HOUSEHOLD FOOD SECURITY AND DIETARY MICRONUTRIENT INTAKE AMONG MOTHERS IN MWEA WEST SUB COUNTY, KIRINYAGA COUNTY, KENYA

BY

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DECLARATION

This thesis is my original work, and to the best of my knowledge, has not been presented for a degree in any other university.

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To my husband Eng. David W. Mugambi, our children Agnes and Bill, Willy and Sally, Alex , Jimmy and Grace and our grandchildren, Tumaini, Siana, Gambi, Nula, Ania, Ella and late Angelique and Juliana .

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ABBREVIATIONS & ACRONYMS

ACC/SCN	Administration Committee on Coordination/ Standing Committee on Nutrition.
AWSC	African Women Studies Centre
ALRMP	Arid Lands and Resource Management Project
CBO	Community Based Organization
CDF	Constituency Development Fund
DDP	District Development Plan
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization
FEWSNET	Famine Early Warning Systems Network
FSAU	Food Security Analysis Unit.
GoK	Government of Kenya
HFSSM	Household Food Security Survey Model
ICRW	International Centre for Research on Women
IFPRI	International Food Policy Research Institute
IPC	Integrated Food Security Phase Classification
1USD	One United State Dollar
IZINCG	International Zinc Nutrition Consultative Group
KU- CFSVA	Kenya urban comprehensive food security and vulnerability analysis and nutrition assessment.
KFSG	Kenya Food Security Steering Group

MDG	Millennium Development Goals
MOH	Ministry of Health
NCHS	National Centre for Health Statistics
NGOS	Non-Government Organizations
RDA	Recommended Dietary Allowance
S&L	Sight and Life
SCF-UK	Save the Children Fund- United Kingdom
USDA	the United States Department of Agriculture
USAID	United State Agency for International Development
UNICEF	United Nations Children's Fund
WFP	World Food Program
WHO	World Health Organization.
WI	Winlock International

OPERATIONAL DEFINITIONS OF TERMS

For the purpose of this study, the following terminologies have been used frequently in reference to the study objectives.

Care: This is an activity performed by a woman for other members of the household including cooking and , serving food, washing clothes , feeding small children , washing dishes, and taking sick children to the hospital , (Pieters, 2013).

Food security: Refers to having enough food for the members of the household .It includes nutrition security, that is, provision of adequate variety of foods with all required nutrients to meet all human nutritional needs (ICRW, 2005).

Chronic or permanent household food insecurity:

Refers to long term lack of adequate food resulting to macro and micronutrient deficiencies.

Household food stability:

Refers to the ability to obtain food all the time so that household members can eat whenever they feel like and without feeling anxious that they may not have enough in future.

Household: Refers to Family unit including a mother and at least one child aged 2-5 years old.

Household head:

Refers to the male or female who makes household decisions regarding utilization of resources. In this study married women have their husbands as household heads.

Food access and consumption behaviors:

Refers to the strategies used by mothers to cope when own food runs out and there is no money to purchase food at the prevailing market prices

Food access: Refers to getting own food personally grown using own labor and other resources or purchasing from the market using money earned as salaries or wages or doing business

Dry season: Refers to Period between January and March whereby the study area is dry. Crops planted during the short rains (October to December are expected to be ready and available for harvesting and use by the households.

Wet season: Refers to Period between April to June whereby the study area gets rain. It is lean season and members of the households are busy planting and weeding in the farms.

Female headed households:

Refers to households where the woman respondent is single, separated, divorced or widowed.

ABSTRACT

Household food security has been the subject of many studies, majority of them focusing on members of the household other than women. The purpose of this study was to investigate household's food security status and dietary micronutrient intake. It targeted mothers. The study was carried out in dry and wet seasons in Kangai and Mutithi locations of Mwea West Sub County, Kenya. Data were collected on socio demographics/ economics characteristics of the mothers as well as their food access and consumption behaviors, dietary intake of Vitamin A, iron, and zinc and risk factors for micronutrients utilization. The study design was cross sectional survey while data collecting instruments included a structured questionnaire and a meal preparation observation guide. Sampling techniques included probability proportionate to population and random walk and quarter to select the respondents. Data were coded, edited and analyzed using SPSS software. The findings were presented in tables, bars and pie charts while inferential statistics were used to test hypotheses. Health Canada's, Household Food Security Survey Model (HFSSM) was used to compute food security status; Food Consumption Score tool was used to compute acceptable , borderline and poor categories of dietary intake of micronutrients and National Nutrient Data base for Standard Reference, Release 26 Software v.1.4, to compute nutrient content in foods. The food access and consumption behaviors and the dietary intake of micronutrients were found to be significantly different in the two locations ($p < 0.05$). An analysis of foods prepared indicated that Kangai mothers had less deficit (iron -3.9 mg, zinc -1.8mg) than Mutithi ones (iron – 9.5mg, zinc -4.1 mg). On the whole, mothers did not meet the recommended dietary allowances (RDA) for Vitamin A, iron and zinc, while food consumption score (FCS) tool showed that 33% (from Kangai) and 51% (from Mutithi) were categorized with poor dietary micronutrient intake . The study showed a significant difference in exposure to factors that impact on micronutrient utilization, between the two locations ($p < 0.05$). The conclusion was that mothers from Kangai had better socio economic status, were less food insecure, and had better dietary micro nutrient intake than the Mutithi ones, but were more exposed to risk factors for micronutrient utilization. The study concluded that 55% of Mutithi mothers were severely food insecure while 21% of Kangai ones were in similar category. On the whole, 39% of the study mothers were food secure, 21% were moderately insecure, while 40% were severely food insecure. The study concluded that mothers in the two studied locations experience chronic food insecurity and hence recommended interventions for the 40% of severely food insecure mothers through provision of clean drinking water, and facilitation with irrigation water to increase food production.

CHAPTER ONE: INTORUDCTION TO THE STUDY

1.0 Introduction

This chapter gives:- background to the study; problem statement and justification of the study; purpose of the study; objectives of the study; the study hypotheses; significance of the study; study limitation; study assumptions and conceptual framework.

1.1 Concept of Household Food Security Status and Micronutrient Intake

The 1996 World Food Summit in Rome defined food security as a state 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 and healthy life (FAO 2010). Household food security is the application of this concept to the family level with individuals within the household as the focus of concern. On the other hand , household food insecurity exists when household members (children , women, men) do not have adequate physical, social or economic access to sufficient , safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2011). Household food insecurity includes deficiencies of both macro (carbohydrates, proteins, fat) and micro nutrients (Vitamins and mineral salts) (Dickson, 2008).

Food security can be considered at various levels including global, regional, national, household and individual (FAO, 2011; Pelletier et al., 2000). At global level, food security concerns the availability of food in the whole world, of which 850 million people are food insecure (FAO, 2008a). At regional level, food security concerns food availability in developed and developing countries. Eight hundred (800) million people in developing countries are food insecure; up to

180 million food insecure people are in Sub Sahara Africa and 60% of these are in East Africa (FAO, 2002).

At national level, food security means food availability and this results from the balance of importing food and producing it within the country. At household level food security concerns the availability and access to food by the household, which results from the household's farm production, economic ability to purchase food and the availability of the commodities in the market. At individual level, food security/insecurity concerns the consumption of food and its utilization by the body. This is facilitated by availability of the food, its access by the household and distribution within the household members (Andersen, 2009).

An individual is food secure when she or he has enough, safe and nutritious food for physiological utilization. This implies that in addition to food access, there are other factors to consider like safe drinking water, primary health care and environmental hygiene, to minimize gastro-intestinal infections that can negate the benefits of a nutritious diet (Andersen 2009). Food is a fundamental need in that each individual must have access to the necessary nutrients (both macro and micro nutrients) to survive and to participate actively in society.

Household food insecurity refers to a household's having limited and uncertain availability of food, or limited and uncertain ability to acquire acceptable foods in socially acceptable ways, as a result of inadequate financial resources (Skalicky et al., 2006). It results to hunger which currently renders 870 million people undernourished worldwide due to lack of sufficient food, out of which forty million are from Africa (FAO, 2010; FAO, 2008a).

1.1.1 Household Food Security Status in Kenya

According to African Women's Studies Centre (AWSC, 2014), 7.1 million Kenyans (18 per cent of the population) are chronically food insecure and that they are always hungry. The food insecure people may be the poor in the communities, including urban poor, pastoralist in drought prone zones and the resource poor households, that are, landless and unemployed .These people have been described as the most vulnerable to food insecurity because they have low purchasing power, and hence they have limitation in accessing food (GoK, 2005). Another category of the poor are the women. Studies have found that the proportion of female headed households, that have been ranked very poor, is normally higher than male headed households (Sharkey et al 2011; AWSC, 2014). Women have been considered as one of the food insecure vulnerable groups (Mbithi, 2000; FAO, 2014).

1.1.2 Micronutrient Intake among Women

Globally, food insecurity is associated with low micronutrient intake and an estimated 4.5 million people worldwide are affected by inadequate micronutrient intake. Of the 4.5 million, the most vulnerable groups are women (WHO, 2012; Dickinson, 2008). Inadequate intake of micronutrients, especially Vitamin A, iron and zinc affect many women of reproductive age and are associated with adverse health effects (Black, 2008; Dickson, 2008).

Many people in developing countries including Kenya suffer from inadequate intake of micronutrients, especially Vitamin A, iron, and zinc. As a result, they are vulnerable to illnesses, fatigue, blindness, and memory loss. Going by the definition of food security (AWSC, 2014; FAO, 2010), adequate intake of micronutrients is important for people at all times to lead

an active healthy life. However, research shows that inadequate intakes of these trace elements are common among women (Onyango, 2001; Dickson, 2008; Black, 2008).

1.2 Problem Statement and Study Justification

In rural areas, women are ever busy and are the ones involved in household food production including tilling the land, planting, weeding, and harvesting. They also feed and milk the livestock. In addition, they gather the food to be cooked, collect fire wood, fetch water, cook and distribute the food to household members. Other responsibilities for women include are washing clothes, feeding children, washing dishes and caring for older persons in the community.

According to Kenya Gender Country Profile, (2007), 40% of small rural farms are managed by women. They manage the farms for their families for free. In addition, they carry out all the household tasks, most of which are gender categorized, and are only done by women. The women do more than their share of household and farm work, yet their own food security and micronutrient intake, and often those of their daughters, are neglected at household level, where discriminatory socio and cultural norms prevail. Women serve the household members without complaining while they do not get their share of food intake. When households do not have enough food, men and boys are served first and women and girls eat whatever remains (WFP, 2009). As a result, it has been reported that 60% of women are undernourished worldwide (WFP, 2009). However, limited studies have been done, in a poor rural community to assess women's food security status and dietary micronutrient intake.

Women in rural areas have very heavy workloads. They have to work on the farm to ensure food security, care for children and the sick members of the family. Their workload is made heavier by inadequate access to improved water supplies and excessive dependence of wood fuel as a source of domestic energy (Migiro, 2004; Sekitoleko, 2004). All these activities make them work for very many hours, hence requiring energy and quality food to supply micronutrients. However, few studies have been done to highlight women's food security status, hence this study sought to fill that gap by focusing on women in the household as the respondents.

Mwea West, which was the study area, is a poverty pocket in a county that has been found to have low food insecurity (6.1%) by a national study on household food security status (AWSC, 2014). However, the sub county has the largest proportion of poor people in Central Province at 49 % (GOK, 2009). This means that, according to the definition given by the District Development Plan (DDP) of Kirinyaga County, 49 persons in every 100 lived on less than Ksh.1562/- a month per capita. This amount was what was needed for an individual to access basic food and non-food necessities by the time of the study. The sub county's poverty rate was higher than the current 42% national average (AWSC, 2014). It was also higher than, the average for other neighboring sub counties including: Kirinyaga Central, Kirinyaga West and Kirinyaga East which had poverty rate of 32, 33%, and 34% per cent respectively (GOK, 2005). Poverty is the most important cause of household food insecurity (Esturk, et al 2014; Jones, 2013; USAID, 2013; Temitope, 2012; Kakota et al., 2015, AWSC, 2014)). According to Tarasuk, (2001), since food insecurity results from poverty, poor disadvantaged members of the society should be studied with an aim of identifying their vulnerability and arresting the

situations before they become too bad. In addition, other studies, for example, Olson et al 1996: WFP, 2009; 2011), have investigated the food security status of locations on the basis of existing poverty levels. There was need, therefore, for this study focusing on women in Mwea West Sub County for determining food security status among the participants. Furthermore, no other study on household food security status and micronutrient intake has been done in this specific area since national studies are not able to reach all sub counties.

1.3 Purpose of the Study

The purpose of this study was, therefore, to investigate the households' food security status and micronutrient intake among mothers in Mwea West Sub County. The study was expected to identify the vulnerability status of women, representing the household, to food insecurity. It therefore focused on women, the main actors in the household, and assessed their socio demographic and socio economic status, experiences and behaviors when there was inadequate food in the household and their food consumption frequency, especially of micronutrient rich foods. In addition, the study investigated the risk factors that interfered with women's micronutrient utilization in Mwea West Sub County, in Kenya.

1.4 Objectives of the Study

1.4.1 General Objective

The general objective was to study the household's food security status and micronutrient intake among mothers in Mwea West (Kangai and Mutithi locations), Kenya, during the dry /harvesting and wet /planting seasons.

1.4.2 Specific Objectives

The specific objectives of this study were:-

i. To determine mothers socio demographic and socio economic characteristics in Kangai and Mutithi locations of Mwea West Sub County.

ii. To establish mothers food security status in both Kangai and Mutithi locations of Mwea West Sub County, during the dry and wet seasons.

iii. To determine mothers dietary intake micronutrients (Vitamin A, iron and zinc), in Kangai and Mutithi locations of Mwea West Sub County during the dry and wet.

iv. To determine risk factors for micronutrient utilization among mothers in Kangai and Mutithi locations of Mwea West Sub County.

1.5 Null Hypotheses

The study had four null hypotheses:

H_{O1} There is no significant difference in mothers socio demographic and /socio economic characteristics in Kangai and Mutithi locations of Mwea West Sub County.

H_{O2} There is no significant difference in mothers food security status in Kangai and Mutithi locations of Mwea West Sub County, during the dry/ harvesting and wet/ planting seasons.

H_{O3} There is no significant difference in mothers dietary intake of Vitamin A, iron and zinc (micronutrients), in Kangai and Mutithi locations of Mwea west Sub County during the dry/ harvesting and wet/ planting seasons.

H_{O4} There is no significant difference in mothers risk factors for micronutrient utilization, in Kangai and Mutithi locations of Mwea west Sub County.

1.6 Significance of the Study

Mwea West Sub County is in Kirinyaga County, a county that is rated as having low household food insecurity at 6.1% (AWSC, 2014). The sub county also has a high poverty at 49% (GOK, 2005) and according to this study, (using Health Canada HFSSM 2012), 61% of the women studied were food insecure (39 % severely and 22 moderately food insecure).

The results of this study should be useful to the National government especially Ministry of Health, the Constituency Development Fund (CDF) management, and the County Government all of who can direct some of their resources to the area in order to improve the food security situation. Women empowerment would help a lot in handling issues of household food security status and micronutrient intake. The findings may also be useful to churches, other community based organizations (CBOS) as well as non-government organizations (NGOS), whose goals may be to educate and assist poor people (GoK, 2008). Using the findings, the vulnerable households / in the communities can be identified and targeted for both short term and long term interventions.

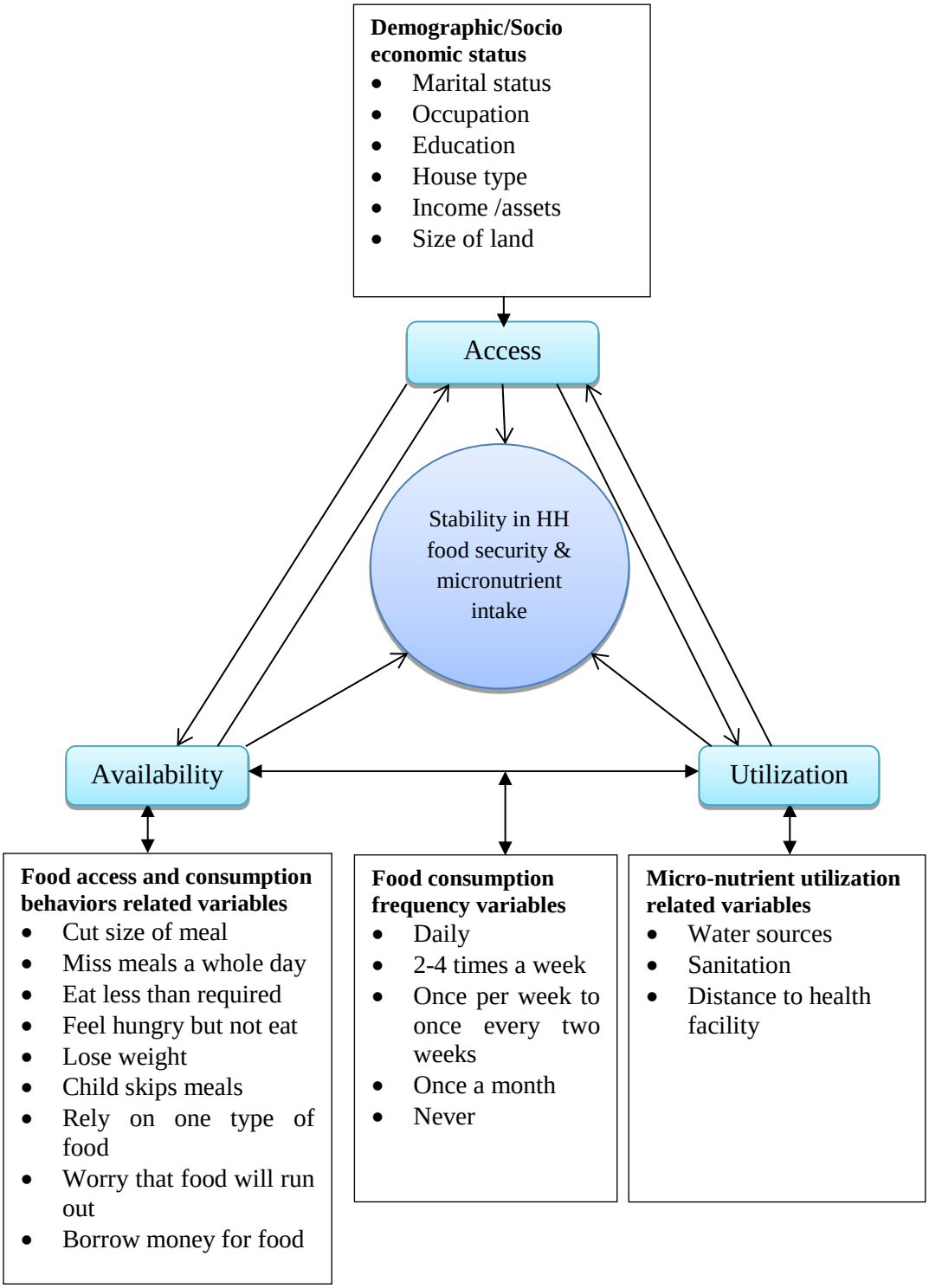
1.7 Limitation of the Study

The study was carried in Mwea West Sub County whose agro/ecological conditions are quite different from other sub counties. In addition, the study targeted mothers in the households who could be having different responsibilities and behaviors from mothers in other sub counties. For this reason, generalization of results from this study should be done with caution.

1.8 Assumption of the Study

The study was done in two locations, Kangai and Mutithi, both growing food crops, but Kangai accessing water for irrigation while Mutithi does not access. Therefore the assumption of the study was that the mothers from Kangai (area with irrigation) were able to access and consume adequate and quality foods including vegetables and fruits from the locality. This means that mothers from the area with irrigation water did not need to travel far to acquire the products when they needed them.

1.9 Conceptual Framework



Source: Adapted from AWSC, (2014) and modified for study suitability

Figure 1-1 Conceptual Framework

1.9.1 The study variables

The conceptual frame work illustrated here has been adapted and modified to be the base for this study and it has independent variables, intervening variables and the dependent variables.

The independent variables

The independent variables include socio demographic and socio economic characteristics of the respondents, the food access and consumption behaviors, the frequency of dietary consumption of micronutrient rich foods, water sources and environmental sanitation.

Socio demographic and socio economic variables

These include:-

- Gender (HH head)
- Marital status
- Occupation
- Education
- House type
- Income /assets

Food access and consumption behavior variables

These include:-

- Cut size of meal
- Miss meals a whole day
- Eat less amount than required
- Feel hungry but not eat
- Lose weight

- Rely on one type of food
- worry that food will run out
- Borrow money for food.

Food consumption frequency variables

These include:-

- Daily
- 2 – 4 times a week
- Once per week to once every two weeks
- Once a month
- Never

Micronutrient utilization risk variables

These include:-

- Water sources
- Sanitation
- Distance to health facility

The intervening variables

- These include the four pillars of household food security which include:-
- Availability, Access, Utilization and stability

Dependent variables

- These include household food security status and micronutrient intake.

1.9.2 Description of the Conceptual Framework

The conceptual framework has the four dimensions (pillars) of household food security and micronutrient intake as well as variables important in the four objectives of the study. According to Pieters et al., (2013), the four dimensions of food security (availability, access, utilization and stability) are interlinked, meaning that food availability is necessary but not sufficient condition for realization of food access. In turn, Pieter et al., (2013) argue that food access is necessary but not sufficient condition for the realization of food utilization. The authors go on to describe the fourth dimension (stability) as the efficient performance of food availability, access and utilization aspects. Hence, the four pillars of household food security and micronutrient intake are shown as a triangle in Figure 1 because all of them have to be present at the same time.

Household Food Availability

Household food availability is described as the amount of food physically available to the household through own production (micro level) or in the area of concern (macro level). Food available to the household can be that which is locally produced, commercially imported or in form of food aid (Pieters et al., 2013; FAO, 2006). Food availability is also described as the extent to which food is within reach of the household, for example, in the house/ farm, local shops and markets. The food must be acceptable, both in term of quantity and quality (Pieters et al., 2013).

Household food availability at the micro level is strongly related to overall availability of food, which is determined by domestic (own) food production, commercial food imports and food aid

(FAO, 2006). Women play an important role in domestic food production. It is estimated that 40% of all small farms are managed by women (Kenya Country Gender profile (2007), in AWSC, 2014). The women are engaged in the production of food crops as well as rearing of livestock (World Bank, 2009). According to Doss, (2011), the share of women labor input in food production has significant impact on the national food availability and positively influences domestic food productivity. On the whole, socio demographic and socio economic (characteristics) variables have impact on household food availability (Figure1: objective 1).

Household Food Access

A household is food secure when it has access to the food needed for a healthy life for all its members (adequate in terms of quality, quantity, safety and culturally acceptability) and when it is not at undue risk of losing such access (Bajagai, 2014). Food access is one of the pillars of food security and refers to the affordability of food. There are two types of food access a) direct access in which a household produces own food using human and other resources such as equipment and materials b) economic access in which a household purchases food grown elsewhere. The assets of a household including income, land, livestock, wages /salaries and gifts can determine a household's access to food. Poverty on the other hand, can limit a household's access to food because , access depends on whether the household has enough income to purchase food at prevailing prices or has sufficient land and other resources to grow its own food. Households with enough resources can overcome unstable harvests and local food shortages and maintain their access to food (FAO, 2012). On the other hand, lack of both direct and economic access results in household's behavioral characteristic such as cutting the size of the meal, missing meals a whole day, eating less than preferred, not eating even when one feels

hungry, skipping meal and relying on one type of food among others (Figure 1, objective 2) . These characteristics, if prolonged, will result in weakening members of the household, making them unable to work and worsening chances of future food access.

Household Food Utilization

Food utilization refers to an individual's dietary intake and his / her ability to absorb nutrients contained in the food eaten. Utilization relates to both quantity and quality of food eaten. The quantity of food eaten is influenced by the frequency of food consumption (Figure 1, objective 3), while quality is influenced by the type of foods consumed. Pieters et al., 2013) argues that food access does not grantee food utilization and that a household may have food access but poor utilization. This is because a household may have money, but may prefer to purchase nonfood materials or food of poor quality food instead of nutritious foods such as animal products, vegetables and fruits. For example a household may sell eggs (high quality protein food) to get money to buy bread (Banerjee and Duflo, 2006).

Food utilization is also affected by many factors including intra household food distribution, care practice, education level of the care giver and health of the environment. Unequal distribution of food within the household might cause some members of the household to eat more and others less. For example, the man of the house may be given food with meat while the woman eats vegetables. Care is also an important consideration in food utilization. The capacity of the caregiver, usually the woman, to meet the needs of different household members, depends on resources available and knowledge of what is appropriate care. The education level of the caregiver is important. Research has found that educated women are able to understand

important issues concerning health, nutrition and hygiene, all of which are important in food utilization. The method used to cook food is also important. Over cooking vegetables may destroy all the water soluble Vitamins, making them unavailable for absorption. Another important factor is that most micronutrients are not stored in the body .For this reason the micronutrient rich foods have to be consumed frequently.

The quality of health environment is also a determinant of food utilization. Good water supply, sanitation, housing condition and waste disposal are all factors that enhance food utilization (Figure 1, objective 4). Another important factor in food utilization is household resources , for example , higher real incomes allow for better access to health services and for improved health environment within the household (Pieters ,2013).

Household Food Stability

Household food security and micronutrient intake can be transitory, seasonal or chronic, and any of these can affect households. At household level transitory food insecurity and low micronutrient intake can result when natural disasters like floods and droughts strike, resulting in crop failure. This may result in decrease of food availability. When these calamities occur rural households become vulnerable to food insecurity because their livelihoods fail to function (Pinstrup, 2009). Other factors that impact household food security and micronutrient intake are civil conflicts, instability in market prices resulting in high food prices, loss of employment or loss of productivity due to illness.

Seasonal household food insecurity results from regular pattern of food growing seasons. Households may not access all their food requirements during some seasons, but normal access and consumption resumes after a while if rain patterns come when expected. In chronic or permanent food insecurity and low micronutrient intake, households are constantly at risk of being unable to access food to meet the needs of all the members.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

In this chapter literature has been reviewed in line to the four objectives of the study including: 1) demographic and socio economic characteristics of the study respondents, 2) household food security status 3) frequency of dietary intake of micronutrient rich foods (Vitamin A, iron and zinc) and 4) risk factors of micronutrient utilization.

2.1 Objective One: Socio Demographic /Socio Economic Characteristics of Women and Household Food Security Status.

Studies have found socio demographic and socio economic characteristics useful in the issue of household food security status (Maxwell, 2013; Segal-Correa, 2008). Some important characteristics include: gender of household head, marital status and age, education, income, housing quality and ownership of livestock, assets and land.

2.1.1. Gender of Household Head, Marital Status and Age

Female headed households with children under 5 years old have been found to be vulnerable to food insecurity. However, some studies have also found female headed households to be more food secure than the male headed households (Bahiigwa, 1999). A recent study done by Kammi et al., (2015) in Nicaragua, found that among cash cropping households in Africa, food availability and dietary energy adequacy were better in female headed households compared to male headed households. This implies that the cash crops empower women who in turn are able to access adequate food for their families.

In relation to household headship , which is usually the man's responsibility in case of married couples, Kennedy and Peters (1992), cited in Kiriti and Tisdell, (2003) , reported that household food security status and micronutrient intake were influenced by interaction and gender of the household head. They reported that in situations where the official household head (man) was away for more than 50 percent of the time, the women took over the headship and controlled a low budget and other resources. In cases like this, the study reported that the nutritional status of the pre scholars was better than in higher income but male headed households. The report concluded that improving women's income and empowering them to control the income is vital in maintaining food security and micronutrient intake in households.

Marital status is considered important in issues of household food security. A married woman may be at an advantage over a single, divorced or widowed woman when it comes to household food security since two are better than one. On the other hand, the age of the respondent is also an important variable. This is because young household heads may not be having their own resources and may be depending on other adults for their livelihoods. In addition, younger household heads, living in rural areas have been found to be more food insecure than the older ones (Kaloi et al., 2005).

Household size is considered a determinant of household food security status. Households with larger dependency ratio tend to be more food insecure (WFP, 2011; Kaloi et al., 2005; Matheson and Mclntyre, 2013). It has been reported that households with large families and many dependents, may not be able to provide sufficient quantity and the right quality of food intake for each member of the family. Studies have found that at certain times of the year family

members may take one meal a day (AWSC, 2014). However, it is also a known fact that large families living in the rural areas contribute to the farming activities and hence in household food production. The joint family effort in labor provision can help to increase food production as long as other resources such as land are available.

2.1.2. Women's Education, Employment and Food Security Status

Women's access to education is a determinant factor in level of access to quality food which has an impact on nutrition and health status for the household members. Studies have revealed that children of mothers who have spent five years in primary school are 40 percent more likely to live beyond the age of five years (FAO, 2011). Also households headed by women who have Kenya Certificate of Education are more food secure than households headed by men at the same level (AWSC, 2014).

Unemployment is an indicator of low household food security and micronutrient intake. It has been found that women's cash earning outside the household is an important source of income (Kiriti- Nganga 2003 as reported in AWSC, 1214). In her study of Nyeri district, Kiriti reported that income earned by women can be used for food expenditure. She further reported that women are known to spend a greater percentage of their income on food than men. In her study, she found that employed women were contributing Ksh 1000- 9000 to the total household income and as is known, most of women's income is used for food purchases. Kiriti's study (2003) concluded that women play a major role in food security, dietary diversity and household's health. But unfortunately, women are more likely to be unemployed than men since

they spend a lot of their time doing unpaid domestic work and caring for children and other household members.

Women are better able to improve their young children ‘nutrition as well as that of their families as whole. However, they often face some constraints in both food production and consumption. The African Women Studies Center (2014; collaborative initiative of ICRW/ IFPRI/ USAID, (2005); supported by Smith et al (2008), report that women do not often own the land they work on. Therefore they lack the authority to decide where, what and when to plant; whether or how to irrigate the land; when to rest the land or to use inputs to improve soil fertility; how to prevent soil erosion to preserve crop nutrients; how much crop to sell and what to do with money obtained after sale of crops (Smith, et al 2008). In addition, women have very heavy workloads. They have to work on the farm to ensure food security, care for children and the sick members of the family. Their workload is made heavier by inadequate access to improved water supplies and excessive dependence of wood fuel as a source of domestic energy. All these factors contribute to food insecurity (Migiro, 2004; Sekitoleko, 2004).

Women are in charge of cooking and serving food to the household members. During periods of food shortage, they have to make adjustments in the intra-household distribution. Research has found that, within the household, food is usually given to small children first followed by the husbands and other male members. The female members eat last and if the food is inadequate, the mother in particular may go without food (WFP, 2005). Nutrition and health status of women may be compromised; they are likely to suffer from malnutrition as a result of not consuming adequate food with the required nutrients.

Women are more vulnerable to individual and household food insecurity (Sharkey et al., 2011).. Rural women are particularly vulnerable to household food insecurity and its consequences. They have unique characteristics such as less education, less chances of employment opportunities while being more likely to be mothers and caring for children (Sharkey et al., 2011). In addition, it is well known fact that women are actively involved in the household food production.

2.1.3. Income, Household Food Security Status and Micronutrient Intake

Low income is associated with food insecurity. Poor communities often have little income to spend on food. They therefore rely on monotonous plant based diet, low in animal products, and women are especially vulnerable, as their incomes are on average lower than men's. Income is commonly used as a socio economic (SES) indicator. However, according to Doocy et al. (2006), income is self-reported. This is likely to create inaccuracies related to reporting biases from: 1) motives to report increased or decreased incomes due to misconception such as the belief that survey responses will qualify respondents for aid; 2) the seasonal nature of incomes from rural area results in an increased likelihood of measurement error when monthly income is reported; 3) rapid inflation may increase the difficulty of estimating income over extended periods of time and result in recall bias ; 4) in traditional poor rural society ,the concept of monthly income is unfamiliar to individuals who live day to day and may not be able to accurately approximate monthly or annual income (Doocy et al, 2006).

2.1.4. House Type, Household Food Security Status and Micronutrient Intake

Housing quality, that is, the quality of material used in a housing structure, is a good proxy indicator of the respondent's wealth (KU- CFSVA, 2010). Measures of housing condition include roofing, flooring, walling materials as well as primary energy source for cooking, household water source and sanitation facilities (Doocy et al., 2006). Poor communities use natural materials like grass for roofing and walling their dwellings while the well-off communities use stones or brick for wall, tiles or corrugated iron sheets for roofing and concrete floors. The wealthy households, as may be indicated by housing quality, are expected to be more food secure than the poor households.

2.1.5. Livestock Ownership, Household Food Security Status and Micronutrient Intake

According to the Government of Kenya (2007), Kenya Integrated Household Survey (KIHS 2005/2006), 66 percent of Kenyan households kept livestock. Majority of the rural households (84%) kept livestock. Large livestock like cows are owned by men but small livestock like chicken, goats and sheep are the property of women. The small livestock especially chicken can be used for high quality proteins in form of eggs and meat and enhance access and consumption of food to the household. Goats and sheep also provide high quality protein foods in pastoralist communities. Presence of cows in a household may indicate availability of milk which is rich in proteins and micronutrient. However, while presence of cows in the family may indicate availability of milk as a food, not all households allow the women to control the milk (AWSC, 2014). In order to reduce food insecurity, Lo Bianco, (2007) recommends that women can be supported in the role of livestock ownership to strengthen their ability to make decisions that can break the poverty cycle.

2.1.6. Asset Ownership, Household Food Security Status and Micronutrient Intake

According to Morris et al., (2000), and Schellenburg et al., (2003), asset ownership is an indicator of socio economic status (SES). Since assets can be sold, a household with many assets can be assumed to have the ability to access adequate food for family members. Household asset ownership is assessed using 19 currently owned household and productive assets including: mosquito net, shoes, pots and pans, kitchen utensils, table, chairs, cupboard , refrigerator, television, radio/tape recorder, bed and mattress, sofa, bicycle, cart, animal drawn plow, agricultural hand tools, metal working machine, and wood working tools (Morris et al., 2000). These assets are the ones commonly included in asset indices used to estimate SES in rural Africa (Doocy et al., 2006).Asset ownership is a proxy of wealth. It is associated with a level of resilience or ability to withstand the impact of a potential shock relating to food security (WFP, 2011). For purpose of providing a comparative tool in studies, an asset wealth has been created by counting the number of different assets owned by each household. Diversity of asset ownership alone cannot be taken as a measure of the entire wealth of the household, but can be considered as a good proxy (WFP, 2011). The index ranges from 0 (no assets) to 19. The standard cuts off points are used to create asset ownership categories (Table 2.1).

Table 2-1 - Asset Ownership Categorization

Category	Number of assets
Asset poor	0 – 4
Asset medium	5-9
Asset rich	≥ 10

Source: WFP, (2011)

2.1.7. Land Ownership, Household Food Security Status and Micronutrient Intake

Land is a very important food production resource. In rural areas, absence of land ownership or access to land commonly means casual labor livelihood and as a consequence, poverty. Poverty is an important basic cause of food insecurity (AWSC 2014). The minimum number of acres of land necessary for subsistence varies from country to country and is determined according to three criteria including the area needed to: a) employ a family b) satisfy a family's nutritional requirements c) produce a basic income. It is expected that once a family is self-employed on the land, it would have a basic income to facilitate access to food and non-food necessities. The World Bank and FAO have recommended adequate household land (in acres) by country as follows: Bangladesh (2), Egypt (3) and Kenya (12), A study done by World Food Program in Northern Rakhine State, Myanmar categorized subsistence farmers as having poor food access if they had <2 acres of land and only medium food access if they had 2 to < 3 acres (WFP, 2011).

A study done in India by Chung et al., (1997) indicated that 40% of the households were food insecure because of landlessness or the lack of good quality land. Quality land is more important than quantity in determining food security status of a family (Chung 1997). Large dry land is not useful unless irrigated. Lack of irrigation water means that farm production is hinged on abundant and timely rainfall. In contrast, access to irrigation means that inferior land could be fairly productive. According to Chung, (1997), households with a modest amount of fertile land or irrigation would be expected to be better off than those with plots which are dry and infertile. There is evidence from other studies, which show that land ownership is linked to

wealth. Very little land or no land at all means lack of economic resources in the rural area, and this amounts to poverty. Poverty is a basic cause of food insecurity (Doocy et al, 2006).

2.2 Objective Two: Household Food Security

Food security exits when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious foods to meet their dietary needs and preferences for an active and health life (FAO, 1996; State of food insecurity, 2001). On the other hand, food insecurity is defined by American Institute as "whenever the availability of nutritionally adequate and safe food or the ability to acquire acceptable foods, in socially acceptable ways is limited" (FAO, 2010).

According to (FAO 2010, and Schmeer, 2015), household food insecurity is a critical public health problem, with one in eight people around the world lacking constant access to food to meet their needs for a health life. The food insecure households often have diets that are less diverse and of lower energy content, leading to poor nutritional status. Schmeer, (2015), further points out that food insecurity poses a serious threat to individual wellbeing and undermines national level productivity especially in low income (developing) countries where many people are food insecure.

2.2.1 Types of Household Food Security Status

Going by the definition of household food security, which touches on availability of nutritionally adequate and safe food (FAO, 2010), low food security results to hunger. Household food security status has hence been categorized by severity as well as duration of hunger.

2.2.1.1 Household food security status by severity of hunger (Tarasuk, 2001)

To categorize levels of household food security status, Tarasuk, (2001) equates low food security to hunger. Hunger is a term which has four meanings including; a) the uneasy or painful sensation caused by want of food, b) the exhausted condition caused by want of food, c) a strong desire for food or craving, and, d) the want or scarcity of food in a country (World Hunger and Poverty Facts and Statistics, 2013). Hunger is caused by poverty which in turn is caused by lack of resources, unequal distribution of resources, conflicts and disasters. Hunger results to poor health, low levels of energy, and mental impairment, therefore preventing an individual to work for his upkeep. Hunger also leads to poverty by reducing people's ability to work and learn, leading to even greater hunger in future (World Hunger and Poverty Facts and Statistics, 2013).

The presence of hunger within a household is evidenced by certain food consumption behaviors among the household members including: cutting size of meals; missing meals a whole day; eating less than required; feeling hungry but not eating; skipping meals; relying on one type of food and losing body weight. According to Kenya Urban Comprehensive Food Security and Vulnerability Analysis (KU – CFSVA, 2010), these behaviors are also referred to as coping strategies, which are applied by households when faced with low food security situations. The behaviors result in low dietary intake of micronutrient rich foods. Presence of hunger is an indicator of household food insecurity and Tarasuk, (2001) theorizes four levels of household food security status (Table 2-2).

Table 2-2 Household Food Security Status by Severity of Hunger

Food security status category	Description
Food secure	Household shows no or minimal evidence of food insecurity
Low Food security without hunger	Food insecurity is evident in household's concerns and adjustments to household food management, including reduction in diet quality, (omitting some food items such as fruits) but with no reduction in quantity of food intake.
Low food security with moderate hunger	Food intake for adults in household is reduced to an extent. This implies that adults are experiencing hunger due to lack of resources to purchase food.
Low food security with severe hunger	Households with children reduce the children's food intake to an extent. This implies that children experience hunger as a result of inadequate household resources. Adults in households with children experience extensive reduction in food intake which may include going whole days without food.

Source: Tarasuk, (2001).

According to Tarasuk, (2001) household low food security status begins when resources start to diminish as would happen if a) the head of the household loses a job b) crops in the farm fail to mature due to lack of rain or c) the bread winner gets sick and cannot work. These events results in several reactions: 1) they cause anxiety to the household especially the parents as they worry how they will feed their families. 2) If there is no remedy taken, resources continue to diminish (stored food may be used up, and money saved in the bank may get finished). At this stage the parents may change their eating habits, for example eat whatever food that is available and not necessarily what they like eating, and they may also result to eating limited variety of food, that is compromising food quality.3) As resources continue to diminish and food access becomes difficult because money for purchasing is not available, parents especially the mother may eat less food than required, skip meals or even go a whole day without food. 4) The last stage implies severe low household food security. It is a stage when households are desperate and

have exhausted all the resources. They have no food even to feed the children. It is at this stage when children can go a whole day without food (Figure 2.1).

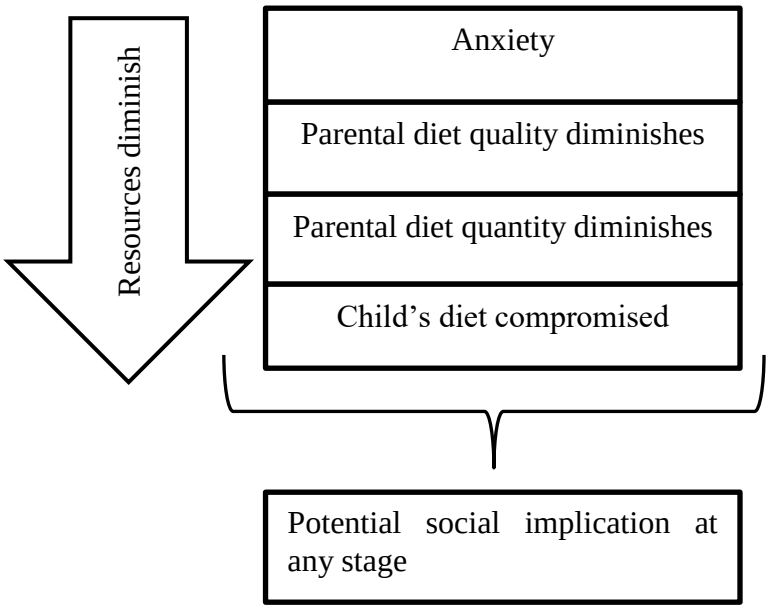


Figure 2-1 How Household Low Food Security Status Progresses

Source: Tarasuk, (2001)

All the stages of food insecurity, initiated by lack of resources (poverty), have socio implications. Children from food insecure households may start showing signs of malnutrition and fail to attend school .This may have negative implications for their future. In addition, food insecure adults may result to harmful coping strategies like migrating, selling assets or stealing. Food security studies should capture households vulnerable to low food security and action taken before final irreversible stages.

2.2.1.2 Household food security status by duration

According to Pinstrup, (2009), a household is considered to be in low food security status "whenever the availability of nutritionally adequate and safe food or the ability to acquire

acceptable foods, in socially acceptable ways is limited" (FAO, 2010), and if it has no ability to acquire the food needed by its members at all times. Pinstrup, (2009) indicates that there are two types of low household food security status: chronic and acute or transitory low food security status.

Chronic low household food security status

According to Pinstrup, (2009), chronic food security status is when people do not have minimum food requirement for an extended period due to poverty. They lack resources such as financial as well as assets such as land or livestock. Chronic food insecurity is characterized by a persistent inability to attain food access over the long term. A household is defined as chronically food insecure if its calorie adequacy falls below 70% of required daily calorie intake which is 2250 calories per adult equivalent (G o K, 2004). This is nevertheless higher than the 2000 kilocalories daily requirement per adult equivalent suggested by the FAO (FAO, 2008b). The calorie adequacy is also used as food poverty bench mark. An adult who is not able to access 2250 kilocalories per day is described as falling below the food poverty line. This therefore means that there is a relationship between poverty and food insecurity. However, other authors have suggested 80% as a better bench mark calorie cut off, as what is required to attain a minimum activity lifestyle. It should be noted that a household that is unable to meet calorie requirement is also likely to have micronutrient deficiency.

Acute or transitory low household food security status

Pinstrup, (2009) describes transitory /acute low household food security status as sudden lack of food or reduction in the ability to acquire food or produce food due issues beyond one's control

such as floods, earthquake, conflict or war. Acute low household food security status is characterized by abrupt decline in food security status over a relatively short period of time. These short term declines in household food security status may occur on a fairly regular basis as a result of seasonal variations which result in crop failure. This phenomenon is quite common in areas that do not get enough rain and yet depend on rain fed farming.

2.2.2 Pillars of Household Food Security

In 2009, the World Summit on Food Security stated that there are four pillars of household food security including availability, access, utilization and stability (FAO, 2009). Household food security status is composed of all the four pillars and these are fully described in the conceptual framework (Figure 1.1; section 1.9), which is used for this study.

2.2.3 Characteristics of Households with Low Food Security Status

Studies have shown that members of food insecure households have the following characteristic: adults worried: that their food would run out before they got money to buy more, or before crop in garden was ready, that food bought just did not last and they did not have money to get more, that they could not afford to eat balanced meals and have to rely on inexpensive non nutritious foods. In addition, members of the food insecure households may report that they had to: cut the size of meals or skipped meals, eaten less than they felt they should, stay hungry without eating, all because they could not afford enough food. They also had to acquire food through socially unacceptable means such as food aid, as well as borrowing money for food or buying food on credit (Bajagai, 2014). These characteristics were evidenced by a study done by Kenya urban comprehensive food security and vulnerability analysis and

nutrition assessment (KU – CFSVSA, 2010). According to this study, the majority of respondents, who were categorized as having poor food consumption, had reduced the number of meals per day, had skipped meals, had borrowed money for food, and had skipped meals for entire day (KU- CFVSA, 2010). The household food insecurity characteristics are used as indicators of inadequate food access and consumption, in qualitative household food security studies (Gunderson, 2008).

2.2.4 Poverty, Household Food Security Status and Micronutrient Intake

According to (FAO, 2010) poverty is defined as state of scarcity. It is measured by a living expenditure of ≤ I USD per day. It is also measured by an expenditure on food of ≥ 70% of the total income. Poverty is associated to low socio demographic and socio economic status and the obvious ones are gender of household head, marital status, occupation, education and house type. Since the demographic/ socio economic variables are the proxy indicators of household food security status and micronutrient intake, they have a correlation with poverty, hunger and malnutrition.

Low household food security status is central to being poor. Households living in poverty face serious constraints on their incomes and may make choices that may result in low food security, for example, they may spend their money on non-food items like alcoholic drinks or buy poor quality food. Poor people often have little income to spend on food. They are therefore likely to rely heavily on monotonous plant base diet, for example, maize, rice or root crops, and such cassava. They are likely to consume Vitamin and mineral rich foods such as animal products and vegetable and fruits very rarely. Therefore, low income, resulting from unemployment and

lack of other resources such as land, are associated with low household food security status (FAO, 2010).

2.2.5 Models for Measuring Household Food Security Status

Several household food security measuring models have been developed by different organizations including the United States Department of Agriculture (USAD), Health Canada, United Nations Food and Agriculture Organization (FAO), World Food Program (WFP) and Government of Kenya (GoK), as shown (Appendix 22). Two of the models, Health Canada (HFSSM, 2012) and World Food Program (FCS/ FCGs, 2011), were found to be relevant to this study and hence were adapted.

Health Canada household food security survey model (HFSSM 2012)

According to Kennedy (2005) and Andrews et al., (2000), Health Canada Household Food Security Survey Model (HFSSM) is qualitative method of measuring food security status. It measures the prevalence and severity of food insecurity. According to these authors, the technique has been validated by Unites States Department of Agriculture USDA, (2012) and has been used by many countries globally, including Orissa State India, (Holben, 2000), Mateveleland Zimbabwe, and Tanzania, (Satpathy, 2001), Kenya (African Women Studies Centre, 2014), Bangladesh, Ethiopia, Burkina Faso, and Guatemala (Kennedy 2005). The authors also argue that the technique is well grounded in science, it is quick to administer and analyze and that it is a more direct proxy measure of food security status. The model, a qualitative measure of household food security status, has been described by Kennedy (2005) as having external validity as well as being a more direct measure of household food security

status than any other proxy measure. Household Food Security Survey Model has been found to correlate significantly with the more traditional measures such energy intake per capita.

According to (Kennedy, 2005) data interpreted with HFSSM categorizes the food security situation experienced by households as food secure, food insecure, (moderate) and food insecure, (severe). Food secure households have access, at all times to enough food for an active, healthy life for all household members. The food insecure households are those who are uncertain of having, or unable to acquire, enough food to meet the needs of all their household members because they have insufficient money for food. In these households, adults or children or both adults and children experience food insecurity. Depending on the extent of the experience, households are either moderately food insecure or severely food insecure. Food insecure, (moderate) households are those with an indication of compromise in quality and or quantity of food consumed. On the other hand the food insecure (severe) households are those with an indication of reduced food intake and disrupted eating patterns. It should be noted that whenever the quality and quantity of food is compromised, both macro (proteins, carbohydrate and fats) and micro nutrients (minerals and Vitamins) will lack from the diet, hence, undernutrition whose ultimate result will be deficiency diseases.

The questions in the food security model are intended to measure four underlying behaviors in the household: 1) Anxiety about the food budget or food supply; 2) perceptions that food is inadequate in either quantity or quality; 3) reduced food intake in adults; and 4) reduced food intake in children. Tarasuk, (2001) has illustrated the progression of these behaviors

representing mild (anxiety) to severe (child not eating a whole day/ child's diet compromised (Figure 2.1).

The questions in the HFSSM require responses of "yes" or "no". If the response is yes, (affirmative) the question has options for "often" or "sometimes" or "almost every month", or "some months but not every month". A household is considered food secure if none or only one of the questions in adult or child scale, respectively, can be answered affirmatively. Table 2-3 shows the number of affirmative responses required for classification into each of the food security status categories.

Table 2-3 Health Canada Household Food Security Survey Model (HFSSM 2012): Categories and Criteria for Measuring Food Insecurity

Food security status	Adult status based on adult scale	Child status based on child scale	Household status derived from adult and child
Food secure	No, or one indication of difficult with income related food access. *Zero or one affirmative response*	No, or one indication of difficult with income related food access. *Zero or one affirmative response*	Both adult and child are food secure.
Moderately food insecure	Indication of compromise in quality or quantity of food consumed. *2 to 5 (20% to 50%) affirmative responses*	Indication of compromise in quality or quantity of food consumed. *2 to 4 (20% to 40%) affirmative responses*	Either adult or child or both are moderately food insecure
Severely food insecure	Indication of reduced food intake and disrupted eating pattern. *>6 (60%) affirmative* responses	Indication of reduced food intake and disrupted eating pattern. *>5 (50%) affirmative* responses	Either adult or children in household are severely food insecure.

Source: Health Canada: www.hc.sc.gc.ca., (2012)

Food consumption score (FCS) and food consumption groups (FCGs) model

Food Consumption Score Model (FCS) is a technique used by WFP to do food insecurity vulnerability assessment using food consumption score (FCS) tool. The tool is used to measure food access and uses survey method (WFP, 2008). It is a composite score based on dietary diversity, food frequency and relative nutritional importance of different food groups. The FCS is calculated using the frequency of consumption of different food groups consumed by a household during the 7 days before the survey. Each food group is given a weighting. The score is calculated by grouping food items according to nutrient density. The groups so created are then given a weighting as indicated on (Table 2-4).

Table 2-4 Food Consumption Score (FCS), Food Consumption Groups (FCGS) and weighting

	Food items	Food groups	weight
1	Maize, rice, sorghum, millet, chapattis and other cereals Cassava, potatoes, sweet potatoes, matoke , yams , arrowroots and other tubers	Main staples	2
2	Beans, peas, groundnuts, cashew nuts and others	pulses	3
3	Vegetables (including leaves)	vegetables	1
4	Fruits	fruit	1
5	Beef, goat, poultry, eggs, and fish	Meat and fish	4
6	Milk, cheese, yogurt and other dairy	milk	4
7	Sugar and sugar products	sugar	0.5
8	Oils, fats, butter	Oil	0.5
9	Spices, tea, coffee, salt, fish power , small amount of milk for tea	condiments	0.0

Source: (WFP, 2008; 2011).

After food items are grouped, and consumption frequency recorded, the respondents are categorized as poor, borderline or acceptable according to the cut off points (Table 2.5)

Table 2-5 Food Consumption Score Profiles

Food consumption scores (FCS)	Profiles
0-21	Poor
21.5-35	Borderline
>35	Acceptable

Source: (WFP, 2008; 2011)

The world food program has recommended the use of a minimum of either 21 or 28 scores. The 28 scores are seen as the basic consumption score where majority of the respondents may be found to be consuming sugar as well as oil daily. On the other hand maximum scores have been recommended at 35 and 42 (Appendix 10a to 10d)

According to WFP (2008), FCS tool does not require information on actual quantities of food eaten reasons being:

1) That the bias in recalling the actual amounts eaten is generally accepted to be much greater than recalling the number of days the food / food group is eaten.
2) That inclusion of fruits and vegetables in the list prevents the accurate calculation of caloric contribution of that group.
3) That the time and skill required asking the questions on actual amounts consumed, while providing useful data, is too demanding of time and enumerator capacity for most surveys.

According to WFP, (2008), FCS tool measures food consumption diversity (carbohydrates, animal proteins, plant proteins, vegetables and fruits) and frequency and hence correlates with dietary **micronutrient intake** in addition to calorie intake. However, it is suggested that a separate module to measure quantities of food consumed may be of interest in some context (WFP, 2008).

2.3 Objective Three: Dietary Intake of Micronutrients (Vitamin A, Iron, Zinc) among women.

This section addresses women's dietary intake of Vitamin A, iron and zinc. It has several sub sections including: introduction to micronutrients and micronutrient deficiencies, micronutrient deficiencies risk factors and dietary intake, consequences of micronutrient deficiencies, Vitamin A deficiency (VAD), iron deficiency anemia (IDA), zinc deficiency, food groups as proxy indicators of micronutrient intake and relationship between household food security status and micronutrient intake.

2.3.1 Micronutrient Deficiencies

According Food and Agriculture Organization (FAO, 2009), micronutrients play leading roles in production of enzymes, hormones and other substances, helping to regulate growth, activity development and functioning of human immune and reproductive systems. However, according to (Bamji, 2011) lack of dietary intake of Vitamins and minerals (micronutrients), results in deficiency diseases.

Over 2 million people worldwide suffer from micronutrient malnutrition called hidden hunger (FAO, 2002). These people's diets supply inadequate vitamins and mineral salts such Vitamin

A, iron and zinc among others. Deficiencies of these nutrients result when habitual diets lack diversity and do not include sufficient fruits, vegetables, dairy products, meat and fish, that are best sources of micronutrients (FAO 2002). Globally, some of the three micro nutrient deficiencies of great public health significance are those of Vitamin A, iron and zinc. They have been found to be very common and of great concern for women (FAO, 2009: Skalicky, 2006).These micronutrient deficiencies can be eliminated by modifying diets to include a greater diversity of nutrient rich foods (FAO, 2009). Micronutrient deficiencies reduce work capacity. Research findings suggest that iron deficiency anemia reduces the productivity of a manual laborer by up to 17%. As a result, hungry and malnourished adult earn lower wages. This is because they are unable to work as many hours or years as well-nourished people. They also fall sick more often and have a shorter lifespan.

2.3.2 Micronutrient Deficiency Risk Factors and Dietary Intake

Micronutrient deficiency results from many basic factors including poor utilization of the micronutrients by an individual as a result of, among others, unsafe water source, poor sanitation and long distances to health facilities (Bamji, 2011). People who have low food security status eat diets with less variety, consume lower amounts of fruits and vegetables, and are more likely to have micronutrient deficiencies (Bamji, 2011; Shenkin, 2006). Food based approaches have been cited as one of the primary means to improve micronutrient status of vulnerable groups including women (Kennedy et al, 2012; FAO, 2009). The approaches are designed to increase micronutrient intake through the diet and are simple and cheap. They involve the count of food groups consumed and an analysis of their nutrient value. They also act as proxy indicators of micronutrient intake among the respondents (Arimond, 2010).

There has been an effort in promoting and implementing food based strategies to achieve sustainable improvements in micronutrient intake. These strategies focus on improving availability, access, and consumption (utilization) of Vitamin A and mineral rich foods. Benefits of such food strategies include not only improved intakes of specific nutrients but also improved overall diet and health status (FAO, 2009).

2.3.3 Consequences of Micronutrient Deficiencies

Vitamin A and mineral deficiencies (iron and zinc) have a significant impact on human welfare and on the economic development of communities and nations. These deficiencies can lead to serious health problems, including reduced resistance to infectious diseases, blindness, lethargy, reduced learning capacity, mental retardation and sometimes death. The deficiencies in total result in loss of human capital and work productivity especially for women (FAO, 2009). According to Bamji, (2011), inadequate intake of micronutrients (micronutrient deficiencies) has very adverse effects. He says that apart from human suffering due to morbidity and mortality, micronutrient deficiencies have a high economic cost. He argues that productivity losses due to poor nutrition are estimated to be more than 10% of life time earnings for an individual, and 2-3 % of gross domestic product to the nation (GDP). He also adds that the cost of treating malnutrition is 27 times more than the investment required for its prevention through dietary intake.

2.3.4 Vitamin A, Iron and Zinc Deficiencies among Mothers

2.3.4.1 Vitamin A Deficiency (VAD) among Mothers

Vitamin A is essential for the functioning of the human immune system and can help to increase resistance to disease, protect against blindness and improve chances of survival, growth and development (WHO, 2006). The earliest manifestation of Vitamin A deficiency (VAD) is night blindness and bitot spot on the white of the eye. Severe Vitamin A deficiency leads to keratomalacia (ulceration of the cornea) and total blindness (Bamji, 2011).

Close to 20 million women in developing countries are Vitamin A deficient. One third of this number is clinically blind (FAO, 2003). The cause of VAD is poor diet. Cereal-pulse based diets are common in many developing countries. However, they are poor sources of Vitamin A. It has been found that regular consumption of Vitamin A rich foods such as animal products (liver, milk ,yoghurt, cheese eggs ,oily fish) , orange and yellow fruits and vegetables, dark green leafy vegetables and oil (especially palm oil) could prevent VAD (Bamji, 2011).

2.3.4.2 Iron Deficiency Anemia (IDA) among Mothers

Iron deficiency anemia, the most common nutritional disorder in the world, lowers resistance to disease infection and weakens physical stamina. It is a consequence of poverty and a significant cause of maternal mortality. It also increases the risk of hemorrhage and infection during childbirth (Bamji, 2011). Nearly 2 billion people are estimated to be anemic and millions are iron deficient, the vast majority of them women. A range of factors cause iron deficient anemia, including inadequate diet, blood loss associated with menstruation and parasite infections such as hookworm (Bamji, 2011). Other factors that contribute IDA are the presence of inhibitors of

iron absorption as well as repeated pregnancies. Iron deficiency anemia can be reduced by poverty reduction, improving access to diversified diet**,** improving health services and sanitation and improving care and feeding practices for vulnerable groups (Kennedy et al., 2012).

Beck et al., (2014) indicate that the diets people eat have enough iron if enough food to give adequate energy is eaten. These authors, however, add that women may be at risk of having iron deficiency anemia. This is because they have lower energy needs; hence they consume less food than other groups. A factor just as important as the total iron content of the diet is the bioavailability of the iron ingested, that is, its absorbability. How much iron is effectively absorbed by the body varies considerably depending on a number of factors including presence of ascorbic acid (present in fruits, green leafy vegetables, and fermented cereal products) and, animal proteins (meat, poultry, fish). It should be noted that most foods of plant source contain iron. However, a percentage of this iron is not absorbed due to the presence of phytates (present in cereal grain, legumes, nuts , seeds) and polyphenols including tannins (present in coffee, tea, cocoa, herbal infusions) , in the same food (Beck et al., (2014) .

2.3.4.3 Zinc Deficiency among Mothers

Zinc promotes normal growth and development and is an element in enzymes that work with red blood cells, which move carbon dioxide from tissues to lungs. It also helps maintain an effective immune system. Zinc deficiency in malnourished children contributes to growth failure and susceptibility to infections, and is also thought to be associated with complications of childbirth. This deficiency usually occurs where malnutrition is prevalent and is now recognized as a public health problem in many countries (Sardi, 2013). Trials in Bangladesh,

India and Indonesia have shown reductions of about one third in the duration and severity of diarrhea in children receiving zinc supplements and a median 12 per cent decline in the incidence of pneumonia (Sardi, 2013).

Zinc supplements have helped reduce the most severe malaria cases. According to a study done on zinc and Vitamin A supplementation, the number of severe cases attending clinics reduced by more than a third. Overall clinic visits by those receiving zinc decreased by a third, and signs of other infections were reduced by 20-50 percent. The cost of a year supply of zinc supplement for a child is one dollar. Zinc deficiency, increasingly recognized as widespread among women in developing countries, is associated with long labor, which increases the risk of maternal and infant deaths. A number of studies have found that zinc supplementation reduces complications of pregnancy (UNICEF, 1998; Sardi, 2013).

The WHO, UNICEF, and International Zinc Nutrition Consultative Group (IZiNCG) jointly have recommended three methods for assessing the zinc status of the population or the risk of inadequate zinc intake. These are a) blood plasma or serum zinc concentration b) dietary zinc intake and c) stunting prevalence. The concentration of zinc in blood plasma or serum is the best available biomarker of risk of zinc deficiency in populations (IZiNCG, 2007). The risk of zinc deficiency is considered to be elevated and of public health concern when the prevalence of low serum Zinc concentration is < 20%.

Chronic inadequate dietary intake of zinc is the most likely cause of zinc deficiency. Hence estimating the adequacy of zinc intakes through quantitative dietary surveys is useful to

evaluate the risk of zinc in the population ((IZiNCG, 2007). The risk of zinc deficiency is considered to be elevated and of public health concern when the prevalence of inadequate intakes is > 25% (IZiNCG, 2007).

Stunting is low height for age. It is the best known and easiest to measure of the outcomes associated with zinc deficiency in the populations. Stunting prevalence is expressed as the percentage of children under five years of age with height for age below the expected range of a reference population i.e. -2 standard deviations with respect to reference median. Stunting prevalence > 20 % in the population indicates a risk of zinc deficiency of public health concern (IZiNCG, 2007) (Table 2-6)

Table 2-6 Methods and Benchmarks of Zinc Status

Method	Benchmark
Dietary zinc	Prevalence of inadequate zinc > 25 %
Blood plasma/serum zinc	Prevalence of low serum zinc > 20%
Stunting prevalence	Prevalence of low height for age > 20 %

Source: Adapted from IZiNCG (2007).

2.3.5 Food Groups as Proxy Indicators of Micronutrient Intake

According Arimond, (2010), food based approaches are the primary means to improve micronutrient intake through diet. They are simple and cheap. They involve the consumption of variety of micronutrient rich foods and the assessment of dietary intake of micronutrients is done by counting the food groups consumed as well as giving them a value (paragraph 3.7.3). The food groups act as proxy indicators of micronutrient intake among the respondents.

2.3.6 Relationship between Food Security Status and Micronutrient Intake

There is a link between food insecurity and micronutrient deficiencies (Temilope, 2012). This illustrates the challenges of having limited varieties of foods in the diet. In many developing countries, the most common diets lack diversity and the traditional food consists mainly of cereal or root staples with very little micronutrient rich animal source **proteins, vegetables and fruits**. One third of disease burden affecting women is due to micronutrient deficiencies in food. Four micronutrients are especially vital for good nutrition and health. These are Vitamin A, iron, and iodine and zinc (Temilope, 2012).

2.4 Objective 4: Risk Factors of Micronutrient Utilization

Micronutrients (minerals and Vitamins) are required by the body in very small quantities, but they have to come from specific foods especially animal products, vegetables and fruits. They have the role of protecting the body from infections as well as facilitating growth. However, there are many risk factors that affect micronutrient utilization negatively including: poor access to health care, low education/low literacy of the mother resulting to low income, poor water and sanitation resulting to infectious diseases, inadequate care practices, monotonous plant based diet, low intake of animal source foods, and seasonal variations.

2.4.1 Lack of Access to Health Care

According to Benson, (2004), people with poor access to health services are at increased risk of infectious diseases, which affect food utilization and hence may increase risk of micronutrient deficiency. This is because; an infection that is not given medical attention immediately

interferes with the appetite of the individual and this affects food intake and hence lowers the amount of nutrients absorbed.

2.4.2 Low Education and Low Income

According to Konttinen et al., (2012), low education is related to low income. Low income in turn is a risk factor for micronutrient utilization. According to Konttinen et al., 2012, the less educated people tend to consume greater amount of energy dense food than the educated people with more income who will normally consume plenty of fruits and vegetables. The researchers found that people with low incomes consume very little healthy food (fruits and vegetables). According to Konttinen et al., (2012), people with low education and hence low income perceive that fruits and vegetables to be expensive and hence spend their money on the familiar energy dense foods like ugali, potatoes and rice. The conclusion is therefore that low income, resulting from low education is a risk factor micronutrient utilization because people with low income or nor income at all will have no money to spend on micronutrient rich foods (animal products, vegetables and fruits). In rural areas where majority of people depend on the food they grow, items like meat and other animal products are usually a luxury only likely to eaten during Christmas when every family tries to have at least one meal with meat.

2.4.3 Water and Sanitation

According Howard and Edge, (2013), water is essential for drinking, preparing food, and maintaining proper hygiene. Lack of access to clean water, (free from microorganisms and other pollutants), is risk factor to micronutrient utilization. Dirty water will result in diarrhea and other water borne diseases all of which interfere with ingestion and absorption of

micronutrients, resulting to micronutrient deficiencies. Acute infection resulting from dirty water and poor sanitation increases physiological demand of micronutrients on the individual and makes the micronutrient deficiency even more acute.

2.4.4 Care Practices

Other risk factors cited are inadequate care practices as well as unhealthy environment (FAO 2008). Failure to have hygienic practices, like washing hands after visiting the toilet, before eating and preparing foods, may result in ingesting disease causing microorganisms. This may make them have food infection and poisonings accompanied by diarrhea and vomiting, which results in poor food absorption (poor micronutrient utilization).

Disease prevention and management, including proper sanitation and hygiene practices, are also important for proper micronutrient utilization. Undernourished human bodies are more susceptible to illness like diarrheal disease and pneumonia. But with proper nutrition, (diets with the recommended dietary allowances), sanitation and hygiene, many diseases, especially those caused by food and water contaminants, are less likely to occur.

2.4.5 Monotonous Plant Based Diet

According Howard and Edge, (2013), it has also been found that monotonous plant based diet (ugali, rice, cassava, potatoes bananas), result in low micronutrient intake and poor bioavailability especially of minerals. In addition, low intake of animal source foods, (milk, eggs, poultry meat) due to poverty prevailing in rural areas, is especially a critical factor for micronutrient utilization (www.who.int/nutrition /publications/ micronutrients).

2.4.6 Seasonal Variations of Micronutrient Intake

In rural areas, people access food by growing their own food. They depend on adequate and timely rainfall. It is possible to grow many types of food crops for household consumption. However, there may be times when the rain fails the households because crops do not grow. If this happens, micronutrients and in general food consumption becomes affected more so because people in rural areas are unemployed and lack money to buy food. This results in poor food access and insufficient intake of micronutrient rich foods.

2.5 Knowledge Gaps in Literature Reviewed

Women are more vulnerable to individual and household food insecurity (Sharkey et al., 2011). The gendered nature of food related hardships may be related to women being more likely than men living in poverty. They do low paying casual jobs, are responsible for unpaid domestic work such as caring for children and other family members, washing clothes and cleaning the house. Rural women are particularly vulnerable to household food insecurity and its consequences. They have unique characteristics including less education, less chances of employment opportunities while being more likely to be mothers and caring for children (Sharkey et al., 2011). In addition, it is well known fact that women are actively involved in the household food production. However, few studies have been done to highlight their food security status, hence this study sought to fill that gap by focusing on women in the household as the respondents and studying their demographic and socio economic characteristics (objective one).

Until recently, concepts of household food security and micronutrient intake have been linked to clinical signs of malnutrition (underweight, stunting, wasting and low birth weight) Health

Canada (2012). However, Kennedy (2005), has developed qualitative data collecting tool that measures household food security status and micronutrient intake using indicators of food insufficiency and hunger. This tool uses data that is poverty driven and not limited to clinical outcomes of food insecurity. It should be noted that signs of clinical malnutrition come much later after long experiences of household food insecurity and micronutrient intake insufficiencies. Addressing household food security status and micronutrient intake inadequacies, using qualitative data (Kennedy (2005), is likely to save clinical malnutrition, which is likely to have devastating effects on women and other members of the household. Since no study has been done to identify signs of poor diets using qualitative data from a rural community, this study used that technique to address the gap in objective two.

Many studies on household food security status examine the sufficiency of calorie intake (Webb, 2001). They are concerned with quantity of food taken and concentrate on energy dense foods which supply calories and not the quality. This study has addressed that gap in objective three, by looking at the dietary intake of micronutrients especially Vitamin A, iron and zinc, among women.

Since the study looked at the dietary intake of micronutrients, it was also found necessary to investigate the factors that may interfere with absorption of Vitamins and mineral salts after food is ingested. Identification of these risk factors was found necessary because they were specific to the study area (objective four).

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter focuses on: study design, study area, target population, sampling procedure, research instruments, validity and reliability of the instruments, data collection procedure, data analysis and presentation, and lastly legal and ethical considerations.

3.1 Study Design

This study was a cross sectional survey in nature, and adapted Health Canada Household Food Security Survey Model (HFSSM, 2012). According to Kennedy (2005), HFSSM, (2012) is a qualitative method of measuring household food security status. It measures the prevalence and severity of household food insecurity. As is the norm with cross sectional survey designs, self-reporting data for the study were collected from the respondents using a questionnaire that was researcher administered. According to Mugenda, (1999) and Kombo and Tromp, (2009), a survey attempts to collect data from members of the population in order to determine the current status of that population with respect to one or more variables. A survey design is also suitable for collecting original data for the purpose of describing a population which is too large to observe directly.

In this study, the survey design facilitated collection of self-reporting data of the respondents on demographic /socio economic status, food access and consumption behaviors, dietary intake of micronutrients and deduced risks of micronutrient utilization. The survey was done during two seasons: Season one data collection constituted a survey which was preceded by pre-testing of the study instruments and was implemented by administration of a household questionnaire, to a sample of 399 mothers, selected randomly. The survey took place in the months of January,

February 2013, which corresponded to a dry season, crop maturity and harvesting. Season two data collection was a repeat of the survey. It took place in the months of April and May 2013 and this corresponded to a wet, planting and weeding season.

3.2 Study Area: Mwea West Sub County

Mwea West Sub County is in Kirinyaga County (Appendices 8 &9) and covers an area of 204 square kilometers. It has 2 locations, Kangai and Mutithi as well as 4 sub locations (GOK-KCDP, 2013). According to the 2009 national census, Mwea West Sub County had approximately 46,164 persons in 12,909 households and a population density of 375 persons per square kilometer (GoK, 2010). The sub county occupies the lower altitude zone of an expansive low lying area mainly characterized by black cotton soils. The sub county gets low amounts of rainfall. The mean annual rainfall is 445.8 mm with maximum falling in April/May (long rain) and October/November (short rains). The average maximum temperatures are in the range of 16 - 26.5ºC while relative humidity varies from 52 to 67% (Mutero et al., 2003; GOK, 2009).

Mwea West Sub County is one of the poorest areas in central province. While the absolute poverty in the province stood at 31.4 % in 2004, this area had 49% of its population living below the poverty line. This was 3% above the national poverty line which was 46% (GOK, 2005; GOK, 2009). However, the 2007 household budget survey reported reduction of the poverty rate to 43%, though one location still had a poverty prevalence rate at 53%, which was 7% above national average (GOK, 2007; GOK- DDP 2008 – 2012).

Mwea West sub county borders Kirinyaga west and Central to the North, Mwea East to the East, Murang'a county to the west and Mbeere Sub County (of Embu County). Most residents in the sub county are subsistence farmers, dependent on rain, and growing crops such as maize, beans, cowpeas, chick peas, pigeon peas, green grams, sorghum, and millet. They also keep livestock including cattle, sheep, goats and poultry.

The sub county is served by three tarmac roads, Makutano Sagana High Way, Makutano Ngurubani Embu High Way and Sagana Kutus Road. In addition, the sub county has several murram and earth roads connecting to the tarmac roads such as Kagio Kandongu Road, P I Karaba Road, Kimicha Kangiciri Road, Karii Gatuto Road and Kangai Kwa Mukungi Dam Road. The community in Kangai is served by many public secondary and primary schools.

3.3 Study Target Population

The target population in this study included mothers in the 12,909 households (GOK, 2009). The sampling frame was all mothers with at least one child aged 2 to 5 years. This was found necessary in order to leave out elderly, pregnant and lactating mothers who may have had different dietary needs. The age categorization was borrowed from Schmeer, (2009) and Jefferds, et al 2010. In his study 'married mothers resource position and household food expenditure in Cebu, Schmeer selected mothers who had children aged 0 - 8 years old, while Jefferds et al., used mothers who had at least one child aged 6 to 59 months. In the current study, the mothers of children 2-5 years old were the care givers, farmers and cooks. It was therefore important to understand that their nutrition status and health could play an important economic role within the household and could therefore have an impact on household food security (Schmeer, 2009).

3.4 Sampling Procedures

3.4.1 Sampling Frame

The sampling frame for this study was mothers in the households. Mwea West, is a rural Sub County with households depending on farming for their livelihood. It is composed of two locations, Kangai and Mutithi. Kangai has furrows for irrigation water while Mutithi communities depend on rain water for farming. The total number of households in the two locations was 12,909 (GOK Population Census, 2009).

3.4.2 Sample Size Determination

Since poverty is a basic indicator of food insecurity, the sample for this study was calculated using the national poverty rate at 46% (GoK, 2005).The size of the sample was calculated using an appropriate procedure for survey studies as outlined by Fisher et al., (1991) as indicated by the formula:

$N = z^2 (PQ) \div D^2$

Where: -

N= Desired sample size

Z= Standard normal deviate (1.96) corresponding to 95% confidence interval.

P= Current national prevalence rates for poverty (46%, GoK, 2005),

Q= 1- p which is the national population without poverty, 0.54%

D= degree of accuracy required (0.05)

$N = z^2 (pq) \div d^2$

$= 1.96 \times 1.96 \times 0.46 \times 0.54 \div 0.05 \times 0.05$

$= 381.70$

$= 382$ (Add 5% for incomplete data =19)

Total = 401

3.4.3 Sampling Households Using Probability Proportionate to Size of Population

Since Kangai had fewer number of households (5302) than Mutithi (7607 , probability proportionate to size of population sampling technique , as suggested by Turner (2003) , in his sampling strategies, was used to arrive at the number of required households from each cluster (location) ,(Turner ,2003; Esturk, 2014; Kakota et al., 2015; Table 3.1).

Table 3-1 Number of Households and Respondents by Location (Cluster)

Location	Total number of household	Number of respondents
Kangai	5,302	165
Mutithi	7,607	236
Total	12,909	401

Source: GOK, population census (2009)

3.4.4 Sampling of Mothers Using Random Walk and Quarter Sampling Technique.

As indicated on section 3.3, the study targeted households and a household was included in the study if it had a woman with at least one child 2 to 5 years old. The woman was the respondent and was selected using the random walk and quarter sampling technique as recommended by Turner, (2003) and Kennedy (2012). Following Turner's guideline and with help of the Village in Charge, the research team approached the community from a market place, a school or the chief's camp. The team moved from one homestead to the other and administered the household questionnaires to the qualified respondents. The process continued until the number of the respondents allocated to the location (cluster) was reached. This process was carried out twice, during the dry and wet seasons.

3.5. Research Instruments

Research instruments included 1) a structured household questionnaire (AWSC, 2014), including a four week food consumption frequency 2) in depth questions relating to household food access and consumption behaviors and 3) a meal preparation observation guide.

3.5.1 Household Questionnaire

The pre tested household questionnaire (Appendix 5), had sections A to E. Section A sought for information about marital status and religion, section B solicited for demographic / household profile information, section C sought for information regarding socio economic characteristics of the mothers. The information collected from sections A, B and C was used for objective one of the study. Section D of the questionnaire solicited information about food consumption frequency in four weeks period (dietary intake patterns) and the responses were used for objective three. Section E of the questionnaire sought for information required for objective four (risk factors for micronutrient utilization). It had questions on water sources and safety as well as environmental sanitation.

3.5.2 In Depth Questionnaire for Household Food Security Survey Module, based on Health Canada (HFSSM 2012)

This questionnaire had two parts, a and b. Part (a) asked questions that related to the woman's (mother's) food access and consumption behavior in a period of three months prior to the study. The questions sought to know whether in the last three months , the mother had: skipped a meal, not eaten a whole day, ate less than felt was enough, was hungry but could not eat, or had lost weight because there was not enough food to eat and there was no money to buy. Part (b) of the in depth questionnaire related to the households food and consumption behavior three months

prior to the study. It had four questions and the responses were also given by the mother (section 3.8.2). The information solicited from the in depth household questionnaire was used for objective two.

3.5.3 Household Meal Preparation Observation Guide

The meal observation guide was used to facilitate recording details of meals prepared as observed during home visits. The guide helped to record for each mother : date , the type of meal (breakfast, lunch, supper) , name of dish (rice, githeri, matoke), ingredients used, quantities of ingredients used, number of people who ate the meal, method used to cook and whether the food cooked was eaten once or twice. The observations generated quantitative data. This was used to support the four week food frequency recall.

3.6 Pretesting the Questionnaire

The questionnaire was pre tested in Koroma, a sub location in Kirinyaga Central, which shares the same agro/ecological characteristics as Mwea West but was not used in the study. Ten mothers respondents, selected randomly, were used to complete the household questionnaire. Data collected was then analyzed and necessary adjustments made to the questionnaire after all the questions were tested for reliability (section 3.6.2). The pre testing was followed by the actual study.

3.7 Instrument Validity and Reliability

3.7.1 Validity of the Research Instruments

According to Sullevan, (2011) validity refers to the degree to which a study accurately reflects or assesses the specific concept or construct that the researcher is attempting to measure. When

designing the questionnaire for the purposes of collecting quantitative data, the researcher consulted the three supervisors from the Department of Food Science, Nutrition and Technology, University of Nairobi, Department of Food, Nutrition and Dietetics, Kenyatta University and Department of Hospitality Management, Kenyatta University, to ensure validity of the instrument, as all of them are experts in the area of study. In addition, the test items in the questionnaire had been used by other researchers. To ensure further validity, the questionnaire was tried out in the field as suggested by Orodho, (2004). Orodho, (2004) suggests that, once the questionnaire has been constructed, it should be pretested. The purpose of pre testing the questionnaire was to identify misunderstanding, ambiguities and inadequacies of the items in the questionnaire. This ascertained construct validity. To further enhance validity, the research assistants were thoroughly trained on how to administer the questionnaire.

3.7.2 Reliability using Cronbach's Alpha

According to Sullevan (2011), reliability refers to whether an assessment instrument gives the same results each time it is used in the same setting with the same type of respondents. Sullevan further describes reliability as meaning consistent or dependable results and that it can be achieved by creating 2 or 3 or more question items to measure the same concept. The difference between the responses (answers) to the questions is calculated and the correlation among the answers is measured using various tests. In this study the reliability of the instruments was ascertained by carrying out a test- retest method and a correlation run using Cronbach Alpha (Table 3.2)

Table 3-2 Reliability Statistics

Objective No.	Title	Cronbach's Alpha	No. of Items
Objective 1	Bio data demographic/ socio economic variables/Food security status	.764	16
Objective 2	Household food security variables	.916	16
Objective 3	Consumption of micronutrient rich food	.724	23
Objective 4	Risk factors on micronutrient utilisation	.830	5

The Cronbach's alpha test is used by most researchers as a test of internal reliability. The test's coefficient normally ranges between 0 and 1. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. George and Mallery (2003) provide the following rules of thumb: *"> .9 Excellent; > .8 Good; > .7 Acceptable; > .6 Questionable; > .5 Poor and < .5 Unacceptable"* (p. 231). This study considered an alpha of at least .7 as a reasonable goal for the instruments.

3.8 Data Collection Methods

Data collected was related to the four specific objectives including assessment of:- demographic /socio economic characteristics of the respondents, food access and consumption behaviors , dietary intake of micronutrients (Vitamin A ,iron and zinc) and risk factors for micronutrient utilization.

3.8.1 Socio Demographic and Socio Economic Characteristic

The study looked at demographic and socio economic characteristics of the respondents in two locations which are in the same agro ecological zone. Although this study was done during two different seasons, information about demographic and socio characteristics (objective one) was

collected during the dry harvesting season only (January – February 2013).This was because the demographic and socio characteristic are constant and are unlikely to change with seasons. Using a researcher administered questionnaire (Appendix 5), several variables were investigated including marital status, religion, education, occupation (sources of income), livestock kept, asset ownership, expenditure on food as well as size of land owned. In addition, an observation was made on type of house (wall, roof, floor) the household had.

3.8.2 Assessment of Household's Food Security Status

Objective two assessed the food access and consumption behaviors of the mothers, and the households. To facilitate the investigation, an in depth household questionnaire (Appendix 6), adapted from the Health Canada Household Food Security Survey Model (HFSSM, 2012; Gunderson, 2008), was used. The HFSSM is qualitative technique for measuring household food security status.

The questionnaire had two parts, a and b. Part (a) asked questions that related to the mother's food access and consumption behaviors in a period of three months prior to the study. The questions sought to know whether in the last three months , the mother had: skipped a meal, not eaten a whole day, ate less than felt was enough, was hungry but could not eat, or had lost weight because there was not enough food to eat and there was no money to buy. The mother was expected to answer yes or no to a set of five questions. If the answer to any question was yes, then the mother was expected to give details of frequency. The frequency options available for each question were: almost every month, some months, in only one month in a period of three months (Appendix 6).

Part (b) of the in depth questionnaire related to the households food and consumption behavior three months prior to the study. It had four questions and the responses were also given by the mother. The questions sought to know whether in the previous three months the mother was worried: whether food would run out before next crop was ready; that food harvested would not last; the questions also asked whether money had been borrowed to buy food and whether the statement that "we could not afford to eat more than one type of food". Was this true and if so how often in the last three months? The frequency options available for each question were: often, sometimes, never true in the last three months.

The questions in the food security module were intended to measure three underlying behaviors by a woman in the household: 1) Anxiety about the food budget or food supply; 2) perceptions that food was inadequate in either quantity or quality; 3) reduced food intake. Tarasuk, (2001) has illustrated the progression of these behaviors representing mild (anxiety) to severe (not eating a whole day), **(Figure 2.1; Table 3.3).**

Table 3-3 Questions in Household Food Security Module and What They Measured Adult Scale (woman)

Question NO	Question	Behavior measured
1	In the last 3 months, did you or other adults in your household cut the size of our meal or skip a meal because you did not have enough food and did not have money to buy? Yes, No.	Reduced food intake
2	In the 3 months, did you or other adults in your household ever not eat for a whole day because you did not have enough food and did not have money to buy? Yes , No.	Reduced food intake
3	In the last 3 months, did you ever eat less than you felt you should because you did not have enough food and did not have money to buy? Yes , No	Reduced food intake
4	In the last 3 months, were you ever hungry but did not eat because you did not have enough food and did not have money to buy? Yes , No.	Reduced food intake
5	Sometimes people lose weight because they do not have enough food to eat. In the last 3 months, did you lose weight because there was not enough food to eat? Yes No	Perception

Table 3-4 Questions in Household Food Security Module and What They Measured Adult Scale (Household)

Question No	Question	Behavior measured
1	In the last 3 months, I worried whether our food would run out before the next crop was ready and before I could get money to buy more food. Yes, No.	Anxiety about quantity of food
2	The food that we harvested did not last and we did not have money to get more. Yes, No.	Anxiety about quantity of food
3	” We could not afford to eat more than one type of food.”	Perception about quality
4	Have you borrowed money for food from anywhere in the last two weeks? Yes/ No	Anxiety about quantity of food

Table 3-5 Scoring of Food Security Status for Mother and the Household

Food security level	Number of affirmative responses	
	Mother	Household
Food secure	0	0
Moderately food insecure	1-3	1-3
Severely food insecure	≥ 3	≥3

Source: Adapted from Health Canada HFSSM (2012)

This study had nine in depth questionnaire items, five for the mother and four for the household all of which were answered by the mother. The five items specific for the mother addressed the mother's behavior as a result of food shortage while the four household items addressed the anxiety and perceptions that would be caused by anticipation that food would run out (Table 3.3 and 3.4).

3.8.3 Determination of Dietary Micronutrient Intake (Vitamin A, Iron and Zinc)

Objective three assessed dietary micronutrient intake. This was done using a four week food frequency technique (dietary patterns) adapted from World Food Program, (2011) as well (meal preparation observation).

3.8.3.1 Food frequency recall

According to Mulligan et al., (2014; Signorello et al., 2009 and Brandford, 2014), food frequency recall is a semi qualitative data collection technique that uses a questionnaire to assess dietary intake of a large population. The technique has several advantages including ease of administration, being low in cost and having the ability to assess dietary intake over a defined period of time. Different researchers specify different recall periods for their desired food

consumption periods. For example, Mulligan et al., (2014 as well as Signorello, (2009) used a recall period of one year for their studies).

Using four weeks food frequency recall technique, commonly consumed food items, which are rich in micronutrients , were classified according food groups including fats and oil, animal products, yellow /orange fruits, yellow/orange vegetables, and dark green vegetables. The respondent (woman) was asked to state how often, in the last four weeks, commonly found foods in each category were eaten. Several options were given for each food type including**:** - every day, 2- 4 times a week, once a week to , once every two weeks, once a month or never. The woman was not asked for quantities of the food eaten and this was in accordance with World Food Program guidelines (WFP, 2008; Mulligan et al., (2014; and Signorello et al., 2009).

(WFP, 2008) says that there is a recall bias in asking for quantity of food eaten in the past. They recommend asking the number of times food was consumed within a given period. In the current study, recall period was four weeks, prior to the study. The four weeks food frequency was chosen in order to capture consumption of some items like animal product which are not likely to be consumed weekly in the study area. Using personal experience, animal products (Meats, eggs, poultry) are likely to be consumed during Christmas and other important national days like Jamhuri Day, New Year Day, or at best at harvesting time when the woman may take some of the produce to the market, get some money and purchase some meat or other animal products.

3.8.3.2 Calculation of Food Consumption Score (FCS) / Food Consumption Groups FCGs)

Following the United Nations World Food Program (WFP, 2008) guidelines the food groups used in the food consumption frequency questionnaire were adapted and weighted to work out the "Food consumption score" (FCS), (Appendix 10).

The FCS was calculated using the frequency of consumption of different food groups consumed by a household during the four weeks before the survey. All the food items including spices, were grouped into specific food groups. The consumption frequencies of food items of the same group were summed and coded by the value of each group. The value obtained for each food group was multiplied by its weight to get the weighted food group scores. These were summed up to get the Food Consumption Score (FCS) (Appendix 10). However, although the thresholds for the FCGs were determined based on WFP, (2008), some modifications were done based on the context and dietary patterns of the population of the study. After the food consumption frequency for each item was recorded, the respondents were categorized as **poor, borderline or acceptable,** according to the cut off points suggested by WFP (2008), (Appendix 10).

3.8.3.3 Meal preparation observation

According to Esturk, (2014), food frequency questionnaires are not sufficient base from which to draw inferences on likely micronutrient status. Also, the WFP, (2008) suggests that, since food frequency survey does not ask for quantities of food eaten, a separate module to measure quantities of food consumed would give useful additional data. This study therefore included the meal observation technique which looked at the composition of food items eaten by study respondents for breakfast, lunch and supper (AWSC, 2014). The technique was applied to sub

sample of 63 mothers, selected randomly, 27 from Kangai and 36 from Mutithi. This number of the respondents was seen to be enough according to Gibson, (2007). Gibson, in her paper "Determining the risk factors of zinc deficiency", recommended the use of a sub sample of 30-40 respondents.

Using Gibson's (2007) suggestion of the size of sub sample (30-40 respondents), more data were collected in addition to FCS, from a sub sample of 63 participants. The respondents were visited and observed at home during meal preparation in June 2013. The meals observed were breakfast, lunch or supper. This corresponds to the three main meals studied by African Women Studies in their study on National Food Security in 2014. The mothers were asked about the name of the dish, the ingredients used and the quantities, the number of people to eat the meal and whether the food was eaten once or twice. The method of cooking was observed or explained if any food was pre-cooked (Appendix 7).The ingredients used to cook the three meals of the day were observed.

3.8.3.4 Per capita food consumption

Although the mothers participating in meal preparation were selected randomly, using random walk and quarter technique, (Esturk, 2014), they were only included in the study if they consented. They were observed as they prepared and cooked any of the three main meals of the day including breakfast, lunch and supper. The purpose of this technique was to get the quantity of food consumed by household members per adult equivalent (members of the household were assumed to consume equal quantities) .The quantity cooked was divided by the number of adult people in the household. This gave quantity of food consumed by an individual. This method

has been used by WPP, (2009), to calculate stock of food at household level. In their study, 'Food security and vulnerability, in selected towns of Amhara and Afar regions, Ethiopia', the total amount of food in stock for the household, was divided by the number of household members to get per capita stock in kilograms.

In this study, the meal observation was done in a two weeks period (3rd to 15th June 2013), and gave per capita consumption of cooked food per adult equivalent. The mean consumption as well as standard deviation were calculated Table 4.26. In addition, the amount of nutrients taken from the various ingredients were calculated. This technique is objective and has the advantage of eliminating recall bias likely to be in food frequency recall method (WFP 2009).

3.8.4 Risk Factors for Micronutrient Utilization

To assess the risk factors of micronutrient utilization (objective four), water sources, water safety and environmental sanitation in Mwea West Sub County were investigated. To do this, section E of the household questionnaire (Appendix 5) was used.

3.8.3.5 Sources of water

The respondents were asked about the sources of water used at home. Options of water sources were given including: piped water, river, canal, roof catchment, protected borehole, unprotected borehole, protected spring and unprotected spring. The mother was asked whether in her opinion, the water she used was safe for drinking. If she said yes, she was not asked further questions about water. However, if she said "no" she was asked what she did to make it safe.

The options available were 1= boil 2= filter 3= use chemical 4 = nothing 5= other to be specified.

3.8.3.6 Environmental sanitation

This section sought to know how the mother disposed of dry waste from the household. Several options were given for her to choose the one she applied including: - burning, compost pit, littering (checked by observation), animal feed and any other. The mother was also asked whether the family had a latrine and if no, what the family used.

3.8.5 Recruitment of Research Assistants and Sample Collection

The researcher recruited four Research Assistants for household data collection. They were from the community. They were required to have completed Kenya Certificate of Secondary Education (KCSE) with a minimum of aggregate C- and a minimum of C- in English Language. The assistants were trained and supervised to interpret the English into the local dialect so that the respondents could understand the questions in the questionnaire, which were researcher administered.

3.8.6 Community Entry and Participant Recruitment

The researcher reported to the county headquarters at Kerugoya to request to be granted permission to interview the community. The County Commissioner introduced the researcher to the Sub County Commissioner who later wrote to the chief and copied the letter of introduction to the assistant chiefs. This process facilitated access to the community.

The researcher approached the community through the help of a village elder referred to as In charge. Using random walk and quarter sampling technique as recommended by Turner, (2003), the research team moved from household to household to administer the questionnaire but interviewed only women with 2-5 years old children. About four hundred households were included in the study, represented by mothers, of which 187 came from Kangai location while 212 came from Mutithi location. (Kangai has less number of household (5302), than Mutithi (7607), GoK, 2009).

3.9 Data Analysis

Two data sets were collected. Set one were was collected during a dry season, in the months of January and February 2013. This was also a harvesting period for crops planted during the short rains. Data set two were collected during a wet/ rainy season in the months of April and May 2013. This was a planting /weeding season (FEWSNET, 2009). The two sets of data were compared using test statistics throughout the study. In addition, the ingredients used to make the three main meals of the day: breakfast, lunch and supper were analyzed for nutrient content using National Nutrient Data base for Standard Reference, Release 26 Software v.1.4 (2013).

Statistical Package for Social Sciences (SPSS) software Version 20 was used to compute: means, standard deviations, proportions, chi- squares, t test, ANOVA, correlation co- efficient and logistical regressions. The student t-test was used to determine whether data sets from two locations, taken in two different seasons, were significantly different from each other. It was used to test the hypothesis ($p< 0.05$), at 95% confidence level. Chi – square test statistics was used to compare proportions used in the study to test the hypothesis at 95% confidence level.

ANOVA was used to compare variances. Finally, logistical regression was used to predict the most influential variables to food security status and micronutrient intake.

3.9.1 Analysis of Socio Demographic / Socio Economic Characteristics Module

Demographic and socio economic data were processed using SPSS software. The data covered gender of household head, marital status of the respondent, religion, educational level, occupation, house type, sources and amount of income, livestock owned, assets owned, expenditure on food as well as size of land owned. They were computed to frequencies and proportions by locations and presented in bar charts and Tables. To test the hypothesis, t -test was used to test for significance levels in differences between the two locations, chi square test was used to test the associations between variables, and ANOVA test was used to analyze the variations while logistical regression was used to determine the most influential variables to food security status and micronutrient intake.

3.9.2 Analysis of Food Access and Consumption Behaviours Module

The responses from the household's food access and consumption behaviors module were computed for frequencies and proportions using the SPSS software Version 20. They were presented in Tables and pie charts. Household Food Security Survey Model (HFSSM), a Health Canada Model, (2012; Table 2.3), was used to establish the food security status of the households namely: severely insecure, moderately insecure and secure (Table 2.3). The student's t-test was applied to test the hypothesis on whether there was any significance in differences in food security status between locations and seasons, for the households.

Consequently all the independent variables in the study were cross tabulated with food security status and micronutrient intake to check for their association

3.9.3 Analysis of Dietary Intake of Micronutrients Module

Dietary intake data, collected through food frequency technique, was computed using SPSS to give frequencies and proportions of responses in the two locations of the study and during the dry/harvesting and wet/planting seasons. The responses were presented in Tables. The data were also used to calculate food consumption scores (FCS) and food groups (FCGs) for the purpose of working out consumption categories (poor, borderline and acceptable; Appendix 22) To test the hypothesis, t -test was used to test for significance of differences between the two locations and the two seasons.

On the observation of meals prepared and cooked, the ingredients used were noted and categorized in food groups. In addition, computation was done to get mean consumption of various food materials in grams per meal. Finally , the ingredients used to make the three main meals of the day (breakfast, lunch and supper) were analyzed for nutrient content, especially Vitamin A, iron and zinc, The analysis was done using the National Nutrient Data base for Standard Reference, Release 26 Software v.1.4 (Table 4.21).

3.9.4 Micronutrient Utilization Risk Factors Module

The responses in this module were computed for frequencies and proportions in the two locations. The results were presented in Tables and pie charts. To test the hypothesis, chi – square was used to test for significance of differences between the risk factors in two locations.

The significant factors identified by the process were then run through logistical regression test, ANOVA and finally cross-tabulated with food security status of households in both locations (Section 4.5).

3.10 Ethical and Legal Considerations

To comply with ethical and legal requirements, the researcher applied for a permit from the relevant authorities including National Commission for Science, Technology and Innovation (Appendix 3), and Ethical Committee of Kenyatta National Hospital / University of Nairobi (KNH/UON) (Appendix 4). In addition the researcher reported to the local administration of the research area including the County Commissioner, the Sub-County Commissioner, the Chief and the Assistant Chiefs (in charge of the villages) as well as County Director of Education. The researcher also assured the respondents of anonymity, confidentiality as well as encouraging them to participate with informed consent. A consent statement accompanying the data collection tools was read out to each of the respondents and only those who consented participated in the study.

CHAPTER FOUR: FINDINGS AND DISCUSSIONS

4.0 Introduction

This chapter contains the findings of the study presented per objective and displayed in bar charts, pie charts and Tables. The results cover :-a) socio demographic /economic characteristics of the respondents b) food access and consumption related behaviors of study respondents c) dietary intake of specified micronutrients (Vitamin A, iron and zinc) by the study participants and d) risk factors for micronutrient utilization resulting from sources of water and environmental sanitation. In addition, discussion relevant to each objective is included. The final sample for the study was composed of 399 respondents, 187 from Kangai and 212 from Mutithi. The respondents had a mean age of 28.1 ± 6.2 for Kangai and 30.4 ± 7.0 for Mutithi locations respectively.

4.1 Objective One: Socio Demographic and Socio Economic Characteristics of Mothers

Objective one of the study addressed the socio demographic and socio economic characteristics of the mothers included in the study. The characteristics studied included marital status, religion, education, age, occupation, house type, amount and sources of income, livestock kept, assets owned, expenditure on food and size of land owned (Figures 4.1 to 4.5 and Tables 4.1 to 4.6)

4.1.1 Marital Status of the Mothers

Using the conventional socially accepted marital categories including married, single, divorced, widowed and separated, the study sought to find out the status of the mothers (Figure 4-1)

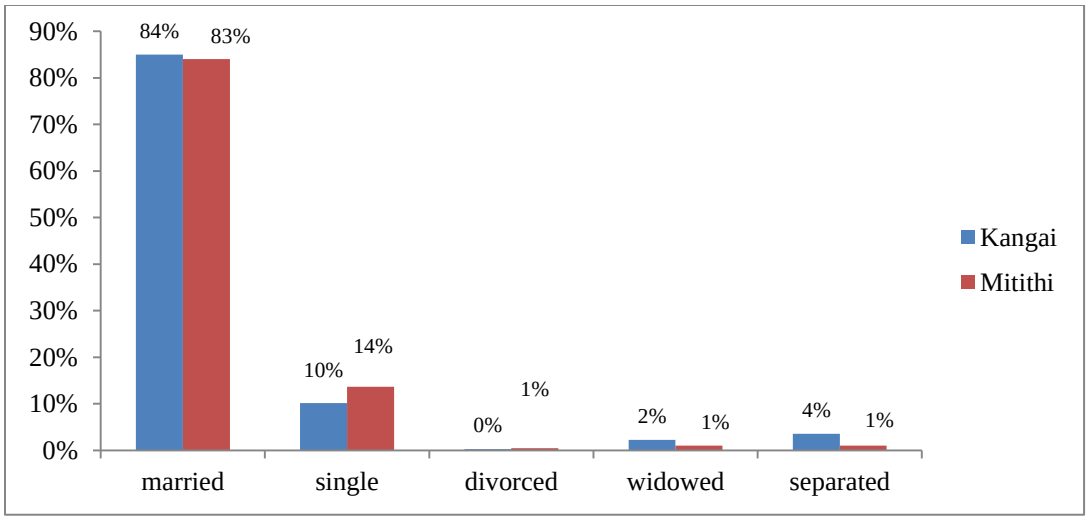


Figure 4-1 Marital Status of the Mothers

Most of the respondents were married 84% in Kangai and 83% in Mutithi respectively. Single mothers were few (10% and 14%) for Kangai and Mutithi respectively while divorced, widowed and separated were even fewer (6% and 2% for Kangai and Mutithi respectively). There were more single respondents in Mutithi than Kangai and the difference was found to be significant using a t- test ($p< 0.05$). The percentage of the respondents categorized as divorced, widowed and separated was small. However, it constituted mothers who carry the burden of caring for the children and things are worse when they are alone. Single, divorced, separated or widowed mothers are also likely to be poor and landless since traditionally women own no land in the study community. In addition, since the study was rural based, the mothers are also likely to be unemployed and heads of their households. Households which are headed by females are likely to be at a risk of food insecurity. On the whole the difference in marital status in the two locations was not significant (p value 0.066; $p > 0.05$ at 95% confidence interval).

The findings of this study were compared with those of AWSC study, (2014). The percentage of married respondents was higher in this study (> 80%) compared to 61% found for Kirinyaga

county by the study done AWSC, (2014). Comparing other categories of marital status, separated, divorced, widowed, this study found only 6.2% while AWSC study, (2014) found 25.1% with majority among this category being widowed (16.2%).

Other studies have found marital status to be an important variable in issues of household food security status. For example, Kaloi et al (2005), in his studies "food security status of households in Mwingi District, Kenya" found that households with married household heads were more food secure than households headed by a single ones. Kaloi et al (2005), also reports more evidence of a positive relationship between marital status and household food security. The authors have cited the findings of a study done in Rhodes Island. In that study, only 17.5% of married women were food insecure compared to 30.8% unmarried ones who were food insecure (Kaloi et al., 2005). The difference in food security status among married and single headed households can be explained by the fact that in married households, there are two grown-ups working together towards meeting the food needs of the household. On the other hand, in single headed households, it is likely to have only one person working, usually a woman, who is also likely to be taking care of the children.

4.1.2 Education Level of the Mothers

The study looked at the education status of the respondents and the findings are shown in Figure 4-2

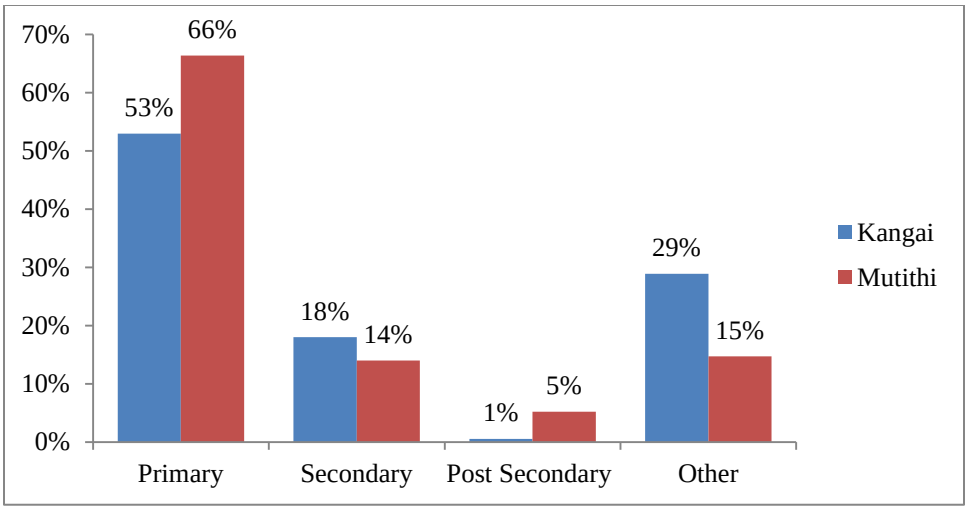


Figure 4-2 Education Level of the Mothers

The results indicated that majority of the respondents had an education because 71% and 85% for Kangai and Mutithi respectively had either completed primary or secondary education. These findings differ from those of AWSC, (2014) which found that 53.4% of their respondents had completed either primary or secondary education. The findings also indicated that a higher proportion of women were educated compared to other African countries. For example, in Ethiopia, the World Food Program (2009) found that only 42.6% of the respondents had an education. The difference in education levels between the two studied locations was tested for significance using a t test. The t- test found the difference in education level of the respondents (mothers) to be significant (P value 0.000; $p < 0.05$ at 95% confidence interval). It has been reported that low maternal education correlates with food insecurity (FAO, 2011). Mothers are responsible for feeding their children and other family members. All mothers need an understanding of foods and various nutrient sources so that they can better utilize the food materials available to them. Ignorance is said to be a cause of food insecurity and can only be eradicated by education. Educated mothers are more likely to get employment, be empowered and can access food for their families through purchasing.

4.1.3 Occupation of the Mothers

Occupation of the respondents was investigated and the findings are shown on Figure 4-3

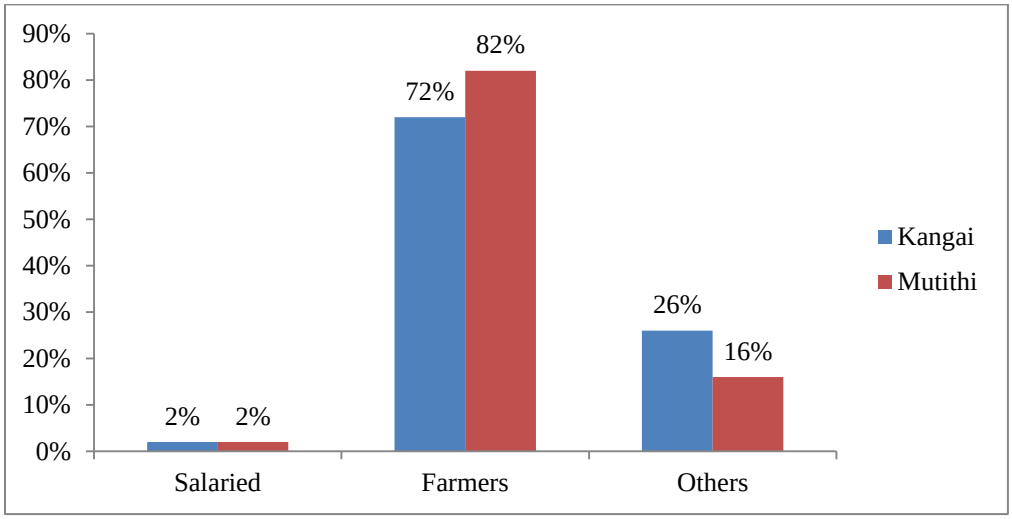


Figure 4-3 Occupation of the Mothers

A very small proportion of the respondents had salaried employment in the two locations studied at 2% in both Kangai and Mutithi. The results indicated that majority of the respondents relied on farming (72% in Kangai and 82% in Mutithi , respectively). The high percentages indicating that mothers engaged in farming tallies with an observation by AWSC, (2014) that agriculture is the main source of livelihood in rural areas. Besides employment and farming, other means of getting livelihood included running small businesses as well as doing casual jobs. On the whole, there were more mothers in Mutithi relying on farming than in Kangai. The t- test found this difference to be significant, (p value 0.000; $p < 0.05$) at 95% confidence interval). Subsistence farming can be a challenge AWSC, (2014), when it is expected to be the means of accessing food for the household. The situation is made worse by droughts which are common occurrence in the study area, uneconomical size of land, and lack of land ownership by women (AWSC, 2014).

Due to gender roles, mothers are expected to produce food and feed their households even when the men (heads of households) are around, and yet they are not allowed to make strategic decisions on land use. For example, a respondent in the AWSC, (2014), reported that "we would have loved to grow other kinds of crops (other than maize) but husbands do not allow us to grow any other type of crop in the farm" (AWSC, 2014). In rural areas, households consume the food they grow. However, if they grow only one type of crop (possibly maize), they are likely to lack food diversity in their diets. At household level, food security can only be assured when a household is able to consume different types of food (from animal and plant sources) in order to ensure provision of adequate macro and micro nutrients.

4.1.4 Type of House wall owned by the Mothers

In this study an investigation on the type of wall, of the house owned by the respondents was done and the findings are shown on Figure 4.4

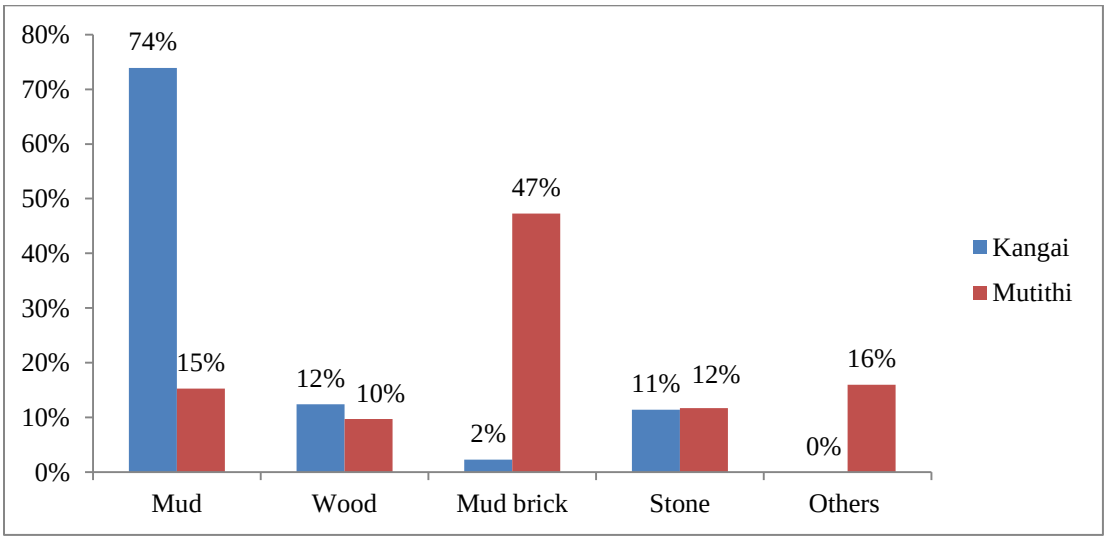


Figure 4-4 Type of House Wall

An observation on walling showed that in Kangai, majority of houses (73.9%) had mud walls while those of Mutithi (47.3%) had mud brick walls. A small percentage of houses (11.4% and 14.7% in Kangai and Mutithi, respectively) had stone walls. Mud walled houses are inferior to stone and wooden ones. The stone and wooden walls predict better socio economic status. The t- test was performed on the wall element of housing. The findings were that the wall materials used in Kangai and Mutithi are significantly different (p value 0.000; $p < 0.05$ at 95% confidence interval).

4.1.5 Type of House Roof and Floor

The findings showed that most houses were roofed with iron sheets except a few, (1.2 %) which were grass thatched. Grass thatched roofs of houses in the community is an indication of poverty which translates to higher risk of food and micronutrient insecurity (Figure 4-5).

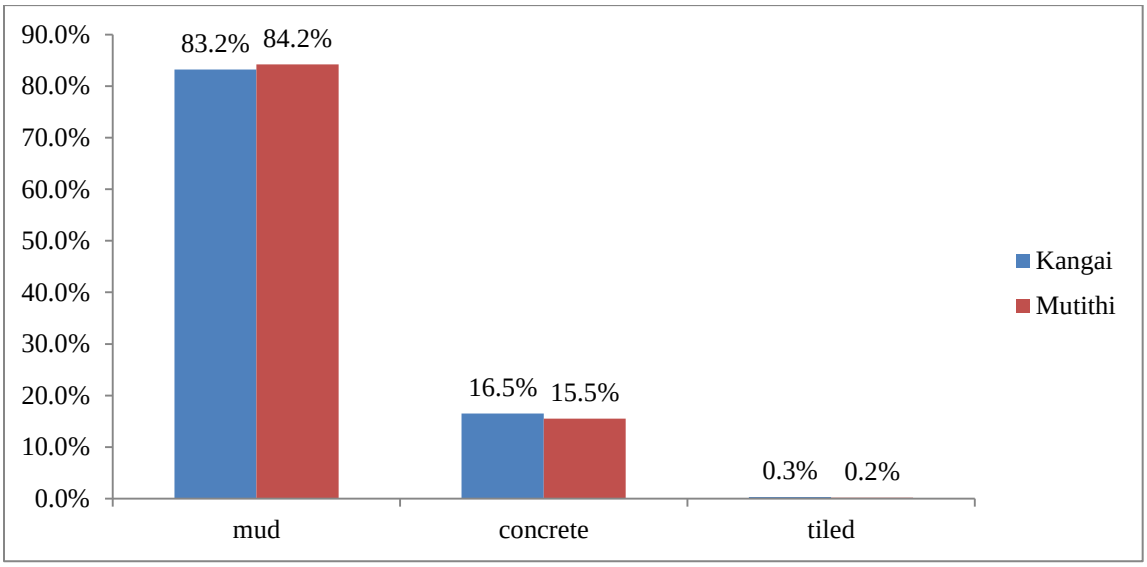


Figure 4-5 Type of House Floor

Majority of households in this study lived in mud floored houses 83.2 % and 84 2 % in Kangai and Mutithi respectively. The house floor constructing materials used in two locations were not significantly different. The type of a house owned by a household is a predicator of socio

economic status (SES). It is a proxy indicator of the respondent's wealth (KU- CFSVA, 2010). The Material used for building a household's dwelling is an indicator of wealth for that household. In rural areas, a house can be constructed using trees found at the farm. The trees can be used for poles to make wall as well as roof structure. The covering of the wall is then done with mud (made by mixing soil with water). The roof can be covered by grass (grass for the roof is grown specifically for the purpose). The floor finishing is done by compressing the soil and leveling. This means that a house can be built very cheaply. On the other hand, rich households build houses which portray their SES status by using natural stones for walls instead of mud, corrugated iron sheets or clay tiles for roofs and concrete or ceramic tiled floors instead of earth. The latter type of houses are easier to keep clean and hence more hygienic.

4.1.6 Source and Level of Income (Ksh) generated by the Mothers

The study sought to know the sources and the amount of income generated by the respondents per month and the findings are shown in Table 4-1

Table 4-1 Monthly Income by Source (in Kenya shillings)

Location	Income	Employment		Business		Farming		Total	
		N	%	N	%	N	%	N	%
Kangai:	<1000	15	8	26	14	100	53	141	75
	1001 - 3000	1	1	2	1	19	10	22	12
	3001-5000	1	1	1	1	10	5	12	6
	5001>	4	2	1	1	7	4	12	6
	Total	**21**	**11**	**30**	**16**	**136**	**72**	**188**	**100**
Mutithi:	<1000	8	4	21	10	130	61	159	75
	1001 - 3000	1	0	3	1	31	15	35	17
	3001-5000	1	0	1	0	9	4	11	5
	5001>	3	1	1	0	3	1	7	3
	Total	**13**	**6**	**26**	**12**	**173**	**82**	**212**	**100**

The study established that subsistence farming was the main source of income for majority of the respondents (72% and 82% for Kangai and Mutithi respectively). Where most of them earned between Ksh 1,000 and 5,000 per month from farming activities. Only a few (4% Kangai and 1% Mutithi) earned more than Ksh.5000. There were very few respondents earning income through business (16% in Kangai and 12% in Mutithi). Majority of the businesses yielded only Ksh. 500 to 1000 per month. Unemployment was high and the few who had jobs earned little money Ksh 500 to 1000 per month with only 1.0 % of the respondents earning more than Ksh 5000. The amount of money earned is likely to be from casual employment and may not sustain a living for a household.

In the rural area where the study was done, majority of the study participants depended on subsistence farming which has a lot of challenges since the area receives very low rainfall (approximately 445.8 mm/annum, Mutero et al., 2003). The farming yielded little earning (Ksh. 500 to 2000 per month. This amount is below the minimum requirement of Ksh 1562 per person per month (Ksh 4686 per 3 member household) to be above the poverty line (GoK 2005). The earnings from farming may not protect households in the study area from food insecurity and micronutrient deficiencies.

4.1.7 Livestock Owned

The study sought to find out the types of livestock owned by the respondents (Table 4-2).

Table 4-2 Livestock Kept by Location

Livestock kept	Kangai location		Mutithi location	
	N	%	N	%
Cows	90	48	69	33
Goats	31	17	26	12
Sheep	1	1	2	1
Chicken	39	21	54	25
Rabbits	5	3	3	1
None	21	11	58	27
Total	187	100	212	100

The most popular livestock were cows and goats which were owned by 65% and 45% of Kanga and Mutithi respondents respectively. Smaller livestock, chicken and rabbits, which are easy to maintain, were owned by a smaller percentage of the respondents, 24% and 27% in Kangai and Mutithi respectively. In reference to the type of livestock commonly raised, this study agrees with findings of KU- CFSVA, (2010). The KU- CFSVA found that the most popular livestock kept by the respondents were chicken, cows and goats in that order while in this study , the most popular livestock were cows (owned by over 70% of the respondents) followed by chicken and finally, the goats.

According to Kenya Integrated Housing and Budget Survey (KIHBS, 2007) reported in KU-CFSVA, (2010) , animal products are expensive and constitute 11.4% of the household expenditure .This percentage is used to purchase animal products (milk , meats, eggs , cheese, sausages).These products are expensive and not easily accessible in rural areas where unemployment may be expected to be high. The reason for including livestock in this study was due to their contribution in reduction of household food insecurity and micronutrient deficiencies. All livestock can be sold to facilitate access to food. Cows and goats produce milk

which can cushion household members from micronutrient insecurity (deficiencies). In addition, small livestock (chicken and rabbits), which are easy to keep, can be eaten to provide high quality animal proteins as well as micronutrients. Ownership of livestock is a sign of food security (Morris et al., 2000; KU- CFSVA, 2010).

4.1.8 Assets Owned by the Mothers by Location

Asset ownership was also investigated and the findings are shown on Table 4-3

Table 4-3 Types of Assets Owned by Location

Asset	Kangai location		Mutithi location	
	N	%	N	%
Car	4	2%	2	1%
Bicycle	113	60%	60	28%
Motorbike	5	3%	6	3%
Radio	41	22%	78	37%
Television	2	1%	1	0%
None	22	12%	65	31%
Total	187	100%	212	100%

Most households owned bicycles (60.4% in Kangai and 28.6% in Mutithi). They also owned radios, 21.9% in Kangai and 36.8% in Mutithi. A small percentage (2.1%) and 9%) from Kangai and Mutithi respectively owned cars. The importance of asset ownership is that they can be sold in times of crisis to access food for the household. However, since the assets are luxury goods, it is reasonable to assume that household owning assets are food secure unless they have a calamity. Asset ownership is used to estimate wealth in rural Africa (WFP, 2011; Morris et al., 2000; Schellenberg et al., 2003). In this study, only luxury assets were considered. It was assumed that assets like radio, car, bicycle and motor bike can only be bought after basic needs are satisfied and hence, a household that has them is more food secure than one without.

4.1.9 Household Expenditure on Food among the Mothers by Location

The respondents were asked to indicate their weekly household expenditure on food per week. The Figure they gave was multiplied by four to get the monthly expenditure (Table 4-4). The weekly data was used derive the monthly data so as to reduce the recall bias.

Table 4-4 Amount of Money Spent on Food per Month by Location

Expenditure on food (per month, in Ksh)	Kangai location		Mutithi location	
	N	%	N	%
400-799	4	2%	3	1%
800-1599	4	2%	5	2%
1600-2399	29	16%	8	4%
2400-3199	36	19%	36	17%
3200 plus	114	61%	160	75%
Total	187	100%	212	100%

The study found that most of the respondents (61% from Kangai and 75% from Mutithi) spent more than Ksh3200 per month on food. However, the findings were also that 39 % and 25% spent < Ksh 3200 per month. It has been suggested that a household in the rural area that spends less than Ksh. 2913 per person per month (at least Ksh 8739 per household per month) lives below the poverty line (USAID 2013). It should be noted Ksh 2913 per person per month is just about Ksh 97 per person per day. In this study, 39.0% in Kangai and 25.6% in Mutithi respectively, spent between Ksh. 400- 3200 per month per household respectively. The smallest household in this study was expected to have two members, mother and child. It is therefore obvious that a family that spends between Ksh. 400 – 3200 per month is living below the cut-off point by the Kenyan standards. Nevertheless, it is known that a household in rural set up may manage on the Ksh. 2913 or less per capita. This is because most of the food materials including

grain, milk and vegetables are not always purchased by cash. They are normally available from the small holdings.

On the other hand, there are normally spells of droughts which cause crop failure forcing households to have cash for purchasing all food and non-food requirements. In this case, unavailability of the minimum amount of money to spend on food means poverty, or inability to access food. It is actually a concern when 74% of Mutithi respondents spent > Ksh 3200 per month. This may be an indication that they relied on purchased food other than food from their farms while results showed that they earned very little (Ksh 500 -2000). It has also been suggested that low income families are unable to afford frequent consumption of foods especially those of animal origin (Folaranmi, 2012). This is an indication of poor food access.

4.1.10 Household Food Expenditure by Occupation

The researcher tabulated the household food expenditure by occupation in order to see the relationship (Table 4-5).

Table 4-5 Household Food Expenditure per Month by Occupation

Income per month (Ksh)	Salaried employment		Farmer		Other		Total	
	N	%	N	%	N	%	N	%
400-799			5	2	1	1	6	2
800-1599			8	3	1	1	9	2
1600-2399	2	25	26	8	9	13	37	9
2400-3199	0	0	56	18	16	24	72	18
3200 >	6	75	224	70	23	34	271	68
Total	8	100	320	100	68	100	396	100

The findings are that 75% of the respondents who were farmers and employed spent more than Ksh 3200 per month on food. Looking at the incomes of the two categories (section 4.1.1.7), it was found that they also earned more income > Ksh 5000 from their respective occupations (livelihoods). However, looking at the food security status, it was found that farmers were the most food insecure. This may be interpreted to mean that, although majority of farmers (75%) spend more than ksh.3200, they do not spend the money on food. May be they spend the money on farming inputs.

4.1.11 Size of land owned by mothers per location

The issue of land size owned by respondents was investigated (Table 4.6)

Table 4-6 Size of Land Owned in Acres by Location

Size of land owned:	Kangai location		Mutithi location	
	N	%	N	%
No land	0	0%	48	23%
< 1acre	160	86%	33	16%
1-3acre	24	13%	128	60%
> 3acre	3	2%	3	1%
Total	187	100%	212	100%

The results were that most of the respondents in Kangai (86%) had less than 1 acre, while in Mutithi 60.4% of the respondents possessed 1-3 acres of land. This indicates that all the study households had far less than the over 3 acres recommended for Northern Rakhine State by WFP, (2011) and far less than the 12 acres recommended for Kenya (section 2.2.7: land ownership). However, the mean of 1.28 acres land size is more than the mean land holding size of 0.0958 Ha (0.2 acres) for the whole of Kirinyaga County (KCDP, 2013).

4.1.12 Hypothesis Testing on Demographic and Socio Economic Variables

This study looked at several demographic and socio economic variables including marital status, education as well as occupation, type of the family house, sources and amount of income generated, livestock kept, assets ownership, amount of money spent on food and the size of land owned by the household. These variables can predict household food security status and dietary micronutrient intake of the respondents. The null hypothesis for the study was that there was no significant difference in socio demographic and socio economic characteristics of mothers from Kangai and Mutithi locations of Mwea West Sub County. The hypothesis was tested using several tests including: t tests, chi square, logistical regression and analysis of variances (ANOVA).

4.1.14.1 (t)-test on Demographic and Socio Economic Variables

The t-test was used to test whether there were significant differences between the two locations (Kangai and Mutithi) in regard to all the independent demographic and socio economic variables used in the study. The variables included land size, household income, age of household head, and the amount of money spent on food (Table 4-7).

Table 4-7 (t)-test on Demographic and Socio Economic Variables

Demographic characteristic	T	Sig. (2-tailed)
Marital status of the woman	2.758	.066
Religion of household head	-2.725	.007
Gender	5.923	.510
Age in years	-5.370	.072
Occupation	10.938	.000
Education	5.350	.000
Type of house wall	-14.165	.000
Type of house floor	.803	.422
What are your sources of income?	5.893	.000
How much land do you have? Acres	-5.579	.000

Findings show p< 0.05 for occupation, education, type of house wall, and income of household head. The conclusion of t-test was that the demographic and socio economic characteristics in a Kangai and Mutithi are significantly different. The null hypothesis is therefore rejected.

4.1.12 Chi square test on demographic and socio economic variables

The chi square was used to compare the proportions of all independent demographic and socio economic variables used in the study (Table 4-8).

Table 4-8 Chi square test on Demographic and Socio Economic Variables

Demographic characteristic	Pearson Chi-Square	P-value
Marital status of the household head	8.946	.062
Religion of household head	29.640	.000
Gender	38.434	.410
Age in years	74.299	.061
Occupation	120.713	.000
Education	99.062	.000
Type of house wall	204.435	.000
Type of house floor	1.210	.041
Income of household head	73.663	.000

The test indicated that the following variables were significantly different in the two locations studied: religion of household head, occupation, education, type of house wall, and income of household head each with a (p< 0.05). The conclusion of chi square test was that the demographic and socio economic characteristics in a Kangai and Mutithi are significantly different. The null hypothesis is therefore rejected.

4.1.14.3 Logistical Regression Test on Demographic and Socio Economic Variables

Logistical regression test was used to determine the most important demographic and socio economic factors in reference to food security status and dietary micronutrient intake, for the mothers in Mwea West, Kirinyaga County (Table 4-9).

Table 4-9 Logistic Regression Test on the Demographic /Socio Economic Variables

Variable	Coefficients:	Std. Error	p- value
(Intercept)	0.2292	0.7073	0.746
Occupation	-0.8589	0.2447	0.005 *
House wall	5.196	0.8283	0.000*
Land size /acres	0.9052	0.3134	0.004 *

Significant codes: '*' 0.05

From Table 4.10, the occupations of mothers in the two locations were significantly different. Likewise, the type of the house walls was different, and the difference was significant. In addition households' expenditure between Kangai and Mutithi was significantly different ($p<0.05$). The last demographic/ socio economic group of factors is one involving occupation (business as well as farming). The percentages of respondents who were in the two categories of occupation were different and the difference was significant at $p< 0.05$). Therefore, we reject the null hypothesis.

4.1.14.4 Results of analysis of variances on demographic socio economic variables

The variables were further tested using ANOVA. This test was used to identify the most critical variables in socio economic model (Table 10).

Table 4-10 ANOVA on demographic socio economic variables

Social economic variable	Sum of Squares	Mean Square	F	p-value
Occupation	198.309	198.309	130.393	.000
Education	758.633	758.633	45.123	.000
Type of house wall	462.479	462.479	375.267	.000
Type of house roof	0.118	0.118	4.742	.030
Sources of income	227.037	227.037	65.169	.000
Size of land owned	28.144	28.144	41.845	.000

The ANOVA for the demographic and socio economic factors also revealed that occupations, education, type of house wall, sources of income and size of land were statistically significant at the two locations ($p< 0.05$ at 95 % confidence interval). The results of the four tests, namely, t test, chi square, regression and ANOVA, suggest that we reject the null hypothesis.

4.2 Objective Two: Household's Food Access and Consumption Behaviors

4.2.1 Introduction

Objective two of the study addressed the issue of food access and consumption related behaviors by mothers, and the households as a whole three months prior to the study. The objective tested food access which refers to affordability of food for household members as well as usage of food grown by the household. Access to food depends on whether the household has enough income to purchase food at the prevailing prices especially when own grown food runs out. The aim of this part of the study was to assess the behavior of the respondent (woman /mother), and household as a whole when food access is limited.

4.2.2 Mother's Food Access and Consumption Behaviors by Location

The first set of data was collected from the locations in the months of January and February 2013. These months are dry and food crops planted during short rains (October / December) are expected to have matured. Data collection was repeated during a rainy / wet season (April/ May 2013). The two data sets were used to assess the mothers' food access and consumption behaviors in times of inadequate food supply in the household (Table 4-11)

Table 4-11 Mother's Food Access and Consumption Behavior by Location during Dry Season

Access and consumption behavior	Dry season				
	Kangai		Mutithi		t-test
	F	%	F	%	p- value
Cut size of meal	44	23.5	157	74.1	0.00
Did not eat a whole day	20	10.7	62	29.2	0.592
Ate less than felt was enough	59	31.6	150	70.8	0.00
Felt hungry but could not eat	42	22.5	57	26.9	0.008

4.2.2.1 Mother's Food Access and Consumption Behaviors by Location during the Dry Season

The results indicated that, the mothers in Kangai, within a period of 3 months during the dry /harvesting season: 23.5% had skipped a meal, 10.7% did not eat the whole day, and 31.6% had eaten less than they felt was enough, while 22.5% felt hungry but could not eat. Within the same period, results from Mutithi indicated that 69% skipped meal, 5.5% did not eat a whole day, 58% ate less than they felt was enough, and 5.5 % felt hungry but could not eat. The findings showed that there were more mothers in Mutithi than Kangai showing undesirable characteristics related to food insecurity. This may indicate that, although data were taken during the dry harvesting period, there was not enough food harvested by Mutithi mothers.

A statistical test (t- test), was applied to all responses relating to mother's food access and consumption behavior by location.

According to the t- test all the responses for the mothers from the two locations were significantly different except one "did not eat the whole day" at 95% confidence interval. In rural areas, majority of people depend on farming for food and other needs. This may mean that the food crops they harvest may be sold to get money for other non-food needs, for example education of the children, medical expenses among others.

4.2.2.2 Mother's Food Access and Consumption Behaviors by Location during the Wet Season

The second set of data were collected during a rainy / wet season (April/ May 2013), and was used to assess the mothers' food access and consumption behaviors in times of inadequate food supply in the household (Table 4-12).

Table 4-12 Mother's Food Access and Consumption by Location during the Wet Season

Access and consumption behavior	Wet season				
	Kangai		Mutithi		t-test
	F	%	F	%	p- value
Cut size of meal	74	36.8	138	69	0.602
Did not eat a whole day	45	22.4	11	5.5	0.009
Ate less than felt was enough	84	41.8	117	58	0.309
Felt hungry but could not eat	75	37.3	11	5.5	0.102

The findings for season (Table 4-12 indicated an increase in percentage of Kangai mothers who: - cut meals from 23.5% to 36.8%; did not eat a whole day from 10.7% to 22.4%; ate less than felt was enough from 31.6% to 41.8%; felt hungry but could not eat from 22.5% to 37.3 %; lost

weight due to lack of food from 35.3% to 37.8%. On the contrary, a decrease in percentage was observed among Mutithi mothers who :- cut meals -from 74.1% to 69.0% ; did not eat a whole day – from 29.2% to 5.5% ; ate less than felt was enough from 70.8% to 58.5% ; felt hungry but could not eat from 26.8% to 5.5 % ; lost weight due to lack of food 74.5% to 63.0% .

A statistical test (t- test), was applied to all responses relating to mother's food access and consumption behavior by season (Table 4.12. According to the test, the difference in food access and consumption behavior is not statistically significant except for one variable "did not eat a whole day". This may imply that the respondents face challenges of food access and consumption during both dry and wet seasons. It can therefore, be concluded that the respondents encounter **chronic** low food security.

Households experience food shortages during the rain seasons. They are likely to have sold out food that was harvested during the previous season in order to take care of nonfood needs. In addition, food becomes expensive in the market. During this time, any food purchases may include cereals only leaving out vegetables and fruits which are essential for provision of micronutrients. During this time, households may experience hunger and hence result to adaption of coping strategies which are harmful to the household members especially mothers.

4.2.2.3 Mother's Food Security Status by Location

Using the Health Canada Household Food Security Survey Model (HFSSM 2012; Table 3.4), mother's food security status by location was found as shown on Figure 4.6

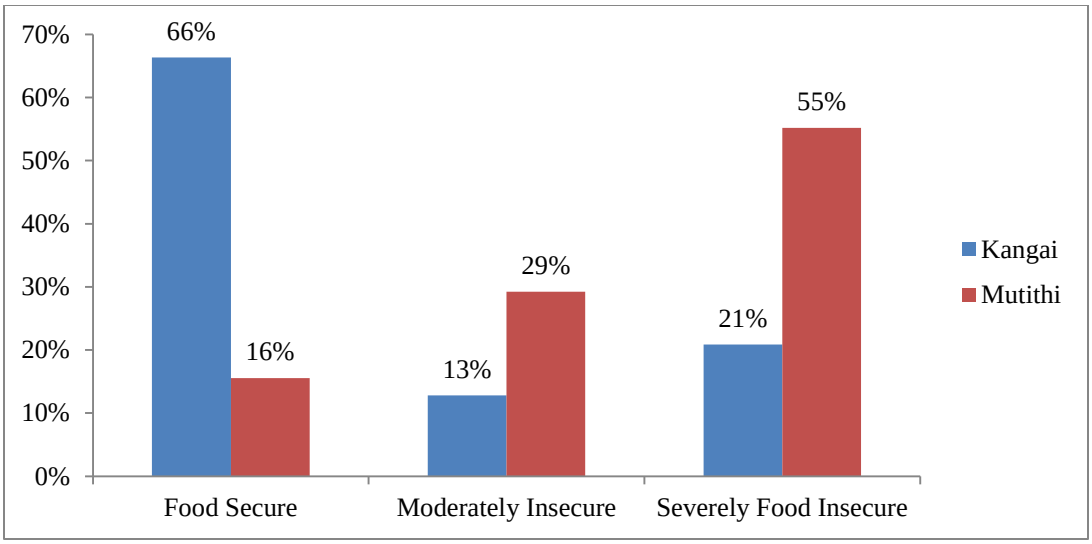


Figure 4-6 Mother's Food Security Status by Location

When comparing household food security status for Kangai and Mutithi respondents (mothers), the findings were that more of the Mutithi mothers (55%) were severely food insecure compared to 21% of the Kangai mothers.

4.2.2.4 Overall Mother's Food Security Status

Using the Adapted Health Canada, Household Food Security Survey Model (HFSSM 2012), the mother's food security status was found as shown on Figure 4.7

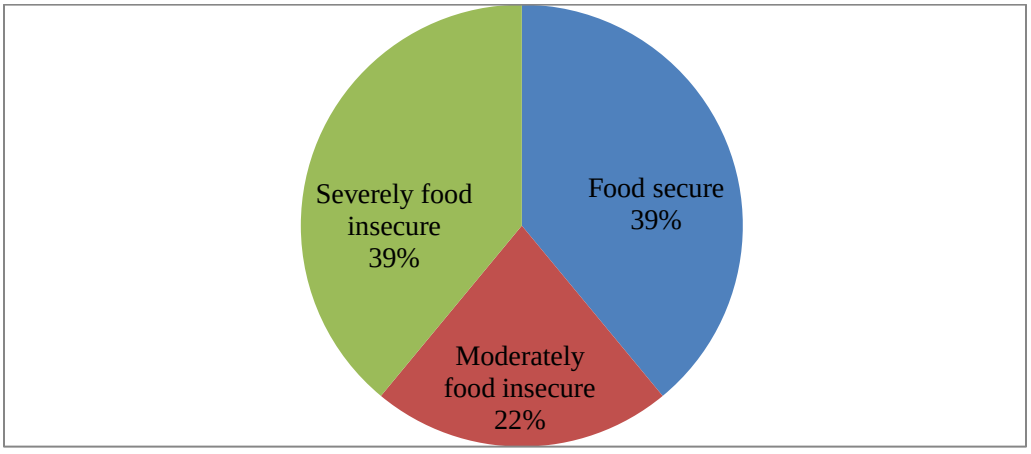


Figure 4-7 Overall Mother's Food Security Status

The findings were that 61% of the women (mothers) were food insecure, with 39% being severely food insecure and 22% being moderately food insecure. These findings are different from those of study on food insecurity done in Mwingi. In their study on household food insecurity in Mwingi, Kaloi et al (2005), found that 38% of their respondents were food insecure while 62 % were food secure.

4.2.3 Households Food Access and Consumption Behaviors by Location

The study of food access and consumption was extended to the household. The first set of data were taken during the dry season while a second set was taken during the wet season.

4.2.3.1 Household's Food Access and Consumption Behaviors by Season.

The data were related to anxiety and perception about food quality and quantity for the household

Table 4-13 Household's food access and consumption behaviors during the dry season

Food access and consumption variables	Dry season				
	Kangai		Mutithi		t-test)
	F	%	F	%	p- value
Worried that food would run out before next crop	126	62.7	137	68.5	.268
Food harvested did not last	117	58.2	125	62.5	.159
Could not eat more than one type of food	116	57.8	113	66.0	.224
Borrowed money for food	88	43.8	109	51.4	.510

The findings for dry season, using (HFSSM, 2012; Table 2.4), showed that households in Mutithi had a higher food access and consumption behavior than Kangai as follows: Worried that food would run out before next crop was ready (Mutithi 84.0%; Kangai 52.9%); food

harvested did not last (Mutithi77.4%; Kangai 45.4%); could not eat more than one type of food (Mutithi 71.1%; Kangai 28.4%); borrowed money for food (Mutithi 68.4%; Kangai 34.2%).

The hypothesis that there was no significant difference in household food access and consumption by households living in Kangai and those living in Mutithi was tested using t- test. The test showed significant difference ($p>0.05$) in food access and consumption behavior in the two locations. The conclusion was that the null hypothesis was not rejected. Although mothers from both Kangai and Mutithi showed characteristics of low food security, there were more mothers in Mutithi showing those characteristics than in Kangai and the difference was significant ($p< 0.05$ at 95% confidence interval).

4.2.3.2 Household's Food Access and Consumption Behaviors During the Wet Season

Table 4-14 Household's food access and consumption behaviors during the wet season

Food security Pillar	Food access and consumption variables	Wet season				
		Kangai		Mutithi		t-test
		F	%	F	%	p- value
Availability	Worried that food would run out before next crop	99	52.9	178	84.0	.000
Availability	Food harvested did not last	85	45.4	164	77.4	.000
Utilization	Could not eat more than one type of food	53	28.4	152	71.1	.000
Access	Borrowed money for food	64	34.2	145	68.4	.000

The findings were that mothers from both locations worried that: - food would run out before next crop was ready; food harvested did not last; family could not eat more than one type of food and also borrowed money for food. However, during the wet season, the percentages rose for Kangai while they decreased for Mutithi.

A test statistics (t- test) was applied to the responses for the household's food access and consumption by season .The t-test showed that there was no significant difference (insignificant) in food access and consumption behavior in the two different seasons.

This study concludes that the low food security status evidenced by the data is of chronic nature and does not improve by season. (Orson, 2005; Tarasuk, 2001). As a result, mothers indicate characteristics of food insecurity and this can manifest into malnutrition.

4.2.3.3 Household's Food Security Status by Location

Using the adapted Health Canada's Household Food Security Survey Model (HFSSM 2012; Table 3.4), the household's food security status by location was found as shown on Figure 4.8

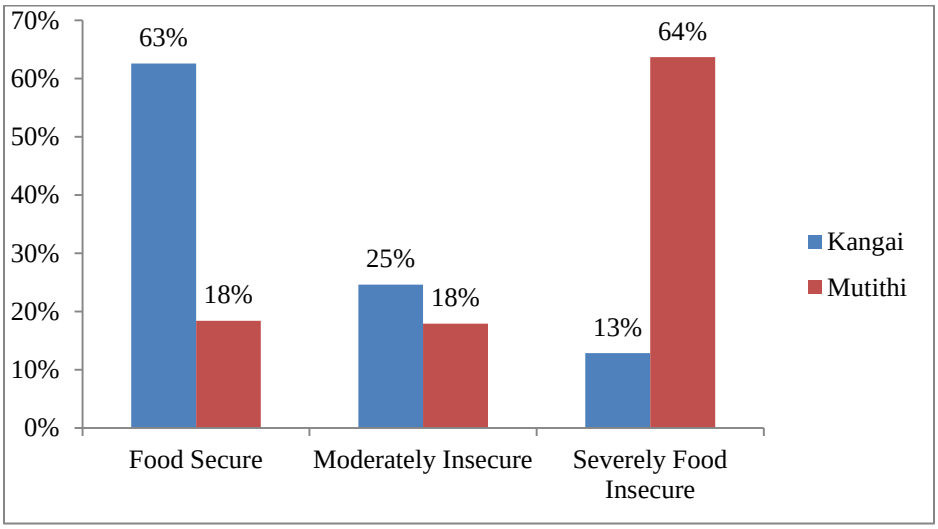


Figure 4-8 Household's Food Security Status by Locations

When comparing household's food security status for Kangai and Mutithi locations by examining anxiety and perceptions, the findings were that more of the Mutithi households (64%) were severely food insecure compared to 13% of the Kangai ones. On the other hand,

more of the Kangai households (63%) were food secure compared to only 18% of the Mutithi ones.

4.2.3.4 Overall Households' Food Security Status

Using the Health Canada Adapted Model, the Household Food Security Survey Model (HFSSM, 2012), the household's food security status for the two locations was found as shown on Figure 4.9

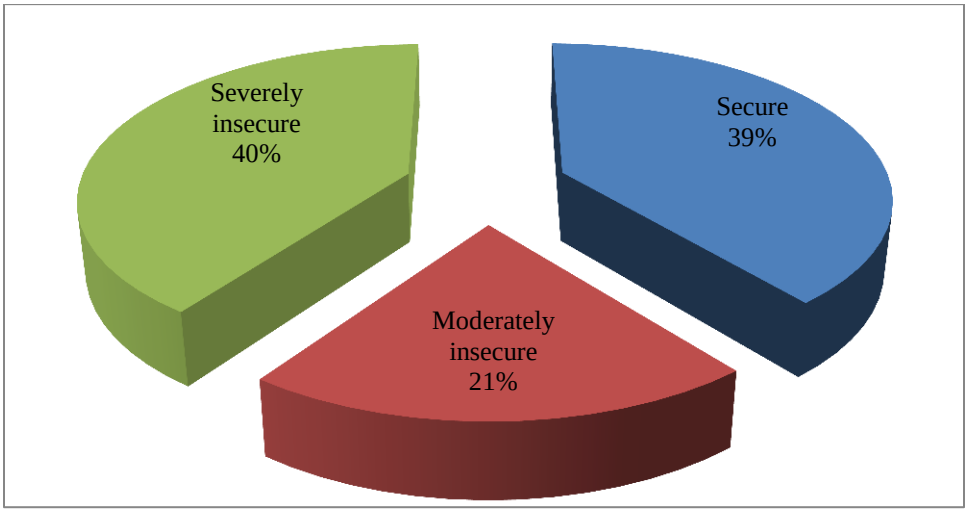


Figure 4-9 Households' Food Security Status

On the whole, 39% of studied households were food secure, 21% were moderately food insecure while 40% were severely food insecure.

4.3 Objective Three: Mother's Dietary Intake of Micronutrients

4.3.1 Introduction

This section presents the results of an assessment of dietary intake of micronutrients (Vitamin A, iron and zinc) rich foods in Kangai and Mutithi locations during dry and wet seasons. The assessment was done using two techniques: a) the 4 week food consumption frequency and b) observation of meals as they were prepared.

4.3.2 Findings from Food Consumption Frequency

The results of food consumption frequency were presented in terms of food groups, location and season. The food groups included fats and oils, animal products, yellow /orange fruits, yellow orange vegetables as well as dark green vegetables.

4.3.2.1 Consumption Frequency of Fats and Oils Food Group

Data were collected during the dry and wet seasons and, the respondents from two locations were asked how often they consumed specific fats and oils (Table 4-15).

Table 4-15 Consumption Frequency of Fats and Oils Food Group by Location and Season

Food group: Fats &oils	Consumption frequency	Kangai N=187		Mutithi N=212		P value (season)	P value (location)
		Dry season %	Wet season %	Dry season %	Wet season %		
Margarine	Daily	4	2	1	1	.058	.226
	2-4 times/week	6	4	1	2		
	Once a week to Once in 2 weeks	10	10	6	16		
	Once a month to once in 3 months	10	8	26	38		
	Never	69	78	65	43		
Cod liver oil	Daily	4	3	0	1	.453	.000
	2-4 times a week	1	1	0	0		
	Once a week to once in 2 weeks	3	4	0	2		
	Once a month to once in 3 moths	5	7	4	5		
	Never	89	87	95	93		

The findings were that in Kangai, margarine and cod liver oil were never consumed by majority of the respondents (69% and 89%) respectively during the dry season while only 4% of them consumed the two products daily during that period . The proportions of those who never consumed the products remained high during the wet season at 78% and 87% for margarine and cod liver oil respectively. On the other hand, margarine and cod liver oil were consumed at least once a week by 20% and 8 % of the respondents respectively during the dry season while the same product was consumed by 16% and 8 % of the respondents during the wet season. On the whole both margarine and cod liver oil were consumed less than 3 times a week by more than 75 % of the respondents in both wet and dry seasons.

In Mutithi, the findings were that, margarine and cod liver oil were never consumed by 65% and 95% during the dry season. During the wet season, there was a slight change as 43% and 93% never consumed margarine and cod liver oil respectively. On the positive side, margarine was consumed by 8% of the respondents at least once a week during the dry season while the same product was consumed by 19% of the respondents at least once a week during the wet season while cod liver oil was not consumed. A (t) test was used to test the significance of differences of consumption of fats and oils between the seasons. Although the proportions of the respondent's never consuming margarine and cod liver oil during two seasons looked different, the difference was not statistically significant ($p > 0.05$). However, the consumption remained very low during the two seasons.

A t- test was repeated to check whether the difference in consumption of fats and oils between the two locations was significant. It was noted that consumption of cod liver oil was significantly different between Kangai and Mutithi (P value .000; $p < 0.05$ at 95% confidence interval. On the other hand consumption of margarine was not significantly different although it was very low in the two locations.

4.3.2.2 Consumption Frequency of Animal Products Food Group

Information sought to find out how often animal products were consumed by the mothers during the dry and wet seasons (Table 4-16).

Table 4-16 Consumption Frequency of Animal Products Food Group by Location and Season

Food group:	Consumption frequency	Kangai		Mutithi		p-values	
		Dry season %	Wet season %	Dry season %	Wet season %	P (sea)	p (Loc)
Meat	Every day	4	3			.082	.000
	2- 4 times a week	19	11	5	4		
	Once a week to once every two weeks	33	38	12	13		
	Once a month to once every 3 months	34	35	64	66		
	Never	11	14	19	17		
Fish	Every day	2	0			.733	000
	2- 4 times a week	6	6	1	2		
	Once a week to once every two weeks	8	21	28	26		
	Once a month to once every 3 months	21	15	55	57		
	Never	63	58	16	15		
Eggs	Every day	8	4	2	2	.031	000
	2- 4 times a week	15	16	11	12		
	Once a week to once every two weeks	41	40	73	72		
	Once a month to once every 3 months	22	21	13	13		
	Never	14	19	2	2		
Milk	Every day	92	94	93	94	024	.086
	2- 4 times a week	2	0	2	3		
	Once a week to once every two weeks	4	3	3	3		
	Once a month to once every 3 months	1	1	0	0		
	Never	1	2	1	1		

In Kangai, during dry season, the animal product consumed by most of respondents was milk. It was consumed every day by 92% of the respondents. However, milk is likely to be used for making tea beverage other than for making any other dish in the studied community. Eggs were consumed at least once a week to once every two weeks by 41% of the respondents. Meat was consumed once a month by 34% of study participants. This finding was different from that of

AWSC, (2014). The AWSC, in their baseline survey on Kenya National food security status found that 46% of their respondents consumed meat (animal product) at least 4 times within seven days. Fish was never eaten by 63% of the respondents, although it was consumed at least once a month by 21% of the participants.

During the wet season the consumption of milk increased by 2% (from 94% - 96%). This could be explained by an increase of milk in the market during the rainy season. The consumption of eggs was well distributed with the majority of the respondents (40%) eating the product once a week to once in two weeks. Eggs may be easier to get than other animal products and they provide give high quality proteins and micronutrients. Majority of the respondents consumed meat once every week to once every two weeks (39%) and also once a month to once every three month (35%). In regard to fish consumption, the percentage of people who had never consumed the product dropped by 5% (from 63% - 58%).

On the whole the findings were that the consumption frequency for Kangai did not vary by season. In Mutithi during the dry season, milk was consumed daily by 93%. Eggs were the next popular products and they were consumed once a week to once every two weeks by 73% of the respondents in the dry season. Meat and fish were consumed once a month to once every three months by 64% and 55% of the respondents, respectively. The pattern of consumption did not change during the wet season. Milk was the most frequently consumed product and was consumed daily by 94% of the respondents. The next best consumed product was eggs and they were consumed by 72% of the respondents once a week to once every two weeks. On the other hand meat and fish were still consumed once a month to once every three months by 66% and

57% of the respondents respectively. The consumption pattern showed little variations during the seasons. However, some variations were noted between the locations.

To test the significance of differences of consumption of animal products (meat, fish, and eggs milk) between the seasons, t- test was applied .There was no significant difference in the consumption of Meat, Fish, Eggs, Milk between the dry and the wet seasons ($p > 0.05$). Among the animal products (Table 4.16) showing meats, fish, eggs and milk), milk was the only one which was consumed daily by more than 80% of the study group in the two locations. However, the Kangai respondents had better consumption of animal products than the Mutithi ones. For example, 4% and 2% of the Kangai respondents consumed meat and fish daily while none of the Mutithi respondents consumed the product daily.

Considering consumption frequency of 2- 4 times a week, Kangai had better results showing that 19% and 6% of the respondents consumed meat and fish respectively 2-4 times a week compared to 4% and 5% of Mutithi respondents who consumed the products with the same frequency. However, Kangai had more respondents (66%) never consuming fish than Mutithi (28%). On the whole, Mutithi respondents were worse off than the Kangai ones on frequency of consumption of meat, eggs and milk, but had better consumption of fish.

A (t) test was used to check the significance of differences in consumption of animal products between Kangai and Mutithi respondents. Except for milk, the consumption of animal products was significantly different between the two locations, with Kangai respondents consuming the products more frequently than the Mutithi ones. However, the finding on the consumption of fish was that there were more respondents from Mutithi consuming fish than from Kangai.

This could be because most Mutithi respondents lived near Tana River. It can be assumed that the respondents accessed fish from the river.

4.3.2.3 Consumption frequency of yellow/ orange fruits food group

Data was collected during the dry and wet seasons and the respondents from the two locations were asked how often they consumed yellow /orange fruits (Table 4.17). The fruits are rich in Beta carotene which is converted by the body to Vitamin A.

Table 4-17 Consumption frequency of yellow/orange fruits food group by location and season

Food group: yellow /orange fruits	Consumption frequency	Kangai		Mutithi		p value	
		Dry %	Wet %	Dry %	Wet %	Season	Loc*
Pawpaw	Every day	33	14	11	4	.357	.000
	2- 4 times a week	19	38	6	16		
	Once a week to once every two weeks	27	38	51	34		
	Once a month to once every 3 months	17	7	9	7		
	Never	5	4	0	2		
Ripe Bananas	Every day	24	8	5	1	.229	.601
	2- 4 times a week	18	31	9	17		
	Once a week to once every two weeks	43	54	52	40		
	Once a month to once every 3 months	14	6	4	4		
	Never	2	2	1	0		
Guava	Every day	10	7	19	1	.873	.002
	2- 4 times a week	2	10	1	1		
	Once a week to once every two weeks	6	27	3	3		
	Once a month to once every 3 months	46	28	7	7		
	Never	37	31	59	47		
Oranges	Every day	5	0	6	0	.263	.000
	2- 4 times a week	13	12	4	1		
	Once a week to once every two weeks	17	34	17	49		
	Once a month to once every 3 months	35	36	39	5		
	Never	29	21	8	23		
Mangoes	Every day	89	1	68	1	.000	.000
	2- 4 times a week	2	6	4	0		
	Once a week to once every two weeks	5	36	14	3		
	Once a month to once every 3 months	3	59	1	2		
	Never	2%	1%	2%	47%		
Passion	Every day	19	1	4	0	.251	.005
	2- 4 times a week	11	23	5	2		
	Once a week to once every two weeks	23	29	49	62		
	Once a month to once every 3 months	23	33	7	10		
	Never	24	17	8	2		

*Loc = Location

The findings were that in Kangai during the dry season, mangoes were consumed daily by 89% of the respondents. A high percentage of respondents may have been able to access mangoes at the time of the study because they were in season and they also grow well in that area. Most

mothers could get the fruit from their gardens without requiring money to buy. Other fruits that were consumed daily during the dry season were paw paws and bananas which were consumed by 33% and 10% of the respondents respectively. Ripe bananas were also consumed once a week to once every two weeks by 43% of the respondents. Oranges were consumed once a month by 35% of the respondents; passions were consumed once a week and once a month to once every three months by 23 %, in each case, of the respondents. Guavas were never consumed by 37% of the study participants.

According to the findings, the daily consumption of yellow /orange fruits changed drastically during the wet season. The high daily consumption of mangoes reduced to 1%, while the consumption of paw paws and bananas dropped by 19% (33-14%) and by 3% (10-7%) respectively. The findings showed that most of the respondents consumed fruits once a week to once every two weeks. It is advisable to consume fruits daily as they are sources of micronutrients (Vitamins and mineral salts) which come from the foods we eat and are required by the body on daily basis.

In Mutithi, during the dry season, the findings were that the most commonly consumed yellow /orange fruit was mango and it was consumed daily by the majority (68%) of the respondents. Other frequently consumed were paw paws and bananas whose consumption was once a week to once every two weeks by 51% of the respondents and the daily consumption was low. During the wet season, the findings, as indicated by Table 4.18, consumption of were very low. According to the findings, the daily consumption was almost zero, only 16% of the respondents consumed fruits 2-4 times per week. Majority of the respondents, (between 30- 60%) consumed

yellow /orange fruits only once a week to once every two weeks and this may be seen as inadequate and tallies with Monteiro's findings (2006). According to Monteiro, (2006), most people do not consume fruits and in Eastern Africa, fruit consumption is less than 50g of fruit per day per person. It has also been found that low fruit intake is a major contributing factor to micronutrient deficiencies.

A t- test was used to check the significance of differences in consumption of yellow and orange fruits between seasons by Kangai and Mutithi respondents (mothers). Findings suggest that mangoes were the most frequently consumed by both locations during the dry season. However, during the wet season the consumption was low in both locations. The consumption patterns for the other fruits remained the same confirming that they were never frequently consumed in both seasons. This means that although the consumption during the dry season seemed to be more frequent than in the wet one, the difference was not significant ($P > 0.05$).

An analysis of consumption frequency of yellow/ orange fruits (pawpaw, ripe bananas, guavas, oranges, mangoes, passion fruits) done by location. Findings suggest that mangoes were frequently consumed in locations. To test the significance of differences of consumption of fruits (yellow /orange) between the locations, t- test was performed and it showed that the differences in consumption of all fruits between the two locations was significantly different except for ripe bananas ($p< 0.05$).

4.3.2.4 Consumption Frequency of Yellow/Orange Vegetables Food Group

Data was collected during the dry and wet seasons and the respondents from the two locations were asked how often they consumed yellow /orange vegetables (Table 4-18). The yellow /orange vegetables are rich sources of Beta Carotene. This substance is converted to Vitamin A by the body.

Table 4-18 Consumption frequency of yellow/orange vegetables food group by location and season

Food group: yellow /orange vegetables	Consumption frequency	Kangai		Mutithi		P-value	
		Dry season%	*Wet season %*	*Dry season %*	*Wet season %*	*season*	*Loc**
Carrots	Every day	36	17	37	9	.000	.001
	4 times a week	9	27	25	38		
	Once a week	26	28	27	43		
	Once a month	21	21	6	11		
	Never	9	9	5	1		
Pumpkin	Every day	23	2	8	2	.000	.760
	4 times a week	11	27	9	4		
	Once a week	19	16	32	33		
	Once a month	24	32	44	54		
	Never	22	25	6	9		
Tomatoes	Every day	89	90	89	46	.000	.000
	4 times a week	4	3	2	43		
	Once a week	4	4	4	8		
	Once a month	0	4	2	3		
	Never	3	1	1	1		
Sweet potatoes	Every day	3	0	2	0	.001	.069
	4 times a week	7	9	9	4		
	Once a week	13	31	13	41		
	Once a month	66	51	48	42		
	Never	11	11	26	13		

*Loc = Location

In relation to frequency of consumption of yellow/ orange vegetables including carrots, pumpkins, tomatoes, and orange sweet potatoes, (Table 4.18). The findings for Kangai during the dry season showed that tomatoes , carrots, and pumpkins were consumed daily by 89%, 36% and 23% of the respondents respectively while, the orange sweet potatoes, were consumed only once a month by 51% of the study participants. The study was repeated during the wet season. The findings for the Kangxi's wet season were that tomatoes, carrots, and pumpkins

were consumed daily by 90%, 17% and 2 percent of the study responds. There was a drop of consumption of carrots by 19% as well as pumpkins (by 21%). This may indicate that the vegetable are seasonal and that access to them depends on seasonality. On the other hand, the high consumption of tomatoes during dry and wet seasons may indicate growing the crop by irrigation and hence the availability of product to the respondents.

The Mutithi respondents were asked about the consumption frequency of yellow orange vegetables including carrots, pumpkins, tomatoes, and sweet potatoes during the dry and wet seasons. The findings were that during the dry season, tomatoes, carrots, pumpkins and sweet potatoes were consumed daily by 89%, 37%, 8% and 2% respectively, of the respondents. The findings for the wet season showed that the vegetables were also consumed daily but by fewer of the respondents. For example , during the wet season, the percentage of the respondents consuming tomatoes daily dropped to 46% (from 89%) , daily consumption of carrots dropped to 28% (from 37%) while the daily consumption of pumpkins dropped to 2% (from 8). Yellow sweet potatoes were still consumed once a month by a large percentage of the respondents (54%). Although tomatoes were consumed by a large percentage of respondents they were likely to be used for flavor other than as cooking ingredients.

To test the significance of differences of consumption of vegetables (yellow /orange: carrots, pumpkins, tomatoes, yellow sweet potatoes) between the seasons, a (t) - test was used. The findings showed that there was a significant difference in the consumption of carrots, pumpkins, tomatoes, and yellow sweet potatoes between the seasons. This could have been attributed to the fact that by the time of collecting data for wet season, most of vegetables had not matured

and there was scarcity in the market. Hence, the respondents had higher consumption frquency during dry the dry season than the wet one. The difference in consumption during the wet and dry seasons was significant (p value 0.000, $p< 0.05$; Table 4.18).

To test significance of differences of consumption of yellow /orange vegetables: (carrots, pumpkins, tomatoes, yellow sweet potatoes) between the locations, a t - test was run. The findings were that the difference in consumption of most of carrots and tomatoes was significant the yellow / orange vegetables was significant ($p< 0.05$). However, the difference in consumption frequency of pumpkins and yellow sweet potatoes, was not statistically significant (Table 4.20).

4.3.2.5 Consumption frequency of dark green leafy vegetables food group

Data was collected during the dry and wet seasons and the respondents from the two locations were asked how often they consumed specified dark green leafy vegetables (DGLV) (Table 4.19). Dark green leafy vegetables are a good source of non haeme iron.

Table 4-19 Consumption Frequency of DGLV Food Group by Location and Season

Food Group: (DGLV)	Consumption Frequency	Kangai		Mutithi		P-Values	
		Dry %	*Wet %*	*Dry %*	*Wet %*	*Season*	*Location*
Spinach	Every day	11	6	15	2	.798	.000
	2- 4 times a week	13	16	12	10		
	Once a week to once every 2 weeks	21	32	58	82		
	Once a month to once every 3 months	23	15	9	6		
	Never	32	32	5	0		
Pumpkin leaves	Every day	48	31	14	1	.191	.000
	2- 4 times a week	7	26	8	7		
	Once a week to once every two weeks	17	27	31	43		
	Once a month to once every 3 months	21	8	40	40		
	Never	8	9	8	10		
Amaranths (terete)	Every day	46	39	18	2	.064	.000
	2- 4 times a week	9	29	8	14		
	Once a week to once every two weeks	13	22	58	75		
	Once a month to once every 3 months	25	5	10	4		
	Never	8	6	5	5		
Cowpea leaves	Every day	13	25	3	0	.000	.000
	2- 4 times a week	6	30	2	6		
	Once a week to once every two weeks	17	23	41	66		
	Once a month to once every 3 months	54	8	9	10		
	Never	9	16	43	18		

*Loc = Location

The frequency of consumption of dark green vegetables (Table 4.19) was also considered due their contribution to dietary iron. The findings for Kangai during the dry season were that spinach, pumpkin leaves, amaranths and cow pea leaves were consumed on daily basis by 11%, 46 % 46% and 13%, of the respondents. The consumption frequency was also determined during the wet season. The findings for the wet season were that, the vegetables were still consumed on daily basis but the percentage of the respondents consuming had reduced. For example, during the wet season, spinach, pumpkin leaves, amaranths and cowpea leaves, were

only consumed by 6%, 31%, 40% and 25% respectively of the respondents. Dark green vegetables are good sources of micronutrients and need to be eaten on daily basis.

Due to the importance of dark green vegetables in their contribution to the essential micronutrients, the researcher investigated how they were consumed in Mutithi (Table 4.19). During the dry season, spinach, pumpkin leaves, amaranths and cow pea leaves were consumed daily by only 16%, 15%, 18% and 5% respectively, of the respondents. The consumption pattern had changed during the wet season. According to the findings, the spinach, pumpkin leaves and amaranths, were only consumed daily by only 2%, 1% and 2 % respectively, of the respondents. During this period, majority of the respondents (over 40%) consumed dark green vegetables once a week to once every two weeks. This may be interpreted to mean that by the time of data collection, vegetables had not grown in the gardens and that majority of the mothers did not have money to buy from the markets. On the whole, the findings were that the consumption of dark green vegetables was more frequent in Kangai than in Mutithi.

A (t) test was done to check the significance in the differences in consumption frequency of DGLV by respondents in dry and wet seasons. The t-test showed that there was a significant difference in the consumption of the cow peas leaves between the dry and the wet season. This could be attributed to the fact that cow peas are seasonally grown and are therefore in plenty during the wet season as opposed to the dry season. The difference by season of consumption frequency of other DGLV (spinach, pumpkin leaves and amaranths), was not significant ($p > 0.05$). However, consumption of these vegetables was quite low in the two seasons.

To test for significance of differences of consumption of vegetables (dark green vegetables: spinach, pumpkin leaves, amaranths and cowpeas leaves) between two locations, t- test was done. On the whole, the frequency of consumption of DGLV within Kangai and Mutithi locations was significantly different (p value 0.000; p< 0.05). However, there was less consumption in Mutithi than Kangai. Lack of adequate consumption of vegetables may result in micronutrient deficiencies because, according to Aphane et al (2002), consumption of fruits and vegetables is the most sustainable way of reducing and controlling micronutrient deficiencies especially in resource poor communities. A (t) test was done to check the significance of differences in dietary consumption of various food groups that yield micronutrients (Table 4.20).

Table 4-20 T-Test Results for Significance of Difference in Consumption of various Food Groups by Location

Food Categories	t	P- value
Fats &oils	1.99	0.022
Fruits	6.76	0.044
Animal products	3.17	0.045
Yellow/orange veg	4.89	0.000
DGLV	3.54	0.636

DGLV = Dark green leafy vegetables

The t test indicated that the difference in intake of micronutrient rich foods including fat and oils, animal products, yellow/ orange fruits, yellow /orange vegetables, between Kangai and Mutithi, was significant (P< 0.05) at 95% confidence interval. This test concluded that there was a significant difference between Kangai and Mutithi in dietary intake of micronutrients rich foods and therefore, the null hypothesis was rejected.

4.3.2.7 Dietary Intake of Micronutrient Rich Foods as Identified by Food Consumption Score (FCS) and Food Consumption Groups (FCGS) tools (WFP, 2008)

This study looked at the dietary intake patterns of the most commonly used food products in the community. These included fats and oils, animal products, fruits, vegetables and grains and legumes, with aim of identifying consumption patterns of micronutrient rich foods by season and location. Using the criteria recommended by the (WFP, 2008; Table 2.6), all the respondents were categorized as acceptable, borderline or poor (Figure 4.10).

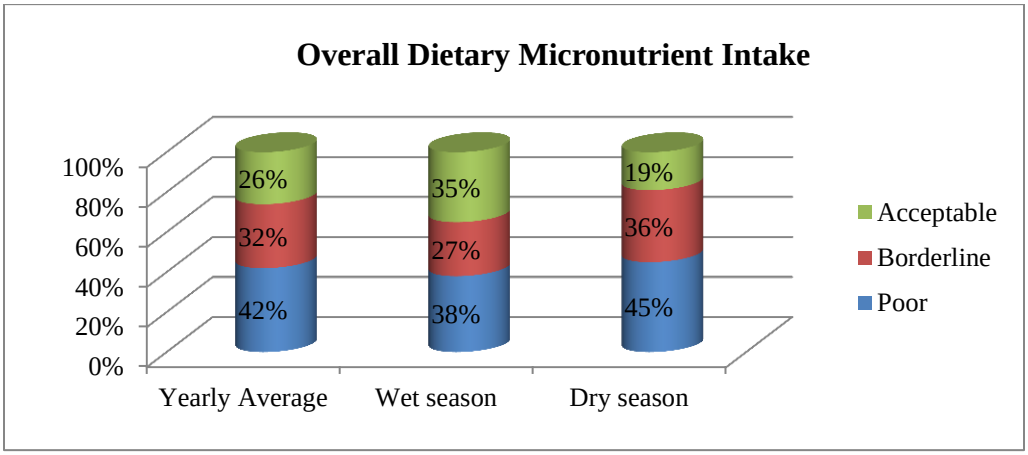


Figure 4-10 Overall, Dietary Micronutrient Intake of Mothers in the Study Area

The findings were that during the dry season, majority of the mothers (45%) were categorized as poor in consumption of micronutrient rich foods, with only 19% being in the acceptable category. There was a slight improvement during the wet season with the acceptable category rising from 19% to 35% while the poor category decreased from 45% to 38%. Considering the yearly average, the findings were that 74%, were categorized as having poor and borderline consumption of micronutrient rich food while only 26% were in the acceptable category.

4.3.2.8 Dietary Intake of Micronutrients by Location and Seasons

This study looked at the dietary intake patterns of the most commonly used food products in the Kangai and Mutithi locations by season. These included fats and oils, animal products, fruits, vegetables and grains and legumes, with aim of identifying the micronutrient rich foods that are eaten by the mothers by season. Using the criteria recommended by the (WFP, 2008; Table 3.3), the respondents were categorized as indicated in Figure 4.11 and 4.12.

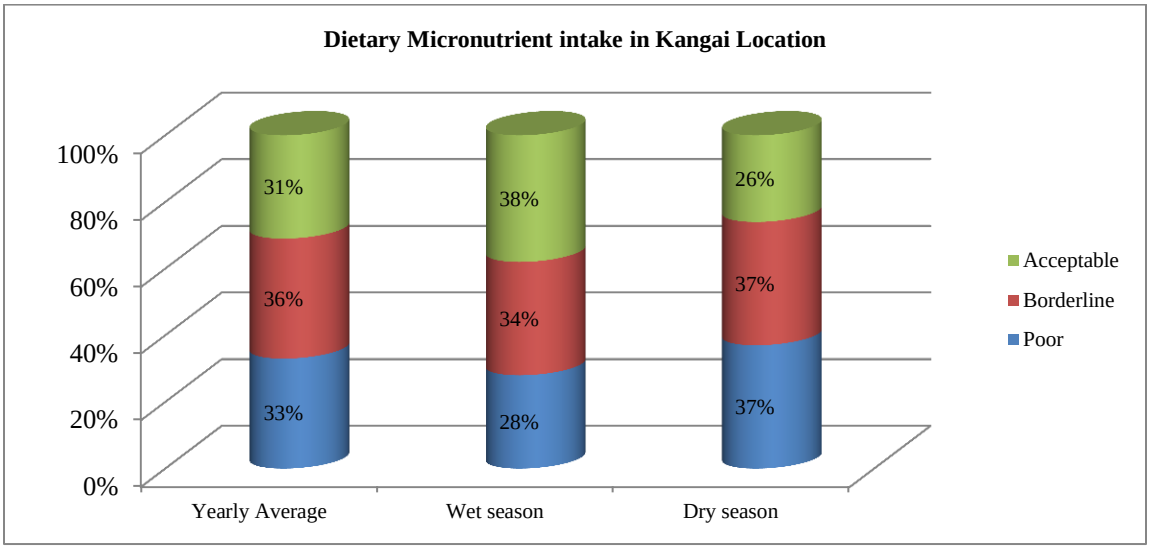


Figure 4-11 Dietary Micronutrient intake of Mothers in Kangai by Seasons

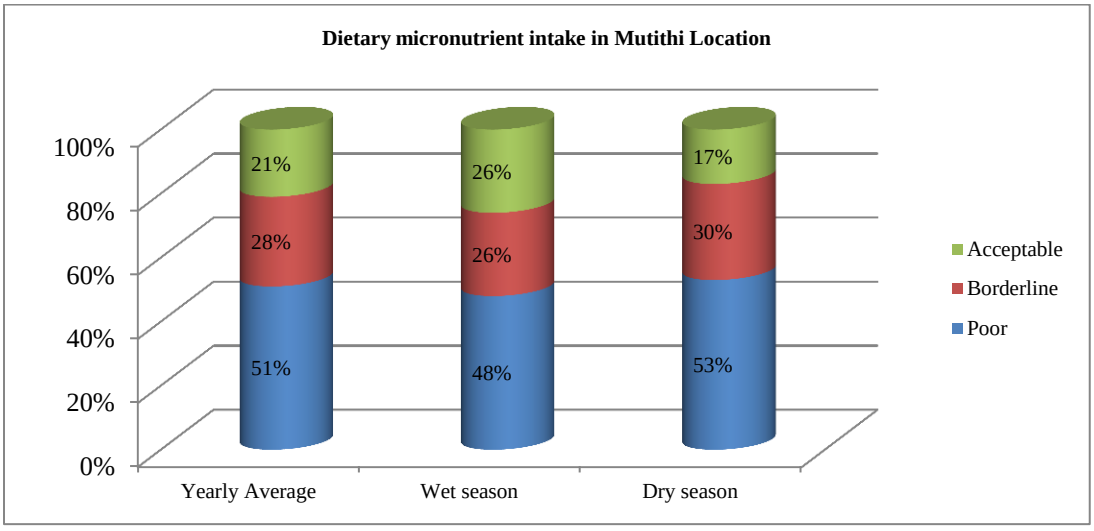


Figure 4-12 Dietary Micronutrient intake of Mothers in Mutithi by Seasons

The findings for Kangai were that during the dry season, 74% of the mothers were categorized as poor and borderline while 26% were in the acceptable category in dietary intake of micronutrient rich food. During the wet season, 62% of the mothers were in the poor and borderline category, a 12% improvement. Considering the yearly average, the findings were that 69% were in the poor and acceptable categories while 31%, were categorized as having acceptable intake.

The findings for Mutithi were that during the dry season, 83% of the mothers were categorized as poor and borderline while 17% were in the acceptable category in dietary intake of micronutrient rich foods. During the wet season, there was a slight improvement as the poor and borderline categories had improved by 9% to 74% while the acceptable category was also better than during the dry season at 26%. Considering the yearly average, the findings were that 79% were categorized as having poor and borderline while 21% were in the acceptable category.

A t-test was run to check whether the difference in dietary intake of micronutrient rich foods in the two locations between **seasons** was significant. The test showed that the dietary intake patterns varied significantly between the seasons in both **locations** ($p < 0.05$). It was noted there were more mothers in Kangai falling under acceptable consumption (26% and 38% in dry and wet seasons respectively) than in Mutithi with 17 % and 26% during the same period. The conclusion reached was that the respondents did not consume some food groups frequently enough especially animal products, fruits and vegetables. This suggests that they are likely to be vulnerable to micronutrient deficiencies because their consumption of the micronutrient rich foods was far too below what was recommended as normal consumption by a study done by World Food Program in 2011.

This study categorized the respondents as having a) poor consumption b) border line consumption and c) acceptable consumption. The poor consumption category were those who consumed: cereals, sugars and oil nearly on daily basis; animal products rarely; fruits very rarely; vegetable four times a week. They also consumed insufficient quantity to meet the required calories. The border line category were those who consumed: cereals and other starchy foods on nearly daily basis; vegetables five times a week; animal products 3-4 times a week; fruits two times a week and just sufficient amount to meet the calorie requirements. The acceptable consumption category were those whose diet was diversified and included foods from all food groups on daily basis and the amount was sufficient to meet the calorie requirements (WFP/FAO, 2011).

4.3.3 Findings of Observation of Meal Preparation

4.3.3.1 Groups of Ingredients Observed During Meal Preparation

The ingredients observed and used to make the three main meals of the day: breakfast, lunch and supper, were grouped as follows (Table 4-21).

Table 4-21 Food Groups Consumed By Mothers in Kangai and Mutithi Locations

Kangai	Mutithi
Starchy foods: Bread, rice, Irish potatoes, maize , maize flour, millet four, sorghum flour, cooking bananas, wheat flour	Starchy foods: Bread, Millet flour, rice , iris potatoes, sweet potatoes, cooking bananas, maize , maize flour, wheat flour
Plant source protein foods : beans Animal source protein foods : beef	Plant source protein foods : beans Animal source protein foods : eggs, milk
Vegetables: cabbage, cow pea leaves, gourgette, tomatoes	Vegetables: Sukuma wiki, cabbage, carrots, tomatoes
Fats and oils: cooking fat	Fats & oils: cooking fat, margarine
Condiments : salt, sugar, onions, cocoa , tea leaves, milk for tea	Condiments: sugar, salt, onion, cocoa, tea leaves, milk for tea

The findings of observation of meal preparation and cooking were that mothers from Kangai and Mutithi used similar ingredients. In both locations, fruits, which are good sources of Vitamins and mineral salts, were missing from the meals observed.

4.3.3.2 Consumption of Different Ingredients by Location

The ingredients used to prepare meals during the meal observation module were computed for quantities consumed by the mothers by location (Table 4-22)

Table 4-22 Mean Quantity of Food Materials (Ingredients) Consumed by the Mothers by Location

		Locations	
		Kangai N= 27	Mutithi N= 36
Meal	**Food item**	**Mean consumption per person (in grams**	**Mean consumption per person (in grams)**
Breakfast	Millet/sorghum four(g) (porridge)	18 ± 2.36	3 ± 0.12
	Sugar(g)	15 ± 1.12	4 ± 0.57
	Milk(ml)	112 ± 3.40	44 ± 12.5
	Eggs(g)		4 ± 6.0
Lunch	Rice(g)	30 ± 5.10	16 ± 4.36
	Beans(g)	20 ± 3.40	10 ± 0.52
	Wheat flour(g)	7 ± 1.01	3 ± 0.01
	Maize flour (ugali)(g)		11 ± 2.41
	Potatoes(g)	7 ± 1.01	5 ± 1.38
	Cabbage(g)		5 ± 0.23
	Tomatoes(g)	13 ± 1.56	12 ± 0.90
	Bananas(g)		5 ± 0.52
	Maize (githeri)(g)		10 ± 3.99
	Milk (with ugali)(g)		23 ± 3.25
	Kales(g)		5 ± 1.38
Supper	Rice (g)	23 ± 8.77	30 ± 5.10
	Beans(g)	15 ± 5.78	13 ± 3.69
	Maize (githeri)(g)	20 ± 3.40	13 ± 3.69
	Maize four (ugali)(g)	11 ± 7.22	5 ± 4.17
	Bananas (g)	2 ± 0.81	5 ± 8.33
	Potatoes(g)	3 ± 1.39	6 ± 1.67
	Kale (g)	5 ± 0.94	5 ± 4.17
	Cabbage(g)	21 ± 4.36	
	Tomatoes (g)	12 ± 2.18	8 ± 6.77
	Carrots(g)		1 ± 0.01

According to the mean consumption of the main ingredients (rice, bean, maize , maize four,) used to make the main meals, the findings were that Kangai mothers consumed a mean of 30g , 20g , 20g and 11g ,respectively while the Mutithi mothers consumed 16g, 13g, 1og and 5g of the same ingredients. The results showed that the Mutithi mothers consumed less than the Kangai ones.

4.3.3.3 Nutrient content of meals of observed

The ingredients used during the observation of meal preparation, were analyzed for nutrient content using National Nutrient Data Base for Standard Reference, Release 26 Software v.1.4 (Table 4.23).

Table 4-23 Nutrient Content of Meals Prepared and Consumed in Kangai and Mutithi Locations.

			Kangai N=27		Mutithi N=36	
Nutrient	Unit measure	RDA	Mean intake	variance	Mean Intake	variance
Energy	Kcal	2250	1905.2	-344.8	1773	-477
Protein	G	60	53.4	-6.6	39.2	-20.8
Carbohydrate	G	338	319.8	-17.7	286.3	-51.2
Iron Fe	Mg	18	14.1	-3.9	8.5	-9.5
Zinc zn	Mg	9.4	7.6	-1.8	5.3	-4.1
Vitamin B12	Mg	15	0.3	-14.7	0.5	-14.5
Vitamin A (RE)	RE(IU)	500	122.8	-377.2	540.9	40.9

The findings were that meals cooked and consumed by the mothers for a period of two weeks, gave the respondents nutrients as indicated in Table 4.24. The nutrient yields of the meals actually consumed were compared to the recommended dietary allowances (RDA). It was noted that the respondents had a deficit of all the nutrients studied. However, the Mutithi

respondents had a higher deficit than the Kangai ones. It should be noted that the respondents in this study consumed animal product rarely, for example meat, which is more readily available was consumed by 57% and 75% of Kangai and Mutithi respondents respectively once a week to once a month.

The actual meals, observed as prepared also indicated that fruits were never included in the meal plans, animal products were rare and vegetables appeared occasionally. This confirms findings of data obtained on food consumption frequency, Section (4.3.2). An analysis of the food materials cooked and consumed yielded inadequate nutrients (lower than recommended dietary allowances, RDA). Therefore it was concluded that micronutrients, which are supplied by animal products, as well as fruits and vegetables such as Vitamin A, Iron and zinc, may be missing from the respondents' diets.

4.3.3.4 Dietary Intake of Vitamin A

According to the findings of food frequency research, margarine (680RE/100g) cod liver oil (40,000RE/100g) which are good sources of preformed Vitamin A (retinol) were consumed less than 3 times a week by more than 75 % of the respondents in both Kangai and Mutithi. Among the animal products (meats, fish, eggs and milk), milk, which is low in Vitamin A, (27RE) was the only one which was consumed daily by more than 80% of the study groups. Except for milk and cod liver oil, the consumption of animal products in the locations was significantly different ($p < 0.05$) at 95% confidence interval.

The respondents were further asked to state how often they consumed yellow orange fruits (pawpaw, mangoes, ripe bananas, guava, oranges and passion fruits). These fruits are locally grown. The findings (Table 4.17) were that mangoes (400RE/100g), were consumed at least 4 times a week by majority of the respondents (over 80%). In relation to frequency of consumption of yellow/ orange vegetables including carrots, pumpkins , tomatoes, and orange sweet potatoes (table 4. 10), carrots (2813RE/100g) were consumed daily by 35% of the respondents while , the orange sweet potatoes(2006RE/100g), the only vegetable which can constitute a meal was never eaten by over 30% of the study participants. The frequency of consumption of dark green vegetables (Table 4.16), was also considered due their contribution to dietary Vitamin A. The findings were that the consumption of dark green vegetables was more frequent in Kangai than in Mutithi. On the whole, the frequency of consumption of all the fruits and vegetable within Kangai and Mutithi locations was significantly different ($p< 0.05$) at 95% confidence interval.

The nutrient values (in brackets) were obtained from food composition Tables (secondary data). In addition, ingredients recorded during the meal preparation observation sessions were analyzed for nutrient content. The findings were that Vitamin A intake was less in Kangai (122.8 RE) than in Mutithi (540.9 RE). This finding concurs with the findings of frequency of consumption of fats and oils as well as animal products. The findings were that there was a higher percentage of respondents never consuming fish (67%), eggs (20%) in Kangai than in Mutithi (28%) fish, and (9%) eggs.

The data was collected in the month of January when mangoes were in season and therefore more easily accessible. In addition, tomatoes were also consumed by at least 4 times a week by more than 80% of the respondents. However, it should be noted that tomatoes are mostly used as flavoring agents and not as food. Among the Vitamin A rich vegetables are orange sweet potatoes which are normally eaten as the main dish. Unfortunately, the orange sweet potatoes were consumed less than three times a week by more than 80 % of study population. Carrots, which are quite rich in beta carotene (pro formed Vitamin A, 2813RE) were consumed at least four times a week by more than 40% of the respondents. In addition, the results showed that the consumption frequencies of Vitamin A rich fruits and vegetables between the two locations was significantly different ($p< 0.001$) at 95% confidence interval.

4.3.3.5 Dietary Intake of Iron

Using the food frequency method, the respondents were asked how often they consumed selected commonly found animal products as well as fruits and vegetables (Table 4.24). The findings were that most of animal products including cod liver oil, eggs, fish, meats, which are good sources of haeme iron, were rarely consumed. Milk was the only animal product that was regularly consumed. This was evidenced by 93.6% and 83.0 % of Kangai and Mutithi respondents respectively who indicated that they consumed the product daily. However it should be noted that most of the milk is used for preparation of tea beverage. Milk is also a poor source of iron, yielding only 0.1 mg/ 100g (Sehmi, 1993).

In regard to the consumption of locally grown fruits and vegetables fruits and vegetable including carrots, pumpkins, tomatoes, orange sweet potatoes, pawpaw, mangoes, ripe bananas,

guavas, and oranges, the findings were that mangoes, tomatoes and amaranth (terere) were the most commonly consumed products. Their contribution of iron in the diet per 100 grams edible portion (secondary data) are as follows: mango 0.13mg; tomatoes 0.45mg; terere 4.0mg (Sehmi, 1993). The food materials frequently consumed by the respondents included mangoes and tomatoes which are quite low in iron. The meal preparation observation revealed that the most common dishes were rice or githeri (maize and beans). According to the desk research, rice yields 2.0mg/100g edible portion while white maize, which is the type likely to be used by the respondents, yields 2.5mg/100 g edible portion (Sehmi 1993). However, beans, which were observed to the main protein ingredient among the meals prepared, have a higher yield of iron (9.0 mg/ 100 g edible portion).

An analysis of food prepared, cooked and consumed indicated that the Kangai respondents consumed a mean of 14.1mg/day (less 3.9mg RDA 18mg/day) while the Mutithi respondents consumed a mean of 8.5mg/day (9.5mg less than the 18mg RDA). It should be noted that animal products are infrequently consumed possibly because they are expensive. Therefore the iron intake is mainly from plant sources. But iron from plant sources has low bioavailability i.e. little of it is absorbed by the body. This is because of the presence of absorption inhibitors such as phytates and phenols in all plant foods such rice, wheat, maize. The situation is made worse by the absence of animal proteins and fruits which aid absorption

4.3.3.6 Dietary Intake of Zinc

Using food frequency technique, this study looked at the consumption patterns of the most commonly used food products in the community. These included animal products, fruits, and

vegetables with an aim of identifying their zinc content. The consumption of grains and legumes was studied in the meal preparation observation. Among the animal products, milk was consumed frequently, that is daily, by 93.0% and 83.0% of Kangai and Mutithi respondents respectively. The zinc content of milk is 0.4 mg/100.The results indicated that mango fruit was consumed daily by 88.8% and 65.6% of Kangai and Mutithi respondents respectively. However, mango's zinc content is only 0.04 mg/100g of edible portion.

An investigation of consumption of yellow orange vegetable showed that tomatoes were consumed daily by 88.8% and 85.8% of Kangai and Mutithi participants, respectively. The zinc content of tomato is 0.09mg/100g of edible portion. Among the dark green vegetables, pumpkin leaves were consumed daily by 47.7% and 19.2% of Kangai and Mutithi study participants respectively. The zinc content of pumpkin leaves is 0.1mg/100g of edible portion.

The results of meal preparation observation (Table 4.24) indicated that rice and githeri (maize and beans) were the most frequently prepared and cooked meals. The zinc content of these food materials are: rice 2.02 mg/100g; white maize 0.46 mg/100g; beans 2.9mg/ 100g of edible portion (GOK, 2003). An analysis of ingredients used during the meal observation indicated that the Kangai respondents consumed a mean zinc of 7.6mg/day (1.8mg less than the 9.4mg RDA) while the Mutithi respondents consumed a mean zinc of 5.3mg/day (4.1mg less than the 9.4mg RDA mean national recommended intake).

Animal products including meats, fish and eggs (8.8mg/100g; o.3mg/100g; 4.93mg/100g edible portions, (GOK 2003), respectively) are the best sources of zinc. These were not regularly

consumed by the study participants. Food materials of plant origin, which were regularly consumed), have some zinc. However, this zinc may not be available for absorption due to several factors which are part of plant materials including phytic acid, oxalate, fibres and polyphenols (tannins). These substances are found in most plant food materials including rice, wheat, maize and maize flour, and various types of beans, coffee and tea. These are the food materials included in the menus used by the study participants. It may therefore be concluded that the study respondents did not consume enough zinc.

4.3.3.7 Testing of Hypothesis 3 (H_{o3})

The hypothesis of objective three of this study stated that there was no significant difference in the dietary intake of Vitamin A, iron and zinc (micronutrients) by mothers during dry and wet seasons in Kangai and Mutithi locations of Mwea west Sub County. A t- test was done to check the significance in the differences in dietary intake micronutrients by the respondents of the two locations (Kangai and Mutithi).

The t- tests (see Table 4.17) of food frequency consumption of micronutrient rich foods (Vitamin A, iron and zinc) showed: - that the consumption of fats, oils and animal products, which are rich in Vitamin A, was significantly different in the two locations. This was further confirmed by meal preparation observation (Table 4.24), which showed that poorer meals were prepared by Mutithi mothers than the Kangai ones. The conclusions of the findings were that both Kangai and Mutithi respondents did not consume micronutrient rich foods frequently and that the Mutithi respondents generally consumed less than the Kangai ones. Therefore, the null hypothesis was rejected.

4.4 Objective Four: Risk Factors of Micronutrients Utilization

4.4.1 Introduction

A situational analysis was done to determine risk factors of micronutrients (Vitamin A, iron and zinc) utilization. Specifically, sanitation of the environment as well as water sources were investigated and their impacts on household food security status and micronutrient intake (dependent variables) was checked. The variables considered here do not change by season; hence the differences investigated and observed were by locations only.

4.4.2 Water, Sanitation and Environmental Conditions

4.4.2.1 Water Sources

The respondents were asked about the source of the water they used (Figures 4.13 and 4.14)

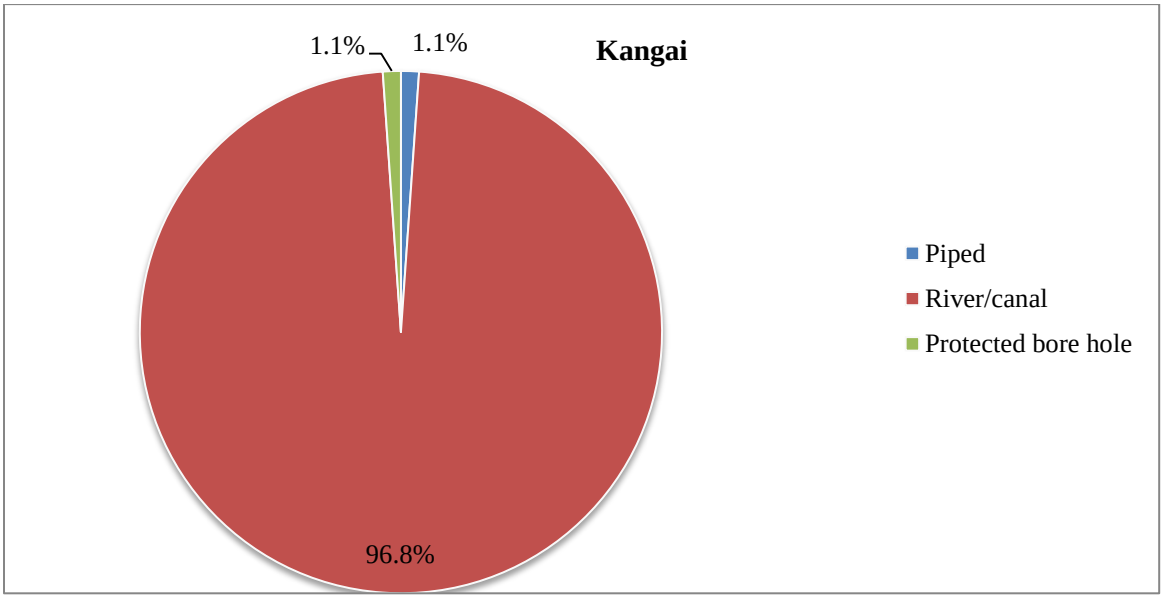


Figure 4-13 Percentage of People in Kangai Using Water from Various Sources

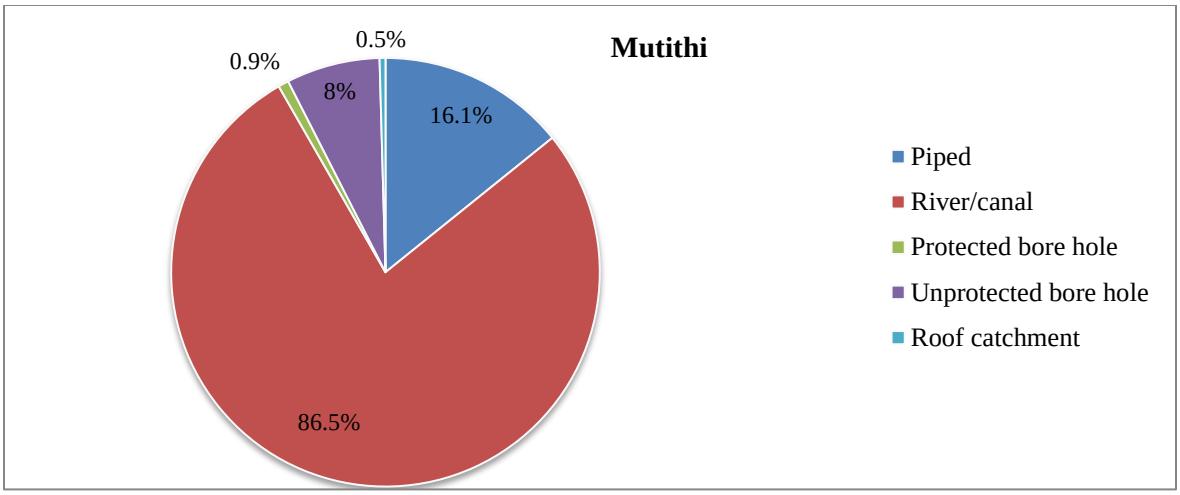


Figure 4-14 Percentage of People in Mutithi Using Water from Various Sources.

The findings were that river and canal water was used by majority of the population, 96.8% in Kangai and 86.5% Mutithi and only 1% and 16% of the respondents accessed piped water in Kangai and Mutithi, respectively. The percentage of respondents using surface water is alarmingly high and is much higher than the findings by Famine Early Warning Systems Network (FEWS NET, 2013). In their document, Kenya Food Security Brief of December 2013, only 39% of the population used surface water mainly from lakes, rivers streams and canals. The respondents were also asked whether they considered the water they used to be safe for drinking and the findings were tabulated (Table 4-24).

Table 4-24 Proportion of Respondents who Indicated Water Was Safe for Drinking Irrespective of the Source

Water safe for drinking?	Kangai (N= 187)	Mutithi N=212)	t-test p value
Yes	58.4%	30%	
No	41.6%	70%	0.000
Total	100	100	

Majority of Kangai respondents, 58.4%, said yes (that the water was safe for drinking) while only 30 % of Mutithi respondents had a similar opinion. Over 40% of Kangai and 70% of Mutithi respondents respectively, were of the opinion that the water they used was not safe for drinking. They were then asked what they did to make it safe. Over 50% and 15.6% of Kangai and Mutithi respondents, respectively, said that they did nothing (Table 4-25).

Table 4-25 Table to Show Percentage of Those Who Treated Water for Drinking

Treated water?	**Kangai (N= 187)**	**Mutithi (N=212)**	t-test p value
Yes	42.8%	84.4%	
No	57.2%	15.6%	0.000
Total	100%	100	

On the other hand, however, some, 42.8 % (Kangai) and 84 %(Mutithi) indicated that they made the water safe by either boiling, using chemicals or filtering. The percentage of respondents treating their water was quite high compared to findings of other studies. For example, a study done by WFP, (2009) found that only 2.1 % treated their drinking water while 97.1% of the respondents did not.

Water that is safe for drinking should be piped and treated to ensure that it has no pathogenic microorganisms and other dangerous substances like industrial wastes. This study found that only 1.1 % and 16.1% of Kangai and Mutithi respondents accessed piped water. Bore holes were used by about 9% of the respondents which means that they are uncommon in the study area. However, other studies found bore holes to be quite important sources of water. For example, Waiswa (2008) found that 76.6 % of her respondents used bore holes and public wells

as sources of water. In this study majority of the respondents, 96.8% (Kangai) and 87.8 (Mutithi) used either canal or river water.

The access of piped water in the study area was lower than for Kirinyaga County (4%). The access to piped water was also lower than findings of another unpublished thesis report in same county whose results were that only about 53% of the respondents used river /canal water (Mugambi 2000). In addition, a similar report for Cambodia rural area indicated a relatively higher access to piped water at 3.3 % (www.foodsecurityatlas.org 2009). Safe drinking water is a determinant of health and nutrition status of mothers and other members of the household. Safe drinking water can reduce the risk of major diseases such as diarrhea (WFP, 2011). Water is required for domestic work and its availability is necessary for washing and cooking and this helps to control infections.

4.4.2.2 Sanitation and Environmental Conditions (Waste Disposal)

A participant observation as well as questioning technique was used to get an understanding of how solid waste was disposed (Figures 4.15 and 4.16).

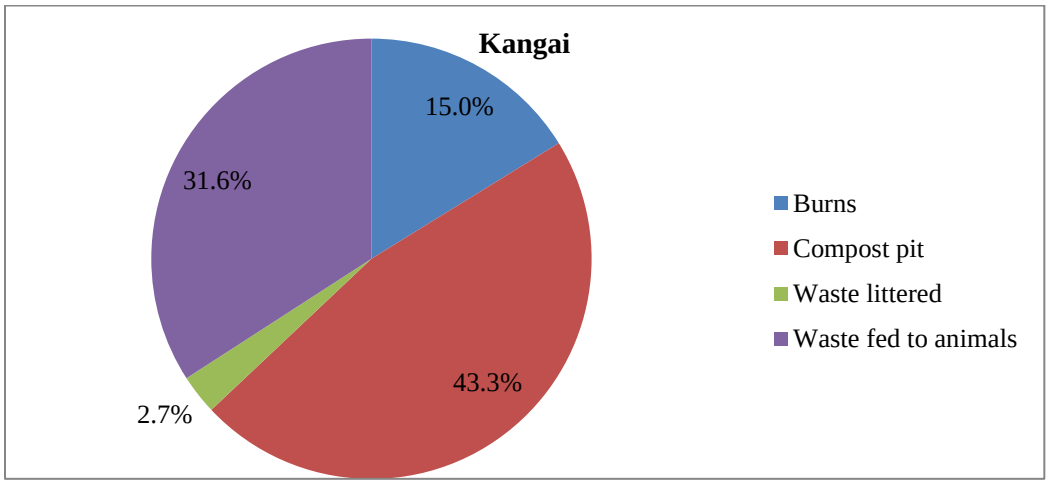


Figure 4-15 Percentage of Respondents Disposing Waste in Various Ways

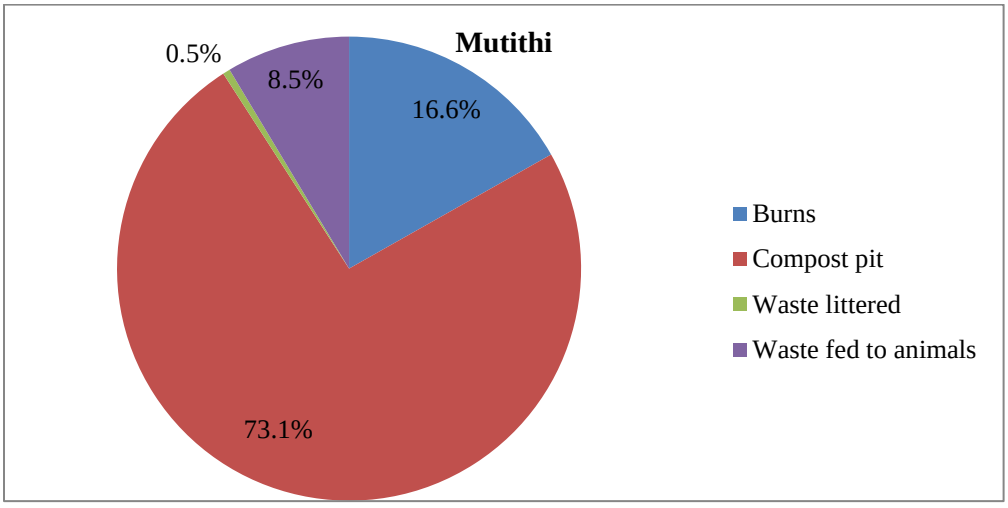


Figure 4-16 Percentage of Respondents Disposing Waste in Various Ways

In Kangai, 89.9% of the respondents disposed the solid waste by burning, using a compost pit or feeding to livestock, with only 2.7% littering. In addition, 96.3% of respondents had latrines. The situation was the same in Mutithi where 98.2% of the participants burnt the refuse, put in a compost pit or fed it to livestock. Majority of them, (97.2 %), also had pit latrines, with the few without indicating that they used the neighbor's.

Solid waste disposal was found to be poorly managed. Majority of the respondents, (88.9%) put the waste in a compost pit while 2.7% just littered the compound. The littered solid waste is likely to hold water which can be a breeding ground for mosquitoes. Access to improved sanitation facility, like access to piped water is very important. A household's toilet facility is considered hygienic if it is used only by household members (not shared by other households). This study was in a rural set up and the findings were that 96.3% and 97.2% of Kangai and Mutithi households respectively, had pit latrines and only 1.1% and o.9% without. The findings were almost similar to those of Waiswa (2008). In her study "household food insecurity and

micronutrient status of the under five years old in Nava Kholo Division, Kakamega (2008)," Waiswa found that 1.5% of her respondents did not have latrines. Those without latrines used the neighbor's. The percentage of respondents accessing a latrine is also similar to that of Kirinyaga County (90%) CDP, 2013). The rate of accessing a latrine was very good when compared to other countries like Cambodia where only 16.4 % of the rural residents had access to a toilet/ latrine (www.foodsecurityatlas.org 2009).

4.4.2.3 Significance of Water, Sanitation and Environmental Conditions Module

The null hypothesis for objective four was that there was no significant difference in risk factors (water sources, solid waste disposal and access to a latrine) for micronutrient utilization for Kanga and Multichip respondents. The hypothesis was tested using chi square, logistical regression and analysis of variances (ANOVA).

The chi square test was used to compare the proportions of specific independent variables used in the study. The test was meant to check whether there was significant difference in the way Kangai and Mutithi respondents got their water, viewed it in terms of its safety for drinking and how they treated it. The test also covered the various methods of solid waste disposal, used as well as availability of family latrine. The chi square test revealed that Kangai and Mutithi respondents had significant differences in their sources of water, their opinion about safety of drinking water , treatment of water to make it safe and methods of solid waste disposal. For example, Kangai had 10 % more respondents than Mutithi using river water. Kangai also had 15% fewer respondents than Mutithi accessing piped water. In addition, Kangai had fewer respondents (41.6%) than Mutithi treating the drinking water.

As well as using a chi square, a regression was used to test the most important risk factor of micronutrient utilization among mothers .The findings were that the water source was the most critical factor. This was also confirmed by an analysis of variance test. This test identified water source and opinion about water safety as two critical micronutrient risk factors in the study ($p< 0.05$). On the whole Kangai seamed to be worse off than Mutithi on issues of micronutrient risk factors. For example , 96.8% of Kangai respondents used river/canal water, 58.4% said the water was safe for drinking and 42% treated water for drinking while in Mutithi, 86.5 used river/canal water, 30% said water was safe for drinking 84.4% treated water for drinking.

4.4.2.4 Testing Hypothesis Four

The null hypothesis for objective four was: “there is no significant difference in risk factors for micronutrient utilization for mothers in Kangai and Mutithi” The hypothesis was tested using chi square, regression and ANOVA tests on: source of water, opinion on safety of drinking water, how to make water safe and solid waste disposal, (water, sanitation and environmental conditions). All the tests revealed that mothers (women) from the two locations had differences in their sources water, opinion about water safety, methods of treating water as well as method of waste disposal. The differences were statistically significant ($p < 0.05$); hence the null hypothesis was rejected. Poor access to drinking water as well as poor environmental conditions are all indicators of poor utilization of micronutrients. Hence, it may be concluded (95% confidence interval) that the communities studied are likely to be both food and micronutrient insecure (Bamji, 2011).

According to Bamji (2011), micronutrient deficiencies, referred to as hidden hunger, are not an obvious killer. However, they contribute to protein – calorie malnutrition because they contribute to proper utilization of macro nutrients (proteins and Carbohydrates) which are calorie yielding. In addition, they fight disease infections. Micronutrients deficiencies are due to poor **dietary intake** 4which results from poverty, ignorance and low agricultural productivity resulting to low food availability. However, Bamji (2011) cites other factors that contribute to micronutrient deficiencies including inadequate access to: safe drinking water, clean disease free environment, health care facilities, and care for vulnerable members of the society. Bamji, (2011) goes on to say that infections, which result from dirty water and dirty environment, cause loss of appetite and impaired absorption and utilization of micronutrients.

4.5 Relationship between Household Food Security Status and Key Study Variables

This section shows the relationship of the identified food and micronutrient security yard stick with other important variables such as, education of the mother, occupation and income, size of land, as well as other basic health, sanitation and environmental variables for example, sources of water and treatment of drinking water.

4.5.1 Cross Tabulation: Household Food Security Status by Education level of the Respondents

The education level of the respondents was correlated with household food security status (Figure 4-17).

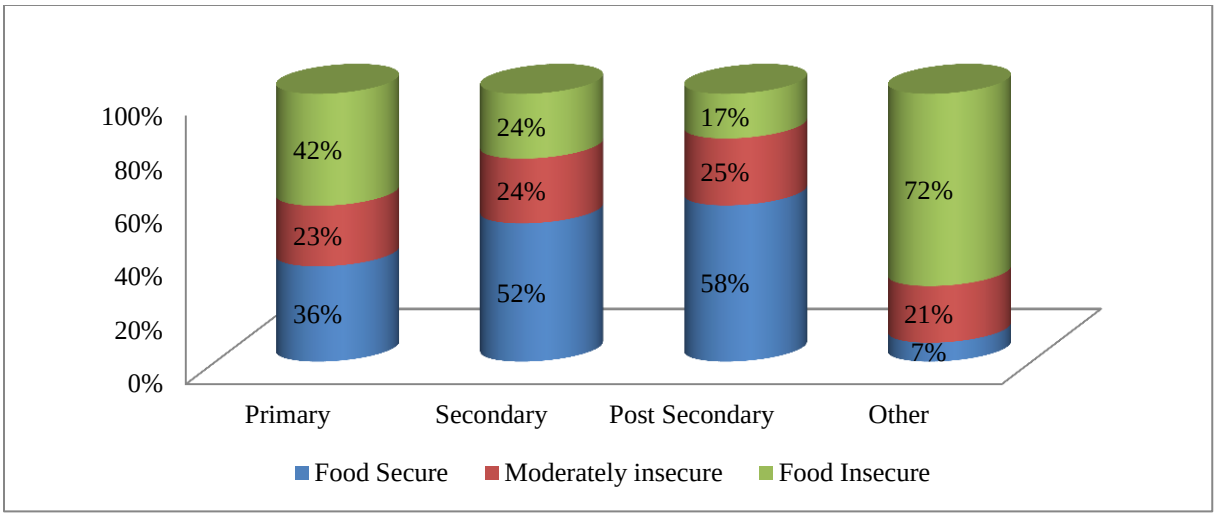


Figure 4-17 Education Level of the Respondents by Household Food Security Status

The respondents who were possibly either primary school dropout or did not attend primary school (72%) were severely food insecure. This shows a strong correlation between food insecurity and low level of education. All those who attended post-secondary education were food secure. These findings tally with those of Kaloi et al., (2005). In their studies "food security status of households in Mwingi District, Kenya", the researchers found that the level of education of the household head positively correlated with food security status. They argued that an increase in formal education lead to an increase in food security. This is further confirmed by a study on "prevalence of hunger and food insecurity in Rhodes Island "(Department of Health, Division of Family Health, Rhodes Island, 2001 as in Kaloi et al., 2005 This study found that household food security increased as the number of years of education increased. Their findings were that among those who had an education of more than 12th grade (post-secondary), only 14% were food insecure compared to 25% and 39% of those who graduated from 12th grade (secondary education) and those who had less than the 12th grade respectively.

Education is important for life. People who are educated especially mothers are better of economically. In fact, low maternal education correlates with food insecurity (AWSC, 2014). The reason for this can be explained by several facts such that uneducated mother: 1) may not be able to get an income earning job, which means she cannot access/purchase suitable foods for her family 2) may lack nutritional knowledge and this may lead to inability to prepare and cook available food materials for the benefit of the family, 3) may lack good hygiene practices which may lead to preventable illnesses. These factors result in poor food utilization (food insecurity) by family members.

4.5.2 Household Food Security Status by Occupation of the Mothers

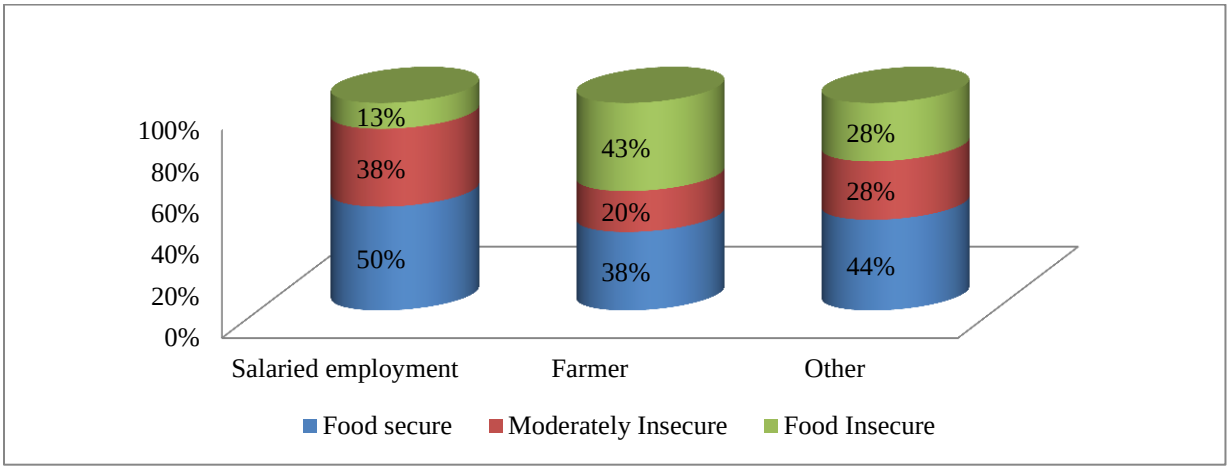


Figure 4-18 Occupation of the Respondents by Household Food Security Status and Micronutrient Intake

It is clear that the farmers (43%) as well as the casual workers (28%) were the most food insecure. This indicated a strong relationship between source of income and the household food security status and micronutrient intake. It was noted that the farmer was not quite food secure. The occupation of the respondents has been found to be very significant ($p< 0.05$). In Kangai 67% of the respondents subsisted on farming while in Mutithi the percentage was higher,

(87.3%). A study done in Nepal on food security found that the 85.9 % of the respondents lived on farming (Maharjan 2006). The Nepal study had a higher percentage living on farming than Kangai in this study and less than Mutithi. This study showed that in rural areas farming can yield more money than other activities. When compared with employment and self-employment, those in farming illustrated that they made more money (11. % earning Ksh > 5000). Income is a good indicator of food security status. Studies have also showed that communities in farming have better food security than those in other occupations especially in rural areas where people consume the food they grow .However this study did not support that. This may mean that, although the farmer respondents made more money than those in other occupations, the money was used for other things and not food.

4.5.3 Cross Tabulation: Household Food Security Status by House Wall

The type of house wall was found to be significant and was correlated with household food security status (Figure 4.19).

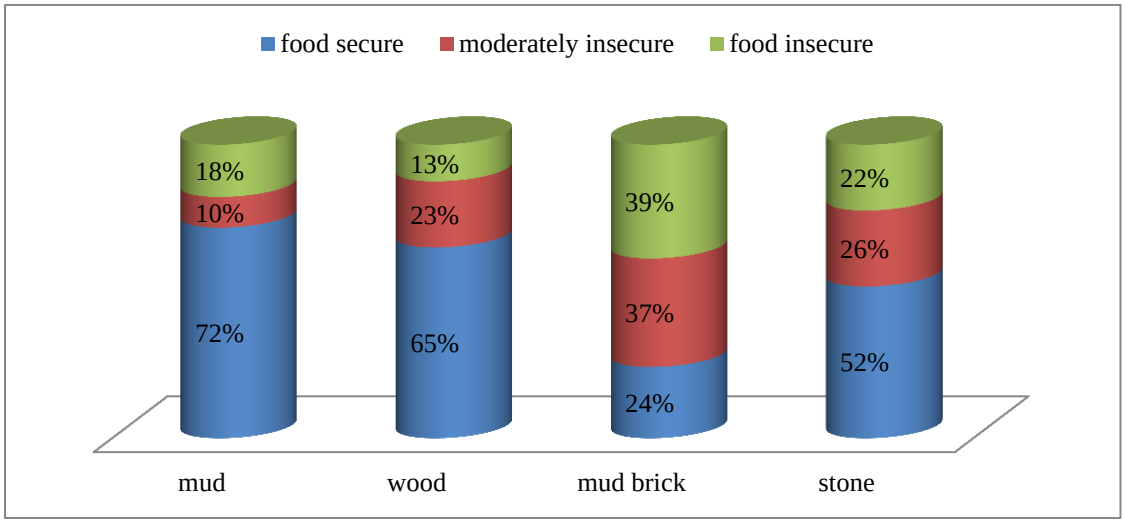


Figure 4-19 The Relationship of Type of House Wall with Food security status and Micronutrient intake

The type of house a family has especially the wall is an indicator of socio economic status. In this study, 39% of the respondents had mud brick walled houses. This predicated poverty as well as food insecurity.

4.5.4 Cross Tabulation: Household Food Security Status by Asset Ownership

As asset ownership is a sign of wealth, it was tabulated with household food security status

Table 4-26 Asset Ownership by Food Security Status and Micronutrient Intake

Asset	Food secure		Moderately insecure		Severely food insecure		Total	
	N	%	N	%	N	%	N	%
Car	3	2	1	1	2	2	6	2
Bicycle	95	67	36	53	43	41	174	55
Motorbike	4	3	2	3	5	5	11	3
Radio	37	26	28	41	54	51	119	38
Donkey/oxcart	1	1	0	0	2	2	3	1
Television	2	1	1	1	0	0	3	1
Total	142	100	68	100	106	100	316	100

The findings were that out of 316 respondents, 142 (45%) were food secure, 68 (22%) were moderately insecure while 106 (33%) were severely food insecure. It should be noted that the respondents were mothers who we likely not to own the assets. Most assets are owned by men in the households.

4.5.5 Cross Tabulation: Household Food Security Status by Income

Since income is essential in food access, it was tabulated by household food security status (Table 4-27).

Table 4-27 Income by Household Food Security Status

Income /month	Food secure		Moderately insecure		Severely food insecure		Total	
	N	%	N	%	N	%	N	%
Below 500	130	92	41	87	78	87	249	89
500-1000	7	5	4	9	11	12	22	8
1001-2000	2	1	2	4	1	1	5	2
2001-3000	0	0	0	0	0	0	0	0
3001-4000	1	1	0	0	0	0	1	0
4001-5000	1	1	0	0	0	0	1	0
5001>	1	1	0	0	0	0	1	0
Total	142	100	47	100	90	100	279	100

The findings were that, 142 (51%) out of the 279 respondents were food secure out of which 130 (92%) had an income of less than Ksh. 500. On the other hand, 47 of the respondents were moderately food insecure out of which the majority 41 (87%) had an income of less than Ksh 500per month. Finally, 90 of the respondents were food insecure out of which 78 (87%) earned less than Ksh 500. This study was done in rural area where majority of the respondents were mothers who depended on farming. In rural set up income can only be obtained after crops have been planted, matured, harvested and then sold for cash. In good season little cash may be needed if enough food is produced, but when rain fails, food insecurity is experienced.

4.5.6 Cross Tabulation: Land Size by Household Food Security Status

The size of land owned was correlated with food security and micronutrient security status (Figure 4-20).

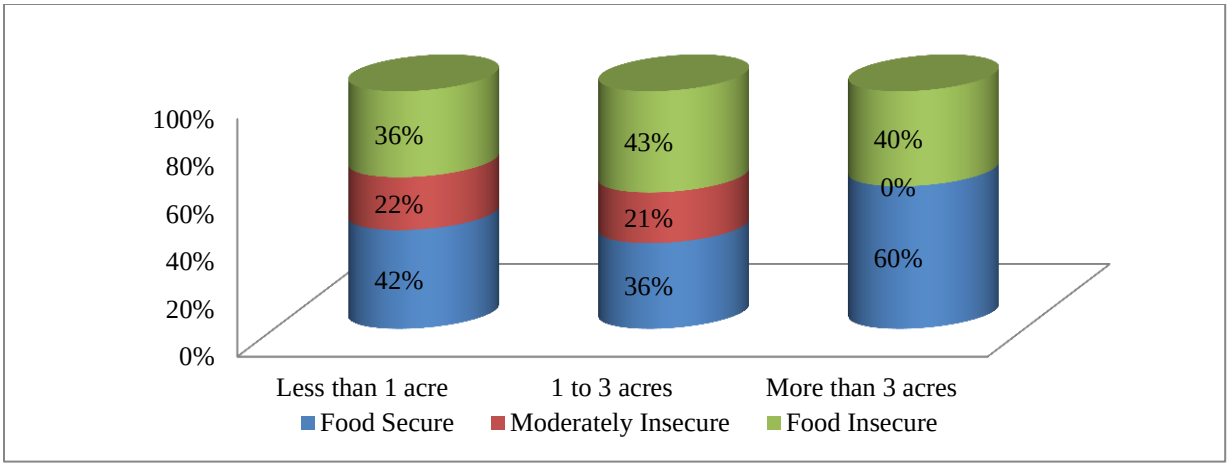


Figure 4-20 Relationship between Size of Land Owned and Household Food Security Status & Micronutrient Intake

The findings were that those who had very little land (<1ac) were likely to be food insecure. This could mean that the land was too small to be relied on as a source of food. On the other hand, those who had (< 3ac) were also found to be food insecure. This finding was unexpected because food security should increase as the size of land increases. It is assumed that the more land owned, the food is available for the household, even allowing some of the food to be sold for cash to purchase animal source foods (meats, eggs, milk) as well as other non-food materials (soaps , salt ,sugar, cooking oil). However, it could be that the land was unproductive and could not produce enough food. Another explanation could be that the land was too big for an individual to manage without appropriate farming tools. The study has found that the participants owned on average < 1 acre. The mean land size owned was 0.951acres. Other studies have showed that communities need a good size and quality land in order to get enough food and money to purchase non- food materials. In Nepal a study on food security showed that the respondents had a mean land size was 0.58ha. Other studies have shown that to be food secure, a good size land of good quality may be required. This point is illustrated by a study by

the World Food Program in (2011). This study 'assessment of food security in Northern Rakhine State, Myanmar', found that households had: poor food access if they had < 2acres, medium food access if they had 2 to 3 acres and good access if they had > 3acres.

However, farming dependent on rain may disappoint vulnerable farmers who may find themselves being chronically food insecure. Large size of land may also need suitable farming tools. None of the respondents reported owning a plough or a tractor which are used to cultivate large pieces of land. It is therefore assumed that the respondents used their own physical energy, and for this reason they were unlikely to be able to handle big pieces of land. The conclusion made after this study is that, communities in the study area live on farming, but the land on which to farm may not be large enough to support food security and other household needs.

4.5.8 Cross Tabulation: Sources of Water by Household Food Security Status and Micronutrient Intake

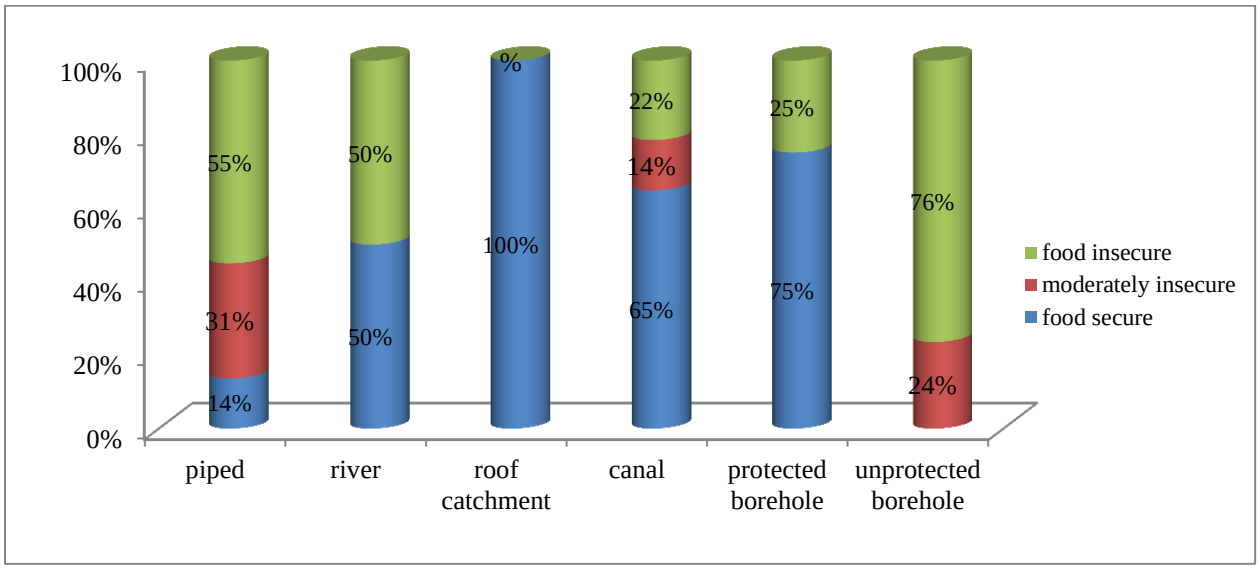


Figure 4-21 Relationship between Sources of Water and Household Food Security Status and Micronutrient Intake

The findings showed that 100% of those who used water from unprotected boreholes were food insecure. This may mean that these respondents are far away from other sources of water and may be they live in a very dry area which may affect their food access and consumption. In addition, the respondents may not be getting enough water for their households because getting water out of the bore hole is also not very easy. The study also showed that 100% of the respondents who used roof catchments were food secure. This may be what is expected since it is only those with a good size of corrugated iron roof can be able to catch enough water. Iron roofed houses are an indicator of a better socio economic status. Another observation was that 86% of those who used piped water were food insecure. This may mean that the water they used has been supplied on humanitarian ground and that the respondents have no activities to support themselves.

Analysis was also done on whether water used was safe for drinking. This was further cross tabulated by household Food security status and Micronutrient intake (Figure 4-22)

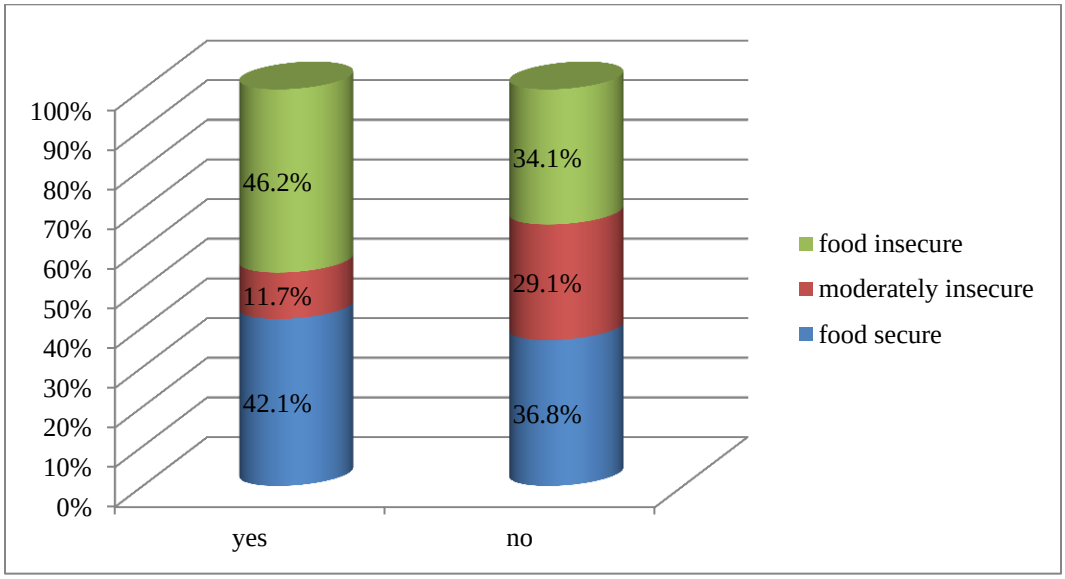


Figure 4-22 Whether Water Was Safe for Drinking and Household Food Security Status and Micronutrient Intake

The findings indicated that 57.9% (46.2 % severely insecure and 11.7% moderately insecure) were food and micronutrient insecure while 63.2% (34.1% severely insecure and 29.1% moderately insecure) were of the same status. However, 42.1 % of those who said yes were food secure while 36.8 % of those who said no were secure. It is assumed that those who were of the no opinion had knowledge and resources required to make the water safe. Availability of resources correlates positively with food security and Micronutrient Status by Location.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

Objective one determined the socio demographic and economic status of the respondents (mothers) in the two locations studied. Majority of the mothers in the study (over 80%) were married, over 50% had completed Kenya certificate of primary education (KCPE), while 70 % of them were farmer earning between KES 500 and 2000. Majority of the mothers lived in houses with mud floors and walls but roofed with corrugated iron sheets. Over 30% of the mothers owned assets such as a cow, a radio or bicycle. Majority of them also owned 1-3 acres of land from where they got most of their food.

Nearly all the independent variables studied, including gender of household head, marital status, religion, education, occupation, sources of income, livestock kept, assets owned and land size owned and were found to be significantly different in the two locations studied ($p< 0.05$) at 95% confidence interval. This implies that the two locations are at different socio economic status.

Objective two assessed household's food security status using Household Food Security Survey Model (HFSSM, 2012) adapted from Health Canada. The model measured food access and consumption behaviors of households in two locations and in two different (wet and dry) seasons. In Kangai 10.7% of the mothers did not eat a whole day during the dry season compared to 29.2 % of Mutithi mothers during the same period. In addition, during the wet season 22.4% of Kangai mothers did not eat a whole day compared to 35.5 % of Mutithi mothers during the same period.

In respect to the household's food security status, the study found that 34.2% of Kangai mothers borrowed money to buy food during the dry season compared to 64.4% of Mutithi mothers who borrowed money to buy food during the same period. The findings for the wet season had similar trend and showed that 43.8% of Kangai mothers borrowed money to buy food compared to 51.4% of Mutithi mothers who borrowed money to buy food during same period.

The findings of this study were that food access and consumption behaviors were at different levels for the two locations. This means that there were differences in the respondent's behaviors relating to food access and consumption between the locations and the differences were statistically significant ($p< 0.05$) at 95% confidence interval. According to the findings, the differences in food access and consumption behaviors between the dry and wet seasons were not significant.

Objective three assessed micronutrient dietary intake (Vitamin A, iron and zinc) in two different locations and during the dry and wet seasons. The findings were that during the dry season , 74% of Kangai mothers had poor to borderline micronutrient intake (37% poor and 37% borderline) while 83% of Mutithi mothers had poor to borderline micronutrient intake (30% poor and 53% borderline) during the same period. The findings for the wet season followed similar pattern, with 62 % of Kangai mothers showing poor to borderline consumption (34% poor and 28% borderline) and 74% of Mutithi mothers showing poor to borderline intake (26% poor and 48% borderline).

The findings were that the micronutrient dietary intake from the five food groups (fats and oils, animal products, yellow /orange fruits, yellow orange vegetables and dark green vegetables), which are rich in micronutrients specified in the study, (Vitamin A , iron and zinc) was significantly different in the two locations ($p < 0.05$) at 95% confidence interval. There was no significant difference in dietary consumption of micronutrient rich foods between seasons.

Objective four intended to determine risk factors for micronutrient utilization. The findings were that 96.8% of Kangai mothers used water from the river/ canal while 86.5% of Mutithi mothers used water from same source; 58.4 % of mothers of Kangai mothers were of the opinion that the water they used was safe for drinking while 30 % of Mutithi woman were of similar opinion. In reference to waste disposal, 43.3% of Kangai mothers used compost pit with 2% littering while 73.1% used compost pit with only 0.5 littering. The findings were that, the respondents from the two locations had differences in their water sources, their opinion about safety of drinking water, their method of water treatment as well as methods of solid waste disposal. The differences between the two locations were found to be statistically significant ($p < 0.05$) at 95 % confidence interval.

Poor access to drinking water was found to be significant by all statistical tests performed (chi square, regression, ANOVA). Lack of access to safe drinking water is likely to be an indicator of poor utilization of micronutrients. Untreated water can be a source of infection, which is likely to course diseases like diarrhea which interferes with nutrient absorption, resulting to their unavailability for metabolic use. Hence, it may be concluded (at 95% confidence interval)

that the communities studied were at the risk of waterborne diseases which may result in poor utilization of micronutrient.

5.2 Conclusions Based on Findings

5.2.1 Objective One: Socio Demographic / Economics Status of Mothers in the Study

There was a positive association between socio economic characteristics of the respondents (mothers) and food security status. The specific characteristics identified included: level of education, mother's occupation, housing quality, income levels, and size of land. These variables are proxy indicators of food security status.

5.2.2 Objective Two: Household Food Security Status

About **61%** of the (mothers) mothers, were food insecure **(39% severely insecure and 22% moderately insecure), while 39% were food secure.** However, there were more mothers in Mutithi (84%) than in Kangai (34%) with characteristic of food insecurity (Figure 4.7). In regard to season variations, this study concluded that the food security status, as evidenced by the data, was of **chronic** nature and did not improve by season. Mothers showed characteristics of food insecurity during both dry and wet seasons.

5.2.3 Objective Three: Mothers Dietary Intake of Micronutrients (Vitamin A, Iron and Zinc)

About 74% of the respondents had poor and borderline dietary intake of micronutrients (42% poor and 32% borderline) while 26% had acceptable consumption. In regard to locations, 74% of Kangai's respondents were at poor and borderline consumption during dry season while 83% of Mutithi's respondents had poor to borderline intake during the same period. During the wet

season, both locations had made some improvement in their micronutrient dietary intake; 62% of Kangai's respondents were at poor and borderline consumption (12%) better than during dry season), while 74% of Mutithi respondents were at poor to borderline intake during the same period (9% better than during dry season. The respondents from the two locations had a deficit of all the nutrients including calories, carbohydrates, proteins, iron, zinc and Vitamin A and that the Mutithi respondents were worse of. This was further confirmed by mean quantities of the ingredients consumed, which showed that fewer quantities of ingredients were consumed by Mutithi mothers compared to the Kangai ones.

5.2.4 Objective Four: Risk Factors for Micronutrient among Mothers

Situational analysis, including sources of water, safety of drinking water, household waste management and sanitation of the environment, was done. The conclusion of the study was that sources and safety of drinking water were two issues requiring attention. The study found that 96% and 87% of Kangai and Mutithi respondents respectively, used canal/ river water for their consumption. Studies have found river and canal water to be polluted with micro-organisms (bacteria, virus, and parasite) which cause diseases like typhoid, cholera, diarrhea and dysentery (Marshall, 2011). These diseases interfere with micronutrient absorption and utilization.

5.3 Recommendations

5.3.1 Recommendation for Practice

1. The study found that Mutithi mothers had lower socio economic status and as a result a bigger percentage of mothers from this location was also food insecure and had low micronutrient intake. This study recommends that mothers be targeted for empowerment

by county government. They should be encouraged to participate in small businesses to increase their ability to buy food.

2. Education level of mothers was found to have a relationship with food insecurity. This study recommends that, out of the formal school system, the leaders at the local level (members of county assembly, MCAs) should encourage mothers to learn life skills in small socio groups where mothers can learn from each other. Some of the issues mothers may learn are a) health education (importance of boiling drinking water) and b) nutrition (importance of fruits and vegetables in the diet, importance of balanced diet).

3. The study found that both Kangai and Mutithi respondents consumed less than the recommended dietary allowances (RDA) of all nutrients especially micronutrients included in the study (Vitamin A, iron and zinc). They were also found to have poor and borderline consumption of micronutrient rich food. In order to improve on consumption of micronutrient rich foods, this study recommends that mothers be encouraged and organized to utilize the funding available from the Government for the purpose of raising chicken for household consumption. Chicken are easy to keep and provide eggs which have high value proteins as well Vitamins and mineral salts. At the time of the study only 20- 25 of mothers kept chicken.

4. Mango fruit, which is rich in carotene, was found to be accessed and consumed by majority of the respondents. It is, however seasonal as it was available and cheap during the dry months, that is January and February. The study recommends mango

preservation and analysis of its nutrient content when it is dry so that households can have it when it is out of season.

5.3.2 Recommendation for Further Research

1. This study recommends an intervention research targeting food aid for the 39% of the mothers who were found to be severely food insecure.
2. Since this study was mainly qualitative in nature using proxy indicators of household food security status and micronutrient intake, a further research is recommended using serum biochemical analysis of Vitamin A, iron and zinc in order to get the actual status of these micronutrients in the community.

5.2.3 Government Policy (Ministry of Health)

1. The study found that majority of people use canal/ river water. Whereas these sources were what was available then, it is recommended that the county's ministry of public health educate people at community level on dangers of drinking water from those sources without boiling. Unsafe water from canals and rivers poses a lot of danger to health and is an obvious risk to micronutrient utilization.
2. The study also recommends that the County's ministry of water establishes a piped and treated water supply system to provide clean drinking water to communities in these two locations as soon as possible.

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7.0 APPENDICES

Appendix 1: Research Authorization by Graduate School, Kenyatta University

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: T130/23393/2013

DATE: 12th May, 2013

The Permanent Secretary,
Ministry of Higher Education, Science & Technology,
P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION RAHAB M. MUGAMBI– REG. NO. T130/23393/2013

I write to introduce **Ms. Rahab M. Mugambi who** is a Postgraduate Student of this University. She is registered for Ph.d degree programme in the **Department of Hospitality Management.**

Ms. Mugambi intends to conduct research for a Ph.d proposal entitled, **"Food and Micronutrient Security among Mothers and Preschools Children: The Case of Kirinyaga South District."**

Any assistance given will be highly appreciated.

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

DNN/rwm

Appendix 2: Research Authorization by National Commission for Science Technology and Innovation (NACOSTI)

NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2241349, 20-267 3550,
0713 788 787, 0735 404 245
Fax: +254-20-2213215

Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke

9th Floor Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

When replying please quote

Our Ref: **NACOSTI/RCD/14/013/1706**

Date:

25th September, 2013

Rahab Muthoni Mugambi
Kenyatta University
P.O.Box 43844-00100
Nairobi.

RE: RESEARCH AUTHORIZATION

Following your application dated ***13th September, 2013*** for authority to carry out research on "***Food and micronutrient security among mothers and preschool children: The case of Kirinyaga District,"*** I am pleased to inform you that you have been authorized to undertake research in **Kirinyaga County** for a period ending **31st March, 2014.**

You are advised to report to **the County Commissioner and the County Director of Education, Kirinyaga County** before embarking on the research project.

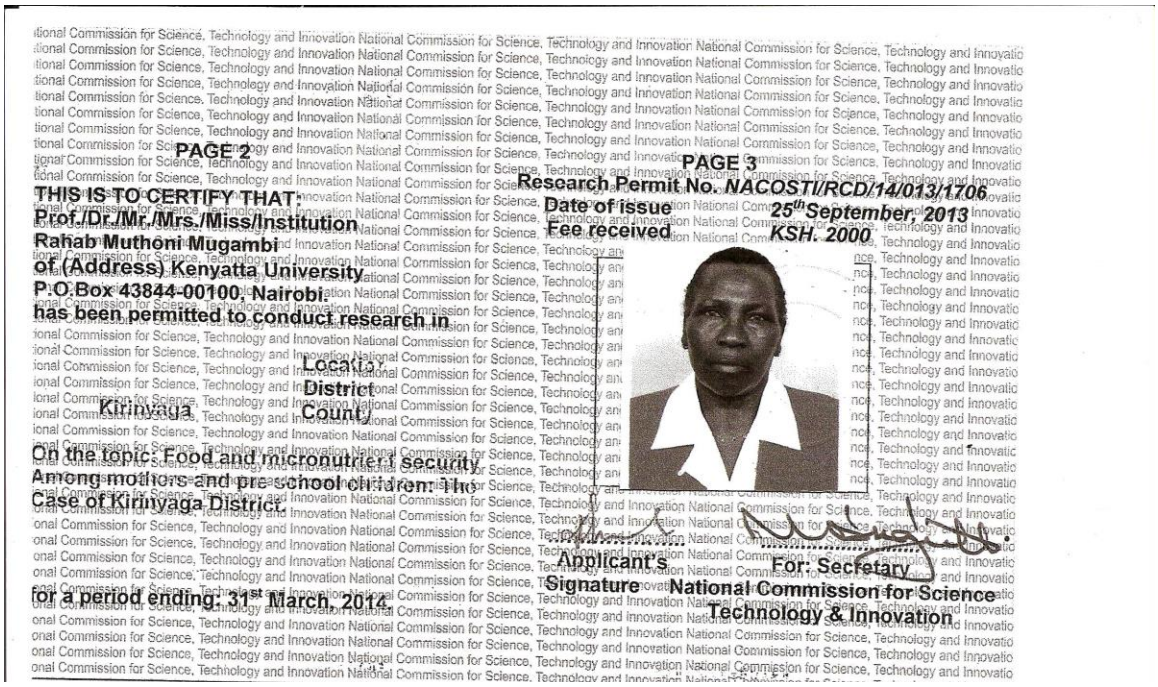
On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COMMISSION SECRETARY
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Copy to:

The County Commissioner
The County Director of Education
Kirinyaga County.

Appendix 3: Research Permit



PAGE 2

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss/Institution

Rahab Muthoni Mugambi

of (Address) Kenyatta University

P.O.Box 43844-00100, Nairobi.

has been permitted to conduct research in

Location

District

County

Kirinyaga

On the topic: Food and micronutrient security Among mothers and pre-school children: The Case of Kirinyaga District.

for a period ending: 31st March, 2014

Applicant's Signature

PAGE 3

Research Permit No. NACOSTI/RCD/14/013/1706

Date of issue 25th September, 2013

Fee received KSH. 2000

For: Secretary

National Commission for Science Technology & Innovation

Appendix 4: Research Authorization by Kenyatta National Hospital / University Of Nairobi Ethics Committee

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

KNH/UON-ERC
Email: uonknh_erc@uonbi.ac.ke
Website: www.uonbi.ac.ke
Link:www.uonbi.ac.ke/activities/KNHUoN

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/293

13th September, 2013

Rahab M. Mugambi
School of Hospitality Management
Kenyatta University

Dear Rahab

RESEARCH PROPOSAL: FOOD AND MICRONUTRIENT SECURITY AMONG MOTHERS AND PRESCHOOL CHILDREN: THE CASE OF MWEA WEST DISTRICT, KIRINYAGA COUNTY (P193/05/2013)

This is to inform you that the KNH/UoN-Ethics & Research Committee (KNH/UoN-ERC) has reviewed and **approved** your above proposal. The approval periods are 13th September, 2013 to 12th September 2014.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and severe adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

For more details consult the KNH/UoN ERC website **www.uonbi.ac.ke/activities/KNHUoN.**

Yours sincerely

PROF. A.N. GUANTAI
CHAIRPERSON, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Principal, College of Health Sciences, UoN
AD/Health Information, KNH
Supervisors: Prof. J.K. Imungi, Dr.Alice Ondigi, Prof. Judith N. Waudo

Appendix 5: Household's Questionnaire

A questionnaire to be filled by a mother of a child 2-5 years old.

DISRTICT LOCATION…….SUBLOCATION…….
VILLAGE…….
QUESTIONNAIRE NO……
NAME OF INTERVIEWER……..
DATE OF INTERVIEW……
RESPONDENT…….. (1= mother)
SEX…… female = 1
A .MARITAL STATUS AND RELIGION OF HOUSEHOLD HEAD…

1= Married	4= Widowed
2= Single	5= Separated
3=Divorced	6= other (specify)

RELIGION OF THE RESPONDENT

1=Catholic	4=Gospel
2=Anglican	5=other (specify
3=SDA	

B.DEMOGRAPHY: HOUSEHOLD PROFILE
(Household includes man, wife and their children)

Serial No	Sex	Age in yrs.	Occupation	Education
	A	B	C	D

KEY

SERIALNO	COLUMN A	COLUMN B AGE IN YEARS	COLUMN C	COLUMN D
	1= MALE		1Salaried employment	1.completed std 8
	2=FEMALE		2. farmer	2.completed forms 1-4
			3.casual laborer	3.attended youth polytechnic
			4.business	4.attended post sec .college
			5.housewife farmer	5.attended adult education
			6.other (specify)	6. Did not attend school.
				7.Attending primary school
				8.attending secondary school
				9.Attending college
				10.Attending pre school
				11.under school age
				12.any other

C. SOCIO- ECONOMIC

1. What are your sources of income?

1= farming	4=business
2=employment	5=farming and employment
3=farming and business	6= other(specify)

2. What type of a house does the family have?

Wall	Roof	Floor
1= mud	1= iron sheet	1= mud
2= wood	2= tiles	2= concrete
3= mud brick	3= grass thatched	3= tiled
4= stone	4= other (specify)	4= other (specify)
5= other (specify)		

3 .How much income do you get per month from: -?

1= Employment Ksh……

2= Business Ksh……

3=Farming Ksh……

4. What livestock do you keep?

1= cows	4= chicken
2=goats	5= rabbits
3= sheep	6= other(specify)

5. Which of the following do you have?

1= car	5=radio
2=bicycle	6=donkey/ oxcart
3=motorbike	7=television
4= computer	8= other

6. How much money do you spend on food per week?

1=0-99	4=400-599
2=100-199	5=600-799
3=200-399	6= 800 plus

(The following questions should be answered by a mother of a child 2-5 years).

7. How much land do you have? (Acres…….)

8. How much land do you cultivate?

1= 2-4 ac	3=6-8 ac
2=4-6 ac	4=other (specify)

9. What crops do you grow?

1=maize	7=chick peas
2=beans	8=tomatoes
3=sweet potatoes	9=French beans
4=cow peas	10=pumpkins
5=thoroko	11=bananas
6=ndengu	Other (specify)

10. How many bags of the following did you harvest last season?

Maize	Ndengu
Beans	Other (specify)

11. How much food do you still have in the store (at time of study?)

Maize	Ndengu
Beans	Other (specify)

12. In your opinion, how long will the stored food last?

1-2 months	3-4 months
2-3 months	Other (specify)

13. Do you irrigate your crops?

1= yes

2= no

14. If yes, in question 13, which crops do you grow by irrigation?

1= tomatoes	6=sukuma wiki
2=French beans	7=squash
3=maize	8=spinach
4=beans	9=potatoes
5=sweet potatoes	10= other (specify

15. What help do you get for looking after the shamba? 1= family members 2= casuals 3= employees 4= none

D. DIETARY PATTERNS: food frequency

16. How often does the family consume the following foods in a week?

FOOD ITEM	FREQUENCY	FOOD ITEM	FREQUENCY
FATS AND OILS		PROTEINS	
Butter		Meat	
Margarine		Fish	
Cod liver oil		Eggs	
FRUITS		Milk	
Pawpaw		VEGETABLES	
Ripe bananas		Carrots	
Guava		Pumpkins	

Oranges Mangoes Passion fruits Other (specify)		Tomatoes Spinach Pumpkin leaves Amaranths (terere) Cowpea leaves Yellow sweet potatoes Black night shade (managu) Comfrey (masecondary)	

KEY

1= every day	5=once every two weeks
2=4 times a week	6=once a month
3=2 times a week	7=once every 3 months
4=once a week	8=never

E. WATER SOURCES AND ENVIRONMENTAL SANITATION

17. From where do you get your water?

1= Piped
2= River
3= Roof catchment
4= Protected spring
5= Canal
6= Unprotected spring
7= Protected borehole
8= Unprotected borehole
9= other (specify)

In your opinion, is the water you use safe for drinking?

1= yes 2= No

If no, how do you make it safe?

1= Boil 2= Filter 3= Use chemical 4= Nothing 5= other (specify)

18. How does the household dispose of waste?

1= burn	4=feed to livestock
2=compost pit	Other (specify)
3=litter	

19. Does the family have a latrine / toilet? Yes NO

If no, what does the family use? 1=Neighbor's latrine 2= bush 3=other (specify)

Appendix 6: In-depth Questions Based on Household Food Security Survey Module (HFSSM) ADAPTED FROM HEALTH CANADA (2012)

A questionnaire to be filled by a mother of a child 2-5 years old.

DISRTICT LOCATION…….SUBLOCATION…….

VILLAGE…….

QUESTIONNAIRE NO……

NAME OF INTERVIEWER……..

DATE OF INTERVIEW……

RESPONDENT…….. (1= mother)

SEX…… female = 1

The household food security survey module uses 18 questions, 10 for adults (adult scale) and 8 for a child (child scale). This study adapted Health Canada HFSSM 2012 and used only 9 questions for mother, 5 for herself and 4 questions for hou2sehold.

Adult scale (mother)

In this study, the adult scale has five questions relating to an adult food consumption behavior. The questions were put to a mother of a 2-5 year child to assess food consumption behavior in last three months before the study as follows:

1) In the last 3 months, did you or other adults in your household cut the size of our meal or skip a meal because you did not have enough food and did not have money to buy?

If yes above, how often did this happen – almost every month, some months, in only one month.

2) In the last 3 months, did you or other adults in your household ever not eat for a whole day because you did not have enough food and did not have money to buy?

If yes above, how often did this happen – almost every month, some months, in only one month.

3) In the last 3 months, did you ever eat less than you felt you should because you did not have enough food and did not have money to buy?

If yes above, how often did this happen – almost every month, some months, in only one month.

4) In the last 3 months, were you ever hungry but did not eat because you did not have enough food and did not have money to buy?

If yes above, how often did this happen – almost every month, some months, in only one month.

5) Sometimes people lose weight because they do not have enough food to eat. In the last 3 months, did you lose weight because there was not enough food to eat? Yes No

Household scale

In this study, the household scale had four questions relating to the household's food access and consumption behavior. The questions were put to a mother of a 2-5 year child to assess the household's worry and resulting behavior in last three months before the study as follows:

1) In the last 3 months, I worried whether our food would run out before the next crop was ready and before I could get money to buy more food.

If yes above, how often did this happen – often, sometimes, never.

2) The food that we harvested did not last and we did not have money to get more. Was that often, sometimes or never true for you in the last 3 months?
3) " We could not afford to eat more than one type of food." Was this often, sometimes or never true for you in the last 3 months?
4) Have you borrowed money for food from anywhere in the last two weeks? Yes/ No

If yes, from where ? 1. Friend 2. Relative 3. Women's group 4. other.

Appendix 7: Household Meal Preparation Observation Guide

A HOUSEHOLD MEAL PREPARATION OBSERVATION GUIDE USED FOR A MOTHER OF A CHILD 2-5 YEARS OLD.

DISRTICT LOCATION…….SUBLOCATION…….

VILLAGE…….

OBSERVATION GUIDE NO……

NAME OF OBSERVER……..

DATE OF OBSERVATION……

RESPONDENT…….. (1= mother)

Visit a mother of at least one child aged 2 to five years old during preparation of one main meal of the day (breakfast, lunch, supper).

Introduction: my name is…….. Kindly allow me to be present as you prepare a meal for you and your family. The observation details will be used for an academic research only.

Details to be observed and noted

Meal type: breakfast, lunch or supper

Recipe:

Name of the dish / beverage

Ingredients and quantities used

Method of cooking

Number of people to eat the meal

Whether meal is for one or two meals

Appendix 8: Statement of Consent

My name is _____ and I am conducting a research on the household food security and food intake among mothers in Mwea West Sub County of Kirinyaga County. I have a questionnaire that is designed to gather information from mothers on their food consumption/ food preparation behavior. Participation is purely voluntary.

I will therefore ask you a few questions on the food consumption/ food preparation behavior at your household. Please be as honest as you can and provide the most accurate information. There are no correct or incorrect answers. The information you provide will be treated with strict confidence. You are not required to provide your name unless you choose to. If you get uncomfortable answering any particular question, please let me know.

Okay, are you ready to participate?

[ ]Yes [ ]No

If the mother **does <u>not</u>** consent, do not administer the questionnaire or food preparation guide, thank the respondent for her time and proceed to the next.

If the respondent consents, please continue with the questionnaire / food preparation guide

Appendix 9: Map Showing Kirinyaga County

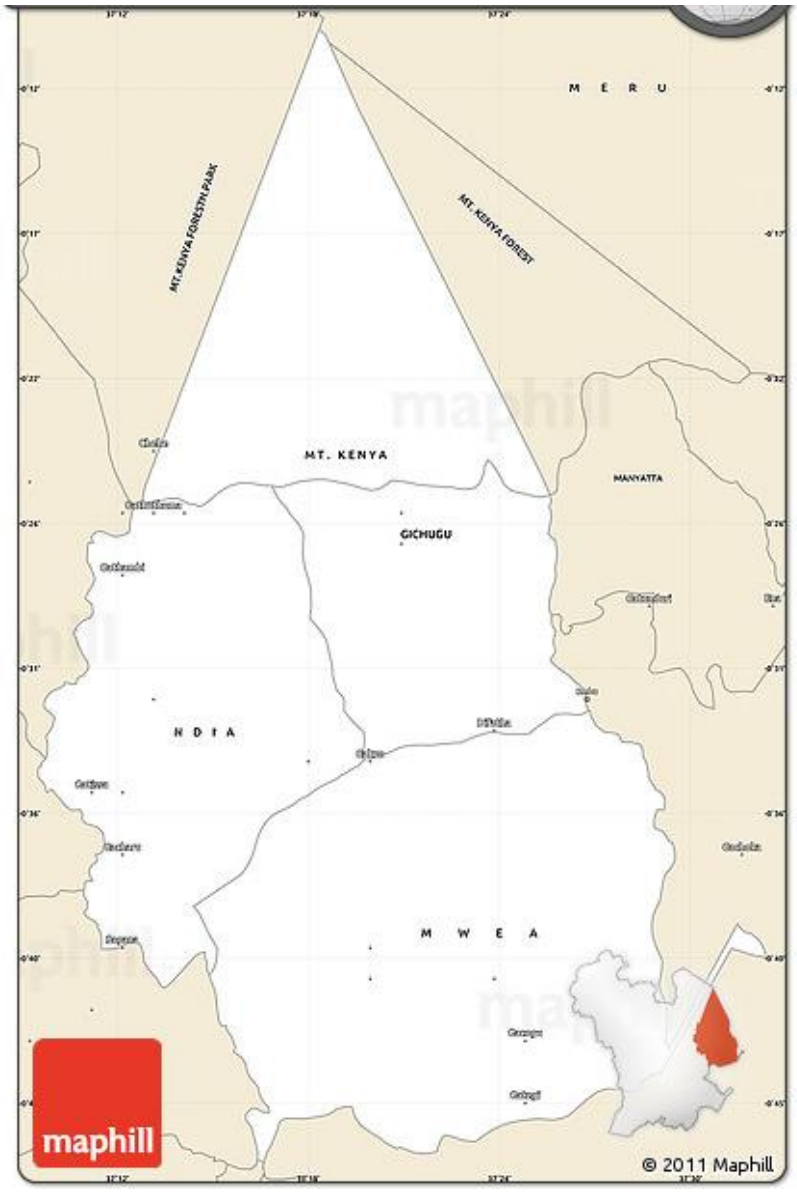
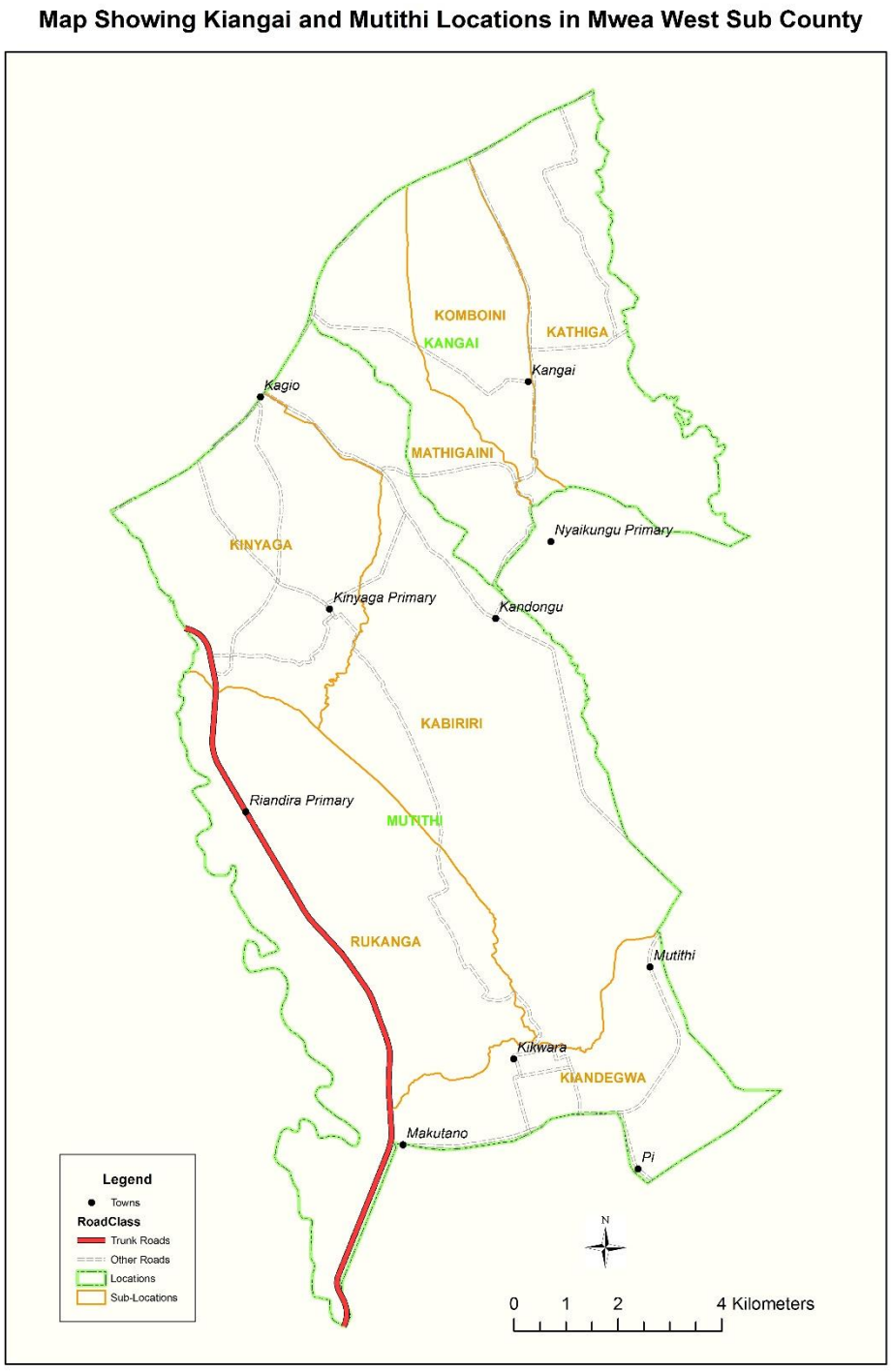


Figure 3. 1 Map of Kirinyaga County (Source: Maphill)

Appendix 10: Map Showing Mwea West Sub County



Appendix 11a: To Work Cut Off (Minimum 21) (FCS) Scores

Assume that cereals and tubers (a score of 2) are eaten daily for 7 days	7x2 = 14
Vegetables (a score of 1)are eaten daily for 7 days	7x1 = 7
Total	21

Source: WFP, (2008)

Appendix 11b: To Work Cut Off Scores (Minimum 28)

Assume that cereals / tubers (a score of 2) are eaten daily for 7 days	7x2 = 14
Vegetables (a score of 1)are eaten daily for 7 days	7x1 = 7
Fats and oils (a score of 0.5) are used daily for 7days	7x 0.5 = 3.5
Sugar (a score of 0.5) is consumed daily for 7 days	7x0.5 =3.5
Total	28

Source: WFP, (2008)

Appendix 11c: To Work Cut Off Scores (Maximum 35)

Assume that cereals and tubers are eaten daily for days	7x2 = 14
Vegetables are eaten daily for 7 days	7x1 = 7
Fats and oils are used daily for7/ 7days	7x 0.5 = 3.5
Sugars 7/7 days	7x0.5 =3.5
Pulse 4/7 days	4 x 3 = 12
Total	35

Source: (WFP 2008)

Appendix 11d: To Work Cut Off Scores (Maximum 42)

Assume that cereals and tubers are eaten daily for days	7x2 = 14
Vegetables are eaten daily for 7 days	7x1 = 7
Fats and oils are used daily for4/ 7days	4x 0.5 = 2
Pulse 4/7 days	4 x 3= 12
Fruit are eaten daily for 7 days	7*1 = 7
Total	42

Source: WFP, (2008)

Appendix 12: Food Consumption Score (FCS), Food Consumption Groups (FCGS) and Weighting

	Food items	*Food groups*	*weight*
1	Maize, rice, sorghum, millet, chapattis and other cereals Cassava, potatoes, sweet potatoes, matoke , yams , arrowroots and other tubers	Main staples	2
2	Beans, peas, groundnuts, cashew nuts and others	pulses	3
3	Vegetables (including leaves)	vegetables	1
4	Fruits	fruit	1
5	Beef, goat, poultry, eggs, and fish	Meat and fish	4
6	Milk, cheese, yogurt and other dairy	milk	4
7	Sugar and sugar products	sugar	0.5
8	Oils, fats, butter	0il	0.5
9	Spices, tea, coffee, salt, fish power , small amount of milk for tea	condiments	0.0

Source: (WFP, 2008; 2011).

Food consumption score profiles

Food consumption scores (FCS)	Profiles
0-21	Poor
21.5-35	Borderline
>35	Acceptable

Source: (WFP, 2008)

Appendix 13: Data Analysis Techniques for Objectives

OBJECTIVE	*TOOL/SOFT WARE*	*DESCRIPTIVE ANALYSIS*	*INFERENCE ANALYSIS*
Objective 1: Demographic /socio economic variables		SPSSs software v.20	T test for hypothesis Chi square Logistical regression ANOVA
Objective 2: Household food security status	Health Canada (HFSSM 2012)	Household food security status Food secure Moderately food insecure Severely food insecure	T test for hypothesis
Objective 3: Dietary intake of micronutrients		Frequencies and proportions presented in Tables, bar charts.	T –test for hypothesis
Food frequency	FCS/FCGs tool (WFP 2011)	Acceptable borderline poor	
Food preparation and cooking observation	National nutrient data base for standard reference release 26 v. 1.4 soft ware SPSS software v.20	Recommended dietary allowances (RDA) Frequencies and proportions presented in Tables, bar charts.	T- test for hypothesis
Objective 4: risk factors for micronutrient utilization	Spss software v.20	Frequencies and proportions presented in Tables, bar and pie charts.	T- test for hypothesis Chi square ANOVA Logistical regression

Appendix 14: Fats and Oils; Animal Products Vitamin A, Iron and Zinc Yield (per 100 Grams of Edible Portion)

FOOD MATERIAL	VITAMIN A (IU; μg ; RE)	IRON (mg)	ZINC (mg)
Margarine	680 IU	0mg	0mg
Cod liver oil	40,000 IU	0mg	0mg
Meats	24	0mg	8.8mg
Fish(tilapia)	0	1.0mg	0.3m
Eggs	1000	2.8mg	4.93mg
Milk	27	0.1mg	0.4mg
Human milk	137	0.2mg	2.0mg
Cooking oil	0	0	0mg

Appendix 15: Red /Orange Fruits Vitamin A, Iron and Zinc Yield (per 100 Grams of Edible Portion)

	FOOD MATERIAL	VITAMIN A (IU; μg ; RE)	IRON (mg)	***ZINC (mg)***
1	Pawpaw	175	0.100mg	0.070mg
2	Mangoes	400	0.130mg	0.040mg
3	Ripe bananas	8.0	0.310mg	0.160mg
4	Oranges	21	0.100mg	0.070mg
5	Passion fruit	70	1.60mg	0.100mg
6	**Guava**	**145**	**0.310mg**	**0.230mg**

Source :(GoK 1993)

Appendix 16: Yellow /Orange and Dark Green Vegetables Yield of Vitamin A, Iron and Zinc (per 100gram of Edible Portion).

	FOOD MATERIAL	*VITAMIN A(IU; µg ; RE)*	*IRON (mg)*	ZINC (mg)
1	Carrots	2813 RE µg	0.500mg	0.200mg
2	Pumpkins	160RE/ µg	0.800mg	0.30mg
3	Tomatoes	62.0 RE/ µg	0.450mg	0.090mg
4	Orange sweet potatoes	2006 RE/ µg	0.590mg	0.280mg
5	Spinach	672	2.71mg	0.530mg
6	Pumpkin leaves	3600	2.5 mg	0.1mg
7	Amaranths	700	4.0 mg	1.2mg
8	Cowpeas leaves (kunde)	7970	4.0 mg	0.3mg
9	Nightshade (managu)	50	4.0 mg	0.4mg
10	Sukuma wiki(kale)	900	4.0mg	7.7mg
11	Pumpkin seeds			10.3mg
12	Cabbage			0.18mg

Source: RoK (1993)

Appendix 17: Grains and Legumes Food Products Yield of Vitamin A, Iron and Zinc (per 100 Grams of Edible Portion).

	FOOD MATERIAL	VITAMIN A(IU; μg ; RE)	IRON(MG)	*ZINC (MG)*
1	Wheat germ	0RE	3.5mg	15.9mg
2	Millet	25RE	4.0mg	9.3mg
3	Chick peas	60RE	9.0mg	1.3mg
4	Beans	10RE	9.0mg	2.9mg
5	Roasted pumpkin seeds	38RE	10.0mg	7.7mg
6	White maize	0RE	2.5mg	0.46mg
7	Sorghum	20RE	4.5mg	9.3mg
8	Cow peas(thoroko)	15RE	5.0mg	1.58mg
9	Green grams	0RE	5.0mg	1.60mg
10	Rice(brown)	0RE	2.0mg	2.02mg
11	Pigeon peas (njugu)	0RE	5.0mg	1.24mg
12	**Black beans (njahi)**	**45RE**	**6.0mg**	**1.58mg**

Source: RoK (1993) National Food Composition Tables and the Planning of Satisfactory Diets in Kenya (Rok

Appendix 18: t-test on Mother's Food Access and Consumption behavior by Location

Food access and consumption variables	*t*	*df*	*P- value*
Skipped a meal	**13.211**	**789**	**.000**
Did not eat a whole day	**.536**	**785**	**.592**
Ate less felt was enough	**8.803**	**784**	**.000**
Hungry but could not eat	**-2.666**	**784**	**.008**
Lost weight due to not eating enough	**14.070**	**786**	**.000**

Appendix 19: t-test on Mother's Food Access and Consumption Behaviors by Season.

Food access and consumption variables	*t*	*df*	*Sig. (2-tailed)*
Skipped a meal	.522	789	.602
Did not eat a whole day	-2.626	785	.009
Ate less than felt was enough	-1.018	784	.309
Hungry but could not eat	-1.638	784	.102
Lost weight due to not eating enough	.875	786	.382

Appendix 20: t-test on Households' Food Access and Consumption Behaviour by Location.

Food access and consumption variables	*t*	*df*	*p-value*
We relied on one type of food	9.056	386	.000
Worried that food would run out	8.286	387	.000
Food harvested did not last	5.765	387	.000
We could not eat more than one type of food	8.591	382	.000
have borrowed money for food	7.393	388	.000

Appendix 21: t-test on Households' Food Access and Consumption Behaviour by Season.

Food access and consumption variables	*t*	*df*	*p-value*
We relied on one type of food	2.625	397	.009
Worried that food would run out	1.110	397	.268
Food harvested did not last	-1.410	397	.159
We could not eat more than one type of food	-1.218	397	.224
Have borrowed money for food	-.660	397	.510

Appendix 22: Logistic Regression on Risk Factors of Micronutrient Utilization among Women

Coefficients	Estimate	Std. Error	z value	P-value
(Intercept)	7.116e+01	7.801e+04	0.001	0.9993
qn43	3.651e+00	1.816e+00	2.011	0.0444 *
qn43c [T.river]	-5.920e+01	2.177e+04	-0.003	0.9978
qn43c [T.roof catchment]	-6.228e+01	2.177e+04	-0.003	0.9977
qn43c [T.protected spring]	-8.000e+01	2.171e+05	0.000	0.9997
qn43c [T.canal]	-7.094e+01	2.177e+04	-0.003	0.9974
qn43c [T.protected borehole	-5.272e+01	2.177e+04	-0.002	0.9981
qn43c [T.unprotected borehole]	-1.373e+01	3.718e+05	0.000	1.0000
qn43b	-3.689e+00	1.927e+00	-1.915	0.0556.
qn43d	.110e+00	2.604e+00	1.578	0.1146
qn43e	1.875e+00	1.342e+00	1.398	0.1622
qn44 [T.compost pit]	-3.741e+00	3.332e+00	-1.123	0.2615
n44 [T.litter]	-3.029e+01	4.745e+07	0.000	1.0000
qn44 [T.feed to livestock]	-1.741e+00	3.108e+00	-0.560	0.5753
qn45 [T.no]	-6.390e+00	2.160e+05	0.000	1.0000

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Appendix 23: ANOVA Test on Risk Factors of Micronutrient Utilization among Women

Source of water	10.710	1	0.001065 **
Water safe for drinking?	3.810	1	0.050956.
Method of making water safe	2.410	1	0.120578
Method of waste disposal	1.909	3	0.591553
Family has a latrine?	0.000	1	0.999923

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' 1

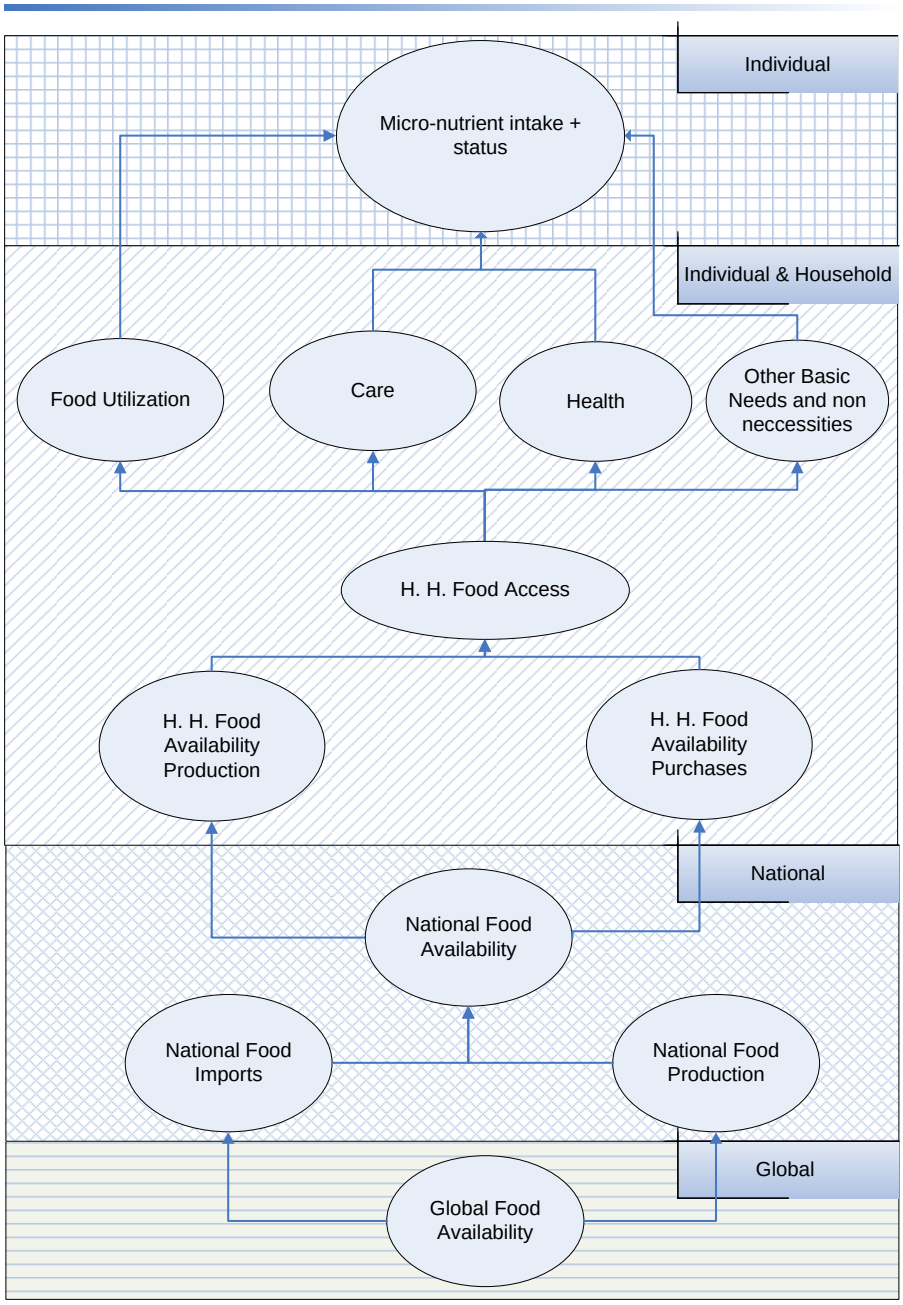
Appendix 24: Models for Measuring Household Food Security Status

Several household food security measuring models have been developed by different organizations including the United States Department of Agriculture (USAD), Health Canada, United Nations Food and Agriculture Organization (FAO), World Food Program (WFP) And Government of Kenya (GoK), as shown On Table 2.3

Models of measuring household food insecurity by different organizations

Organization	Household food insecurity category	Description
USDA	Very low food security	Reports of multiple indications of disrupted eating patterns and reduced food intake (skipping meals, missing meals a whole day).
	Low food security	Reports of reduced quality and variety (missing micronutrient rich foods e.g. fruits and vegetables, eating limited types of foods which may be undesirable. Little or no indication of reduced food intake.
	Food security	One or two reported indications of food insecurity, typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diet or food intake.
HEALTH CANADA (HFSSM)	Severely food insecure	≥ 6 adult or ≥5 child affirmative responses
	Moderately food insecure	2- 5 adult or 2-4 child affirmative responses
	Food secure	0 or 1 adult or 0 or 1 child affirmative response

Appendix 25: Relationship /Association Between Household Food Security Status and Micronutrient Intake



Source: Adopted from Pelletier et al 2001