household food access was assessed using a 3- day household dietary diversity, a 3-day household food record and household income.

2.4.1.3 Dietary methods

These methods may be used to assess the third dimension of food security, utilization and adequacy. The quantities of foods consumed are converted into macro and micronutrients and intake adequacy per day may be calculated from the recorded quantities and compared to Recommended Daily Allowance (RDA). These methods include;

Household methods

Household food consumption methods attempt to measure all food and beverages available for consumption by a household, family group, or institution during a specified time period. The following methods are used: food accounts, household food records, household dietary diversity and household 24-hr recalls. In this study, household food record and household dietary diversity were used.

Household food record: The amount of all foods actually eaten by a household at each meal is recorded separately (by householder or fieldworker) either by weight or volume using household measures, before subdividing into individual helpings. Detailed descriptions of all the foods and their methods of preparation are recorded. This is the most accurate method though with a high respondent burden (Gibson, 2005).

Household dietary diversity: To better reflect a quality diet, the number of different food groups consumed is calculated, rather than the number of different foods consumed. Knowing that households consume, for example, an average of four different food groups implies that their diets offer some diversity in both macro- and micronutrients (FSAU,

2005). This is a more meaningful indicator than knowing that households consume four different foods, which might all be of the same group (Swindale and Bilinsky, 2006; FSAU, 2005; Hoddinott and Yohannes, 2002). Table 2.1shows household dietary diversity classification (% HHs consuming diversified diets) as used by the FSAU.

Table 2.1: Household dietary diversity classification of population

Reference indicator (% HH units)	*Acceptable*	*Alert*	*Serious*	*Critical*	*Very critical*
Poor dietary diversity for population(<4 food groups)	< 5%	5 to <10%	10 to <25%	25 to <50%	>50%

Source: FSAU, 2005

The household food consumption methods vary in their complexity and respondent burden. Foods eaten outside the home, food wasted or fed to pets are difficult to account for. Instead, a wastage factor of all edible foods is applied.

Individual methods

24-hr recall: Respondent recalls exact foods taken during the preceding 24hr period, giving detailed descriptions of all foods and beverages consumed, including cooking methods, and (vitamin) supplements. Quantities are estimated in household measures and entered on a data sheet. Then energy and nutrient intake per day may be calculated from the recorded quantities and compared to RDA to check adequacy.

Food frequency questionnaire: The frequency-of-use of food items or food groups consumed during a specified time period is assessed by use of a questionnaire. It is semi-quantitative and can allow derivation of energy and selected nutrient intakes with the

introduction of portion size estimates and computerized self-administered questionnaires. This may be used to assess economic ability to access food and nutrient adequacy when compared to RDA.

Recall methods are affected by the subjects' memory, ability of respondent to convey accurate estimates of portion sizes consumed, the degree of motivation of the respondent and the persistence of the interviewer. It is, however believed that 24hrs is a short memory period and the respondent can provide reliable information. In addition, given that the information provided is analyzed on population basis, the spread of the 24hr recalls among respondents over a period of time takes care of variation in intake over time.

2.4.1.4 Coping strategy

Coping strategies are means adopted by populations to survive a change for the worst in their circumstances. They save the population from deterioration of their well being. A frequency of use of each strategy is used to assess the severity and a food-security score is derived by applying the severity weightings. The level of food insecurity is measured by the type of coping strategy applied and the proportion of the households applying distress coping mechanisms, i.e. *skipping entire days without eating, restricting consumption by adults in order for small children to eat, borrowing food or relying on help from friends or relatives* (FSAU, 2005).

2.4.1.5 Nutritional status of children

Nutritional status is dependent on dietary intake which is dependent on household food security among other factors at individual, household and national/regional levels. These are immediate, underlying and basic determinants for causes of malnutrition (UNICEF, 1990). Nutritional status of children less than five years of age is the most sensitive to slight changes in dietary intake. Since adults will buffer the effect of food shortage on children, it is assumed that by the time nutritional status of children starts to deteriorate due to dietary inadequacy, the food insecurity has already set in. Therefore nutritional status of children can be used to assess acute and chronic household food insecurity (Wendy et al., 2001).

Malnutrition places children at increased risk of morbidity and mortality and has also been shown to be related to impaired mental development. Anthropometry provides one of the most important indicators of children's nutritional status. In this survey, height, weight and MUAC measurements were obtained for children born in the five years before the survey. The age, height and weight data are used to compute three summary indices of nutritional status: height-for-age; weight-for-height; and weight-for-age. These three indices are expressed as standardised scores (z-scores) or standard deviation units from the median for the child growth standards recommended by the WHO. Children who fall more than two standard deviations below the reference median are regarded as undernourished, while those who fall more than three standard deviations below the reference median are considered severely undernourished. Due to double burden of

malnutrition, children who fall above +2 SD of the reference median are considered overweight while those above +3 SD are considered obese.

Nutritional assessment methods

The methods are based on a series of dietary, laboratory, anthropometric and clinical observations used either alone or, more effectively, in combination. Increasingly, nutritional assessment systems are now applied to define multiple levels of nutrient status and not just the level associated with a nutrient deficiency (Gibson, 2005). Only Anthropometric and dietary methods were used in this study because they yield satisfactory results within due ceiling of the available resources.

Anthropometric methods: Anthropometric methods involve measurements of the physical dimensions and gross composition of the body (WHO, 1995). The measurements vary with age (and sometimes with sex and race), and degree of nutrition, and they are particularly used in circumstances where chronic imbalances of protein and energy are likely to have occurred (Gibson, 2005). Table 2.2 shows the cut-off points for nutritional status using anthropometric indicators.

Table 2.2: Cut-off points for malnutrition

Indicators	Moderate (GAM)	Severe (SAM)
Wasting	WHZ; <-2 to ≥-3Z scores	WHZ; below -3Z scores
Underweight	WAZ; <-2 to ≥-3Z scores	WAZ; below -3Z scores
Stunting	HAZ; <-2 to ≥-3Z scores	HAZ; below -3Z scores

Source: WHO, 2006

2.4.2 Challenges in application of food insecurity assessment methods

An important challenge to directly assessing household food security by asking people about their experience has a potential bias in reporting due to self interest. That is, respondents may answer untruthfully to gain food or other assistance. The opposite challenge also occurs if people are reluctant to express the deprivation that they experience during food insecurity because of embarrassment.

Another challenge is that food security may be defined differently in developing countries (e.g. Africa, where the problem of unavailability and inaccess is much severe) than in developed countries (e.g. United States, where problem is typically much less severe and is a social as well as wholesomeness and a biological matter (Wendy et al., 2001)).

Finally, accuracy of most of the dietary methods used for assessing food intake at individual and household level depends on subjects' memory. However, this has been addressed by use of short recall periods and the fact that most of this data is analyzed for population basis hence the spread takes care of the variation. In this study, short recall periods were used (i.e. 3-day as opposed to 7-day household food record). The reporting bias was avoided through careful construction of questionnaire items and combining qualitative and quantitative data collection methods.

2.5 Morbidity and mortality

Malnutrition has been shown to cause 55% and 13% of childhood illness and deaths respectively (UNICEF, 2006). Body immunity is a function of macro and micronutrients that are mainly provided through dietary intake. Dietary adequacy is dependent on household food security. The susceptibility to illnesses is dependent on the level of body immunity of an individual. Children under five years have low immunity and if they are malnourished, they are more susceptible to illnesses and have a higher risk of death. Also illnesses affect dietary intake and body nutrient utilization which consequently, adversely affect the nutritional status of a person.

In assessing morbidity at community level, two methods have been used where mothers of children answer a health interview using a checklist versus keeping a structured health diary for three weeks. Health diary is filled for three weeks for completeness of data but only the first two weeks are used. Children's symptoms are recorded. Both methods yield different results with mothers reporting more symptoms in an interview than in diary. However diaries are not practical in communities with low literacy levels such as Mwea (Bruijnzeels et al., 1998). Hence, in this study a health interview using a structured questionnaire was used.

The last three Kenya Demographic and Health Surveys (KDHSs) have indicated a steady deterioration in child health indicators notably: incidence of malaria, Acute Respiratory Infections (ARI) and diarrhea, immunization coverage and child mortality (CBS, 2009). Nutrition interventions have been acknowledged as being among the most effective preventive actions for reducing mortality among children under the age of five years. Of

these actions, exclusive breastfeeding ranks first; being estimated as having the potential to prevent 13% of all deaths in this age group while complementary feeding and water, sanitation and hygiene would reduce 6% and 3% respectively (UNICEF, 2006). In this study, morbidity and crude mortality was determined retrospectively in a recall period of two weeks (14 days) and three months (90 days) respectively from the date of survey.

2.6 Water, hygiene and sanitation

Water is essential for life, health and human dignity. Average water use for drinking, cooking and personal hygiene in any household is at least 15 litres per person per day (Sphere, 2004).

Poor sanitation, lack of clean water and inadequate personal hygiene are associated with diarrhea disease, worm infestations, skin and eye infections and vector borne diseases (Boot and Cairncross, 1993). Diarrhea is the second most serious cause of mortality in children under five, accounting for 13% of child deaths in developing countries (WHO, 2002b). Excreta are the primary source of diarrhea pathogens and it is estimated that 90% of child diarrhea is the result of poor sanitation, lack of access to clean water supplies and inadequate personal hygiene (WHO, 1997). According to the CBS, 2004, about 83% of households in Kenya have access to some form of sanitary facility. Poor health increases vulnerability to food insecurity and therefore nutritional vulnerability (FSAU, 2005).

2.7 Gaps in knowledge

Except for very few cases, agricultural projects through their various components (irrigation, diversification, commercialization and improved infrastructure) have been shown to increase household income (Benjelloun, 2003). However, it is assumed that

increasing households' incomes would translate into improved dietary intake and consequently improve nutritional status of children, the most nutritionally vulnerable group of the population, without considering the many factors that might affect that assumption. Moreover, the prevalence of malnutrition among children less than five years in rice irrigation schemes and other irrigation projects has been shown to be worse than those of non-scheme children of similar age (Benjelloun, 2003 and Mwadime, et al., 1996). These findings notwithstanding, there is no evidence in literature that food security, morbidity and nutritional status have been addressed in Mwea- Tebere. In addition, no subsequent assessments and/or monitoring of the situation have been undertaken. Furthermore, factors associated with poor nutritional status in Mwea scheme have not been well addressed. Most research and development efforts have put emphasis on health (malaria control), irrigation water management and improved rice growing technologies (Okech et al., 2008 and Mati 2009). With the worsening food situation and economic recession nationally and globally and high population in the settlement, the food security, morbidity and malnutrition situation is likely to be worse in MTIS. This study attempted to address this information gap.

CHAPTER 3: METHODOLOGY

3.1 Study setting

3.1.1 Study site

The study was conducted in Mwea-Tebere division (now in Kirinyaga South District) in Central Province of Kenya, about 100 km North East of Nairobi. Mwea occupies the lower altitude zone of the former Kirinyaga District, in an expansive low-lying, formally wet Savannah ecosystem at an altitude between 1100 and 1200m above sea level. The mean annual precipitation is 950 mm, with maximum rainfall occurring in April–May and October–November in a bimodal climate. The average temperatures range from 16 to 26.5 °C. Relative humidity varies from 52% to 67%. The topography is relatively flat hence allows rice farming through flooding irrigation. The area is covered adequately by two mobile networks, Safaricom ltd Kenya and Zain ltd Kenya. The rural road network is murram roads with main all-weather roads feeding the major Nairobi-Embu highway via two towns, Wang'uru and Kimbimbi. The Mwea rice irrigation scheme is located in the west central region of Mwea Division and has a gazetted area of 30,350 acres (13,640 ha). Land tenure is on tenancy basis. A total of 16,000 acres have been developed for paddy production. Since 1998, about 4,000 extra acres have been developed into paddy. The remaining area is used for settlement, public utilities, subsistence and horticultural crops farming. The scheme is served by two main rivers viz Nyamindi and Thiba Rivers. A link canal joins the two rivers and transfers water from Nyamindi which has surplus water resources to Thiba River which serves about 80% of the scheme. Irrigation water is abstracted from the rivers by gravity by the help of fixed intake weirs, conveyed and distributed in the scheme via unlined open channels. Since inception till

1998, the scheme was being run solely by Nation Irrigation Board (NIB) with little involvement of the farmers' organisations. Today, NIB carries out operation and maintenance of irrigation and drainage and farm roads infrastructure and land administration in the scheme. Planning and implementation of the cropping programme is discussed and agreed upon by the NIB and farmers through their leaders of Water User Associations (WUA). Farmers pay a flat rate fee of Ksh 2,000 per acre per year for infrastructure maintenance and water management (Wendot, 2010).

3.1.2 Study population

Tables 3.1 to 3.3 below show population characteristics of the Mwea-Tebere division and former Kirinyaga district where MTIS falls and therefore were applied to the study population.

Table 3.1: Preliminary data of 2009 National population and housing census [New Kirinyaga South District (formally Mwea Division)]

Division	Location	No. of HHs	No. of people	Males	Females	Male: Female
	Mutithi	7,380	27,395	13,954	13,441	1.03
Mwea-West	Thiba	12,075	41, 251	20,449	20,802	0.98
	Kangai	5,304	19,346	9,661	9,685	1.00
	Murinduko (South Ngariama)	7,934	28,431	14,903	13,518	1.1
Mwea-East	**Tebere**	**13,866**	**48,467**	**22,342**	**26,125**	**0.86**
	Kutus	4,368	13,833	6,837	6,996	0.98
	Nyangati	4,864	15,948	7,737	8,209	0.94
Total		55,791	194,659	95,883	98,776	0.97

HH size =3.5, Sex Ratio, male:female 0.86, Population density = 55,791÷581 km² = 96persons/km².

Source: DC's office, 2010. Kirinyaga South District (former Mwea Division)

Table 3.2: Selected population cohorts of the New Kirinyaga South District

Age characteristic	Population Proportion %	Population
<1yr old children	2.8	1,357
<5yr old children	20	9,694
Women of Reproductive Age (15-49yrs)	27	13,086
Pregnant women	11	5,332
Children ~6-59 months	18.6	9,015
Total population		48,467

Source; MOH, 2007

Table 3.3: Kirinyaga District population characteristics (larger Kirinyaga District)

Population Characteristic		Statistic
Female: Male ratio		100:98
Dependency Ratio		100:70
Population growth rate		1.5%
Population density		257 per km^2
Crude birth rate		28.5 per 1000
Crude death rate		4.6 per 1000
Life expectancy		67.7
Absolute poverty:	Rural	49%
	Urban	32%
Average Household Income:		
Agriculture		72%
Self employment		10%
Wage employment		7%
Urban self employment		8%
Average distance to health centre		63.2 km
% households with access to a health centre		63.8%
Infant Mortality Rate		39.2 per 1000
Under 5 mortality Rate		59.5 per 1000
Total Fertility Rate		4.6

Source: GOK, 2002: Kirinyaga District Development Plan 2002-08

Livelihood: The main economic activity is rice farming, rearing of domestic animals and some horticultural farming including vegetables and fruits. Some people are involved in small scale business of buying and selling rice. Others are involved in casual labor in the rice fields.

Political situation: Mwea- Tebere, like other parts in Central Kenya, is politically stable.

Health facilities: There are 4 government dispensaries in Tebere location. There is no health centre. There are several private clinics. The turnover of private clinics is high with some closing down and other new ones coming up.

3.2 Research methods

3.2.1 Study design

The study design was cross-sectional, descriptive and analytical in nature.

3.2.2 Sampling

3.2.2.1 Sampling unit

The sampling unit was the household. The respondents comprised household heads and/or persons who prepared food for the household. Anthropometry was done on one child 6-59 months old found in the sampled households.

3.2.2.2 Sample size determination

Sample size was calculated using the Fisher's formula as follows:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where; n= Minimum sample size (for population >10,000)

Z= Normal Deviate, taken as 1.96 at 95%CI

p= Estimated underweight prevalence, WAZ <-2 is14.6% and

d=Degree of accuracy desired (usually as a proportion, e.g. 0.05 for 5%), Design effect = 1.0 (assumed there was minimal variation between clusters)

(Fisher et al., 1991)

$$= \frac{1.96^2 \times 0.146(0.854)}{(0.05)^2} = \textbf{192 Children}$$

The number of households to be covered was calculated as follows:

Proportion of under fives in population = 20%

Average HH size = 5

Attrition/Non respondent HH = 3%

Thus, total No. of children =192 + (3÷100×192) = 198

The population that would give 198 children = 198 × (100÷20) = 990

Number of households to be assessed = 990 ÷ 5= **198 Households**

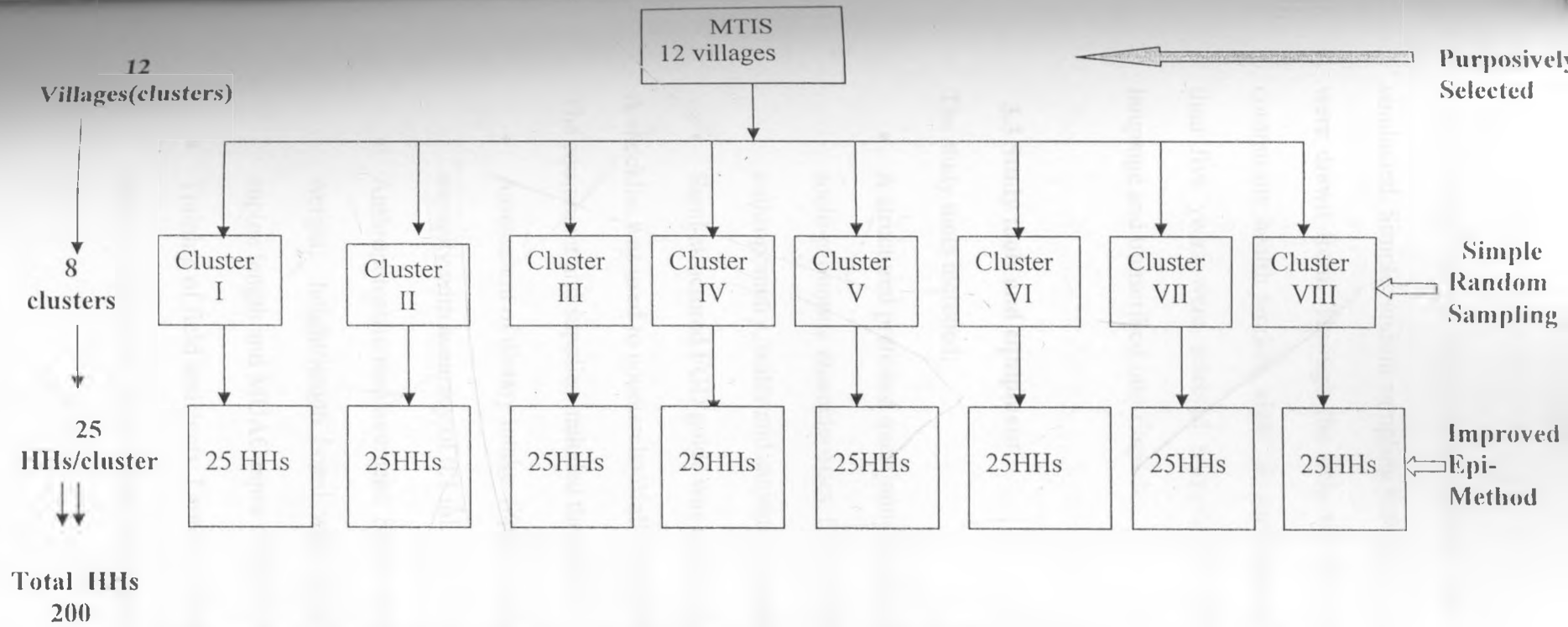
Sample size for mortality: All the **198 HH** visited were also assessed for crude and under five mortality.

3.2.2.3 Sampling frame

The sampling frame of the study consisted of all households in the rice growing villages of Tebere location. With the help of the area Chief and Divisional Public Health Officer, the number of villages and households in each village were randomly selected.

3.2.2.4 Sampling procedures

The study was carried out in the Mwea-Tebere irrigation scheme in the rice farming villages. From the 12 village clusters in Tebere location, two thirds (2/3) i.e. 8 village clusters were selected using simple random sampling. A preliminary survey was carried out to map out the households in the 12 villages. The number of households visited per cluster was calculated by dividing the total number of households in the survey sample (198) by the total number of clusters (8) i.e. 198/8 =24.75 approximately 25 households per cluster. The improved EPI method was used to sample households. Once the interviewer got to the centre of the cluster, s/he spun a pen and followed that direction counting the households on the right and left to the edge/end of the cluster. At the end, if the required number of households was not reached, s/he spun the pen again until it pointed to the cluster and counted households in that direction, enumerated and assigned numbers until the required number of households i.e. 25 was obtained. To decide where to start, a random number was obtained from the enumerated households e.g. a random number (12) between 1and 25 was selected. The household that was assigned number 12 during enumeration became the 1st HH to be assessed. The subsequent households were chosen by proximity. The enumeration and marking of the households helped the enumerator not to mistakenly repeat (revisit) the already picked (interviewed) households. A total of 200 children 6-59 months were assessed (one child per household). In households where more than one child aged 6-59 months was present, simple random sampling was done and one child was assessed. It was assumed that children in the same HH were subjected to similar conditions hence any child sufficed to represent that household (See Figure 3.1).



N.B. Two-thirds of the 12 villages (clusters) i.e. 8 villages were randomly selected. 25 HHs per village were selected using improved Epi-method of sampling. A total of 200 children were assessed.

Clusters: I. Kiriko II. Mahigaini III. Kirogo IV. Matandara V. Mathangauta/Red soil
VI. Kamuchege/Mbahati VII. Nyamindi VIII. Gathigiriri

Figure 3.1: Schematic diagram showing sampling procedure.

Two Focused Group Discussions (FGDs), one for females and one for males were conducted. Simple random sampling was used to select the clusters that the FGD samples were drawn from. Through the help of the Assistant Chief or village in-charge and community health worker, eight (8) mothers and 8 fathers from HH with children less than five years were selected purposively. The FGDs were conducted in the local language and transcribed into English.

3.3 Study tools and equipment

The study tools included:

- A structured pretested questionnaire that was used to collect data on demography, socio-economic characteristics, food availability and access, food record and anthropometry, water and sanitation, immunization, morbidity and mortality.
- Semi-structured FGD guide was used to collect qualitative data.

A checklist was used to countercheck all the required logistics.

The equipment and supplies included those for:

- Assessment of dietary intake: liquid measuring cylinders of 1000 and 100 ml capacity with accuracy of 0.1 ml.
- Anthropometric measurement: Salter scales (spring) with accuracy of 0.1 Kg for weight, height/length board with accuracy of 0.1 cm to measure height and supine length and MUAC tapes with accuracy of 0.1cm for children.
- Training of field assistants: Laptop, LCD projector, newsprint, felt pens, masking tape and newsprint holder stand, document wallets, pens and notebooks.

3.4 Recruitment and training of field assistants

The recruitment of Field Assistants (FAs) was advertised verbally and through posters. The minimum requirements included having completed form four with the Kenya Certificate of Secondary Education (KCSE). Those with experience in data collection in household surveys had an added advantage. The interview was conducted to select those with required qualities and skills. Interview items assessed included general knowledge, translation of English sentences to both Kiswahili and Kikuyu, fluency and effective communication, good handwriting and general presentation.

Training curriculum for Field Assistants (FAs) covered; background and objectives of the study, field study ethics, methods of interaction, selecting the household and the respondent, understanding the sections of questionnaire, data collection techniques and use of checklist, measuring weights, height/length and volumes. Role plays and peer discussions were employed in the training to improve their skills and build their confidence in conducting the interview.

Objectives of the training

By the end of the training, the field assistants were expected to be able to:

1. Explain the purpose and objectives of the study
2. Enumerate the expected outputs of the survey
3. Demonstrate survey ethics
4. Interpret and administer the questionnaire
5. Correctly take weight and length, height and MUAC of children 6-59 months

6. Correctly measure the volumes of dishes prepared and consumed in a household in a 3-day food record
7. Interpret the questionnaire in Kiswahili and Kikuyu
8. Demonstrate in a role play how to administer the questionnaire
9. Pretest the questionnaire
10. Use a field checklist.
11. Take care of tools and equipment during and after use.

(See the training program, Appendix iii),

3.5 Pretesting of study tools

Pretesting of the tools was done in one of the four villages that were not included in the sample. Five households were randomly selected and questionnaires were administered. During the pretest, time taken to complete a questionnaire was noted; sequence of questions, understanding of questions by the respondent and the way field assistants asked the questions were also noted by the principal investigator. The pretest results were used to modify the tools accordingly. This also gave the FAs hands-on experience to improve on data quality and speed in administering the questionnaire.

3.6 Data collection

Different methods were employed to collect qualitative and quantitative data.

Demographic data: A pretested structured questionnaire was used to collect data on: the household profile i.e. Household size, sex, age, marital status, relationship to household

head, education level, school attendance, occupation of each household member and income contribution to the household.

Socio-economic data: This included; land and house ownership, size and number of the rooms in the main house, type of material used to construct the house (roof, wall, and floor) and type of cooking and lighting fuel. Each of these variables was scored by weighting and an index was developed for categorizing the households into different socio-economic status. Also, source and amount of income per month, and the proportion of income spent on food were collected.

***Food security*:** Four methods were used;

- Food availability was assessed through own production and consumption. Total food that entered the household either from own production, purchase or donations were recorded. A 3-day household food record was used to estimate food available to the HH for consumption. This was also used to estimate the period their harvest could last by converting their harvest into energy and protein and dividing that by RDAs per consumer unit.
- Food access was assessed by household income and dietary diversity. The proportion of income spent on food is indicative of HH food security status. The share of income going for food is often used as an indicator of affluence, of either a family or a nation. The proportion of income spent for food varies widely among households of different sizes and incomes. Also Household Dietary Diversity (HDD) is indicative of diet adequacy and access. The proportion of HH consuming more than 4 food groups was considered meeting dietary requirements (FSAU, 2005, Kennedy, 2009). Descriptive statistics were used to categorize the

HHs. Later analytical statistics like chi square, t-tests, ANOVA, correlations and regression were performed to establish associations between these variables.

- Dietary adequacy and utilization was assessed by a 3-day HH food record, nutritional status of children 6-59 months and also HH dietary diversity. Consumer units were calculated for diet adequacy based on Adult Equivalents of an adult moderately active male weighing 65 kgs. Weight, height/length and MUAC were measured. Age was obtained from the clinic card or the mother/caretaker's report.

Water: This included; type of water source, treatment, storage and distance to water source.

Sanitation and hygiene: This included; availability and vicinity of toilet, presence of hand washing facility with soap and means of solid waste disposal.

Health facilities: This assessed presence of, and distance to nearest health facility and their perception on that distance, whether near or far for them.

Qualitative data: FGD guide was used to collect qualitative data on environmental issues, perceptions and causes of household food insecurity, problems in rice farming and common diseases. Breastfeeding practices as a human right, human right to food, access to health facilities, socio-economic rating of the poor and the rich households and the emic view for priority interventions were also assessed.

3.7 Data management and quality assurance

The quality assurance was enhanced through close supervision by the principal investigator and supervisor from University of Nairobi. Qualified enumerators were

recruited and given appropriate training to ensure good quality data was collected. At least two readings were taken in the measurements and the average was calculated to reduce measurement errors. Once data was collected on daily basis, there was a field debrief meeting to check completeness of the questionnaires before they were signed and collected. Also the data was entered into the data template the same evening and the feedback was given in the morning to the enumerators. Any corrections on the collected data were addressed before leaving for the field. The questionnaires were kept safely in a metal box that was under the custody of the principal investigator.

Data cleaning checks were defined in data entry template for the expected ranges (high and low) to flag off any errors done during data entry and recording. Frequencies were run to check any missing data and recoding errors. Exploratory Data Analysis was done to check for outliers. The flags were counterchecked against raw data for confirmation. Flags were not included in analysis but were reported in the final report. HHs with missing data (independent variables) crucial for computing composite dependent variables was excluded in the analysis.

3.8 Data analysis

The data analysis was done using SPSS version 16.0, EPI-ENA 2007 and Excel windows 2007 softwares. Exploratory Data Analysis was done to determine the tests appropriate for analysis of different variables. Descriptive statistics including measures of central tendency (mean, median, mode); and measures of dispersion (range, SD, variance) were used to describe the different indicators.

The demography data helped to provide the denominators for calculating percentages, ratios and prevalence. The socio-economic status scoring index was established through focused group discussion to distinguish between high, medium and low socio-economic status of the households. House ownership, type of the house, persons sleeping in a single room, cooking and lighting fuel were weighted by ranking them on a scale of 1 to 3 where 1represents low economic (poor) status while 3 represents high economic (better) status as shown in Tables 3.4 and 3.5.

Table 3.4: Weighted socio-economic characteristics

	Score		
Characteristic	**1**	**2**	**3**
House ownership	Family house	rented	Self-owned
House type	temporary	Semi-permanent	permanent
Persons living in a single room	5 or more	3-4	1-2
Cooking fuel	firewood	Charcoal/kerosene	Gas/electricity
Lighting fuel	Tin and wick	Kerosene lamp	Electricity/solar

The points scored in each of the five socio-economic characteristics were summed up and categorized into a scoring system shown in Table 3.5. The minimum score was 5 (i.e. if a household scored 1 in every socio-economic characteristic. i.e. 1x5) and the maximum was 15 (i.e. if a household scored 3 in every socio-economic characteristic i.e. 3x5). Consensus by the FGD participants on the scoring index (Table 3.5) was reached through proportion pilling technique.

Table 3.5: Scoring system of socio-economic status

Socio-economic status	1=low	2= Medium	3= High
Scoring index	5-8	9-12	13-15

Households with lowest socio-economic status therefore were those with the following combination; lived in temporary, inherited and/or family house, slept five or more people in a single room and used firewood and tin/wick candle for cooking and lighting fuel respectively.

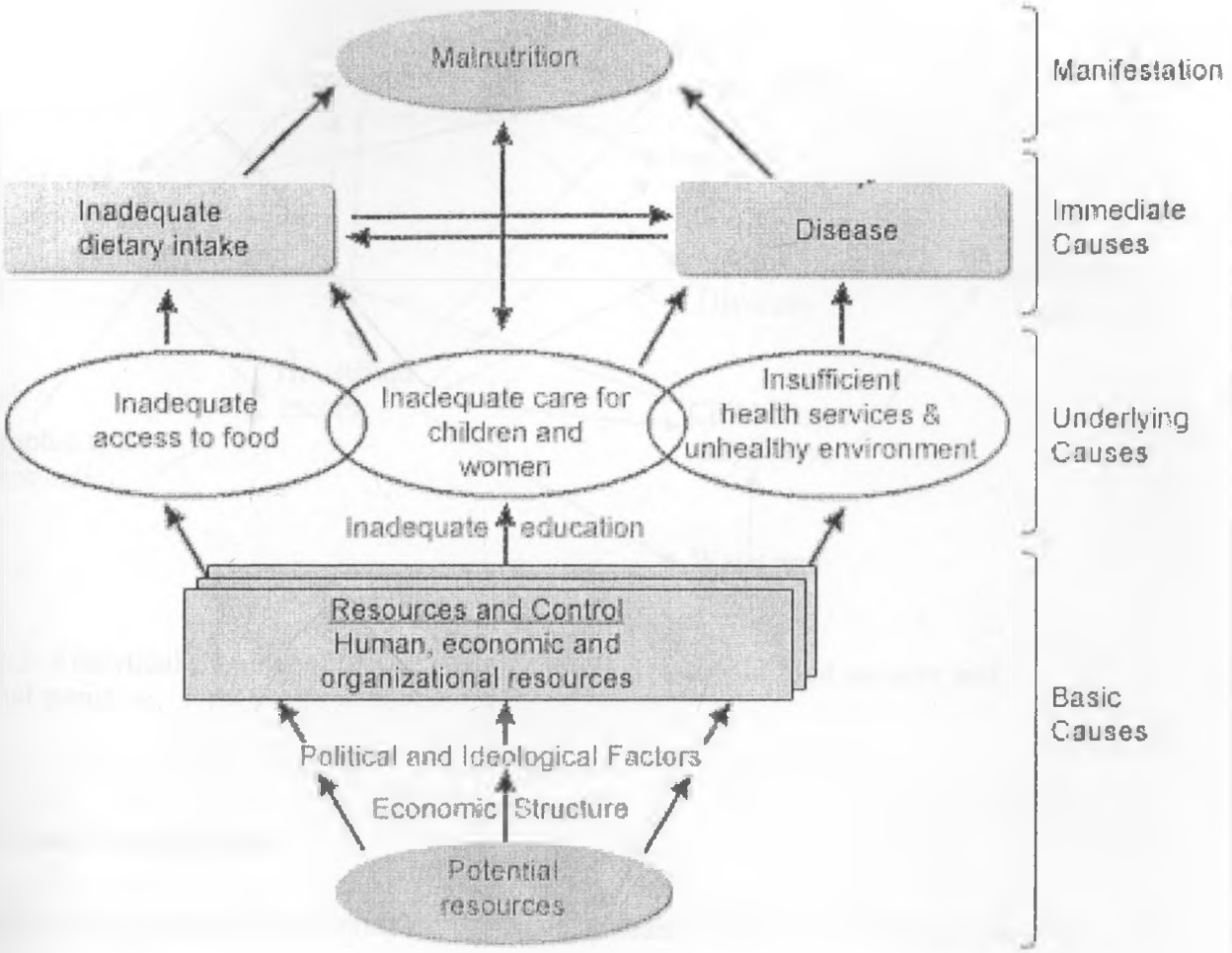
The proportions of male and female headed households, household size, age, sex distribution and education level of the population were established. All these statistics were analyzed to find their association with food security indicators and nutritional status. Socio-economic data was correlated with household dietary, food coping strategies, energy and protein availability, diversity and nutritional status to establish if there was a relationship.

A three day household food record was conducted. Food analysis was done using Nutrisurvey, 2007 software and food consumption Tables (Sehmi, 1993) and data was transferred into SPSS version 16. Energy and protein scales were then used to convert total energy and protein consumed in the household into Adult Equivalents.

Data from morbidity, water, hygiene and sanitation were cross tabulated to find associations with nutritional status. The FGD data provided some insight information for integration with quantitative data about how the community collectively understood their problems and their priorities. Also the opinion of men and women regarding food security, child feeding and health were compared.

Analyses including cross tabulations, ANOVA, χ^2, odds ratio, correlations and regression were performed. F-test, t-test for continuous data and, Fisher's χ^2 for discrete unpaired independent data variables were done. In all cases significant p-value was set at 0.05.

Analytic model: The variables from HH demographic profile, social-economic, dietary patterns, morbidity and HH food security (access, availability, and adequacy) were analyzed to establish how they influenced the nutrient intake and consequently children nutritional status relating it to UNICEFs (1990) conceptual framework for malnutrition shown in figure 3.2. The dependent variable was nutritional status as measured by WAZ, HAZ, WHA and MUAC. Principal Component Analysis (PCA) technique was applied to summarize variables as important factors to predict household food security. ANOVA to test univariate mean differences between the independent and dependent variables such as age, dietary intakes, diversity and malnutrition status were used. The variables identified as defining the nutritional status were subjected to PCA in the Factor procedure of SPSS in order to summarize them into Factors or Components.



Source: UNICEF, 1990

Figure 3.2: UNICEF's conceptual framework for causes of malnutrition.

The strength of association was established using regression analysis. Figure 3.3 shows an association model used for correlation and regression. The arrows represent the direction in which the cause-effect relationship is anticipated. For instance, household food security is affected by agricultural production, food access, health care, household income, demographic and socio-economic factors. Likewise, income affects, health care access, dietary diversity, food access and nutrient intake which in turn influence nutritional status.

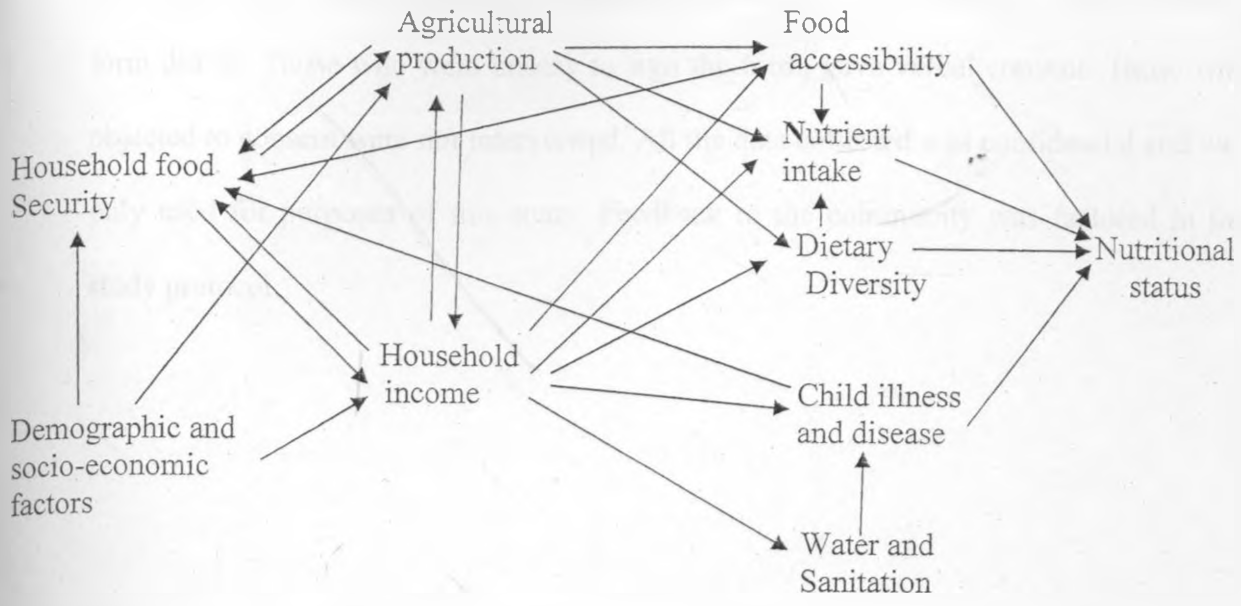


Figure 3.3: Analytical framework of association between household food security and nutritional status.

3.9 Ethical consideration

To gain legal grounds for undertaking the study, research permit was obtained from the Research and Ethical Clearance Committee in the Ministry of Science and Technology through the University of Nairobi. The study proposal was also approved by the Board of Postgraduate Studies (BPS) of University of Nairobi. The District Officer (Mwea Division) and Chief (Tebere Location) were informed about the objectives and methodology of the study and there was no objection. The District Medical Officer of Health (DMOH), District Public Health Officer (DPHO), Divisional and Locational Public Health Officers were also informed about the objectives and methodology of the study. All the procedures of data collection were non-invasive. The respondents were well informed on the purpose of the survey and were allowed to ask questions and raise

any fears which were addressed accordingly. Those who were willing to sign a consent form did so. Those who were uneasy to sign the form, gave verbal consent. Those who objected to consent were not interviewed. All the data collected was confidential and was only used for purposes of this study. Feedback to the community was factored in the study protocol.

CHAPTER 4: RESULTS

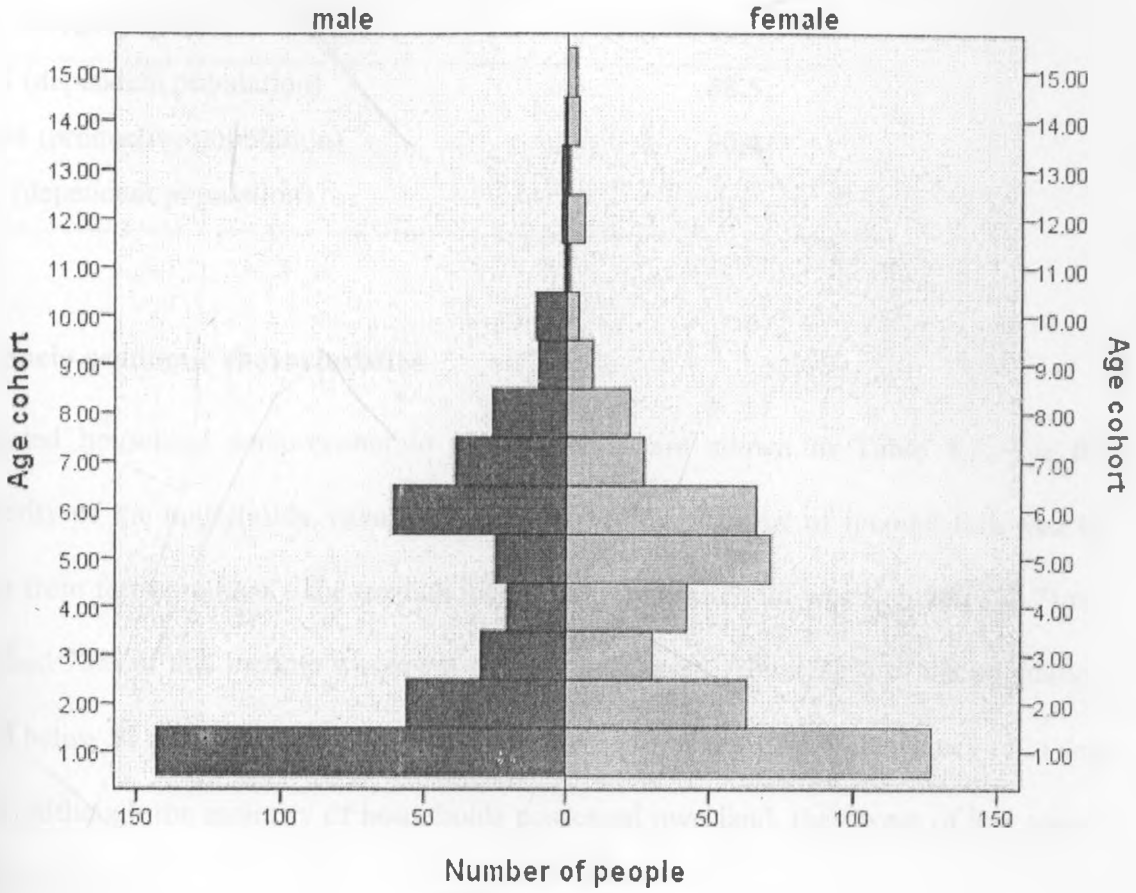
4.1 Household demographic characteristics of study population

A total of 200 households and 200 children aged 6-59 months were assessed. The mean household size was 4.5± 1.6 and mean number of underfives per household was 1.3±0.5. Male to female ratio of the population was 1:1.1. One in five households was headed by a female. Table 4.1 shows selected demographic characteristics of the study population. The mean age of the population was 18.1±15.1 years.

Table 4.1: Selected household demographic characteristics of the study population

Characteristic	%(N=200)
Sex ratio	
Male:	47.4
Female	52.6
Sex of Household Head	
Male	80.0
Female	20.0
Marital status of the household head	
Married	80.5
Single	10.0
Separated	6.0
Divorced	2.5
Widowed	1.0

There were more females than males in 16-30 years age cohorts as shown in the population pyramid below (Figure 4.1)



Scale (yrs)

1=0-5	**2**=6-10	**3**=11-15	**4**=16-20	**5**=21-25	**6**=26-30
7=31-35	**8**=36-40	**9**=36-40	**10**=41-45	**11**=46-50	**12**=51-55
13=56-60	**14**=61-65	**15**=65+			

Figure 4.1: Population pyramid

Almost half of the population was below the age of 15 years. Only 1% of the population was 65 years and above as shown in Table 4.2.

Table 4.2: Age distribution on basis of dependency status

Age category (yrs)	% (N=906)
0-14 (dependent population)	48.5
15-64 (productive population)	50.4
65+ (dependent population)	1.1

4.2 Socio-economic characteristics

Selected household socio-economic characteristics are shown in Table 4.3. For the majority of the households, casual labour was the main source of income followed by sales from farm produce. The median income for the household was Ksh 200 ($2.7) per day and 75% of this income was spent on food purchases. About 72% of the population lived below $1 per day. Their percapita income was $0.67 per day. Dependency ratio was 0.98. Although the majority of households possessed own land, they were of low socio-economic status.

Table 4.3: Selected household socio-economic characteristics of the study population

Socio-economic characteristic	***% (N=200)***
Main source of income	
Casual labour	44.7
Sale of farm produce	40.7
Business	9.5
Salary/wage	4.0
Remittance	0.5
Destitute	0.5
Possess land	73.0
Land type	
Own	63.4
Rented	15.9
Both(own and rented)	20.7
Weighted socio-economic status index	
Low	61.5
Medium	29.5
High	9.0

4.3 Occupation

Majority of the population aged 18 years and above (N=438) was engaged in farming, casual labour and small trade. Population in different occupations were statistically different (χ^2, $p<0.000$). In most occupations. men were predominant except in domestic chores and small scale trade (Kruskal Wallis χ^2, $p=0.002$) as shown in Figure 4.2.

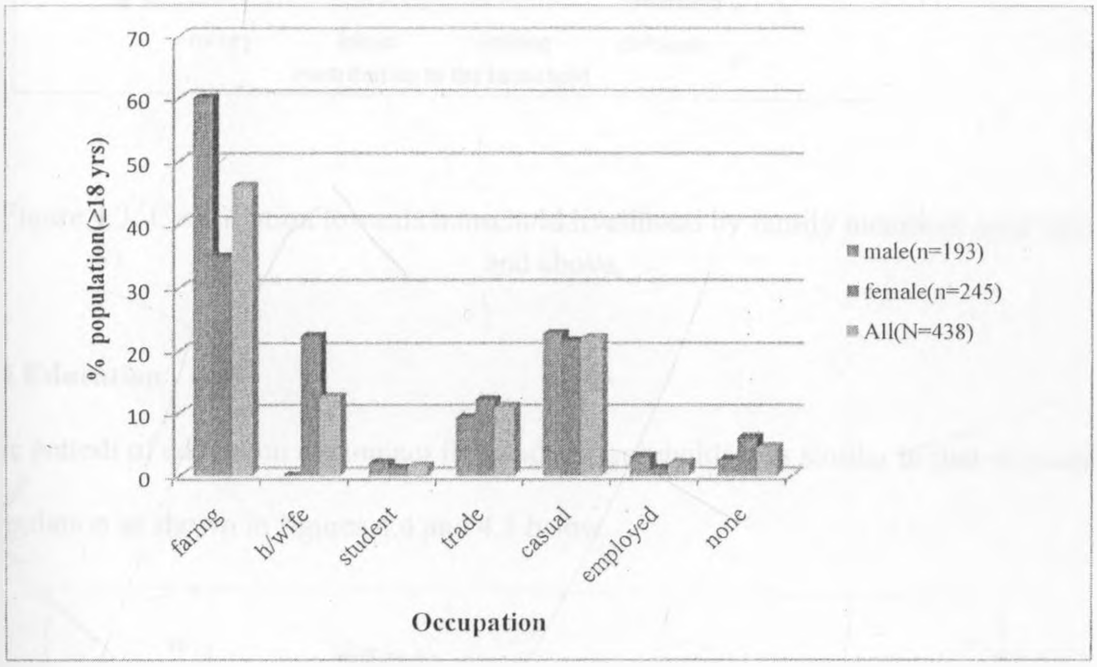


Figure 4.2: Occupation of household members aged 18yrs and above.

Majority of men contributed money while women contributed money, labour and child care to the household as shown in Figure 4.3.

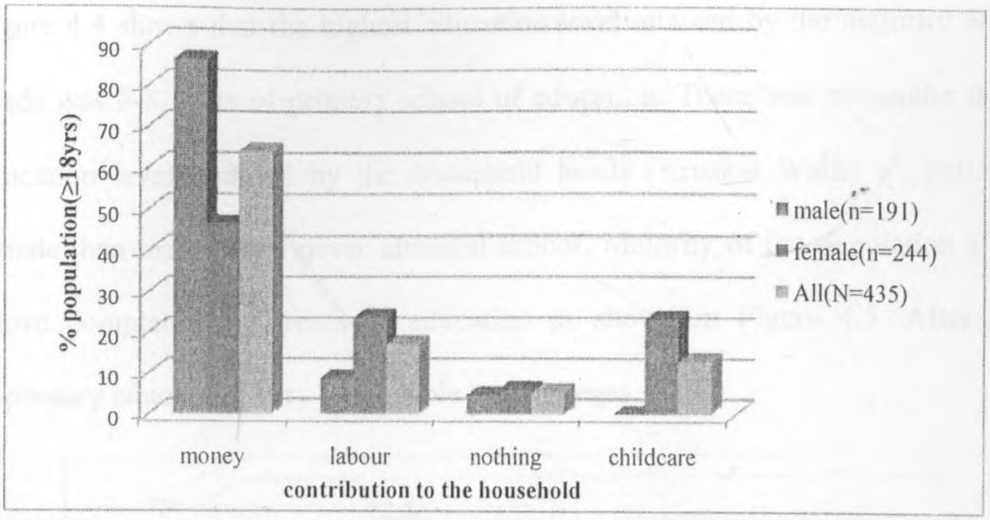


Figure 4.3: Contribution towards household livelihood by family members aged 18yrs and above.

4.4 Education

The pattern of education attainment for head of households was similar to that of general population as shown in figures 4.4 and 4.5 below.

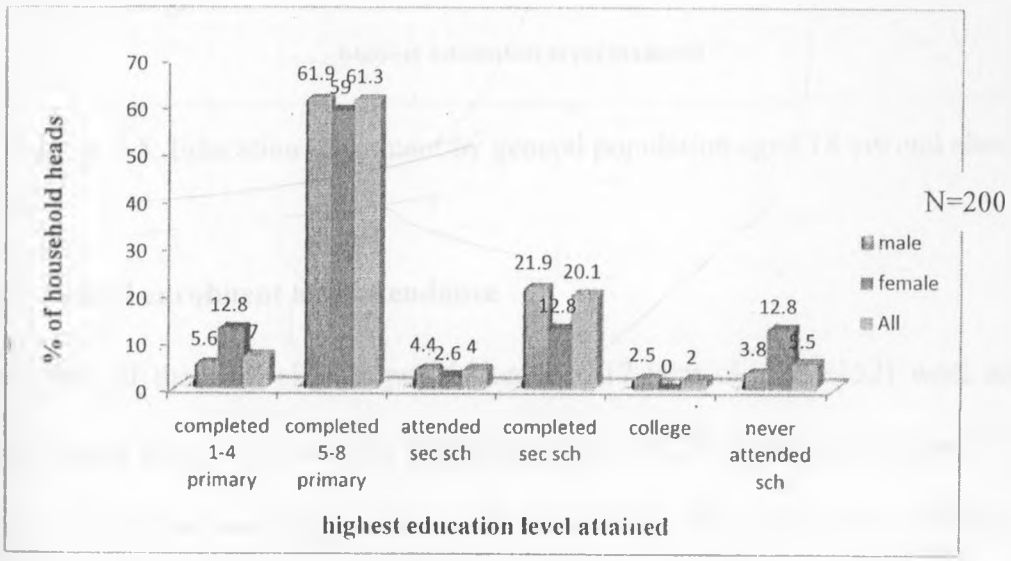


Figure 4.4: Household head educational attainment

Figure 4.4 shows that the highest education level attained by the majority of household heads was 5-8 years of primary school of education. There was no gender difference in education level attained by the household heads (Kruskal Wallis χ^2, p=0.718). More female than male heads never attended school. Majority of the population 18 years and above completed 5-8 years of education as shown in Figure 4.5. After completing secondary education, very few people join colleges.

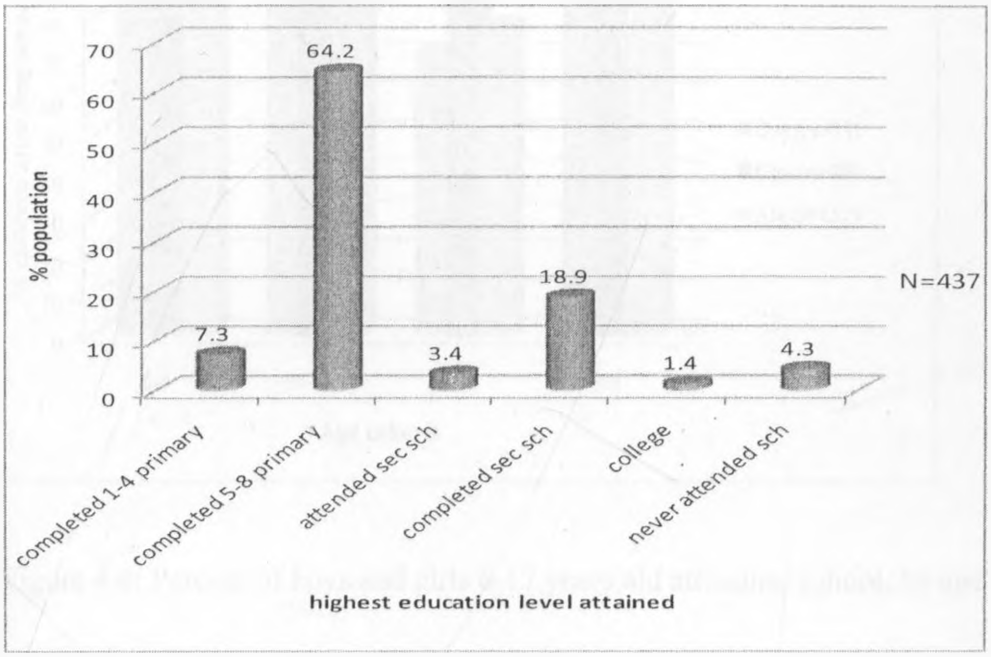


Figure 4.5: Education attainment by general population aged 18 yrs and above

4.4.1 School enrolment and attendance

About 94% of the total eligible population of 6-17 year olds (N=152) were attending school. Out of those who were not attending school, 66.7% were boys. Figure 4.6 shows percent of children attending school. Net attendance ratio (NAR) for primary and/or secondary school measures the proportion of children of primary and/or secondary school age who are attending primary and/or secondary school In Kenyan context, the level

refers to 6-13 years for primary and 14-17 years for secondary (CBS 2009). The NAR was 97.6% and 78.6 for primary and secondary school respectively. There were about 5% more girls attending school than boys but it was not significant (χ^2=1.596, p=0.207). As expected, NAR was lower at secondary than primary school.

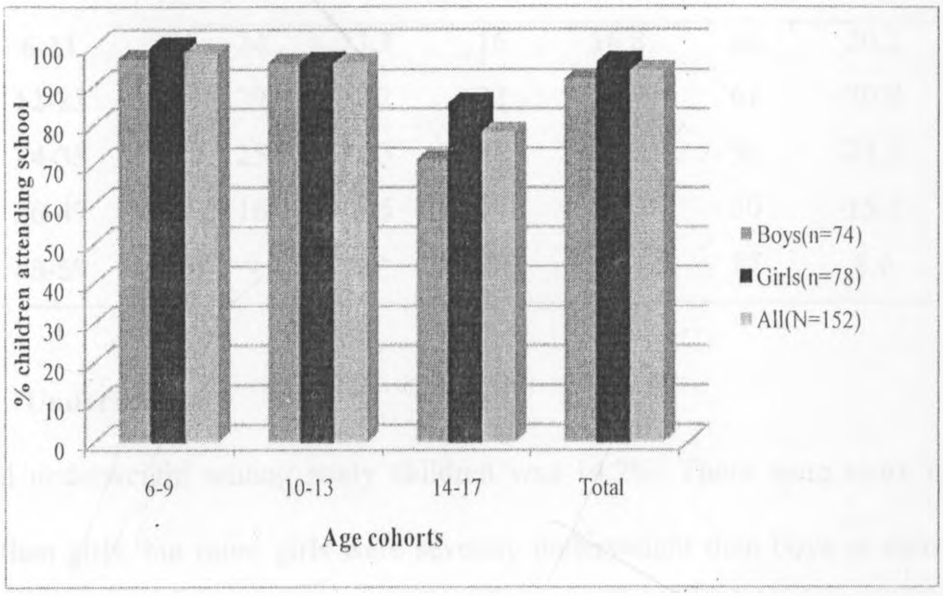


Figure 4.6: Percent of boys and girls 6-17 years old attending school, by age

4.5 Nutritional status

Two children were flagged off (SMART flags) because their ages were found to be outside the required range and were excluded from the analysis. However, this was taken care of by the attrition allowance since the calculated minimum sample size was 192 children. The age distribution of the assessed children is shown in Table 4.4 below. The age groups were significantly different (χ^2 = 29.56, p< 0.000). The overall sex ratio of

boys to girls was 1.08. The ratio difference was highest in 6-11 months. However, the overall gender proportions were not significantly different (χ^2 =1.615, p= 0.805).

Table 4.4: Distribution of study children 6-59 months old by age and sex.

Age (months)	Boys (n=103)		Girls (n=95)		Total (N=198)		Ratio
	no.	%	no.	%	no.	%	Boy:girl
6-11	24	23.3	16	16.8	40	20.2	1.5
12-23	29	28.2	32	33.7	61	30.8	0.9
24-35	25	24.3	25	26.3	50	25.3	1.0
36-47	16	15.5	14	14.7	30	15.1	1.1
48-59	9	8.7	8	8.4	17	8.6	1.1

4.5.1 Underweight

Global underweight among study children was 14.2%. There were more underweight boys than girls, but more girls were severely underweight than boys as shown in Table 4.5 below. However, there was no significant difference in underweight prevalence between boys and girls (χ^2, p=0.507). The mean WAZ was -0.80±1.13. The underweight prevalence was slightly lower than the national prevalence of 16% (CBS, 2009). Two children had z-scores out of range (SMART flags) according to WHO 2006 standards while one child's measurements were missing. These were excluded from the analysis.

Table 4.5: Prevalence of underweight (<-2 z-score) among children 6-59 months old by sex.

	All (N=197)			Boys (n=102)			Girls (n=95)		
	n	%	C.I.	n	%	C.I.	n	%	C.I.
Global underweight (<-2 z-score)	28	14.2	9.1-21.5	17	16.7	10.4-25.6	11	11.6	6.2-20.6
Severe underweight (<-3 z-score)	3	1.5	0.5-4.7	1	1.0	0.1-9.7	2	2.1	0.4-10.3

C.I = Confidence Interval

4.5.2 Stunting

Children below -2 z scores of height-for-age of the reference population were considered stunted. Boys were more stunted than girls for both global and severe stunting as shown in Table 4.6 below. However, this difference was not significant (x^2, p=0.325). The overall stunting was slightly lower than the national prevalence of 35% (CBS, 2009). The mean HAZ was -1.42±1.22. There was no difference between mean z-scores between boys and girls (F_1=0.227, p=0.634). There were nine z-scores out of range and were excluded from the analysis. This might have been due to errors in age estimation when data relied on mother/caretaker's report on date of birth of the child where clinic card was not available. However, this was considered in the attrition/non respondent range in the sample.

Table 4.6: Prevalence of stunting (<-2 z-score) among children 6-59 months old by sex.

	All (N=191)			Boys (n=98)			Girls (n=93)		
	n	%	C.I.	n	%	C.I.	n	%	C.I.
Global stunting (<-2 z-score)	62	32.5	21.7-45.4	35	35.7	24:5-48.7	27	29.0	14.2-50.3
Severe stunting (<-3 z-score)	21	11.0	7.7-15.5	14	14.3	7.7-25.0	7	7.5	3.8-14.3

C.I = Confidence Interval

4.5.3 Wasting

Both GAM and severe wasting were lower than national prevalence of 7% and 2% respectively (CBS, 2009). Girls were more wasted than boys but the difference was not significant

(χ^2 =0.026, p>0.872). Four children had z-scores out of range (SMART flags) according to WHO 2006 standards while one child's measurements were missing. These were excluded from the analysis. Table 4.7 shows the wasting prevalence of the children.

Table 4.7: Prevalence of acute malnutrition among children 6-59 months old by sex.

	All (N=194)			Boys (N=102)			Girls (N=94)		
	n	%	C.I.	n	%	C.I.	n	%	C.I.
GAM (<-2 z-score)	10	5.1	2.3-10.8	4	3.9	1.3-11.1	6	6.4	2.8-14.1
Severe wasting (<-3 z-score)	1	0.5	0.1-4.9	1	1.0	0.1-7.8	0	0.0	0.0-0.0

C.I = Confidence Interval

When malnutrition levels were tabulated with the conventional age cohorts as shown in Table 4.8 below, there were significant differences in WAZ and HAZ between the groups (χ^2, p<0.023) but not in WHZ (p=0.872). The differences in malnutrition levels between sexes were not significant in all the three indices ([2]p>0.05) as indicated in Table 4.8.

Table 4.8: Percent prevalence of global and severe malnutrition by age.

	WAZ		**HAZ**		**WHZ**	
Age (months)	<-3 z-score n=5	<-2 z-score n=29	<-3 z-score n=23	<-2 z-score n=64	<-3z-score n=4	<-2z-score n=12
6-11(n=40)	2.5	10.0	2.5	7.5	7.5	10.0
12-23(n=60)	5.0	21.7	13.1	37.7	1.7	10.0
24-35(n=50)	0.0	12.0	16.0	42.0	0.0	0.0
36-47(n=30)	3.3	10.0	10.0	36.7	0.0	3.3
48-59(n=17)	0.0	17.6	17.6	35.3	0.0	5.9
Total(N=197)	2.5	14.7	11.7	32.5	2.0	6.1
[1]p-value	0.023*		0.000*		0.057	
[2]p-value	0.242		0.325		0.872	

[1]p-value is Kruskal-Wallis chi square significant levels between age groups.
[2]p-value is Kruskal-Wallis chi square significant levels between boys and girls.
** Indicate that the difference between malnutrition levels between age groups were significantly different at 0.05 level of significance.*

Wasting and underweight were highest in first and second years while stunting was critically high during the third year of life. When children were categorized into 6-23months (n=101) and 24-59 months (n=97) old cohorts and their nutritional status compared using ANOVA, only HAZ was significantly different between the two groups (F=10.081, p=0.002). WAZ and WHZ mean z-scores were not significantly different between the two groups (F, p>0.05).

Malnutrition trends shown in Figure 4.7 below indicate that stunting increased rapidly in the first year reaching the peak at third year of life and then decreased towards fifth birthday. A similar trend was observed in underweight prevalence but improved slightly at fourth year and then deteriorated at fifth birthday. Wasting prevalence level was poor in the first year, improved at second and fourth years of life and then deteriorated sharply reaching worst levels at fifth year. ANOVA of malnutrition levels (z-scores) between age cohorts showed significant differences in WAZ (F_4, p=0.026) and HAZ (p=0.000) but not in WHZ (p=0.101). There was no relationship between the gender of the household head and malnutrition in all the three indices (F_1, p>0.637).

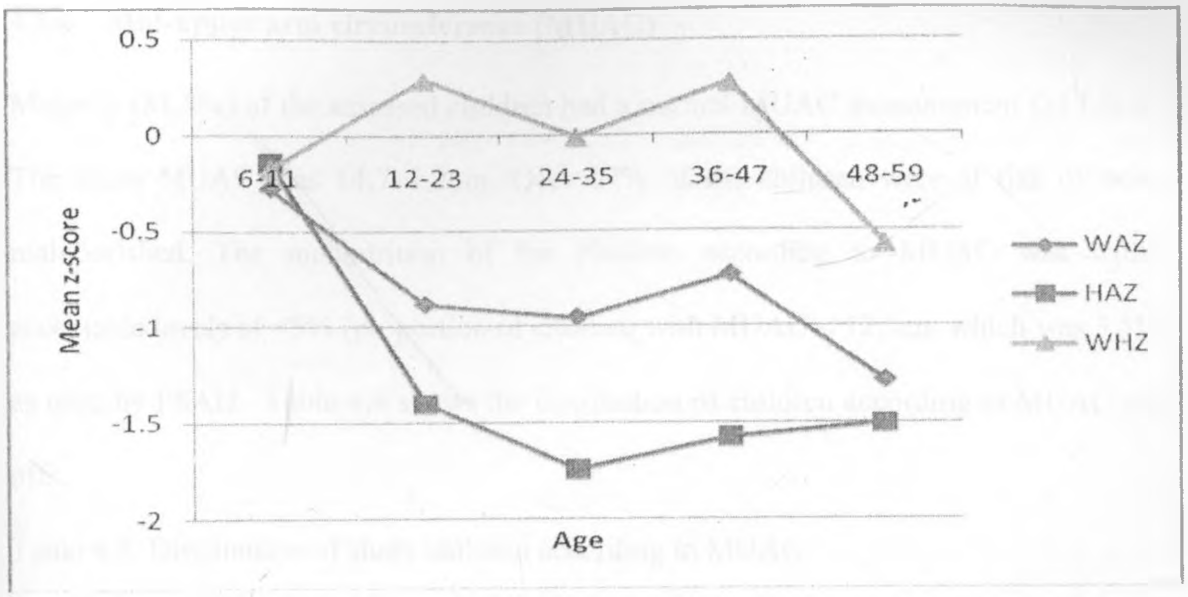


Figure 4.7: Progression of malnutrition.

As expected, chronic malnutrition was more prevalent than acute malnutrition as shown in Figure 4.8 below. Stunting and underweight levels were slightly higher for boys than girls but GAM was higher in girls than boys. However these gender differences in malnutrition were not significant (χ^2 <1.298, p>0.05).

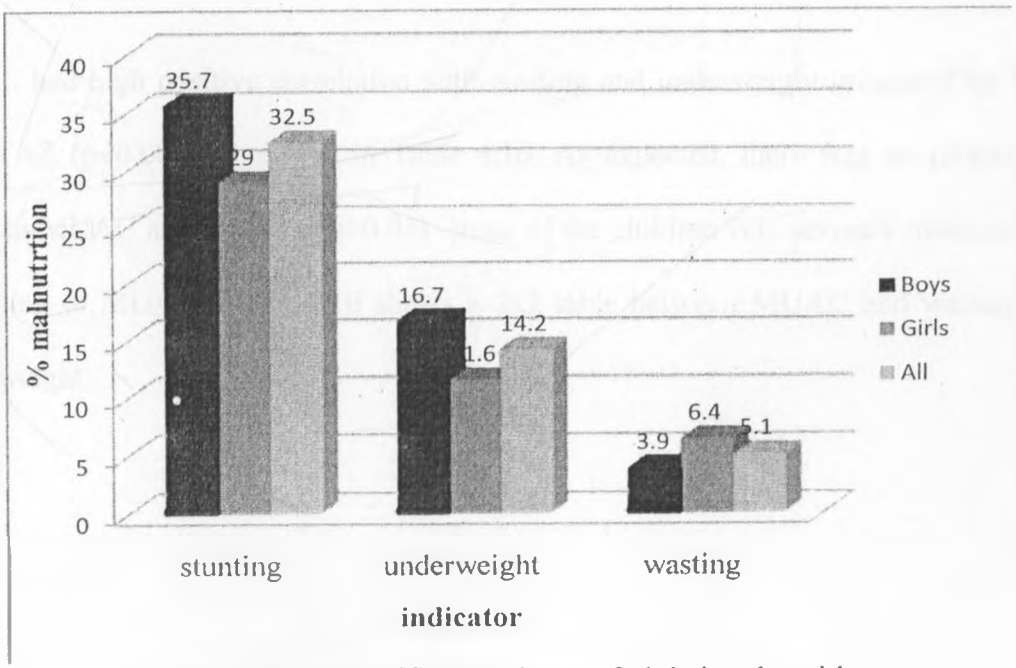


Figure 4.8: Sex specific prevalence of global malnutrition

4.5.4 Mid-upper arm circumference (MUAC)

Majority (81 5%) of the assessed children had a normal MUAC measurement (≥13.5cm). The mean MUAC was 14.7±1.2cm. Over 17% of the children were at risk of being malnourished. The malnutrition of the children according to MUAC was within acceptable levels of <5% (proportion of children with MUAC < 12.5cm which was 3.5%) as used by FSAU. Table 4.9 shows the distribution of children according to MUAC cut-offs.

Table 4.9: Distribution of study children according to MUAC

MUAC (cm)	Diagnosis	prevalence %(N=200)
<11.0	Severe malnutrition	0.0
≥11.0 and <12.0	Moderate malnutrition	1.0
≥12.0 and <12.5	Serious risk of malnutrition	2.5
≥12.5 and <13.5	Moderate risk of malnutrition	15.0
≥13.5	Satisfactory nutrition status	81.5

MUAC had high positive correlation with wasting and underweight measured by WHZ and WAZ ($p<0.000$) as shown in Table 4.10. As expected, there was no relationship between MUAC and stunting ($p>0.05$). None of the children was severely malnourished according to MUAC. Table 4.10 shows a 2x2 table between MUAC and wasting and underweight.

Table 4.10: Percent distribution of study children by MUAC, wasting and underweight status.

		Wasting (WHZ)			Underweight (WAZ)		
		Wasted	Normal	**Total**	Underweight	Normal	**Total**
MUAC	<12.5	2.0	1.0	3.0	2.5	0.5	3
	≥12.5	4.0	185	97.0	12.1	84.8	97.0
	Total	6.0	94.0	100.0	14.6	85.4	100.0

4.5.5 Quality of anthropometry data

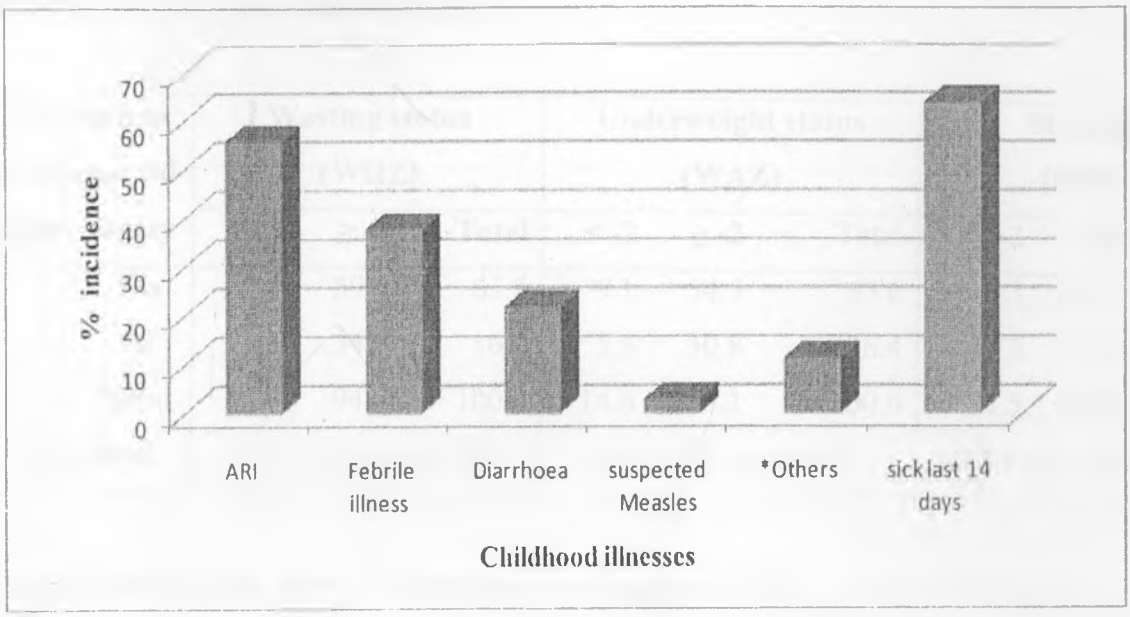
Table 4.11 below shows some data quality statistics on anthropometry data. Shapiro-wilk test indicated that this data was obtained from normally distributed (Gaussian) population because $p>0.05$. Skewness was between -1 and +1. This shows that data was symmetrical. However, data was positively skewed meaning majority (mode and median) of the children (z-scores) were on the negative side of μ on the normal distribution curve. Kurtosis (peakedness) was less than absolute value of 1 meaning that sampling and data collection errors were minimized as much as possible. Thus the quality of data was within the acceptable limits.

Table 4.11: Report on selected plausibility checks for anthropometry data.

Indices	**Shapiro-wilk test p-value**	**Skewness**	**Kurtosis**
WAZ	0.429	0.22	-0.14
HAZ	0.239	0.03	-0.48
WHZ	0.922	0.04	0.06

4.5.6 Malnutrition and morbidity

High morbidity rates were reported with 64% of the assessed children having fallen ill within the 14 day-period prior to the assessment. Figure 4.9 shows the distribution of childhood illnesses for all age cohorts.



**Other infections including skin, eye, ear, burns and injuries.*

Figure 4.9: Distribution of childhood illnesses in the two week-period prior to study by age cohort.

ARI was the most prevalent childhood illness followed by febrile illness. Children 12-23 and 6-11 months were more affected by ARI and febrile illnesses respectively than other age cohorts. However, these differences were not significant for ARI and febrile illness as indicated by χ^2, p=0.473 and 0.519 respectively. Diarrhoea was significantly higher in 6-11 and 24-35 months old children (p=0.041).

Overall disease incidences were cross tabulated with nutritional status indices as shown in Table 4.12 below. The indices computed here included all children with

z-scores >= -5 and < -2 to include extreme cases that could have been caused by diseases and had been flagged off earlier as SMART flags.

Table 4.12: Distribution of study children by morbidity experience in the 14 day-period prior to the survey and nutritional status.

Were sick in 14 day-period before survey	Wasting status (WHZ)			Underweight status (WAZ)			Stunting (HAZ)		
	< -2	≥ -2	Total	< -2	≥ -2	Total	< -2	≥-2	Total
Yes	4.5	59.3	63.8	9.1	54.5	63.6	19.3	44.7	64.0
No	1.5	34.7	36.2	5.5	30.8	36.4	12.2	23.8	36.0
Total	6.0	94.0	100.0	14.6	85.3	100.0	31.5	68.5	100.0
Odds ratio	1.75 (CI: 0.46-6.70)			0.92 (CI: 0.41-2.08)			0.85 (CI: 0.45-1.58)		

A sick child was more likely to be wasted than a well child (OR: 1.75, CI: 0.46-6.70)

Figure 4.10 below compared morbidity between and within the age cohorts. Percentage values were calculated using 'n' shown in the legend as the denominator. Using Kruskal Wallis test, the difference in overall morbidity (children sick in the last 14 days) between age groups was not significant (p=0.326). For specific illnesses, ARI (p=0.473) and febrile illness (p=0.519) incidences were the same but diarrhoea was significantly higher in children 6-11 and 24-35 months old (p=0.041).

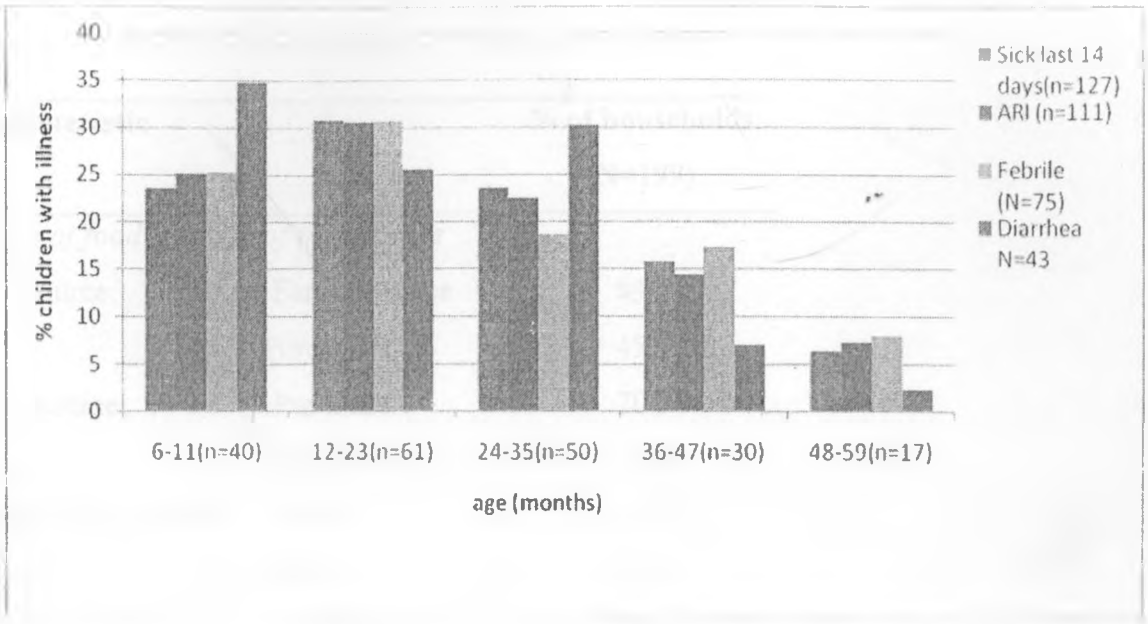


Figure 4.10: Percent distribution of children who had illness during the 14 day-period prior to the survey by age group.

4.6 Household food status

4.6.1 Food production

Majority of households ranked farm produce as their first main source of food (Table 4.13). About 70% of households ranked purchase as their second most important main source of food. More than half of the population produced rice whereas over one-third, one-quarter and 11.2% grew maize, beans and horticultural crops respectively.

Table 4.13: Priority source and type of food grown in MTIS

Characteristic		% of households (N=199)
Source of food in order of importance		
No.1 source:	Farm produce	54.5
	Purchase	45.5
No. 2 source:	Purchase	70.5
	Farm produce	29.5
Type of crops grown:	Rice	55.5
	Maize	39.7
	Beans	24.1
	Horticulture	11.2

The mean production level of rice was 21.7±1.7 bags of 90kgs per household growing rice. However, almost half of the rice produced was sold as shown in Table 4.14. Unlike rice and maize, beans produced were mainly consumed. Almost 60% of the households feared that the rice remaining in the store could not last up to the subsequent harvest.

Table 4.14: Mean amounts of food production and utilization

	n	Production	Consumed	Sold	Donated	Stored	Enough	
							Yes%	No %
Rice (90kg bags)	111	21.7(19.5)	4.6(3.6)	10.1(13.0)	0.8(1.5)	5.9(8.9)	41.6	58.4
Maize(kgs)	79	87.1(137.4)	36.9(45.7)	32.2(96.7)	5.3(15.3)	31.4(58.4)	33.7	66.7
Beans(kgs)	48	13.5(23.4)	12.4(16.1)	1.8(0.9)	0.9(3.7)	7.0(15.2)	26.5	73.5

Note: Figures in parenthesis are standard deviation

The mean amounts of rice, maize and beans produced in a year were converted into energy (kcal) and protein (g) available per day and compared to energy and protein requirements per adult equivalent per day. Table 4.15 shows the household mean energy and protein availability estimated from what had been consumed from the time of harvest to the time the survey was conducted (7 months) assuming that the household composition remained the same over the seven months period.

Table 4.15: Mean energy and protein availability and utilization per day

[1]Energy (kcal/HH)	[2]Protein g	[3]Kcal/AE	Protein g/AE	Energy AE required	Protein AE required
7,667.5±6,365	173.9±152	2,473.4(2580.9)[ns]	60.0(69.3)*	3.1(2.8)*	2.9(3.6)*

*Figures in parenthesis are the mean nutrient intake values per day calculated from 3-day food record.[1]The mean energy consumed by the household per day for the last 7 months. [2]The mean protein consumed by the household per day for the last 7 months. [3]The mean energy available for the household per day divided by mean adult equivalent (AE) in the household (i.e. the mean energy available per AE. AE used for energy and protein were 2900kcal/day (for moderately active male adult) and 52g (0.8g/kg/day) respectively for a male adult of 65 Kgs. *The two values are significantly different, t-test p<0.000. ns=The two values are not significantly differently.*

The daily energy intake estimated from what had been consumed for the last 7 months were lower than consumption estimated from the 3-day food record. The difference was not significant for energy intake (t=0.785, p=0.434) but it was significant for protein (t=4.117, p=0.000). There was a huge variation in energy and protein intake among households as indicated by the wide standard deviations. The foodstuffs remaining in the store were converted into mean energy and protein and the duration it would last was calculated as indicated in Table 4.16 (provided that consumption would meet household

daily energy and protein requirements and that the household composition would remain the same).

Table 4.16: The mean nutrient values available in store and duration for consumption

Energy (kcal) available	Energy Required/day	Duration (months)	Protein (g)	Protein(g) required/day	Duration (months)
1,983,460±3,086,560	3.1x2900	7.3	41,404.5±67,087	2.9x52	9.2

The energy foods that were available in the store could last for about 7 months from the time of this study. That food was enough to last to the subsequent harvest assuming that all of it was used for consumption.

4.6.2 Perceptions on food security

About 41.2% of the assessed households experienced food shortage in the four week-period prior to the survey compared to 46.9% in the previous year whereas 27.6% were experiencing food shortage at the time of the survey. Majority of the households (58-74%) said that what was remaining in the store (rice, maize and beans) could not last to the subsequent harvest and anticipated food shortage. When they were asked to self-evaluate their food situation, about 40% of the households said they were food secure, 24% and 36% said they were food insecure and neither food secure nor insecure respectively.

4.6.3 Household food consumption

4.6.3.1 Energy and protein

The mean energy and protein intake from a 3-day food record are presented in Table 4.17.

Table 4.17: Mean (SD) values of household energy and protein consumption

Nutrient	HH intake/day	Intake/ AE	AE requirement	AE consumed	AE difference	% of HHs meeting AE
Energy (kcal)	8000.7(2539.9)	2580.9	3.1(1.2)	2.8(0.9)	-0.3	39.2
Protein (g)	184.8(70.0)	63.4	2.9(1.1)	3.6(1.4)	+0.7	70.4

Figures in the parenthesis are standard deviation.

The actual mean Adult Equivalents (AE) for energy consumed was significantly lower than the required AE (t_{198} =-5.496, p<0.000). The mean calorie intake per Adult Equivalent was 2580.9 Kcal/day. About 60.8% and 30% of the households were not meeting their energy and protein requirements respectively. The mean protein AE required for adequate intake was significantly lower than protein AE consumed (t_{198}=36.662, p<0.000). The mean protein percapita intake (63.4g) was higher than required (52g/day). Both energy and protein intake was varied across households as indicated by the wide standard deviation. Only 30% of the population was not meeting their protein requirements. There was no significant difference in energy and protein intake between male and female headed household (F, p>0.05).

4.6.3.2 Household energy intake adequacy and nutritional status of children

Households were categorized according to their nutrient intake adequacy status (i.e. whether their energy intake per AE was adequate or not) and their corresponding underfive children's mean z-scores tabulated accordingly as shown in Table 4.18 below. Although WAZ and WHZ were worse off in HHs that had inadequate energy intake, the difference was not significant ($p>0.05$). The mean HAZ was worse off in households with adequate energy intake but it was not statistically significant.

Table 4.18: Mean z-scores by energy intake status

Household energy intake status	**WAZ**	**HAZ**	**WHZ**
HHs with inadequate E intake/AE	-0.88(1.16)	-1.26(1.5)	-0.25(1.1)
HHs with adequate E intake/AE	-0.74(1.18)	-1.41(1.3)	0.02(1.2)
t-test, p-value	0.418	0.470	0.125

Figures in parenthesis are standard deviations.

4.6.4 Dietary diversity

Household dietary diversity assessment was carried out using twelve food groups as stipulated by FAO (2008). The minimum amount for any food group to be considered eaten was 10g per household. The households were categorized as shown in Table 4.19. Most households had the conventional three meals per day with only 16% taking less than three meals per day.

Table 4.19: Household food consumption and Dietary diversity

Number of food groups	*Diversity category*	*%(N=199)*
<4 food groups	low	2.0
4-<6 food groups	medium	31.2
≥6 food groups	high	66.8
Mean HDDS	6.2 (SD=0.9)	
Number of meals per day		
3		84.2
2-<3		15.3
1-<2		0.5

The mean HDDS (6.2) of male-headed and female-headed (5.9) households were not significantly different (F=2.556, p=0.112). Likewise, number of meals eaten per day in male-headed and female-headed households was similar at 2.9 (F=0.055, p=0.814). Figure 4.11 shows the 3-day mean HDDS by gender of household head.

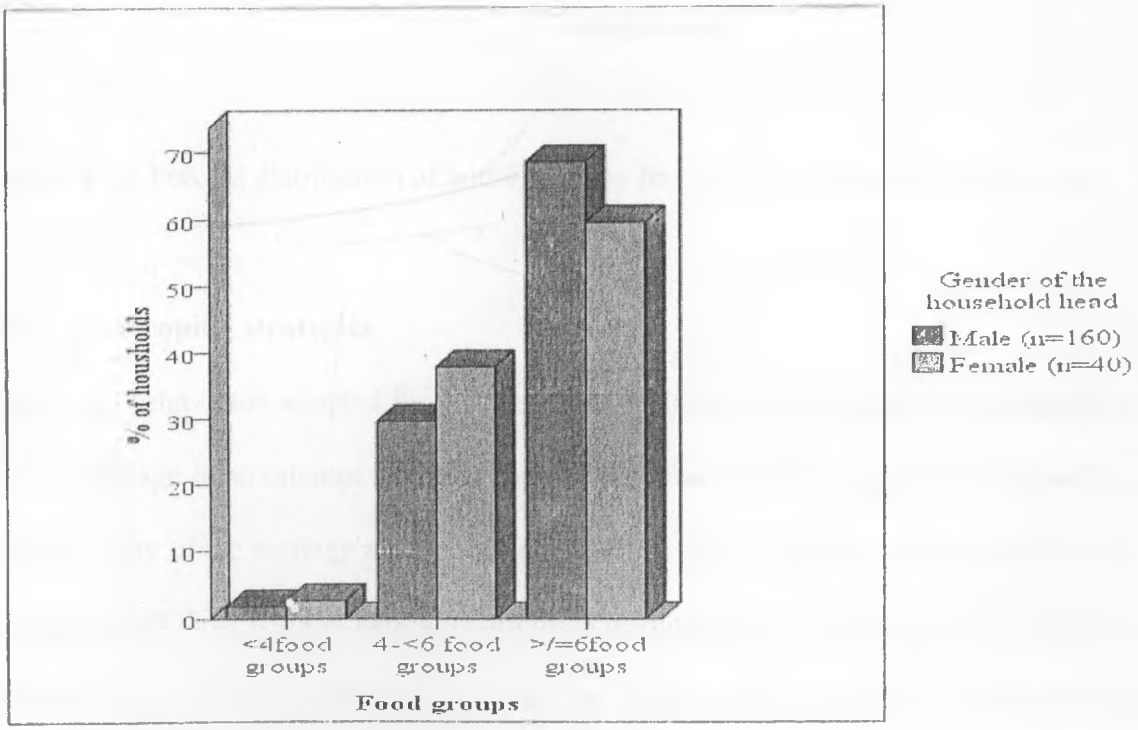


Figure 4.11: Distribution of HDDS among male-headed and female-headed households

Animal protein consumption was very low. Only 24% and 3.4 % of the households consumed meat and eggs respectively. Figure 4.12 shows the percentage of households and food groups consumed over 3 days. Although majority of the households were consuming more than 6 food groups, there was monotony of the food items (i.e. hardly any variation within food groups). Foods frequently consumed were cereals (rice, ugali), pulses (beans), vegetables (cabbage, kales), tubers (potatoes) and tea with sugar.

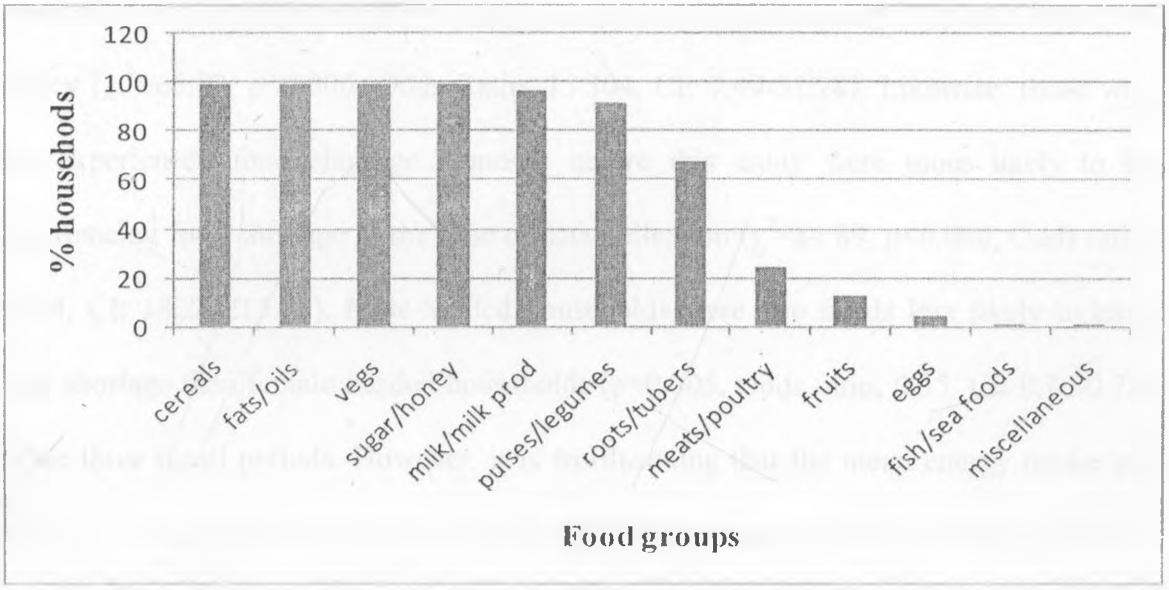
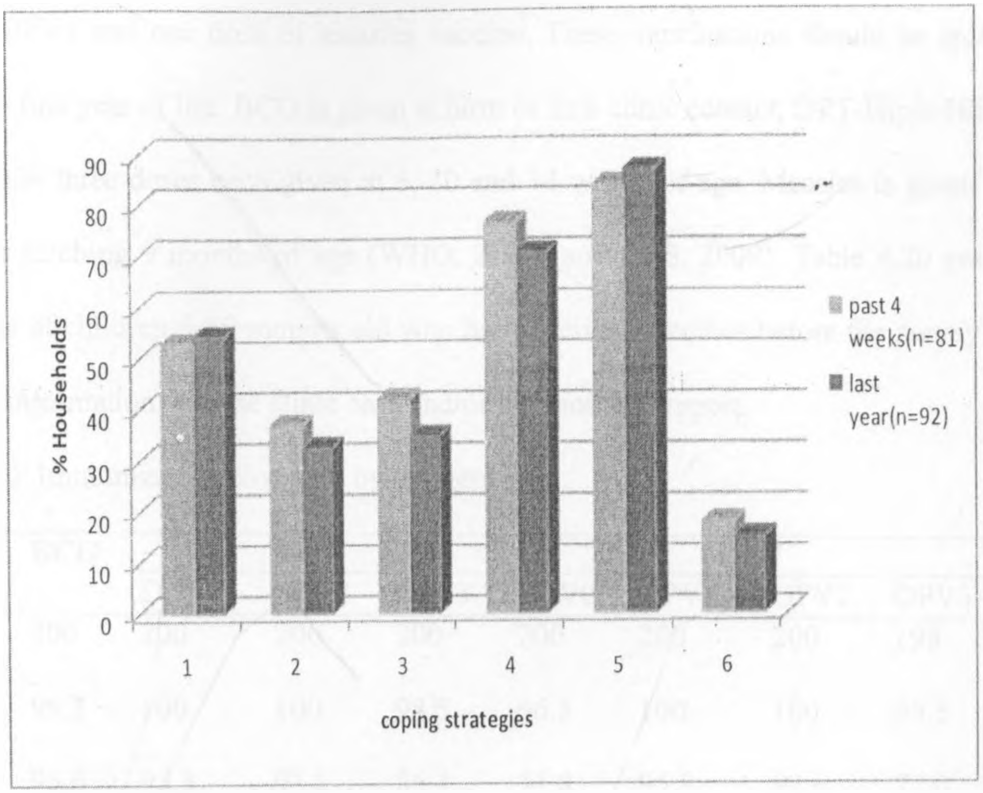


Figure 4.12: Percent distribution of households by food groups consumed in three days.

4.6.5 Food coping strategies

These were behaviours adopted by the household members during and/or in anticipation of food shortage in an attempt to secure food to eat. They had been quantified depending on the severity of the strategy and were used to assess food insecurity at household level. Skipping entire days without eating, restricting consumption by adults in order for small children to eat and borrowing food or relying on help from friends or relatives are

considered as food coping strategy (FCS) or distress mechanisms (FSAU, 2005). FCS for two recall periods; past one year and past one month from time of the survey are shown in Figure 4.13. Majority of the households coped by purchasing food on credit (food seeking to increase the amount available in the short term) followed by limiting portion sizes of meals. However, over half of the population applied distress mechanism of borrowing or relying on help from relatives. Households that experienced food shortage a year before this survey were more likely to experience food shortage a month before the survey (χ^2=65.87, p<0.000, Odds Ratio; 15.304, CI: 7.49-31.28). Likewise, those who had experienced food shortage a month before this study were more likely to be experiencing food shortage at the time of data collection (χ^2=84.89, p<0.000, Odds ratio; 62.64, CI: 18.22-215.38). Male-headed households were two thirds less likely to have food shortage than female headed households (p=0.005, Odds ratio; 0.35, CI: 0.16-0.75) in the three recall periods. However, it is worth noting that the mean energy intake per AE (2737.5 kcal) for those HHs that reported to have experienced food shortage in the past one month was not statistically different from the mean energy intake AE (2887.0 kcal) of HHs that had not experienced food shortage during the same period (p=0.313).



Key: *1. Borrow or relied on help from friends or relatives.*

2. Restricted consumption by adults in order for small children to eat.

3. Skipped entire days without meals.

4. Limited portion sizes at meals.

5. Purchased food on credit.

6. Took children out of school due to lack of food.

Figure 4.13: Food coping strategies employed by households during food shortage.

4.7 Child Health

4.7.1 Immunization

According to the World Health Organisation, a child is considered fully vaccinated if he or she has received a BCG vaccination against tuberculosis; three doses of DPT vaccine to prevent diphtheria, pertussis, and tetanus (or three doses of pentavalent which includes two additional vaccines, Hepatitis B and Himophilus influenza); at least three doses of polio

vaccine (OPV); and one dose of measles vaccine. These vaccinations should be received during the first year of life. BCG is given at birth or first clinic contact, DPT-HipB-Hib and polio require three doses each given at 6, 10 and 14 weeks of age. Measles is given at or soon after reaching 9 months of age (WHO, 2002a and CBS, 2009). Table 4.20 presents percentage of children 6-59 months old who had received vaccines before the survey. The source of information was the clinic card and/or the mother's report.

Table 4.20: Immunization coverage by antigen

Antigen	BCG	DPT			OPV				Measles*	FIC[1]
		DPT 1	DPT2	DPT3	OPV0	OPV1	OPV2	OPV3		
N	200	200	200	200	200	200	200	198	176*	176*
%	99.5	100	100	98.5	96.5	100	100	99.5	93.8	90.3
KDHS 2008	95.6	95.8	93.1	86.4	71.8	95.8	92.6	77.0	85.0	68.3

[1] *Fully Immunized Child is a child who had received all vaccinations against the six childhood preventable diseases by 9 months of age.*
**These are children who had attained age of 9 months at the time of survey and were eligible for measles vaccine.*

Immunization coverage for all antigens was higher compared to national coverage according to Kenya Demographic Health Survey (CBS, 2009).OPV0 coverage was the lowest. Dropout rates (proportion of children who received the first dose of a vaccine but did not go on to get the third dose) for DPT3 and OPV3 was 1.5% and 0.5% respectively. Over 90% of children were fully immunized against all six preventable childhood illnesses.

Deworming against helminthes was very low, with only 40% of children having been dewormed in the three months period prior to the survey. Vitamin A supplementation

coverage (children who had received a dose of vitamin A in the last six months) was 80.4%. Children were supposed to get two doses in a year at 6months interval starting at 6 months of age up to the age of five years.

4.7.2 Mortality

There was no death recorded of a child less than 5 years within three months of recall period and hence mortality rate was 0/10,000/day.

4.7.3 Health seeking behaviour

More than two thirds of the population sought health care at a public health facility. About 19% went to a private clinic for treatment when their children were sick. Table 4.21 shows the different ways in which healthcare was sought.

Table 4.21: Distribution of percent of respondents by health seeking behaviour

Where health was sought	*% (N=127)*
No assistance	6.3
Own medication	8.7
Private	18.9
Public health centre	66.1

χ^2 =119.205, p<0.000

Use of mosquito net was high with 97% of the children having slept under a mosquito net the night before the survey. There was no relationship between febrile illness and use of mosquito net (χ^2, p>0.05).

4.7.4 Access to health facilities

All the assessed households reported to have access to a health facility as shown in Table 4.22. The median time to reach the health facility was 30 minutes with about half of the population perceiving the distance to reach the health facility as near.

Table 4.22: Access to health facilities by respondents

Access to health facility	*% of respondents (N=200)*
Accessed health facility	100.0
Time to health facility	
<15 min	20.5
15-30min	31.5
30-60min	32.5
60+	15.5
Perception of the distance	
Near	51.5
Far	44.5
Not sure	4.0

4.8 Breastfeeding and complementary feeding practices

Households with children 6-24 months were assessed for breastfeeding and complementary feeding practices as shown in Table 4.23. Three quarters of the children aged 6-24 months were breastfeeding at the time of assessment with majority being breastfed on demand as recommended. The rest of the children 6-24 months old were breastfed 3-6 times in 24 hours. Of the children less than two years old who were not breastfeeding at the time of survey, two thirds were stopped from breastfeeding earlier

than the recommended age of two years. Only a third of the non-breastfeeding children had been breastfed for over 18 months.

Over a quarter of the babies below 2 years were introduced (below 6 months) to complementary foods prematurely. Most babies aged 6-24 months were fed complementary foods only 2 or 3 times in a day. Less than 10% of these babies were given complementary foods at least five times a day as recommended by SPHERE (2004) and WHO (2003).

Table 4.23: Feeding practices among children 6-24 months old

Feeding indicator	%
Breastfeeding(n=101)	77.2
Breastfeeding frequency(n=76)	
3-6times	19.7
On demand	80.3
Child age when stopped breastfeeding(n=25)	
<6 months	8.0
6-11 months	16.0
12-18moths	40.0
>18 months	32.0
Never breastfed	4.0
Introduction of complementary foods(n=92)	
0-3 months	6.5
4-5 months	20.7
6 months	56.5
≥7 months	16.3
Complementary feeding besides (6-24 months) breast milk(n=85)	
Once	1.2
2-3times	54.1
4 times	35.3
≥5 times	9.4
Feeding frequency of 25-56 month olds (n=94)	
Once	3.7
2-3times	59.3
4 times	31.5
≥5 times	5.6

There was a correlation between nutritional status (WAZ and HAZ) of children aged 6-24 months and breastfeeding and number of times children were breastfed ($p<0.05$) as shown in Table 4.24.

Table 4.24: Association between feeding practices and nutritional status

Feeding characteristic		Nutritional indices					
		WAZ		HAZ		WHZ	
	n	F	p-value	F	p-value	F	p-value
Whether child was breastfeeding or not	101	6.114	0.015*	3.990	0.045*	3.053	0.084
Number of times child was breastfed in a day	76	3.690	0.059	5.959	0.017*	0.680	0.412
Age when child was stopped breastfeeding	25	2.392	0.085	2.322	0.092	1.933	0.144
Age of introduction of complementary foods	92	0.704	0.731	0.824	0.617	0.718	0.718
Number of times child was given complementary feeds (besides breast milk)	85	0.700	0.650	0.610	0.155	0.892	0.505
No of times child was feed (25-59 month olds)	94	1.171	0.315	1.421	0.247	0.247	0.782

**The mean z-scores are significantly different.*

4.9 Access to water and sanitation

Majority of the population obtained their drinking water from unprotected surface sources like canals, shallow wells and rivers. Table 4.25 shows selected household characteristics on water and sanitation. Only 16% of the population obtained water from safe sources like tap and borehole. Over two thirds of the population did not treat their drinking water. Most of those who treated their water, used chemical (waterguard) treatment followed by boiling. Most households covered their water but only half of the population used containers with narrow neck as recommended by SPHERE (2004).

Table 4.25: Distribution of study households by access to water and sanitation facilities

Water and sanitation characteristic	*% (N=200)*
Protected water source	
Borehole	12.5
Tap	3.5
Unprotected water source	
Shallow well	4.5
River	17.5
Canal	62.0
Use treated water(n=200)	
No	65.0
Water treatment (n=68)	
Boil	35.3
Waterguard	60.3
Decanting	4.4
Storage of drinking water(n=194)	
Covered	93.8
Not covered	6.2
Container with narrow neck	50.5
Container with wide neck	49.5
Time to water source (n=200)	
<15min	81.0
15-<30min	13.5
30-60min	5.5
Access to latrine (n=200)	
Yes	98.0
Latrine within compound (n=200)	
Yes	97.9

Water sources were very near such that the median time to water source was five minutes. This was within SPHERE's recommendation of less than15 minutes to/or from the water source. Majority of the households had access to a latrine/toilet within the compound. Lack of funds, time and space were the reasons given by 2.1% who did not have latrine within the compound. All water and sanitation characteristics summarized in Table 4.25 did not correlate with childhood morbidity experiences ($p>0.05$).

4.10 Hygiene practices

Hygiene was assessed through two practices; how the households handled their solid waste and presence of hand washing facility near a latrine/toilet. Table 4.26 shows hand washing behaviour and solid waste management.

Table 4.26: Hygiene practices

Hand washing facility present	***% of households N=199***
Not present	95.5
Yes with soap	2.5
Yes but no soap	1.5
Yes but no water	0.5
Solid waste disposal	***N=199***
Composite pit	55.8
Throw on the cowshed	21.1
Burn	16.6
Throw on the road	4.5
Throw in the garden	1.5
Bury	0.5

Hand washing practice was poor with only 2.5% of the households having hand washing with soap facility near the toilet/latrine. The main solid waste disposal methods used were composite pit, throwing into cowshed, and burning. Others included throwing into the

road and in the garden. Hand washing and disposal of solid waste practices did not statistically correlate with morbidity experiences (r, $p>0.05$).

4.11 Factors associated with food security and nutritional status.

Selected variables were correlated with dietary diversity and energy intake (Table 4.27).

Table 4.27: Correlation coefficients of selected variables and HDD and Energy intake

	HDDS		*E intake*	
Variable	***Coefficient***	***p-value***	***Coefficient***	***p-value***
Income per day	0.204	0.005**	0.154	0.033*
Income percapita	0.208	0.004**	-0.187	0.009**
Proportion of income spent on food	0.177	0.014*	0.247	0.000**
Income source	-0.232	0.001**	-0.106	0.136
Size of land under rice	0.152	0.078	0.123	0.155
Have 'own land'	-0.230	0.001**	-0.059	0.410
Household grows rice	-0.290	0.000**	-0.920	0.197
Amount of rice produced	0.175	0.067	0.084	0.473
Household size	0.076	0.285	0.475	0.000**
Socio-economic Status	0.183	0.008**	0.049	0.496
Education of household head	0.174	0.014*	0.151	0.033*
Gender of household head	-0.107	0.127	-0.089	0.209
Grow horticulture	0.144	0.055	0.003	0.972
Experiencing food shortage	0.179	0.012*	-0.051	0.475
Source of food	0.146	0.039*	0.105	0.140
Energy AE required in the HH	-0.102	0.153	0.450	0.000**

HDDS= Household Dietary Diversity Score. *Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01level (2-tailed). AE-Adult Equivalent

4.11.1 Income, household size, HDDS, nutrient intake and nutritional status

There was a significant correlation between source of income and total household income. Income from different sources was significantly different ($F=2.518$, $p=0.031$). Salary/wage, business, sales from farm produce and casual labour respectively provided higher household incomes in that order. The higher the income in the household, the higher the proportion of that income was spent on food ($r=0.317$, $p=0.000$). As the income increased, the caloric and protein availability increased at significant levels ($p\leq0.05$) and ($p\leq0.01$) respectively. This indicated that any extra shilling earned was used to purchase more protein sources than energy sources. Also percapita income was positively correlated with energy and protein percapita consumption ($p\leq0.01$). Increase in income was associated with an increase in number of food groups consumed, HDDS ($r^2=0.026$, $p=0.014$). The results showed that increase in HDDS significantly increased total protein percapita ($p\leq0.01$) and energy percapita ($p\leq0.05$) availability. There was a strong relationship between energy and protein intake such that for a unit increase in energy consumed, protein increased by 0.9 units ($p\leq0.05$). There was no direct significant relationship between income and nutrition status ($p>0.05$).

As expected, when the household size increased, the proportion of income spent on food for the household increased ($p\leq0.01$) but the energy and protein consumption per person decreased ($p\leq0.01$). Thus larger households were more food insecure than smaller households. Most variables did not have significant regression relationship with energy intake as shown in Table 4.29. This implied that it was difficult to predict food security situation with such factors in MTIS.

4.11.2 Gender of household head, education, and nutrition status.

There was no significant relationship ($p>0.05$) between gender of the household head, his/her education level and nutrition status of the children when confounding factors like age, sex and morbidity of the child, energy and protein consumed in the household were controlled (Table 4.28). Education of the household head was positively correlated with dietary diversity, energy and protein intake ($p\leq0.05$) as shown in Table 4.27. According to perceptions to food security, the odds of food shortage in male-headed households was 0.35 times the odds of food shortage in female-headed households i.e. female-headed households were more likely to experience food shortage than male-headed households. There was no relationship between gender of the household head and dietary diversity score, protein and energy intake ($p\leq0.05$).

4.11.3 Morbidity, water, sanitation and nutrition status

A child who had fallen ill in the last 14 days prior to the survey was more likely to be wasted than a well child [Odds Ratio (OR); 1.75, CI: 0.46-6.70]. Water treatment was not associated with diarrhea ($p=0.745$), however there was OR of 1.13 of getting diarrhoea for drinking untreated water. There was no relationship between malaria in underfives and use of mosquito net. Sanitation practices did not have significant association with childhood illnesses ($p>0.05$).

Table 4.28: Correlation coefficients of selected variables and nutrition status

	WHZ		*HAZ*		*WAZ*	
Variable	***Coeff.***	***p-value***	***Coeff.***	***p-value***	***Coeff.***	***p-value***
Income per day	0.016	0.825	-0.074	0.309	0.034	0.637
Income percapita	-0.051	0.482	-0.059	0.417	-0.030	0.683
Income source	-0.112	0.119	-0.139	0.051	-.0112	0.119
Child was breastfeeding	0.184	0.009**	-0.190	0.008**	0.072	0.315
Have 'own land'	-0.086	0.226	-0.205	0.004**	-0.169	0.017*
Household grows rice	-0.072	-0.312	-0.197	0.006**	-0.123	0.085
Amount of rice produced	0.160	0.093	0.019	0.093	0.118	0.219
Household size	0.081	0.256	0.005	0.944	-0.047	0.515
Socio-economic Status	-0.001	0.984	0.043	0.544	0.040	0.577
Education of household head	-0.046	0.518	0.096	0.182	-0.006	0.937
Gender of household head	0.013	0.860	-0.076	0.292	-0.95	0.185
Morbidity	0.059	0.408	0.038	0.599	-0.013	0.850
Experiencing food shortage	-0.111	0.123	-0.019	0.796	0.030	0.679
Source of food	0.061	0.396	0.051	0.480	0.085	0.233
Actual AE consumed in HH	0.142	0.046*	0.064	0.372	0.141	0.048*
Kcal consumed in the HH	0.142	0.046*	0.064	0.374	0.141	0.048*

**Correlation is significant at the 0.05 level (2-tailed).*

*** Correlation is significant at the 0.01level (2-tailed).*

AE-Adult Equivalent HH-Household.

Table 4.29: Regression coefficients on selected variables

Variable	***Beta Coefficients***	*t*	*p-value*
3-day average HDDS	0.070	0.799	0.426
Rice produced(bags)	0.025	0.288	0.774
Household income per day	0.003	0.028	0.978
Income spent on food per day	0.032	0.350	0.728
Gender of the household head	0.125	1.467	0.146
AE required in the household	-0.822	-3.177	0.002**
Total protein AE required in HH	0.193	0.752	0.454
Socio-economic score	-0.067	-0.772	0.442
Education of household head	0.066	0.712	0.478

*Regression coefficient significant at 0.01level. Dependent variable: Energy intake per adult equivalent

CHAPTER 5: DISCUSSION

This study assessed the household food security and nutritional status of children 6-59 months old. Nutritional status is considered as an outcome of immediate, underlying and basic causes (UNICEF, 1990). Household food security is influenced by many factors, mostly but not always, poverty and intra-household characteristics.

5.1 Demography

The size of the household in MTIS (4.5) is close to national average for rural areas of 4.7 (CBS 2004). However, it is higher than the average household size in Kirinyaga South district which was given as 3.5 in the preliminary CBS, 2009 report on population and housing census. Large household size affects negatively the nutrient adequacy and consequently the nutritional status of children. The large household size in MTIS compared to the national average thus subjects the households to higher nutrient and other needs.

The sex ratio (men: women, 1:1.1) of the study population is similar to the national trend where women are more than men. Half of the population is below 15 years and the mean age is 18 years. This youthful age structure is typical of populations with high fertility and high mortality (CBS, 2004). When dependent population outweighs productive population, provision of adequate nutrition is compromised.

5.2 Socio-economic characteristics

In this study, socio-economic status has been assessed using production of selected food crops, percapita income, source of income, proportion of income spent on food and housing characteristics.

The fact that majority of the population in MTIS live below percapita income of one dollar a day implies that they do not have adequate capacity to access adequate food. This is also aggravated by seasonality since their livelihood mainly relies on casual labour and farm produce that follows the rice production cycle (August-December). This means that they are not able to access adequate food to sustain healthy lives at all times.

The results on the positive correlation of income and proportion of the income spent on food agree with Angel's law for low income households. This indicates that any extra income earned would be used to acquire food. When food is enough, the proportion of income spent on food starts to decrease. Also, lack of a direct relationship between income and nutritional status agrees with the findings of Mwadime (1996), Haddad et al (2003) and Mariara et al (2008).This is so because nutritional status is influenced by many factors as indicated in the UNICEF's conceptual framework of causes of malnutrition. Findings in this study show a potential of improving nutritional status if income is increased substantially. This is supported by the fact that increasing income also increases the number of food groups consumed, HDDS ($p<0.05$), which is used as a proxy measure of nutrient adequacy of the diet (FAO, 2008). Furthermore, households with increased income are more likely to buy protein foods than energy foods, an indication that households access a quality diet including animal protein when income is increased (Joanne et al, 2001). The

probable reason why income is not associated with nutritional status in this study is that the household income increment is too low to have significant impact on nutrient adequacy of individuals. Again it is possible that the income is spent on accessing other assets and health care leaving too little for diet improvement. Studies have shown that the relationship between socio-economic status and DDS may be affected by the number of food groups used (Kennedy, 2009). Unlike the usual scenario, proportion of income spent on food in the study population increases as the income increases. Expectation is that the proportion of income spent on food decrease as income increases. However, this appears not to happen when the income is too low such that any extra shilling earned is still used to access food.

5.2.1 Education

School attendance decreases as the years in school increase. Most of the population completed primary education but were not able to proceed to secondary school due lack of money. The net attendance ratio for primary and secondary schools is similar to Kenyan national situation where the ratio decreases as years of education increases. For instance in 2008, the national net secondary enrolment rate was 24.2 per cent, indicating that 75.8 per cent of all children of secondary school age were not in school (CBS, 2009). Men tend to complete higher levels of education than women. In MTIS, resources and priorities are not in favour for further education after secondary education.

5.3 Nutritional status of children

Nutritional status of children below five years of age is an outcome of immediate, underlying and basic causes of malnutrition (UNICEF, 1990). The analyses of nutritional status in this study is according to the new WHO 2006 standards and therefore should be utilized with care when comparing with reports that have used earlier growth standards.

The underweight prevalence which is indicative of both chronic and acute malnutrition is lower than previous KDHS reports. Stunting is the outcome of failure to receive adequate nutrition over an extended period and is also affected by recurrent or chronic illness. Although stunting is lower than the national prevalence, it is evident that there has been inadequate caloric availability in the households. Thus by inference this implies inadequate nutrient intake by the children for a long period. In this population, increasing age in children is a risk factor for stunting. Also low deworming coverage (40%) is an indication of infestation by helminthes that deprive the children of the nutrients consumed. Generally the high incidence of childhood illnesses is likely to impact negatively on long term nutritional status of under fives.

The probable reason why acute malnutrition is high at 6-11 months of age is increased nutrient demand and inappropriate introduction of complementary feeds which is evident in MTIS. Also, diarrheal diseases are highest at this age and hence acute weight loss (Boot and Cairncross, 1993 and WHO, 1997, 2002b). The wasting experienced in the fifth year is attributed to inappropriate and inadequate feeding as evidenced by feeding frequency of 2-3 times in a day instead of the recommended five or more times in a day (WHO, 2003).

5.4 Food coping strategies

Through the coping strategies, the households are able to seek food to eat almost to match those households that do not have food shortage. The majority of households employ the least severe food coping strategies first (e.g. purchasing food on credit and limiting portion sizes at meals) before the most severe coping mechanisms like taking children out of school and restricting adults from eating in order for small children to eat. In this population, adult buffering where mothers or other adults eat less so that children can have food to eat is employed. This agrees with the findings of Maxwell et al. (1999), Kruger et al. (2008) and Wendy et al. (2001). This likely explains why nutritional status of children from food secure households (those with adequate energy percapita intake) and food insecure households (those with inadequate energy percapita intake) is not statistically different ($p>0.05$).

5.5 Household food consumption

The fact that households have enough food in the store does not mean they will consume adequately. Other economic pressures alter consumption patterns in an attempt to mitigate anticipated future food shortages. Despite MTIS households having enough food (energy) in store to last to the next harvest, majority still perceive that that cannot last till next harvest. This anxiety of future food shortage (i.e. in October and November just before subsequent rice harvest as expressed in both male and female FGDs) is the reason why households temporarily consume inadequate food despite having enough to last to next harvest so as to cushion the severity of food insecurity in short term. This agrees with the findings of Wendy et al., 2001. Again, the same food is also the source of household income for other needs like school fees,

shelter, and clothing in many of the households hence it has to be shared between consumption and other household needs leaving very little for consumption.

5.6 Dietary diversity

The results indicate that most households in MTIS consume a medium to highly diversified diet. However, consuming a medium to highly diversified diet in MTIS does not necessarily translate into adequate nutrient intake and improved nutritional status. This disagrees with the findings of FSAU of 2005 in Somalia where households consuming above four food groups, are likely to meet their dietary requirements. This is probably because the amount of foods consumed in MTIS are too small and do not contribute significantly to dietary adequacy, albeit being diversified. The monotony of diet variety (food items as opposed to food groups) witnessed in this population may lead to inadequate nutrient balance that negatively affects nutritional status (Kennedy, 2009). Dietary diversity is also known to change with seasons depending on seasonal availability of foods as described by FAO (2008). This study was between July and August, five months after harvest and five months to the next harvest. Observing the anxiety expressed by MTIS households over future food shortage, it is unlikely that this dietary diversity will not be maintained for long.

5.7 Infant and young child feeding (IYCF) and health

Sub-optimal feeding practices witnessed in all key areas of high priority action as recommended by WHO (2003) have contributed to poor nutritional status. The number of times a child is breastfed in a day and also the number of times a child is complementary fed are significantly related to stunting. Immunization coverage is generally high compared to national coverage (CBS, 2009). However, the low

coverage of OPV0 is likely to be due to home deliveries causing infants to miss the first polio dose given at birth. Although water is accessible in less than 15 minutes either way as recommended by SPHERE (2004), it is unsafe and that coupled with poor hygiene practices are responsible for high diarrhoea incidences as suggested by WHO (1997).

5.8 Factors associated with food security and nutritional status

There is no individual measure that captures all dimensions of food security and a suite of indicators are needed to cover the different dimensions of food security. Factors assessed in this study are analyzed in the context of Figure 3.3. Food security is mainly but not absolutely dependent on agricultural production which is a factor of available income. When agricultural production is adequate, households have adequate food to eat and sell for cash which consequently enable them to access health care and hence become healthier to work. However, there is no direct relationship between the amount of food a country produces and the number of hungry people living in that country (Parrott and Marsden, 2002). This concurs with the fact that about 60% of the households in MTIS continued to consume less calories inspite of having enough food to last for 7 months. In MTIS, the rice produced is used for food and cash (MoA, 2008). Majority of the households sell more than half of their produce by the fifth month leaving them food insecure. This agrees with many studies cited by Benjelloun (2003) on impact of agricultural projects on level, form and timing of household income and nutritional status. Household income affects household food security through economic ability to procure and/or produce food. Higher incomes are associated with diversified diets and better health care and consequently better nutritional status (Katz et al., 2001). Household size affects

dietary adequacy where larger households are more food insecure than smaller households (Mariara et al., 2008). Also large households are prone to crowding. Environment and sanitation practices are associated with disease incidences which in turn affect nutritional status (WHO, 2002b).

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The general objective of this study was to assess household food security and nutritional status of children aged 6-59 months and the associated factors in a monocropping scheme of Mwea-Tebere. It is concluded that;

The populations in monocropping schemes comprise large households with individuals living below a per capita income of less than a dollar a day, their main source of livelihood being rice farming. The returns from rice farming are not enough to support their well-being. While their food production appears adequate to meet their energy and protein needs, it is not enough to meet both their income and food needs. Hence, the majority of the households in these schemes have inadequate energy intake.

Although this community consumes different food groups, this does not necessarily translate into adequate nutrient intake particularly energy. Further still, high energy and protein availability in monocropping households does not result in improved nutritional status.

The households use less severe food coping strategies to seek food during food shortage. Households consume less even when there is enough for consumption when they perceive that they don't have enough food or when they are anticipating food shortage in future. Therefore, global acute malnutrition in these communities is at alert level while underweight and stunting prevalence are high with chronic malnutrition at serious levels.

The morbidity experience is high especially diarrhoea during the first and third years of life but mortality rate is low. There is high usage of unsafe water resulting in diarrhoea incidences among children.

There was no relationship between nutritional status and other indicators of food security e.g. food situation at household level due to other confounding factors. Therefore nutrient intake from the three day food record is a good proxy measure of household food security.

6.2 Recommendations

Agricultural projects should integrate nutrition component during planning to develop focused interventions to improve nutrition, health and food security of mono cropping farmers of MTIS and other mono cropping agricultural projects.

Factors interplaying between economic ability to access food and actual dietary intake need to be explored in MTIS e.g. income expenditure priorities and intra-household factors of nutrient acquisition, nutrition education are essential to address malnutrition.

A multisectoral approach that addresses household dynamics, health and nutrition and sanitation issues at community level should be used to accelerate reduction in malnutrition.

REFERENCES

Benjelloun, S. (2003). Human nutrition in developing world: From old to new issues. Rabat, Morocco. Available at http://www1.unihamburg.de/Globale_Zukunft/ausarbeitungen/benjelloun.htm [Accessed 13/05/2010].

Boot, M .T. and Cairncross, S. (1993). Action speaks. The Hague, Netherlands, IRC International Water and Sanitation Centre and London School of Hygiene and Tropical Medicine.

Bruijnzeels, M.A., Foets, M., Wouden, J.C. van der., Prins, A., and Heuvel, W.J.A. van den (1998). Measuring morbidity of children in the community: a comparison of interview and diary data. *International Journal of Epidemiology; 27:96-100.*

Central Bureau of Statistics (CBS) [Kenya] (2004). Ministry of health (MOH) [Kenya] and ORC Macro. *Kenya Demographic and Health survey 2003*. Calverton, Maryland: CBS, MOH, and ORC Macro.

Central Bureau of Statistics (CBS) [Kenya] (2009). Ministry of health (MOH) [Kenya] and ORC Macro. *Kenya Demographic and Health survey 2008*. [Preliminary Report]. Calverton, Maryland: CBS, MOH, and ORC Macro.

Central Bureau of Statistics (CBS) [Kenya] (2010). Ministry of Planning and Vision 2030. National population and housing census. CBS, Kenya.

Coates, J., Swindale, A., and Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). Washington, D.C. Food and Nutrition Technical Assistance Project, Academy for Educational Development. Available at http://www.foodsec.org/tr/nut/hfias.pdf. [Accessed 9/05/2009].

Coates, J., Webb, P. and Houser, R. (2003). Measuring food insecurity: Going beyond indicators of income and anthropometry. Washington D.C. FANTA, AED.

EPZ (2005). Grain production in Kenya. EPZ, Nairobi, Kenya. pp 7.

FANTA (2006). Developing and validating simple indicators of dietary quality and energy intake of infants and young children in developing countries: summary of findings from analysis of 10 data sets. Working group on infant and young child feeding indicators. Food And Nutrition Technical Assistance (FANTA) project, Academy for Educational Development (AED), Washington, D.C.,

FAO (1990). Conducting small scale nutrition surveys. A field manual. Nutrition in Agriculture. Rome, Italy

FAO (2006). Baseline survey report. Protecting and improving household food security and nutrition in HIV/AIDS affected areas in Manica and Sofala Province, Maputo,Mozambique. FAO, Rome.

FAO (2008). Guidelines for measuring household and individual dietary diversity, version 4. Nutrition and consumer protection division. Food and Agricultural Organization (FAO). Rome, Italy.

FAO (2009). The 2009 hunger report. Rome, Italy. Available at http://www.fao.org/ [Accessed 12/05/2010].

Fisher, A.A, Lang, J.E, Stoeckel, J.E., Townsend, J.W. (1991). Handbook for family planning operations research design. 2nd ed. The Population Council, New York.

FSAU (2005). Nutrition. A guide to data collection, analysis, interpretation and use. FSAU, Nairobi.

Gibson, R.S. (2005). Principles of nutrition assessment. 2nd ed. Oxford University Press, New York.

GOK (2008). Launch of 2007 MDGs status report in Kenya. KICC, Nairobi, Kenya.

Government of Kenya (2002).Ministry of Planning and Development [Kenya]. Kirinyaga District Development Plan 2002-08: Management for Sustainable Economic Growth and Poverty Reduction. Nairobi, Kenya.

Haddad, L., Alderman, H., Appleton, S., Song, L., Yohannes, Y. (2003), "Reducing child undernutrition: How far does income growth take us?" *World Bank Economic Review*; ***17(1):*** *107-31* [Accessed 03/05/2010].

Haidar, J., Kogi-Makau (2009). Gender differences in the household-headship and nutritional status of pre-school children. *East African Medical Journal; 86(2): 69-73.*

Hatloy, A., Hallund, J., Diarra, MM. & Oshaug A. (2000). Food variety, socioeconomic status and nutritional status in urban and rural areas in Koutiala (Mali). *Public Health Nutrition;* 3:57- 65.

Heyer, J. (1990). Poverty and food deprivation in Kenya's small-holder agricultural areas. In: J. Dreze and S. Amartya (eds). The political economy of hunger. Clarendon Press. Oxford.

Hiddinnott, J. and Yohannes, Y. (2002). Dietary Diversity as a food security indicator: FCND discussion Papper No 136. International Food Policy Research Institute. Washington D.C. USA.

IRRI (2009). Kenya doing badly in rice production. International Rice Research Institute (IRRI). Available at http://beta.irri.org/news/index.php/rice-news/kenya-doing-poorly-in-rice-production.html [Accessed on 8/08/2010].

Katz, J., West, K.P., Jr., Pradhan, E.K., LeCerq, S.C., Shakya, T.R., Khatry, S.K., and Shrestha, S.R. (2001). Impact of providing a small income on women's nutritional status and household food expenditures in rural Nepal. *Food and Nutrition Bulletin;* **22 (*1*):** *13-18*

KFSSG (2008). Long rain assessment report. Kenya Food Security Steering Group. Ministry of Agriculture. Nairobi, Kenya.

Kennedy, G. L. (2009). Evaluation of dietary diversity scores for assessment of micronutrient intake and food security in developing countries. PhD Thesis Wageningen University, Wageningen, Netherlands.

Kigutha, H.N. (1994). Household food security and nutritional status of vulnerable groups in Kenya: a seasonal study among low income smallholder rural households. PhD Thesis, Wageningen University. Grafisch Bedrijf Ponsen & Looijen BV Wageningen.

Kruger R., Schönfeldt, H.C. and Owen, J.H. (2008). Food coping strategy index applied to a community of farm-worker households in South Africa. *Food and Nutrition Bulletin; **29(1):** 3-14.*

Mariara, J.K., Ndegwa, G.K., Mwabu, D.K. (2008). Determinants of Children's Nutritional Status in Kenya: Evidence from Demographic and Health Surveys. *Journal of African Economies; **18(3):** 363-387.*

Mati, M.B. (2009). System of Rice Intensification (SRI): Growing more with less water: Promoting the adoption of SRI in Kenya. IMAWESA, Kenya.

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

Maxwell, D., Ahiadeke, C., Levin, C., Armar-Klemesu, M., Zakariah, S.,and Lamptey, G.M. (1999). Alternative food security indicators: revisiting the frequency and severity of "coping strategies". *Food policy; 24: 411-29.*

Maxwell, S. and Frankenberger, R.T. (1992). Household food security: Concepts, Indicators Measurements. A technical review. UNICEF and IFAD. New York.

MoA (2008). National rice development strategy (2008-2018). Ministry of Agriculture, Kenya.

MOH (2007). Kenya Expanded Programme on Immunization (KEPI) country targets. Ministry of Health, Kenya.

Mwadime, R.K., Omwega, A.M., Kielmann, N. and Korte, R. (1996). Predictors of nutritional status among participants in a rice irrigation scheme in Kenya. *Ecology of Food Nutrition*; **45**:21-25 http://www.ncbi.nlm.nih.gov/pubmed/12348369. [Accessed 2/05/2009].

Ngare, D.K. and Mutunga, J.N. (1999). Prevalence of malnutrition in Kenya: *East AfricanMedical Journal: 76(7):376-80.* http://www.ncbi.nlm.nih.gov/sites/entrez. [Accessed 4/5/2009].

NIB (2008). Annual Report and Accounts (2007-08). National Irrigation Board, Kenya.

Niemeijer, R., Geuns, M., Kliest, T., Ogonda, V., and Hoorweg, J. (1988). Nutrition Aspects of Rice Cultivation in Nyanza Province, Kenya. Leiden, Netherlands. Available at https://openaccess.leidenuniv.nl/bitstream/1887/9372/1/ASC_1253933_122.pdf [Accessed 12/05/2010].

Okech, B.A., Mwobobia, I.K., Kamau, A., Muiruri, S., Mutiso, N. (2008). Use of Integrated Malaria Management Reduces Malaria in Kenya. Landon Myer, University of Cape Town, South Africa. Available at http://www.taxpayeraccess or http://adsplos.org/adclick.php? [Accessed 12/05/2010].

Parrott, N. and Marsden, T. (2002). The real green revolution: Organic and agroecological farming in the South. Green Peace Environment Trust. London, UK. Available at www.greenpeace.org.uk/trust [Accessed on 13/05/2010].

Sphere (2004). Humanitarian Charter and Minimum Standards in Disaster Response. The Sphere Project. Geneva, Switzerland.

Swindale, A, and Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development.

U N (2009). Millenium development report. UN, New York.

UNICEF (1990). Strategy for improved nutrition of children and women in developing countries: a UNICEF policy review (1990-91). UNICEF, New York.

UNICEF (1998). A situation analysis: children and women in Kenya. UNICEF, Nairobi, Kenya

UNICEF (2006). State of the World's Children. UNICEF, New York.

Walela, B. (2010). Personal communication with Head, Food Crop sub-division. Ministry of Agriculture, Kenya.

Wanjogu R.K, and Mugambi, G. (2001). Improvement of rice production in eastern and southern Africa region through research. Proceedings of a workshop on rice research in Kenya, Malawi, Zambia and Tanzania, KATC, Moshi, Tanzania. *African Journal of Agricultural Research, 3 (9): 605-611.* Available at http://www.academicjournals.org/AJAR

Wanjohi, L. (1978). Report on the nutrition status of the Mwea-Tebere Irrigation Scheme community. Nyeri Provincial Headquarters, Kenya.

Wendot, H. (2010). Personal communication with Scheme Manager, Mwea-Tebere Rice Irrigation Scheme, Kenya.

Wendy, S.,Wolfe and Frongillo, E.A.(2001). Building household food security measurement tools from the ground up. *Food and Nutrition Bulletin; 22: 5-12.*

WHO (1995). Physical Status: The use and Interpretation of Anthropometry. Report of WHO Expert Committee No. 854. Technical Report Series. World Health Organization, Geneva.

WHO (1997). Health and environment in sustainable development: 5years after the summit. Geneva, World Health Organization (WHO/EHG/97.8).

WHO (2002a). State of the world's vaccines and immunization. Geneva,WHO (WHO/V&B/02.21).

WHO (2002b). Improving child health in the community. Geneva, World Health Organization (WHO/FCH/CAH/02.12).

WHO (2003). Global strategy for infant and Younng Child Feeding. WHO. Switzerland, Geneva. [Accessed 03/05/2010].

WHO (2006). Multicentre Growth Reference Study Group. WHO child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva. Available at www.who.int/en [Accessed 13/ 05/2010].

APPENDICES

Appendix i: Energy scale

The following scale was used to calculate energy Consumer Units/Adult Equivalents

Calorie Adult Equivalents

Males	>14yrs = 1.0 CU ⟶	(2900 kcal)
Females	> 11yrs and Boys 11-14yrs = 0.90 CU	
Children	7-10yrs = 0.75 CU	
Children	4-6yrs = 0.4 CU	
Children	<4yrs = 0.15 CU	

Source: Gibson, 2005, pg 35

Nominal adult male value 2900kcal/day for moderately active person (Schmi, 1993) was used to calculate AE available for the household.

Appendix ii: Protein scale

The total protein consumed in the household was divided by 52g (protein required for adult male per day: 0.8g/kg/day for an adult male of 65kgs) to get Adult Equivalent available for the household.

To get AE required for the household, the following scale according to Schmi (1993) was used.

Age		Adult Equivalents	
Male adult		>18yrs	= 0.90
Boys		16->18yrs	= 1.08
		14-<16yrs	= 1.0 ⟶ (52g/day)
		12-<14yrs	= 0.83
Children Boys		10-<12yrs	= 0.65
		7-<10yrs	= 0.52
		5-<7yrs	= 0.40
Female adult		**>18yrs**	**= 0.79**
Girls		16->18yrs	= 1.81
		14-<16yrs	= 0.88
		12-<14yrs	= 0.85
Children (Boys & Girls)		10-<12yrs	= 0.69
		7-<10yrs	= 0.52
		5-<7yrs	= 0.40
		3-<5yrs	= 0.34
		2->3yrs	= 0.30
		1yr	= 0.26

Source: Sehmi, 1993

Appendix iii: Field assistants training program

Day 1				
Time	**Objective**	**subject**	**Learning method**	**Learning aids**
8.00-8.30	Climate setting and introduction	Participants and facilitators introduce themselves	A story	Pictures of Malnourished children
8.30-9.00	Purpose and objectives of the study	Problem statement Purpose of study Specific objectives	Lecture, discussion Question &Answers	Power point, flip charts, handouts
9.00-10.00	Expected outputs of the survey	Anthropometric and Non anthropometric data	Lecture, discussion, demonstration Question &Answers(Q&A)	Power point, flip chart, pictures,handouts
10.00-10.30	**B**	**R**	**E**	**A**	**K**
10.30-11.00	Study ethics	Seeking consent from respondent Personal behavior	Lecture, Question &Answers	Power point, flip chart, pictures,handouts
11.00-12.00	Interpret and administer the questionnaire	Demonstrate how to ask the questions Observation as data collection method	Lecture, Q&A,discussion, demonstration	Power point, flip chart, pictures,handouts
12.00-1.00	Measuring and recording weight, height,length,MUAC	Standardizing tools Positioning the child on height/length board, scale Reading measurements	Lecture, demonstration Q&A	Power point, flip chart, pictures,handouts
1.00-2.00	**L**	**U**	**N**	**C**	**H**
2.00-3.00	Undertake a 24hr recall	Framing the questions Describing the dishes for HH and child Measuring the volumes of dishes and ingredients used	Lecture Demonstration Discussions Q&A	Power point, flip chart, pictures,handouts
3.00-4.00	Interpretation and familiarizing with the questionnaire	Study the questions Interpreting questions	Discussion among peers	
Day 2				
8.00-9.00	Role play	What is a role play Purpose Perform role play	Lecture, demo, Teachback, role play	Power point, flip charts pictures,handouts
9.00-9.30	Using a checklist	Using inventory of equipments	Demonstration	
10.00-4.00	Pretesting questionnaire	Asking questions, recording, identify any modification to be made	Practice and record in the questionnaire.	Sample of filled Questionnaire
4.00-5.00	Feedback	Modify questionnaire, print and photocopy.		

Appendix iv: Map of the study site

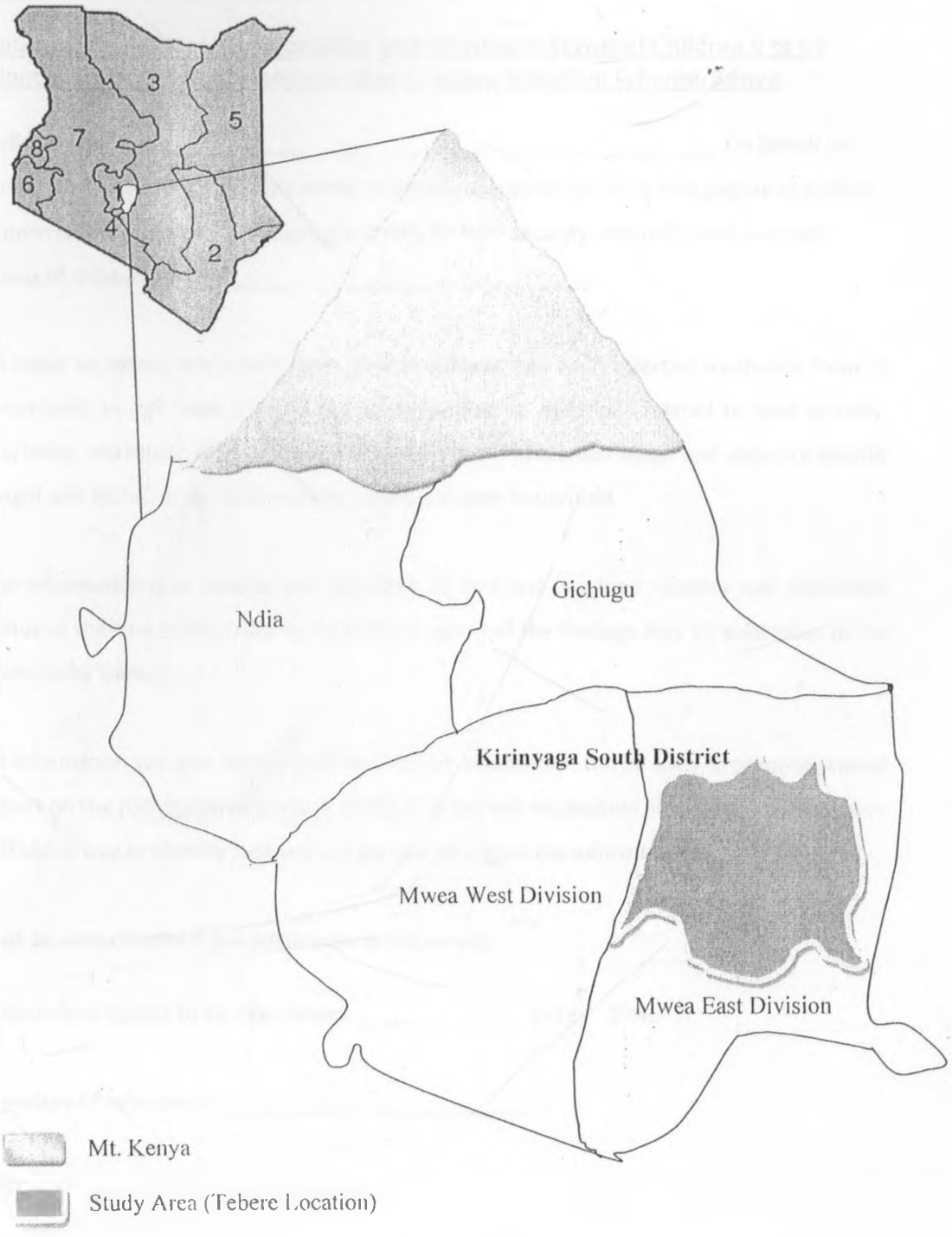


Figure 5.0 : Map of Kenya, abstracted Kirinyaga South district and the study site (Tebere location)

Questionnaire No.

Household No.

Appendix v: Consent Form

Household Food security, morbidity and Nutritional Status of Children 6 to 59 Months and associated factors in Mwea-Tebere Irrigation Scheme, Kenya.

Hello. My name is _____. On behalf of James Njiru, currently a student at the University of Nairobi pursuing Msc degree in Applied Human Nutrition, we are conducting a survey on food security, morbidity and nutrition status of children in _____.

In order to collect this information, your household has been selected by chance from all households in this area. I would like to ask you some questions related to food security, morbidity and health of children in your household. Thereafter, weigh and measure length/ height and MUAC of the 6-59 months children in your household.

The information you provide will be useful to find out the food security and nutritional status of children in this community and the report of the findings may be submitted to the community leaders.

All information you give will be confidential. The information will be used to prepare general report on the population as a whole in this area but will not include any specific name. There will be no way to identify that you are the one who gave the information.

I will be very grateful if you participate in this survey.

Respondent agreed to be interviewed _____ 1=Yes 2=No

Signature of interviewer_____

Date_____

Questionnaire No_____

Household No_____

Appendix vi: Survey questionnaire

Household Food Security, morbidity, nutritional Status of Children 6 to 59 Months and associated factors in Mwea-Tebere Irrigation Scheme- Kenya

Household No: _____ Team No: _____ Cluster No: _____ Sub-location: _____ Village: _____

Date: _____ Name of respondent: _____ Name of interviewer: _____

SECTION I: HOUSEHOLD CHARACTERISTICS

Q1. Kindly let me know the names of the people who have been living in this household in the last 3 months

Serial no.	Name	Age (to nearest Yr)	Sex	Marital status	RHHH	Education Level (In years)	Occup	Contri to HH	(If 6-17Yrs)Currently in sch 1=Yes(What class) 2=No,(Why) (see codes)	
									Yes/no	class/why no
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										

Codes

Sex
1. Male
2. Female

Marital status
1. Married
2. Divorced
3. Separate
4. widowed
5. Single
6. N/applicable

Relationship to H/head
1. Household head
2. Wife
3. Son
4.Daughter
5. Grandchild
6.parent
7. Aunt
8. Uncle
9. Brother
10. Sister
11. In-laws
12. Employees

Occupation
1. Farmer
2. Housewife
3.Unemployed[1]
4.Student/pupil
5.Small-scale trader
6.Businessmen
7.Casual laborers
8. Employed[2]
9. Boda Boda
10.Shamber boy
11. House girl

Contrib to HH
1. Nothing
2. Money
3. Labour
4. Childcare
5.Less than 18yrs

Education
1. Completed i
2. Completed 5-8
3.Attending Pri
4=Attending sec
5=Completedsec
6=college
7=university
8=Preschool
9=never

Currently not in sch(6-17yrs)
1.Lack sch fees
2.child labor
3. refused schooling
4.Others(Specify)

Currentl in sch(6-17Yrs)
1.Class 1-4
2.Class5-8
3.Form 1-4
4. Others(Specify)

[1]Anyone above 18 and not in college or employed
[2] For both adults and for children below 18years who are employed

Questionnaire No

Household No.

SECTION II: FOOD AVAILABILITY

No	Question	Response	Go to
2	In order of importance, what is the source of food for the entire household? Order: 1 | 2 | 3 | 4 | 5 | 6 | 7 code:	1= Purchase 2= Produce from farm 3= Purchase and produce from farm 4= Food aid 5= Others(specify).....	4
3	What type(s) of produce did you produce last season?(Fill the table below)		4

	Type produced	Amt produced (HH units)		Amt consumed (HH units)		Amt sold (HH units)		Amt donated (HH units)		Amt remaining in store(HHunits)		Enough to last to next season?		Codes
		Amt	Unit	Amt	Unit	Amt	Unit	Amt	Unit	Amt	Unit	1=Yes, 2=No		1=kgs 2=kasuku 3=Gorogoro 4=Debe 5=Sack(90kgs)
1														
2														
3														
4														

4	Did you ever experienced food shortage in the **past 4 weeks?**	1=Yes **If yes, how often*?** 1=Rare 2=Sometimes 3=Often 2= No 3= Don't Know		5
5	How did your household cope with the food shortage to ensure that that there was food to eat? **(use coping strategies in Q7)**	1=Yes **If yes, how often*?** 1=Rare 2=Sometimes 3=Often 2= No 3= Don't Know **a=( ) b=( ) c=( ) d=( ) e=( ) f=( ) g=( )**		6
6	Did you ever experienced food shortage in the **past one year?**	During the **past** year(2008)	**Now (2009)**	7
7	How did your household cope with the food shortage to ensure that that there was food to eat?	1= Yes 2=No(*skip to 2009)*		
	a) Borrow food, or rely on help from friends or relatives	1= Yes 2=No	1= Yes 2=No	
	b) Restrict consumption by adults in order for small children to eat	1=Yes 2=No	1=Yes 2=No	
	c) Skip entire days without eating	1= Yes 2=No	1= Yes 2=No	
	d) Limit portion size at meals	1= Yes 2=No	1= Yes 2=No	
	e)Purchase food on credit	1= Yes 2=No	1= Yes 2=No	
	f) Take children out of school	1= Yes 2=No	1= Yes 2=No	
	g) Others(specify).....			
8	Where would you place your household? 1 =food secure 2 = Food insecure 3=Halfway 4 = Don't know			

* 1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks

Questionnaire No

Household No.

SECTION III: SOCIO-ECONOMIC STATUS

No	Question	Response	Go to
9	Do own the house you live in?	1=Self –owned 2=Rented 3=Inherited4=Others.....	
10	How many rooms are available for the household?	Number	
11	How many people live in this household?	Number	
12	Is the house permanent or temporary?	1= Permanent[1] 2= Temporary[2] 3=Semi-permanent[3]	
13	What is the type of the roofing material?	1= corrugated iron sheet 2=Thatched 3=Tiles 4=Asbestos 5=Others.....	
14	What is the type of the **wall** material?	1=Mud 2=Wood 3=Mud and Handcore stones 4=Stones and cement 5=Bricks 6=Iron sheets	
15	What is the type of the **floor** material?	1=Earthen 2=Wood/ballast 3=Cement finished4=Others(specify).....	
16	In order of importance, what is your main source of fuel/energy for cooking?	1=Wood 2=Charcoal 3=Gas 4=electricity 5=Kerosene 6=Others(specify)_____	
17	In order of importance, what is your main source of fuel/energy for lighting?	1=Wood 2=Charcoal 3=Gas 4=electricity 5=kerosene 6=Tin & wink 7=Others(specify)_____	
18(a)	Do you own land?	1=Yes 2=No----------	17

Order	1	2	3	4	5	6
Code						

Order	1	2	3	4	5	6
Code						

19(b) What is the size of the land and the amount of produce last season?

Type of land owned	Size (acres)	Land under rice		Land under maize		Land under other cereals		Land under horticulture		Land under legumes(beans,pes		Land under others		Idle land
		Size (acres)	Prod(hh units	Size (acres)	Prod(hh units)	Size (Acres)	Prod (hhunits)	Size (acres)	Prodn (hhunits	Size (acres)	Prod (hhunits)	Size (acres)	Prodn (hhunits)	
Own														
Rented														
Public														
Total														

[1]*Stone/bricks sand and cement* [2]*Mud* [3]*Wood/iron sheet with cemented floor*

Questionnaire No

Household No.

SECTION IV: INCOME AND EXPENDITURE

No	Question	Response
20	What are the main sources of income for this household(rank in order of importance) Order | 1 | 2 | 3 | 4 | 5 Code | | | | |	1=Sale of farm produce 2= Salaried/wage employment 3=Business 4=Casual labour 5=Remitance 6. Destitute (gifts/begging)
21	How much is the household income?	KSH per day_____ KSH per month_____
22	How much does your household spend on food?	KSH_____per day KSH_____per month

SECTION IV: WATER, SANITATION, HYGIENE AND HEALTH FACILITIES

Q23. What is your main source of drinking water? 1=Tap 2=Borehole 3=shallow well 4=River 5= Canal 6=Others (specify)_____

Q24. Do you treat your drinking water?_____1=Yes 2=No If Yes, how (Specify) 1=Boil 2=WaterGurd/Chlorination 3=Decant 4=Others(Specify)

Q25. How do you store drinking water 1=covered 2=Not covered

Q26. What is the type of your water storage container? 1=With narrow neck 1=With wide neck

Q27. How far is the water source in _____ Km _____minutes (to reach) _____

Q28. (Observe) Access to usable sanitation facility (toilet or latrine)? 1= Yes 2=No

Q29. Is the toilet/latrine within the compound? 1=Yes 2=No **If No, go to next Q30**

Q30. If No, Why? 1=No space to build one 2=Lack of funds 3=Others(specify)_____

Q31. Is there a hand washing facility with soap near the toilet? 1=Yes with soap 2=No 3=Yes but No soap 4=Yes but no water 5=Yes but no water and soap

Q32. How do you dispose solid waste? 1=Burry 2=composite pit 3= throw in the road 4=throw in cowshed 5=Others_____

Q33. Do you have access to health facilities? 1= Yes 2=No

Q34. How far is the nearest health facility? _____Km _____minutes(walking)

Q35. Is the distance far or near for you? _____ 1=Near 2.=Far 3=Not sure 4=Others(Specify)_____

Questionnaire No.

Household No.

SECTION V: CHILD FEEDING AND IMMUNIZATION

Q36-43. Feeding of children aged 0 – 59 months in the household.

First Name	Q36 Date of birth (If child above 23.99 months, skip to Q 42) (Born after 1/7/2007)	Q37(If0-23.99 months)Areyou breastfeeding[3] the child? *(If no, skip to Q 39)1=Yes 2= No*	Q38 (If 0-23.99 months) If breast feeding, how many times/day? *1=2 times or less 2=3-6 3=On demand*	Q39 (If 0-23.99 months) If not breast feeding, how old was the child when you stopped breast-feeding? *1= less than 6 months 2=6-11 months 3=12 – 18 months 4=≥18 months 5= Never breastfed*	Q40 (If 0-23.99 months At what age was child given water/ foods other than breast milk? *1=0-3 months 2=4-5 months 3=6 months 4=7 months or more.*	Q41 (If 0-23.99 months) How many times do you feed the child in a day *(besides breast milk)*? *1= 1-4 times 2= 5 or more times*	Q42 (If 6- 59 months) How many times do you feed the child in a day *1= 1-4 times 2= 5 or more times*	Q 43 Has child been provided with Vitamin A in the last 6 months? *(Ask for clinic card) 1=Yes 2= No*
1								
2								
3								

Q44- Q49 Immunization status of children 0-59 months old.

Serial no	Name of child	Q44 BCG at Birth 1=Yes 2=No	Q45 DPT 1=Yes 2=No			Q46 OPV (Oral polio vaccine) 1=Yes 2=No				Q47. Measles 1=Yes 2=No	Q48 Fully Immunized 1=Yes 2=No	Q49 Dewormed Last 3 months 1=Yes 2=No
			DPT 1	DPT 2	DPT3	OPV 0	OPV1	OPV2	OPV3			
1												
2												
3												

[3]*Child having received breast milk either directly from the mothers or wet nurse breast within the last 12 hours*

Questionnaire No.

Household No.

SECTION VI: ANTTHROPOMETRY AND MORBIDITY

Q50-60 Anthropometry for children aged 6 – 59 months or (65 – 109.9cm) in the household

Child's First Name	Q50 Child Sex *1=Male 2=Female*	Q51 Birth-date (dd/mm/yy)	Q52 Age (months)	Q53 Weight (kg)			Q54 Height (cm)			Q55 Oedema *1=yes 2= No*	Q56 MUAC (cm)			Q57 W/H Z- Score	Q58 W/A Z- Score	Q59 H/A Z- Score	Q60 MUAC Z- Score
				1st	2nd	Ave	1st	2nd	Ave		1st	2nd	Ave				
1																	
2																	
3																	

Q61-67 Morbidity for children aged 6 – 59 months or (65 – 109.9cm) in the household

First Name *Follow same order as per table above*	Q61. Has the child experienced or shown any sign of illness within the last 14 days/2 weeks **(if no skip to Q 67)** *1= Yes 2= No*	Q62 Serious ARI[4] in the last two weeks *1=Yes 2= No*	Q 63 Febrile illness/ suspected Malaria[5] in the last two weeks *1=Yes 2= No*	Q64 Diarrhoea* In the last two weeks 1=Yes 2=No	Q65 (If ≥9 month) Suspected Measles[6] in last one month *1=Yes 2= No*	Q66 Others infections 1=Skin 2=Eye 3=Ear 4=Injuries	Q67 Did child sleep under a mosquito net last night? *1=Yes 2= No*	Q68 Where did you seek healthcare assistance when child was sick? (If yes in any ***Q55 – 98)*** *1=No assistance sought 2=Own medication 3=Traditional healer 4=Private clinic/ Pharmacy 5= Public health facility*
1								
2								
3								

[4] *ARI asked using the three signs : cough, rapid breathing and fever*
[5] *Suspected malaria/acute febrile* illness: - the three signs to be looked for are periodic chills/shivering, fever, sweating and sometimes a coma
[6] *Measles : a child with more than three of these signs– fever and, skin rash, runny nose or red eyes, and/or mouth infection, or chest infection*
* *diarrhoea, more than 3 loose stools per in a day*

Questionnaire No.

Household No.

SECTION VII: DIETARY INTAKE

3-day Household Dietary Diversity

Q69 Three day recall for food consumption in the household

The interviewer should establish whether the previous 3 days and nights were usual or normal for the households.
If unusual e.g. feasts, funerals or most members absent, then another day should be selected.

Food group consumed: What foods groups did members of the household consume in the past 3-days (from this time yesterday to now)? Include any snacks consumed	Did a member of your household consume food from any these food groups in the last 3 days? *1=Yes* *0= No*		
Type of food	Today	Yesterday	Before yesterday
1. Cereals and cereal products *(e.g.maize, spaghetti, rice, bread)*?			
2. Milk and milk products *(e.g. goat/cow fermented milk, milk powder)?*			
3. Sugar and honey?			
4. Oils/fats *(e.g. cooking fat or oil, coconut milk ,butter, ghee, margarine)?*			
5. Meat, poultry, offal *(e.g. goat, beef; chicken or their products)?*			
6. Pulses/legumes, nuts *(e.g. beans, lentils, green grams, cowpeas; peanut,)*?			
7. Roots and tubers *(e.g. sweet potatoes, , cassava, arrowroot Irish potatoes)?*			
8. Vegetables *(e.g. green or leafy vegetables, tomatoes, carrots, onions)?*			
9. Fruits *(e.g. water melons, mangoes, grapes, bananas, lemon)*?			
10. Eggs?			
11. Fish and sea foods *(e.g. fried/boiled/roasted fish, lobsters)?*			
12. Miscellaneous *(e.g. spices, chocolates, sweets, beverages, etc)?*			
Q70 Total number of food groups consumed in the household:_____			

Q71 How many meals [7] has the household had per day in the last three days (from this time yesterday to now)?
A) Today [1 2 3] B) Yesterday [1 2 3] C) Day Before Yesterday [1 2 3]

[7] *A meal refers to food served and eaten at one time (excluding snacks) and includes one of the three commonly known: - breakfast, lunch and supper/dinner*

Questionnaire No.	Household No

Q72 3-day household food record. **The interviewer should establish whether the previous 3 days and nights were usual or normal for the households.**
If unusual e.g. feasts, funerals or most members absent, then another day should be selected. The interviewer should establish how much food came into the household in each of the 3-days, how much was cooked and how much is remaining.

Day	Time	Family mbrs consuming the food (use code) Indicate AGE	Amt of food obtained for cooking	Amt remaining after cooking (HH measures)	Description of food and method of cooking(one line per food)	Amt served	Amt of waste	LABORATORY USE ONLY		
								Amt of food consumed	Intake per "person" [a]	Food code
DAY 1										
DAY 2										

Codes: Mother(M) Age( ), Father(F) Age( ), Son[(S1 Age( ) , S2 Age( ), S3 Age( )], Daughter[(D1 Age( ), D2 Age( ), D3) Age( )],
Male Visitor[(MV1 Age( ), MV2 Age( )], Female Visitor[(FV1 Age( ), FV2 Age( )], Mother Pregnant(MP) Age( ), Female Visitor Pregnant(FVP) Age( )

TIME: 1=Before breakfast 2=Breakfast 3=Btn Breakfast and lunch 4=Lunch 5=Btn lunch and super 6=Super 7=After super

S/No	Time	Family mbrs consuming food(use code)	Amt of food obtained for cooking	Amt remaining after cooking (HH measures)	Description of food and method of cooking(one line per food)	Amt served	Amt of waste	LABORATORY USE ONLY		
								Amt of food consumed	Intake per "person" [a]	Food code
DAY 3										
Meals eaten outside the home. Describe foods and cooking methods. Estimate weights										
DAY 1										
DAY 2										
DAY 3										

Cluster No

SECTION VIII: MORTALITY FOR 0-59 MONTHS

Q73. MORTALITY FORM (one sheet/cluster)

HH No.	Total people in HH	Total under 5 in HH	No. of births since START DATE	Join HH Total	Join HH under 5	Leave HH Total	Leave HH under 5	Total deaths since START DATE	No. < 5 deaths since START DATE
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									

Appendix vii: FGD guide

1. What do you understand by food security in this community?
2. What is the food security situation in this community?
3. What are the major causes of food insecurity in this community?
4. How would you rate this community in terms food security status?
5. In your opinion, how can food security situation be improved in this community?
6. How do you feed a newborn infant? What about feeding a baby who is 6months and above?
7. What are the environmental problems in this community? [Probe on water, toilets, sanitation]
8. What are the common human diseases in this community? What health services are available here? Do you have access to these health services?
9. How can this community address these problems?
10. What is the state of a poor and a rich household in this community?
11. What NGOs work in this area? What services do they provide?
12. Finally, what are the priority problems facing this community