HOUSEHOLD DIETARY DIVERSITY AND NUTRITIONAL STATUS OF CHILDREN AND WOMEN OF REPRODUCTIVE AGE IN MADIZINI TOWNSHIP AND ITS HINTERLAND VILLAGES

ZERIDA SAMWEL LUMOLE

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

2013

ABSTRACT

This study was conducted to assess household dietary diversity and nutritional status of children and women in Madizini township and its surrounding 3 hinterland villages of Manyinga, Lungo and Mhonda. A total of 160 women with their children between 12-59 months old were randomly sampled from village registers. Data were collected by using a structured questionnaire. A 24-hours recall on household dietary intake was conducted from which dietary diversity score (DDS) was calculated using the FAO-Protocol. Heights and weights measurements of the sampled children and their respective mothers were taken where-by data were analyzed by using the Anthro 2005 and SPSS software to obtain nutritional status. Mean DDS showed that Lungo village had the lowest level (2.33±0.09) compared to the Manyinga (2.65±0.08) and Mhonda (2.72±0.07) villages as well as Madizini township (2.61±0.06). The most commonly consumed food groups in hinterland villages and Madizini township were cereals, dark green leafy vegetables, vitamin A rich vegetables, other vegetables, legumes, oils and fats. The least consumed foods included eggs, fish, flesh meat, organ meat, milk and milk products, other fruits and vitamin A rich fruits. Most of the householdsin Lungo and Manyinga villages (hinterland)and Madizini township depends on market for procuring most of the food items for family consumption while own production dominated the households in Mhonda village. Mean BMI values of women in the hinterland villages (Manyinga22.10±0.63, Lungo 22.37±0.53 and Mhonda 22.7±0.56) were significantly lower than those of Madizini township (mean BMI = 26.41) at $p<0.05$. It is not surprising therefore that overweight and obesity rates were higher in Madizini township than in the hinterland villages. Stunting, underweight and wasting were higher among children in the hinterland

villages (35%, 11% and 11% respectively) compared to only (28.4%, 8.4% and 9.8% respectively) in Madizini township.

DECLARATION

I **Zerida Samwel Lumole,** do hereby declare to the Senate of The Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution for a degree award.

_____ _____

Zerida Samwel Lumole Date

(MSc. Human Nutrition Candidate)

The above declaration confirmed;

_____ _____

Prof. J. Msuya Date

(Supervisor)

COPYRIGHT

ACKNOWLEDGEMENTS

I wish to thank God the Almighty for providing me with the courage, strength, guidance, patience throughout my study period, since this work could not be fruitful without his inspiration upon me. My sincere gratitude should go to my supervisor, Professor John Msuya from the Department of Food Science and Technology for his moral support and valuable guidance, advice and positive criticisms throughout this study. His support, consideration and loyalty have contributed greatly to the successful accomplishment of this dissertation. Special thanks should go to Dr. E. Lazaro from Department of Agricultural Economics and Agribusiness for her encouragement, understood and moral support during the entire period of my study.

My foremost appreciation goes to my late lovely Leonard Peter Tambalu who laid down the foundation of this study. May God rests your soul in a peace place in heaven, AMEN. Brilliant appreciation is extended to my parents Mr. and Mrs. Lumole who brought me to this world, to my brothers; Mathew, Mbengwa, Martin and Paul, to my sisters; Prisca, Agness, Jane and Phoebe, to my sisters in law Faraja and Odilia, to my brothers in law; Adamu and Winstone; to my sons, daughters and all my relatives for their prayers and care during this study.

I am grateful for Rural-Urban Complementarities for Reduction of Poverty (RUCROP) project, for providing fund to carry out this study. Since it is not possible to mention every one, let me take this opportunity to express my sincere thanks to staff members of the Department of Food Science and Technology for their various contributions and assistance. To my colleagues Abela Z. Ngimbwa,

Esther Bessango, Annette Goodluck, Sudi Kundelya, Masatu Magafu and Evance Msosa for their prayers and moral support, may God bless you abundantly.

DEDICATION

This work is dedicated to my beloved mother Kezia Kasomambuto who laid down the foundation for my education. It is also dedicated to my beloved one late Leonard Peter Tambalu who built strong foundation for this study. To my son Baraka Leonard Peter Tambalu who indeed his love, encouragement and very strong support had encouraged me throughout my period of study. Above all, to my Lord Jesus Christ for granting me and my son life and ability to study.

TABLE OF CONTENTS

ABSTRACT ..... **ii**

DECLARATION ..... **iv**

COPYRIGHT ..... **v**

ACKNOWLEDGEMENTS ..... **vi**

DEDICATION ..... **viii**

TABLE OF CONTENTS ..... **ix**

LIST OF TABLES ..... **xiii**

LIST OF FIGURES ..... **xv**

LIST OF APPENDICES ..... **xvi**

LIST OF ABBREVIATIONS AND SYMBOLS ..... **xvii**

CHAPTER ONE **1**

1.0 INTRODUCTION **1**

1.1 Background Information 1

1.2 Problem Statement and Justification 3

1.3 Objective of the Study 6

1.3.1 General objective 6

1.3.2 Specific objectives 6

1.3.3 Research questions 6

1.4 Conceptual Framework 7

CHAPTER TWO **9**

2.0 LITERATURE REVIEW **9**

2.1 Dietary Diversity 9

2.2 Dietary Diversity and Food Security 10

2.3 Dietary Diversity and Nutritional Status of Children 11

2.3.1 Dietary diversity and stunting 12

2.3.2 Dietary diversity, underweight and wasting 13

2.4 Dietary Diversity and Nutritional Status of Women 14

2.5 Anthropometric Indicators 15

2.5.1 WAZ, HAZ and WHZ indicators 15

2.5.2 Body mass index for age 16

2.6 Rural-Urban Interactions, Food and Nutrition 17

2.7 Food Consumption in Rural-Urban Interaction 18

CHAPTER THREE 20

3.0 METHODOLOGY 20

3.1 The Study Area 20

3.2 Study Design 22

3.3 Sampling Procedures 22

3.3.1 Sampling unit and sampling frame 23

3.3.2 Inclusion and exclusion criteria 23

3.3.3 Sample size 24

3.4 Data Collection 24

3.4.1 Instrument for data collection 24

3.4.2 Data collection procedures 25

3.4.3 Pre- testing of questionnaire 25

3.4.4 Informed consent 25
3.4.5 Household dietary diversity 26
3.4.6 Anthropometric measurements of children 27
3.4.7 Body mass index for adult women 29
3.5 Data Processing and Analysis 30

CHAPTER FOUR 31
4.0 RESULTS AND DISCUSSION 31
4.1 Demographic and Socio-economic Characteristics of Respondents 31
4.1.1 Age of respondents 31
4.1.2 Marital status, household size and status within households 31
4.1.3 Education level and main occupation 32
4.1.4 Household income 35
4.2 Availability of Food in Households 37
4.2.1 Availability of fruits in households 38
4.2.2 Availability and accessibility of vegetables in households 40
4.2.3 Availability and accessibility of other vegetables in households 42
4.2.4 Availability and accessibility of roots and tubers in households 43
4.2.5 Availability and accessibility of cereals in households 44
4.2.6 Availability and accessibility of legumes in households 45
4.2.7 Availability and accessibility of animal products in households 46
4.2.8 Availability and accessibility of health services related to nutrition ... 48
4.3 Household Dietary Diversity 50
4.4 Food Consumption Pattern 51

4.5 Nutritional Status of Surveyed Women 52

4.6 Nutritional Status of Children 53

4.6.1 Stunting/chronic malnutrition (Height- for- age) 53

4.6.2 Underweight 54

4.6.3 Wasting/Acute malnutrition 54

4.6.4 Relationship between dietary diversity and nutritional status 54

4.7 Discussions 56

4.7.1 Household dietary diversity 56

4.7.2 Food consumption pattern 57

4.7.3 Nutritional status of women 58

4.7.4 Nutritional status of children 62

4.7.5 Rural-urban complementarities, sources of food and food expenditure 67

4.7.6 Rural- urban complementarities and its effect to nutritional status 70

CHAPTER FIVE 72

5.0 CONCLUSIONS AND RECOMMENDATIONS 72

5.1 Conclusions 72

5.2 Future Research and Recommendations 73

REFERENCES 75

APPENDICES 101

LIST OF TABLES

Table 1: WA, HA and WH Z-score classification 16

Table 2: WHO (1995, 1999 and 2004) classification of underweight, normal, overweight and obesity according to BMI by age 17

Table 3: Socio-economic and demographic characteristics of respondents 34

Table 4: Distribution of household income per month in hinterland villages and Madizini township 35

Table 5: Distribution of household expenditure per month on food in hinterland villages and Madizini township 36

Table 6: Distribution of household expenditure per month on other goods and services in hinterland villages and Madizini township 37

Table 7: Availability and accessibility of fruits in households 39

Table 8: Availability and accessibility of dark green leafy vegetables 41

Table 9: Availability and accessibility of other vegetables 42

Table 10: Availability and accessibility of Roots and Tubers 43

Table 11: Availability and accessibility of Cereals 44

Table 12: Availability and accessibility of Legumes 45

Table 13: Availability and accessibility of meat/animal products/fish 47

Table 14: Availability and accessibility of health services related to nutrition 49

Table 15: Household dietary diversity in hinterland villages and Madizini township 50

Table 16: Mean DDS in hinterland villages and in Madizini Township 51

Table 17: Percentage of households consuming different food groups on a single day recall..... 52

Table 18: Distribution of body mass of women of reproductive age in hinterland villages and Madizini township 53

Table 19: Mean BMI of women of reproductive age in hinterland and in Madizini township..... 53

Table 20: Distribution of the WHZ, HAZ and WAZ for children below five years in hinterland villages and Madizini township according to age 55

LIST OF FIGURES

Figure1: Conceptual framework depicting factors influencing nutritional status in women of reproductive age and children below five years of age..... 8

Figure 2: Map of Mvomero district in which the study area is located. 21

LIST OF APPENDICES

Appendix 1: Questionnaire for assessing household dietary diversity and nutritional status of children and women of reproductive age 101

Appendix 2: Household dietary diversity 105

LIST OF ABBREVIATIONS AND SYMBOLS

BMI	Body Mass Index
Ca	Calcium
DDS	Dietary Diversity Score
DRNCD	Diet Related Non Communicable Diseases
FAO	Food and Agriculture Organization
Fe	Iron
FVS	Food Variety Score
HAZ	Height-for-age z-score
HDDS	Household Dietary Diversity Score
HIV	Human Immunodeficiency viruses
Kg	Kilogram
M^2	Meters square
MAR	Mean Adequate Ratio
MDG	Millennium Development Goals
MoPEE	Ministry of Planning, Economy and Empowerment
MPA	Mean Probability Adequacy
NBS	National Beural of Statistics
PA	Probability Adequate
PHC	Primary Health Care
SD	Standard Deviation
SPSS	Statistical Packages for Social Sciences
TZS	Tanzanian Shillings

UNICEF	United Nations Children's Fund
UN	United Nations
URT	United Republic of Tanzania
WAZ	Weight-for-age z-score
WHZ	Weight-for-height z-score
WHO	World Health Organization
Zn	Zinc

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

It is widely recognized in the literature that urban areas diffuse economic development to rural areas through food imports, absorption of surplus labour and provision of services such as health and education (Jayne and Rubey, 1993; Tacoli, 2002a). Such interaction can have negative or positive effects on the populations involved and this can vary depending on the prevailing situation (Bernal and Lorenzana, 2003). It is therefore important to understand the resulting dynamics in such rural-urban complementarities and one of the key areas to focus on is in food and nutrition.

Household dietary diversity in populations can serve as a simple indicator of various parameters that affect the nutrition of people in such groups (Bezerra and Sichieri, 2011). Food security entails three important aspects (availability, access and utilization) (Leyna *et al.,* 2010). Dietary diversity has been positively linked with these three pillars of food security (Hillbruner and Egan, 2008; Styen *et al.,* 2006a).

Seasonality, location with its climate and agricultural practices are among factors that affect food availability in any locality (Swindale and Bilinsky, 2005; Tacoli, 2002b). Households accessibility to food has also been shown to be affected by demographic and socioeconomic factors, accounting for variations in diet quality (Bernal and Lorenzana, 2003).

Nutrition is the cornerstone of socio-economic development of a country. It is an essential component of millennium development goals (MDGs) and Primary Health Care (PHC), and Tanzania is fully committed to implement both (WHO/FAO, 2001). Better nutrition means stronger immune systems, fewer illnesses, better health and a productive community. Freedom from hunger and malnutrition is a basic human right and their alleviation is a fundamental prerequisite for human and national development (Torheim *et al.*, 2010). Malnutrition is one of the major public health challenges in developing countries. Usually referred to as a silent emergency, it has devastating effects on children, women, society and future humankind (Rana *et al*., 2006). Some of the factors that might explain the cause of such widespread malnutrition are low birth weights, insufficient food intake, prevalence of infectious diseases, inappropriate breastfeeding, and improper child care as indicated in conceptual frame work of this study (Figure 1) (Monteiro, 2009a).

The term malnutrition refers to both under-nutrition as well as over-nutrition. The latter is a problem of the developed world, but Tanzania is encountering the double-burden of over and under nutrition (NBS and ICF Macro, 2011). Malnutrition affects almost 800 million people worldwide, with most of them in the developing countries. The proportions are 70% in Asia, 26% in Africa and 4% in Latin America and Caribbean (Ergin *et al*., 2007).

Malnutrition is associated with about half of child deaths worldwide due to frequent illness leading to nutritional status sapping down leading to vicious cycle of recurring sickness and faltering growth (Monteiro, 2009b). All forms of malnutrition

are associated with significant morbidity, mortality, and economic costs, particularly where both under and over-nutrition co-exist as is the case in developing countries undergoing nutrition transition (UNICEF, 2006).

According to Tanzania Demographic and Health Survey of 2010; 21% of children of 6-59 months are underweight, 4% wasted and another 35% stunted. About 11% of women had chronic energy deficiency defined as body mass index (BMI) <18.5, and for lactating mothers the rate is 16.1%. Tanzania is affected by a double burden of malnutrition, with a rising prevalence of over nutrition alongside a high incidence of under nutrition. There is no clear data on over nutrition in children, however the prevalence of overweight in women of reproductive age is 23% and the prevalence of obesity is 6% (NBS and ICF Macro, 2011). Overweight and obesity are considerably higher among women in urban areas (36%) than in rural areas (15%) and both are increasing rapidly. Over nutrition is a predisposing factor for Diet Related Non Communicable Diseases (DRNCD), including diabetes, high blood pressure and coronary heart diseases (FDA, 2010b). These DRNCD are on the rise in Tanzania and account for the deaths of 14%-27% of women aged 15-49 years (Eduardo *et al.,* 2006).

1.2 Problem Statement and Justification

Lack of dietary diversity is particularly a problem among women and children in developing countries (Kennedy *et al.,* 2007a). In sub-Sahara African countries, diets are predominantly based on starchy foods with little or no animal products and few fresh fruits and vegetables (Ruel, 2003b; Torheim *et al.,* 2004). In Tanzania, cereals

contribute more than half (51%) to the total dietary energy supply, followed by starchy roots (19%) (Kinabo *et al*., 2006).Therefore, the dietary diversification index, i.e. the contribution of food groups other than cereals and starchy roots is very low. Studies have shown that dietary diversity is positively associated with overall dietary quality and micronutrient intake of young children and household food security (Steyn *et al*., 2006b; Kennedy *et al.,* 2007a; Kennedy *et al.,* 2009b). A high dietary diversity has also been associated with better nutritional status of children (Arimond and Ruel, 2004; Sawadogo *et al.,* 2006; Arimond *et al.,* 2010a). A diversity of fruits, vegetables and other plant foods contributes to lower rates of morbidity and mortality (Tucker, 2001). Studies have shown that the overall nutritional quality improve with increasing number of food groups (Hatloy *et al.*, 1998; Ogle *et al.,* 2001; Torheim *et al.,* 2004; Kennedy *et al.,* 2010).

On the other hand, malnutrition is highly prevalent in sub-Saharan countries. It is defined as failure to consume adequate energy, protein and micronutrients to meet basic bodily requirements for maintenance, growth and development (Drewnowski and Henderson, 1997). Malnutrition encompasses stunting (low height-for-age), underweight (low weight-for-age), wasting (low weight-for-height), and deficiencies of essential micronutrients (Josney-Hernich and Carriquiry, 2010).

Of the different forms of malnutrition, underweight and stunting are the two most common manifestations in children of below five years of age and chronic energy deficiency (BMI< 18.5kg/m^2) among women of reproductive age (De Onis and Frongillo, 2000). It is known that malnutrition is typically associated with low-

income, poverty, food insecurity, limited access to health care and lack of sanitary conditions (Leyna *et al.,* 2010). These associations are particularly salient in Africa where malnutrition continues to be a major public health issue (Cleaver and Okidegbe, 2006; UNICEF, 2006).

In Tanzania, emerging urban centers are bound to increase with more interaction between the residents in urban centres and those in the surrounding villages mainly for exchange of goods and services (Jeanene *et al.,* 2006). There is shipment of goods from the villages to urban centres e.g. food stuffs like yams, cassava, maize, tomatoes and vegetables. In turn, consumables like beverages, clothing, kitchen utensils and food items like imported rice, beans and bread are normally bought in urban centres (De Haan, 2000). This increase in the interaction can result in change of household diet and diversity (Azadbakht *et al*, 2006). Studies have shown the influence of large cities on the food security of rural areas (Ruel *et al.,* 1998; Tacoli, 2002b and Sthapit, 2004). However, to date there is little literature on the household dietary diversity situation and nutritional status of women of reproductive age and children below five years old in emerging urban centre and their immediate hinterland (surrounding villages). The aim of this study was therefore to assess household dietary diversity and nutritional status of women of reproductive age and children below five years in Madizini township as an emerging urban centre and its immediate hinterland (surrounding villages).

1.3 Objective of the Study

1.3.1 General objective

The general objective of the current study was to assess household dietary diversity and nutritional status of non-pregnant women of reproductive age and children of below five years in Madizini township and its immediate hinterland villages as a way of comparing food security situation in the two locations.

1.3.2 Specific objectives

The above general objective was achieved by undertaking the following specific objectives:

i. To identify the socio-economic characteristics of households in Madizini township and its immediate hinterland villages
ii. To determine the extent of rural-urban interaction through household food access and availability among households in Madizini township and the hinterland villages
iii. To measure household dietary diversity in Madizini township and the hinterland villages
iv. To measure nutritional status of women of reproductive age and children of below five years in Madizini township and the hinterland villages.

1.3.3 Research questions

The study is guided by the following research questions:

i. How do the socio-economic characteristics of households in Madizini township differ from those in the immediate hinterland villages?

ii. What are the main sources of food for households in Madizini township and in the immediate hinterland villages?

iii. Does household dietary diversity situation in Madizini township differ from that in the immediate hinterland villages?

iv. Does nutritional status of women or children of below five years in Madizini township differ from that in the immediate hinterland villages?

1.4 Conceptual Framework

The conceptual framework guiding this study is based on the understanding the factors contributing to nutritional status in women of reproductive age and children below five years of age (Figure 1). The framework centers on the factors which influence food consumption and nutritional status of women and children (UNICEF, 1998). This integrates community and household factors, long term and short term contributors of nutritional status and reproductive health among women. In this respect, livelihood or socio-economic factors- which involve urbanization/ rural environment, income earning opportunities and demographic relations together with nutrition knowledge and altitudes are important factors to consider. These will tend to influence the nutritional status through their determinant of food consumption (involving dietary pattern, dietary diversity and amounts of food and nutrients) and health caring capacity as depicted in Figure 1.

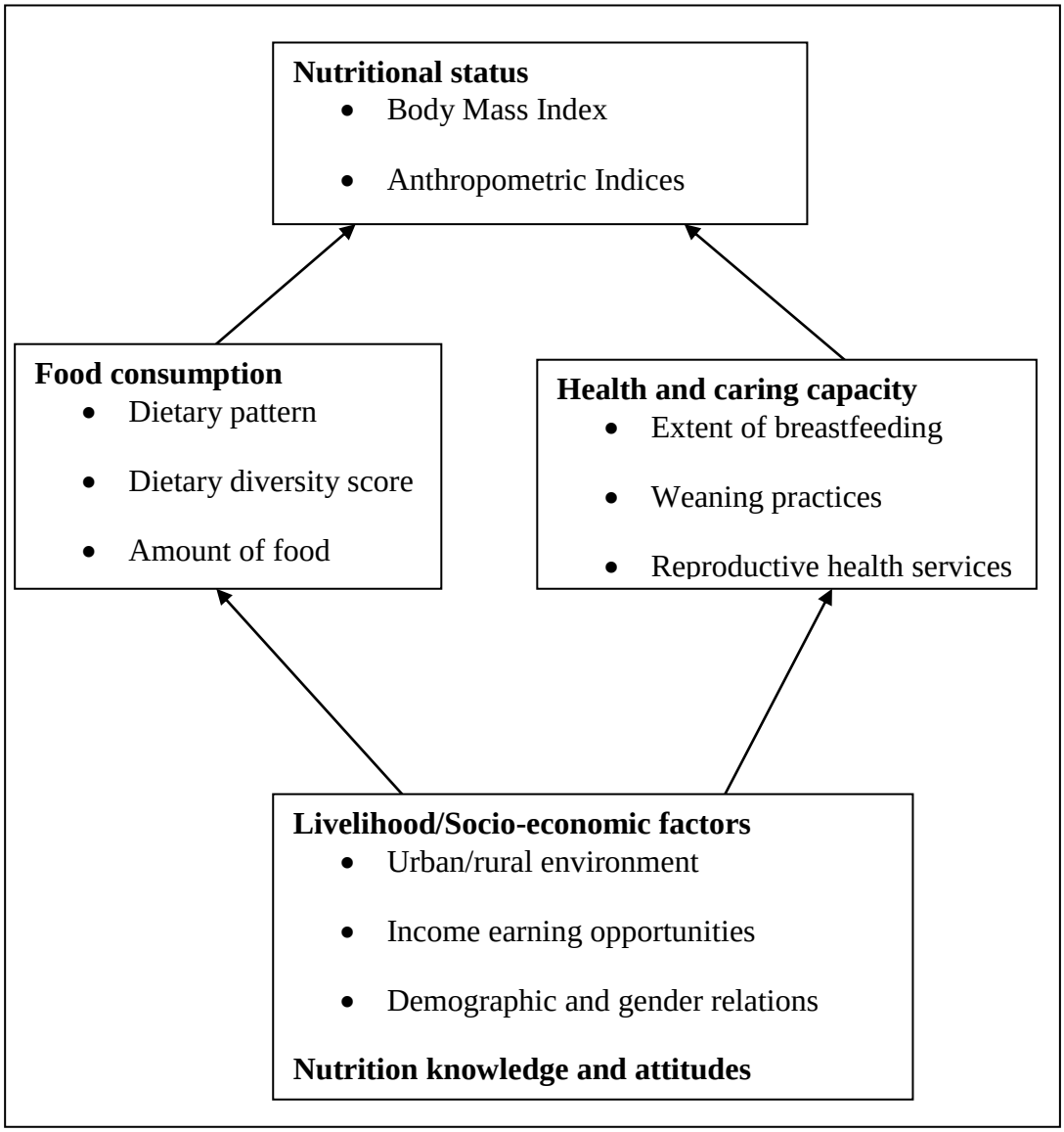

Figure 1: Conceptual framework depicting factors influencing nutritional status in women of reproductive age and children below five years of age

CHAPTER TWO

2.0 LITERATURE REVIEW

Proper nutrition is an asset to human life. Scientific evidence has shown that early nutrition affects key risk factors for developing chronic degenerative diseases during middle and late life (Dwyer, 2006). Overall, good nutrition can reduce the risk of non communicable diseases, including cancer, type II diabetes, and obesity. The direct influence of nutrition on health status and morbidity makes longer life feasible, while minimizing chronic disability (FDA, 2010a). Diverse diet rather than a single food item is necessary to obtain recommended levels of micronutrients e.g. zinc, iron, calcium and folic acid, along with vitamins A, B6, B12 and C can be used to reflex the overall micronutrient intake (Daniels, 2009a).

2.1 Dietary Diversity

Dietary diversity is defined as the number of different foods or food groups consumed over a given reference period (Sthapit, 2004). Definition of dietary quality vary widely, but historically, it has been used to refer to nutrient adequacy (Arimond, *et al*., 2010b). Nutrient adequacy, in turn, refers to a diet that meets requirements for energy and all essential nutrients (Torheim *et al.*, 2004). The growing concern in developed countries as well as in countries in transition (or soon to be in transition) regarding over nutrition and excess intake of certain nutrients and foods has led to a global shift in the definition of dietary quality to include both concepts of nutrient deficiency and over nutrition (Sawadogo *et al.,* 2006). Nutrient adequacy refers to the achievement of recommended intakes of energy and other essential nutrients.

2.2 Dietary Diversity and Food Security

Information about the individual or household dietary diversity in populations can serve as a simple indicator of food security (Azadbakht *et al*, 2006). Food security entails three important aspects (availability, access and utilization) in the relationship between man and food, necessary to ensure that nutrition plays its optimum role in human health. Dietary diversity has been positively linked with these three pillars of food security (Hillbruner and Egan, 2008). Individual and household access to food has also been shown to be affected by demographic and socioeconomic factors, accounting for variations in diet quality (Bernal and Lorenzana, 2003).

Studies have demonstrated the contribution of dietary diversity to population-level nutrient adequacy in developing countries, with fewer studies considering the value of cultivated and wild biodiversity (Ruel, 2003b; Roche *et al.*, 2008; IOM, 2011). It has recently been shown that in a peri-urban area of Dakar, Senegal (in west Africa), dietary diversity is positively correlated with intakes of several key nutrients, specifically Ca, Fe, Zn, vitamin A, vitamin C, thiamin, riboflavin and vitamin B6 (Spigelski, 2004). The study in Vietnam, which included adult women, validated the diversity measures (FVS and DDS) against nutrient intake and nutrient density (Ogle *et al*., 2001). The findings confirm a positive association between the two measures of diversity and intake of energy and a variety of nutrients. Women in the highest tercile of FVS, those who had consumed 21 or more different foods in 7 days, had a significant higher intake of most nutrients studied compared to those from the lowest tercile, who had consumed 15 or less foods (Daniels and Melisa,

2009b). Similarly, women with food group diversity 8 (out of a maximum of 12 groups) had significant higher nutrient adequacy ratios for energy, protein, niacin, vitamin C and zinc than women with lower food group diversity (Hatloy *et al*., 2000). In both regions studied, the percentage of energy from fat and protein was greater among the higher diversity group, whereas the percentage of energy from carbohydrates was lower. The micronutrient density of the diet among the higher diversity group was greater, especially for vitamin C and A, and for riboflavin, but only in one of the two regions studied (Monteiro *et al.,* 2004; Melgar-Quinonez *et al.,* 2006).

Using a multi -country analysis of data from 10 countries Hoddinott and Yohannes (2002) tested whether household dietary diversity was associated with consumption/expenditure and food security. The results indicate that as income increases people tend to diversify their diet (Torheim *et al.,* 2010). Diversity also significantly improves dietary quality and the likelihood that individuals will meet their daily nutrient requirements, especially with regard to essential micronutrients and it may be a good proxy for greater income/expenditure and food security (Vandevijvere *et al.,* 2010).

2.3 Dietary Diversity and Nutritional Status of Children

Nutritional status is considered an outcome of biological processes that involve food utilization while dietary diversity ensures adequate nutrient intakes (Styen *et al*, 2006b; Azadbakht and Esmaillzadah, 2010).It has a direct relationship with favorable nutritional status since it is associated with a number of improved

outcomes such as nutrient adequacy, anthropometric indices and improved hemoglobin concentration. Studies in Mali and Kenya document strong associations between dietary diversity and children's nutritional status (Hatloy *et al*., 2000; Swindale and Bilinsky, 2006). In urban areas of Mali, lower food variety or dietary diversity scores were associated with twice the risk of being stunted or underweight (Thome-Lyman, *et al.,* 2010). In Kenya, diversity measured by the number of individual foods consumed in 24 hour was significant associated with five nutritional status indicators height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ), weight-for-height z-scores (WHZ), triceps skinfold and mid-upper arm circumference among 12- 36 months children (Ogle *et al*., 2001).

2.3.1 Dietary diversity and stunting

Stunting reflects linear growth retardation accumulated before and after birth. Worldwide, stunting affects nearly one-third of children under 5 years of age, with the prevalence being higher in low-resource countries in sub-Saharan Africa and South Asia (WHO, 1999; Bezerra and Sichieri, 2011). Growth failure during infancy and early childhood is often irreversible, leading to short stature (Love *et al*., 2001). Stunting is associated with an elevated risk of child mortality, increased susceptibility to infection and poor cognitive and psychomotor development (Pollitt *et al*., 1995). The long-term consequences of stunting include deficits in school achievement, reduced work capacity and adverse pregnancy outcomes. The etiology of stunting is complex. Nevertheless, it may be largely attributable to chronic intake of a low-quality diet lacking in macro- and micronutrients, as well as to frequent infections (Martorelli *et al.,* 1994). These are all strongly associated with poverty,

where by dietary diversity is an important component of dietary quality: consumption of a higher number of food items and food groups is associated with improved nutritional adequacy of the diet (Hatloy *et al*., 1998; Torheim *et al*., 2003).

Several studies have shown that DDS is positively associated with overall dietary quality, micronutrient intake of young children (Steyn *et al.*, 2006b; Kennedy *et al*., 2007a). A higher DDS has also been associated with better nutritional status of children in developing countries (Arimond and Ruel, 2004; Sawadogo *et al*., 2006). A study by Jee-Hyan Rah *et al.* (2010) in rural Bangladesh determined the association between dietary diversity and stunting among children 6–59 months of age. The study revealed that lack of diversity was a strong predictor of stunting across all age groups of children under-five, regardless of breastfeeding status, morbidity, gender, and maternal and household characteristics. Using data from 10 multiple countries in Africa, Asia and Latin America, Arimond *et al.* (2010b) showed that improved dietary diversity was associated with a higher HAZ among children aged 6–23 months. Similarly, Sawadogo *et al*. (2006) found a positive relationship between infant and child feeding index and HAZ in all age groups of children 6–35 months in rural Burkina Faso.

2.3.2 Dietary diversity, underweight and wasting

Underweight represents depleted body fat and/or lean tissue stores; it remains a major public health problem and is a leading contributor to the disease burden in low income countries (Ezzati, 2005). The most common cause of underweight is malnutrition caused by the unavailability of adequate food. Poor nutritional status

afflicts a significant proportion of children below five years in developing countries. Underweight is linked to growth faltering and is associated with increased morbidity and mortality among children (Savy *et al*., 2005).

On the other hand wasting is a measure which indicates deficit in tissue and fat mass compared with amount expected in a child of the same height or length and may result also from failure to gain weight (Ekesa *et al.,* 2008). Other studies have shown that dietary diversity is significantly associated with nutritional status indicators especially among preschool children (Onyango *et al.,* 1998, Hoffman and Soo-kyung, 2005). However, the study in Democratic Republic of Congo and Burundi revealed poor relationship between dietary diversity and wasting (Ekesa, 2009).

2.4 Dietary Diversity and Nutritional Status of Women

In resource-poor countries across the globe, low-quality monotonous diets are the norm and the risk for a variety of micronutrient deficiencies is high (Daniels, 2009a). Women of reproductive age are among those most likely to suffer from deficiencies. The high nutrient demands of pregnancy and lactation put women in developing countries at high risk (Kennedy-Oji *et al*., 2001). Very little information is available on women's micronutrient status outside of developed countries (Kruger *et al*., 1994). However, even with limited data, it is clear that micronutrient deficiency among women is a global problem and is most severe for women in developing countries (Foote *et al.,* 2004).Women, one of the most vulnerable groups in society, and in particular those from low income populations have problems of micronutrient deficiencies, a greater risk of infectious disease (Maunder *et al.,* 2001; Amodu *et al.,*

2009) and have a low dietary variety (Labadarios *et al.,* 2005). World Health Organization (WHO, 2003) explains that the prevalence of many of these deficiencies varies greatly according to age, gender, physiological, pathological and socio-economic conditions, and yet women's dietary intake receives insufficient attention in many developing countries. Moreover, numerous localized studies in South Africa have indicated high prevalence of iron deficiency (Kruger *et al*., 1994; Dannhauser *et al*., 1999) and of vitamin A deficiency in women (Kennedy-Oji *et al*., 2001; Visser *et al*., 2003).

Measures of DDS and FVS are often validated against nutrient adequacy ratio (NAR), mean nutrient adequacy ratio (MAR), probability of adequacy (PA), mean probability of adequate nutrient intake (MPA), or anthropometric measurements, which indicate nutritional status and socio-economic characteristics (Rani *et al.,* 2010). Few studies within South Africa (Steyn *et al*., 2006b; Oldewage-Theron and Kruger, 2008; Labadarios *et al.,* 2011) have been conducted to relate dietary diversity and nutrient intake of women.

2.5 Anthropometric Indicators

2.5.1 WAZ, HAZ and WHZ indicators

Anthropometrical indicators assess the physical dimensions and the gross composition of the body (Weinsier and Morgan, 1993). These indicators are used throughout the world as the basis for assessing growth and nutritional status of individuals. Anthropometry is combined with other nutrition related information for assessment purposes. The most common anthropometric indicators used for

assessing the nutritional status of children are weight for age z-score (WAZ), height for age z-score (HAZ) and weight for height z-score (WHZ) which are commonly used for assessing nutritional status of children below five years of age as indicated in Table 1 below.

Table 1: WA, HA and WH Z-score classification

WAZ, HAZ and WHZ score	Inference
<-3.0SD	Severe malnutrition
-3.0SD to -2.0SD	Moderate malnutrition
-1.0SD to +2SD	Normal
+2SD to +3SD	Overweight
≥+3SD	Obese

Source: WHO (2004)

2.5.2 Body mass index for age

Body Mass Index for age is an index of weight for height that is commonly used to classify underweight, overweight and obesity in children aged 10-18years and adults (Table 2). It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2). Use of BMI for age is not appropriate for infants and children less than 10 years because of their different rates of weight gain and height gain during development (WHO, 2004).

Table 2: WHO (1995, 1999 and 2004) classification of underweight, normal, overweight and obesity according to BMI by age

Nutritional status	BMI (kg/m^2)
Underweight	<18.5
Severe thinness	<16.00
Moderate thinness	16.00-16.99
Mild thinness	17.00-18.49
Normal range	18.5-24.99
Pre-obese/ overweight	25.99-29.99
Obese	≥30.00

Source: WHO (2004)

2.6 Rural-Urban Interactions, Food and Nutrition

Rural-urban interactions are important elements of the livelihood strategies of both rural and urban households, either in the form of flows of people, natural resources, products, goods and services, information and money, or in the form of income diversification such as urban agriculture and non-farm rural employment (Tacoli, 2002a). However, often rural and urban development is considered in isolation. Their inherent linkage with each other's development is less considered or reduced to only market linkages (Rutasitara, 2002). Although market linkages play significant role, Rural-Urban interaction is beyond this linear kind of assumption and it encompasses many complex interactions and processes (Popkin, 1996). For example, changing food consumption patterns in urban centers as a result of rapid urbanization and income growth offer good opportunities for food producers in rural areas, with the possibility for food consumers to focus on high food value (Ohna, 2007).

(a) Eating habit in urban areas

In the urban areas, food habits and dietary patterns have drastically changed in the last decades especially among the high-income groups (Mirmiran and Azadbakht, 2004). Energy dense foods and western-type fast foods have become readily available on the market and their consumption has increased significantly. The dietary pattern has changed from a traditional diet high in carbohydrates and fibre to consumption of non-traditional processed foods, meat and alcohol (Mazengo *et al*., 1997).

(b) Eating habit in rural areas

In rural settings, family members eat from the same pot: this can affect negatively nutrient intake of some members of the household who do not eat fast enough, e.g. children. In certain communities food distribution is governed by gender norms: males and females eat separately and often the latter only eat once the males are satisfied. Similarly, the quantity of food consumed can be limited and meal frequency varies with the season. Frequency of meat and milk consumption is low. Among certain communities these products are consumed very rarely (Rikimaru, 2000).

2.7 Food Consumption in Rural-Urban Interaction

Diets in urban areas are based more heavily on processed and pre-prepared foods, which generally contain more fat, sugar, salt and preservatives, and have less fiber and often lower micronutrient content (Hatloy *et al*., 2000).Reasons for the shift toward processed foods in urban areas include convenience, availability and

affordability. Bread for example, is prepared fresh daily and sold universally in local shops and on the streets (Daniel *et al.*, 2009a). A study conducted in Tanzania to evaluate food consumption patterns among urban and rural populations found the most commonly eaten foods among urban populations included bread, cookies, vegetable oil, beef and milk, fruits and vegetables while the list of the most commonly consumed foods in rural areas was substantially different and included sweet potatoes, cassava leaves, cassava and fresh vegetables and fruits (Arimond and Ruel, 2004). This study attempts to assess household dietary diversity and nutritional status of non-pregnant women of reproductive age and children of below five years of age in an emerging urban centre and its immediate hinterland villages.

CHAPTER THREE

3.0 METHODOLOGY

This chapter briefly describes the methodology that was used in the study. It includes description of the study area and research design, which covers sampling procedures, sample size and sampling frame, data collection, data analysis and limitation of the study.

3.1 The Study Area

The study area was Madizini Township and three immediate hinterland villages located in Turiani division in Mvomero district (Figure 2). The district is located north of Morogoro region. In the east the district is bordered by Morogoro Municipality and Bagamoyo district; in the north is Kilindi district and south is Morogoro rural district, while in the west the district is bordered by Kilosa district.

Madizini Township comprises of five hamlets (vitongoji) of Kibaite, MjiMpya, Madizini B, Mpingoni and Barabarani. Different services such as markets, shops, metal and wood workshops, transport, banks and health care are found. The town is bordered by Manyinga, Kisala and Mhonda villages in the west; to the east are Kidudwe, Nkunke and Lungo villages; to the south is Lukenge village, while to the north the town is bordered by Lusanga village. Madizini township has a population of 13,380 according to the population census of 2002, with the average household size of 5-7 persons (NBS and MoPEE, 2002). The study area was purposively selected because it is an emerging urban centre which offers suitable location for

studying rural-urban complementarities between an urban centre and its surrounding villages. The existence of Mtibwa Sugar factory and timber factory has led to its development as a highly commercialized urban centre. More than 85% of the population is engaged in agriculture producing maize, beans, cassava, paddy, fruits, sunflower and sugar cane (URT, 2005). Apart from the farming activity, people also work in sugar and timber factories.

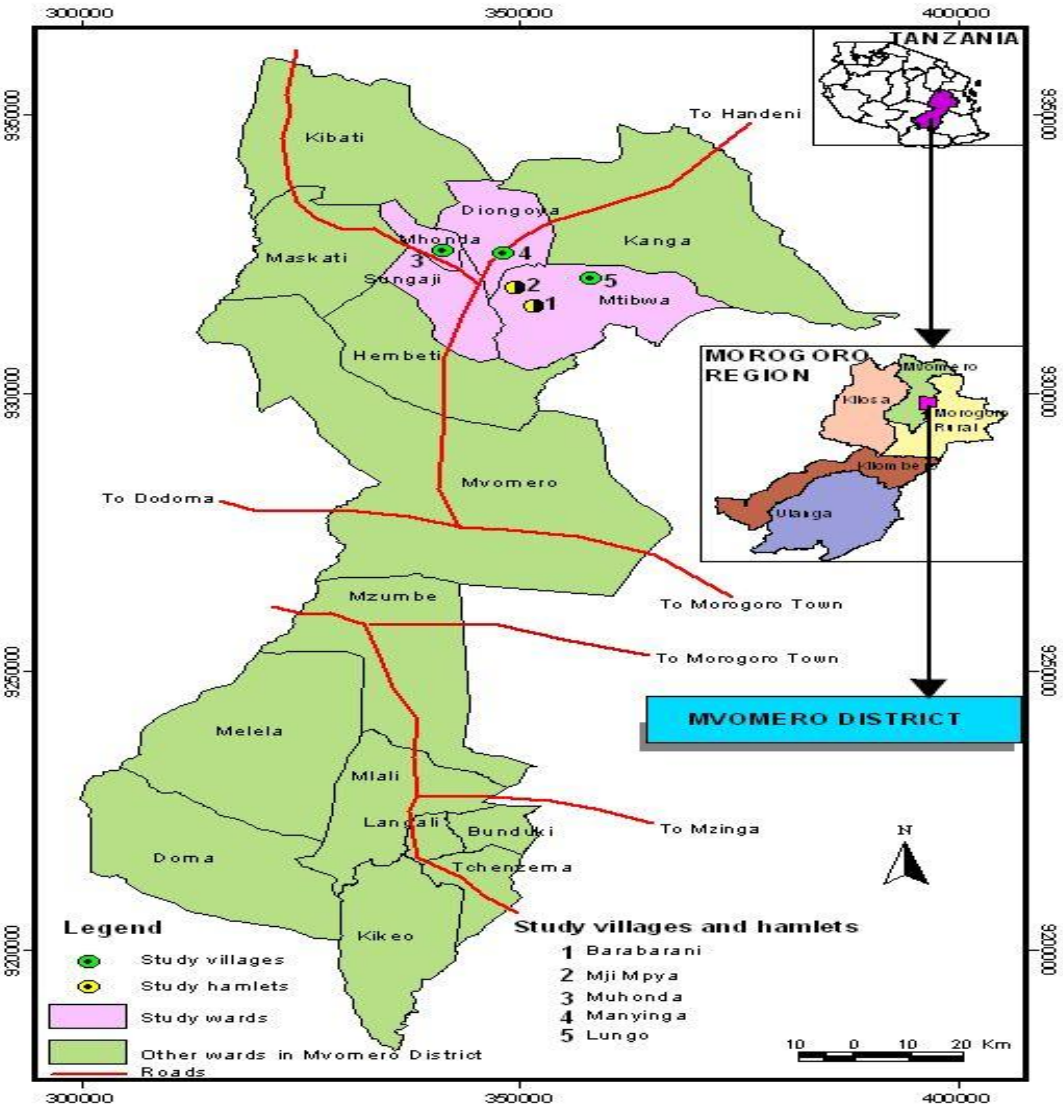

Figure 2: Map of Mvomero district in which the study area is located.

3.2 Study Design

This study was a cros – sectional which allowed collection of data at a single point in time. The reason for the choice of this design is that it is economic to conduct in the situation where resources constraints like money, labor and time do exist (Bailey, 1998). In this type of research study, a subset therefore is selected from the entire population from which data are collected to answer questions of interest. The design is called cross sectional because the information about the respondents that is gathered represents what is going on at only one point in time.

3.3 Sampling Procedures

In this study, different sampling techniques were employed. Three wards were selected purposively. One ward (Mhonda) was far from Madizini township, another one (Diongoya) is nearest to Madizini township, while Mtibwa ward is the one where Madizini township is located. Two hamlets from Madizini township (Mjimpya and Barabarani) and 3 immediate hinterlands (Manyinga, Mhonda and Lungo villages) were randomly selected using a table of random numbers. Simple random sampling was further employed to get proportional number of households with desired characteristics, whereby 37 households were selected from Mhonda, 32 households from Manyinga and 31households from Lungo.

A list of households with women and children of below five years old from each village and hamlet registers were used to select the households using a table of random numbers. In Madizini township, because of its high population compared to other villages, 60 households were selected (30 households from Mjimpya and 30

households from Barabarani hamlets) that made a total of 160 households. The calculation of sample size is described in section 3.3.3 below.

3.3.1 Sampling unit and sampling frame

Sampling unit was a household with a non-pregnant woman of reproductive age (15-49 years) having a child of between 1-5 years old (under five). The sampling frame consisted of children between 1-5 years old and their respective mothers (15-49 years) living in Madizini township and immediate hinterland villages at least three months prior to the study. For households which had more than one child and more than one woman in the selected category, only one mother-child pair was selected for the study. This particular group has been selected because it is the most vulnerable in terms of nutrition and food insecurity (Burke *et al.,* 2005). Also it reflects the overall nutritional status and poverty level in a given population (Nestle and Marion, 2001).

3.3.2 Inclusion and exclusion criteria

All non-pregnant women of reproductive age 15-49 years with children of between 1-5 years old living in the sampled areas were eligible for inclusion into the study. Excluded from the study were pregnant women, all women who did not have an under five child and women who were proven to have known chronic diseases such as HIV positive and pulmonary tuberculosis.

3.3.3 Sample size

The sample had a total of 160 mother- child pairs. This was determined using the formula by Fischer *et al.* (1991) where random sampling technique is used to obtain respondents. The sample size was calculated as following;

$n = Z.^2 p.q/d^2$ ……..(1)

Where: n = desired sample size (when population is greater than 10 000)

Z= standard normal deviation, which is 1.96 set at 95% confidence interval.

p = proportion in target population of children below five years of age estimated to be malnourished (12%) in Morogoro region (NBS and ICF Macro, 2011).

d= degree of accuracy desired 5% or 0.05

q = (1-p) = Proportion of the children who are well nourished (0.88)

Therefore:

$$n = \frac{1.96^2 \text{ x } 0.12 \text{ x } (1-0.12)}{0.05^2} \quad \text{……..(2)}$$

n = 162 children (and therefore mother-child pairs).

3.4 Data Collection

3.4.1 Instrument for data collection

Data was collected using structured questionnaire with both open and closed end questions. The questionnaire is divided into three sections (Appendix 1). Section one sought information on socio-economic and demography of household. Section two

gathered information on extent of rural-urban interaction in food access and availability, while section three collected information on household dietary diversity and nutritional status of the target women and child.

3.4.2 Data collection procedures

A nurse from Bwagala Hospital who is familiar with the study area was recruited as research assistant to assist in data collection. The research assistant was trained for two days so as to understand what she was supposed to do in the field. Data was collected through household visits where-by a sampled woman was interviewed and anthropometric measurements conducted.

3.4.3 Pre- testing of questionnaire

The questionnaire was pre-tested before starting data collection in 20 randomly selected households in Kilimanjaro village. Kilimanjaro village is out of the study area but had similar characteristics to the study area. Ambiguous and unclear questions were corrected before the actual data collection started.

3.4.4 Informed consent

Verbal informed consent to participate in the study was asked from heads of households as well as from each participating woman. This was after the study was fully explained to them. Each eligible woman was free to opt out of the study.

3.4.5 Household dietary diversity

Data on household dietary diversity was collected using 24 hours recall dietary intake. The information collected on dietary consumption allowed to calculate a dietary diversity score (DDS), defined as the number of different food groups consumed by family members over 24 hours. Dietary data was collected by means of a validated 24 hours recall which was not quantified. Respondents were visited at their homes during the survey. As most of the women are involved in cooking household meals at home, it was assumed that they have good ability to remember foods eaten (Mirmiran *et al.* 2006). The 24 hours recall was validated based on Oldewage-Theron *et al*. (2005).

A list of meals, dishes and all food items and beverages consumed in the last 24 hours were recorded. Although using 24-hour recall period does not provide an indication of an individual's habitual diet, but it does provide an assessment of the diet at the population level and can be useful to monitor progress or target interventions (Savy *et al.,* 2005).The recall period of 24 hours was chosen for this study as it is less subject to recall error, less cumbersome for the respondent and also conforms to the recall time period used in many dietary diversity studies (Ruel, 2003a; Steyn *et al.,* 2006b; Kennedy *et al.,* 2007b; Arimond *et al.,* 2010a). Participants were asked for a full description of ingredients in mixed dishes. They were also prompted for specific foods such as snacks and drinks. They were not however prompted for use of supplements.

For this study, the twelve food groups, recommended by Food and Agriculture Organization of the UN (FAO, 2007) were usedto assess household dietary diversity scores (HDDS) (Appendix 2).Yes and No categories were used. Yes was given a score of one (1) to each food group if the household consumed at least one food item from a particular food group for the past 24hours preceding the survey. No was given zero (0) score for a particular food group if the household did not consume any food item from that food group. Finally the scores were counted from each food group and household dietary diversity scores (HDDS) were calculated based on the FAO guidelines for measuring household and individual dietary diversity (FAO, 2007). A DDS of less than 3 food groups was regarded as low household dietary diversity and hence food insecurity. Four to five food groups was regarded as medium dietary diversity and ≥6 food groups was regarded as high dietary diversity hence food secured.

3.4.6 Anthropometric measurements of children

Anthropometric measurements of height/length and weight were taken for use in the computation of nutritional status indices namely weight for age, weight for height and height for age.

(a) Recumbent length

Length board was used for measuring children who were less than 24months of age. Before taking the length, the board was positioned on a hard flat surface. With the mother's help, the child was gently laid on the board with the crown of the head against the fixed head board facing directly up so that the child's line of sight was perpendicular to the measuring board. The research assistant held the child to ensure

the child was placed with crown touching the headboard, the child's shoulders and hips at the right angles to the long axis of the body. The measurement was read and recorded to the nearest 0.1 centimeter.

(b) Height

Height was obtained by use of a stadiometer with precision of 0.1cm for children aged 24-60 months. The bare footed child was assisted to stand straight on the stadiometer which was placed on a flat surface and to look straight ahead. With the help of mother, the heels were maintained together and the body was placed so that the shoulder blades, buttocks and the heels were touching the vertical surface of the stadiometer. The feet were maintained flat on the floor slightly apart, with the legs and back straight and arms at the sides. The shoulders were relaxed and in contact with the stadiometer. As the child stood still, the research assistant took the measurement.

(c) Weight

Weight of a child was measured and recorded to the nearest 0.1kg using a Salter scale (Model 235 6S – England) with a capacity of measuring up to 25kg. The scale was adjusted to read zero before starting the measurements. The child was slipped into a weighing sling and hung on the scale. The weight was recorded as soon as the pointer on the scale had stabilized.

(d) The nutritional status indices

The most common nutritional indices used for assessing nutritional status of children in this study were weight- for -age z-score (WAZ), height-for -age z-score (HAZ) and weight –for-height z-score (WHZ). According to WHO (2004), children whose WHZ, WAZ or HAZ are < -3SD were classified as being severely wasting, underweight or stunting while those whose WHZ, WAZ or HAZ lie between -3SD and -2SD of the standard were regarded as moderately wasting, underweight or stunting respectively. Children with WHZ, WAZ or HAZ between -2SD and -1SD were considered as mild wasted, underweight or stunted. Children whose WHZ, WAZ or HAZ lied between -1SD and +2SD were classified as normal whereas those lying between +2SD and +3SD were regarded as overweight (WHO, 2004).

3.4.7 Body mass index for adult women

The body mass index BMI (kg/m^2) for each subject was calculated as the ratio of body weight in kilogram (kg) and height in meters squared (m^2). Subject was judged to be underweight, normal, overweight or obese using the BMI cut-off points, where-by the BMI < 18.5 was regarded as underweight, 18.6- 24.9 regarded as normal, 25-29.9 regarded as overweight, 30-34.99 regarded as obese class I, 35-39.9 regarded as obese class II and ≥40 regarded as obese class III (WHO 2004). Measurements were taken as follows:

(a) Height

Height was measured by using portable Harpenden stadiometer (Holtain Ltd, UK). A subject was asked to stand bare feet on a flat surface; the feet were placed together

in the centre against the wall. The eyes of the subject looked straight forward and the line of sight was in level with the ground/surface. Shoulders were in the levels, hands pointed vertically downwards against the body, head, shoulder blades and buttocks touched against the wall. When these conditions were met, measurement was recorded.

(b) Weight

Weight was measured by using SECA electronic bathroom weighing scale (0-150 kg) (SECA- Germany), which was placed on a flat surface. The scale was adjusted to zero before taking measurements. Subjects were weighed bare feet with only light dresses. Unnecessary materials in the pockets and body such as mobile phones or wrist watches were removed during measurements. While taking measurements, a person stood in upright position at the centre of the balance with the feet placed in a v-shape. The weight was recorded to the nearest 0.1kg.

3.5 Data Processing and Analysis

The collected data were entered into the Statistical Package for Social Sciences (SPSS) version 16 computer program for analysis. Anthropometric indices (WAZ, WHZ and HAZ) were computed using the Anthro 2005 software and WHO standards. Data were analyzed where-by descriptive statistics (mean, frequency, percentage and cross tabulation) were computed. To compare means of measured variables between two study locations, the t-test for equality of means was applied. Relationships between categorical variables such as between women groups and BMI categories were assessed with a chi-square (χ^2) test. The levels of significance were set at $p \leq 0.05$ for all analyses.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents the results of the study on household dietary diversity and nutritional status of non-pregnant women of reproductive age (15-49 years) and children (1-5 years) in Madizini township and its immediate hinterland villages. The chapter is divided into four major sections. The first section presents demographic and socio-economic characteristics of the respondents. The second section presents the availability and access of food items and health services related to nutrition. The third section presents the results of household dietary diversity while the last section presents the results of assessment of nutritional status of the sampled women and children.

4.1 Demographic and Socio-economic Characteristics of Respondents

4.1.1 Age of respondents

More than half of women from Madizini township (53.3%) and hinterland villages (46%) were in the medium age group (26-35 years). The proportion of girls and boys in hinterland villages and Madizini township were almost similar (Table 3).

4.1.2 Marital status, household size and status within households

Most participants in both hinterland villages and Madizini township were married. Similarly, the status of the respondents within household (head of household) in hinterland villages and Madizini township was mainly wife of head of household (Table3). However, 14% of women in hinterland villages were heads of households

themselves compared to only 5% in Madizini township. Household size in this study ranged from 1 to 13 household members. Participating households were classified into three groups with low, medium or high household size. Thereby, a low household size was a household with one to three members; a household of medium size comprised of four to six members while a large household size meant seven or more household members (Table 3). The latter household size was represented by only 9% and 10% of participants in hinterland villages and Madizini township, respectively.

4.1.3 Education level and main occupation

In hinterland villages, only 5% of women had no primary education compared to 10% in Madizini township. Nearly 79% and two-third of respondents in hinterland villages and Madizini township had completed primary school respectively. Higher education, i.e. few years or completed secondary school or, in one case, even college, was a privilege for about 16.7% of participants in Madizini township and only 12% in hinterland villages as summarized in Table 3.

The typical occupation of women in both hinterland villages and Madizini township was crop farmers growing rice and other crops for food and cash. For example in Manyinga village, nearly 50% were crop farmers growing rice for food and cash. In Lungo and Mhonda villages 35.5% and 45.9% respectively were farmers growing other crops for food and cash. Another income source in both hinterland villages and Madizini township were formal jobs (e.g. teaching) and informal jobs (e.g. traders, food vendors, artisan, etc). However, in Madizini township 23.3% of women were employed in

formal sector and 36.7% were employed in the informal sectors and additionally had a small business, did some casual labour service, food vendors or were handcrafter (Table 3).

Table 3: Socio-economic and demographic characteristics of respondents

Socio- economic attribute	Immediate hinterland villages								Madizini township	
	Manyinga n = 32		Lungo n = 31		Mhonda n = 37		Total n = 100		n = 60	
Age (years)	No.	%	No.	%	No.	%	No.	%	No.	%
Low 15-25	10	31.2	14	45.2	15	40.5	39	39	10	16.7
Medium 26-35	18	56.2	12	38.7	16	43.2	46	46	32	53.3
High above 35	4	12.5	5	16.1	6	16.2	15	15	18	30
Marital status										
Married	25	78.1	29	93.5	22	59.5	76	76	57	95
Single	3	9.4	0	0	14	37.8	17	17	1	1.7
Widowed	1	3.1	1	3.2	0	0	2	2	1	1.7
Divorced	3	9.4	1	3.2	1	2.7	5	5	1	1.9
Occupation										
Growing sugarcane for cash	1	3.1	9	29.0	2	5.4	12	12	1	1.7
Growing rice for food only	13	46.6	4	12.9	10	27.0	27	27	7	11.6
Other crops for food and cash	7	21.9	11	35.5	17	45.9	35	35	16	26.7
Employed by informal sector	10	31.2	4	12.9	8	11.8	20	20	22	36.7
Employed by formal sector	1	3.1	3	9.7	0	0	4	4	14	23.3
Education level										
No formal education	1	3.1	1	3.2	3	8.1	5	5	6	10
Few years in primary school	0	0	2	6.5	2	5.4	4	4	2	3.3
Completed primary school	29	90	26	83.9	24	64.9	79	79	42	70
Higher education	2	6.2	2	6.4	8	21.6	12	12	10	16.7
Status within household										
Head of household	4	12.5	1	3.2	9	24.3	14	14	3	5
Wife of head of household	20	62.5	25	80.6	20	54.1	65	65	46	76.7
Mother of head of household	2	6.3	1	3.2	4	10.8	7	7	3	5
Daughter of head of household	6	18.8	4	12.9	4	10.8	14	14	9	15
Household size										
Low household size 1-3	11	34.4	18	58.1	16	43.2	45	45	25	41.7
Medium household size 4-6	18	56.2	12	38.7	16	43.2	46	46	29	48.3
Large household size >=7	3	9.4	1	3.2	5	13.5	9	9	6	10
Age of children										
12-23mo	12	37.5	14	45.2	6	16.2	32	32	12	20
24-35mo	7	21.9	8	25.8	8	21.6	23	23	16	26.7
36-47mo	8	25	5	16.1	14	37.8	27	27	21	35
48-59mo	5	15.6	4	12.9	9	24.3	18	18	11	18.3
Sex of children										
Boys	15	46.9	15	48.4	18	48.6	48	48	30	50
Girls	17	53.1	16	51.6	19	51.4	52	52	30	50

4.1.4 Household income

This study examined the estimated household income earned per month from income generating activities. The results (Table 4) show that, majority of respondents in Manyinga (71.9%), Lungo (67.7%), and 86.5% in Mhonda (hinterland villages) earned 30 000-200 000TZS per month compared to only 25% in Madizini township. In contrary, in Madizini township about half of respondents reported to earn 210 000-350 000 TZS compared to only 21% in the hinterland villages. The difference between total income earned per month in hinterland villages and in Madizini township was statistically significant ($p<0.005$).

Table 4: Distribution of household income per month in hinterland villages and Madizini township

Amount in TZS	Immediate hinterland villages								Madizini township		
	Manyinga n = 32		Lungo n = 31		Mhonda n = 37		Total n = 100		n = 60		Significance
	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
30 000-200 000	23	71.9	21	67.7	32	86.5	76	76	15	25.0	0.000
210 000-350 000	9	28.1	7	22.6	5	13.5	21	21	31	51.7	
360 000-500 000	0	0	3	9.7	0	0	3	3	9	15.0	
510 000-700 000	0	0	0	0	0	0	0	0	3	5	
710 000-1 000 000	0	0	0	0	0	0	0	0	2	3.3	

$\chi 2 = 48.55$, df = 12

(a) Household income expenditure per month on food

This study also examined income expenditure per month in buying food in hinterland villages and Madizini township. The Chi-square analysis showed statistically significant difference between income expenditure for buying food items in the hinterland villages and Madizinit ownship ($p \leq 0.005$). The results (Table 5) show that, about half of respondents (49%) in hinterland villages reported to spend 20 000-50 000 TZS per month on food the lowest expenditure categories) compared

to only 10% of respondents in Madizini township. On the other hand 48.3% of respondents in Madizini township reported to spend between 110 000-150 000TZS compared to only 8% of respondents in hinterland villages.

Table 5: Distribution of household expenditure per month on food in hinterland villages and Madizini township

	Immediate hinterland villages								Madizini township		
Amount in TZS	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n =32		**n = 31**		**n = 37**		**n =100**		**n = 60**		**Significance**
	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
20 000-50 000	12	37.5	15	48.4	22	59.5	49	49	6	10	0.000
51 000-100 000	17	53.1	16	51.6	10	27	43	43	18	30	
110000-150 000	3	9.4	0	0	5	13.5	8	8	29	48.3	
151 000-200 000	0	0	0	0	0	0	0	0	2	3.3	
210 000-500 000	0	0	0	0	0	0	0	0	5	8.3	

$\chi 2 = 62.941$, df = 12

(b) Household expenditure per month on other goods and services

This study also examined income expenditure per month by household for other goods and services (water and electricity bills, farming activities, building materials, household furniture, and communication, supporting relatives, health services and house rent). The Chi-square analysis showed statistically significant difference between income expenditure per month for buying other goods and services ($p \leq 0.005$) in hinterland villages and Madizini township. The results (Table 6) indicate that majority of respondents (86%) in Manyinga, Lungo and Mhonda villages spent for other goods and services between 30 000 and 100 000TZSper month compared to 20% in Madizini township. In contrary, 61.7% of respondents in Madizini township had an income expenditure per month for other goods and

services of between 110 000 and 200 000 TZS compared to only 12% in the hinterland villages.

Table 6: Distribution of household expenditure per month on other goods and services in hinterland villages and Madizini township

	Immediate hinterland villages								Madizini township		
Amount in TZS	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n = 32		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
30 000-100 000	28	87.5	26	83.9	32	86.5	86	86	12	20	0.000
110 000-200 000	4	12.5	3	9.7	5	13.5	12	12	23	61.7	
210 000-300 000	0	0	2	6.4	0	0	2	2	5	8.3	
310 000-400 000	0	0	0	0	0	0	0	0	2	3.3	
Above 400 000	0	0	0	0	0	0	0	0	4	6.7	

$\chi 2 = 36.7$, df =12

4.2 Availability of Food in Households

This study assessed the availability and accessibility of food items as one of indicator of household food security. Food items covered in this specific objective were cereals, fruits, vegetables, roots and tubers, legumes and animal products. This was assessed by asking questions to respondents about the main source of food for their family consumption i.e. whether own production or purchasing. Additionally, the place of purchasing also was established i.e. whether they purchased within the village or at Madizini market/shops.

4.2.1 Availability of fruits in households

Results in Table 7 summarize availability and accessibility of fruits in hinterland villages and Madizini township. It was surprising that almost all respondents in Lungo and Manyinga villages obtained orange, pineapple, watermelon, mango, pawpaw/papaya, ripe banana and cucumber at Madizini market/shops. In contrary, this was different in Mhonda village where-by over half of respondents accessed these fruits by purchasing within the village. Similarly, over half (54.1%) of respondents accessed mango and two thirds (64.9%, 62.2%) accessed ripe banana, pawpaw/papaya and guava respectively through own production. Almost all respondents in Madizini township accessed fruits by purchasing at Madizini market/shops.

Table 7: Availability and accessibility of fruits in households

	Immediate hinterland villages								Madizini township		
	Manyinga		Lungo		Mhonda		Total				
Fruits/Source	**n = 32**		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
Orange	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**P-value**
Madizini market/shops	15	46.9	27	87.1	2	5.2	44	44	49	81.7	0.000
Own production	9	28.1	3	9.7	14	37.8	26	26	11	18.3	
Within village	8	25	1	3.2	21	56.8	30	30	0	0	
Pineapple											
Madizini market/shops	22	68.8	29	93.5	7	18.9	58	58	60	100	0.00
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	10	23.8	2	4.8	30	71.4	42	42	0	0	
Mango											
Madizini market/shops	11	34.4	25	80.6	0	0	36	36	59	98.3	0.00
Own production	13	40.6	2	6.5	20	54.1	35	35	1	1.7	
Within village	8	25	4	12.9	17	45.9	29	29	0	0	
Ripe banana											
Madizini market/shops	13	40.6	24	77.4	0	0	37	37	44	73.3	0.000
Own production	11	34.4	2	6.5	24	64.9	37	37	16	26.7	
Within village	8	25	5	16.1	13	35.1	26	26	0	0	
Watermelon											
Madizini market/shops	21	65.6	27	87.1	13	35.1	61	61	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	11	34.4	4	12.9	24	64.9	39	39	0	0	
cucumber											
Madizini market/shops	19	59.4	29	93.5	2	5.4	50	50	59	98.4	0.000
Own production	2	6.2	1	3.2	8	21.6	11	11	1	1.7	
Within village	11	34.4	1	3.2	27	73.0	39	39	0	0	
Jack fruit											
Madizini market/shops	12	37.5	24	77.4	0	0	36	36	57	95	0.000
Own production	13	40.6	4	12.9	27	73	44	44	3	5	
Within village	7	21.9	3	9.7	10	27	20	20	0	0	
Papaya											
Madizini market/shops	15	46.9	23	74.2	0	0	38	38	57	95	0.000
Own production	12	37.5	6	19.4	24	64.9	42	42	3	5	
Within village	5	15.6	2	6.5	13	35.1	20	20	0	0	
Guava/Mapera											
Madizini market/shops	18	56.2	24	77.4	0	0	42	42	58	96.7	0.000
Own production	12	37.5	4	12.9	23	62.2	39	39	2	3.3	
Within village	2	6.2	3	9.7	14	37.8	19	19	0	0	

4.2.2 Availability and accessibility of vegetables in households

The results (Table 8) show that, most of exotic vegetables (cabbage, spinach and Chinese cabbage) in hinterland villages and Madizini township were accessed through purchasing either at Madizini market or within village. For example, 50% of respondents in hinterland villages reported to purchase cabbage and spinach at Madizini market, while in Madizini township almost all of respondents purchased the exotic vegetables at Madizini market. However, for indigenous vegetables (amaranth, nightshade, pumpkin leaves, sweet potato leaves and cassava leaves) majority of respondents in hinterland villages reported that own production was their main source of procuring for family consumption.

Table 8: Availability and accessibility of dark green leafy vegetables

Vegetable/source	Immediate hinterland villages								Madizini township		
	Manyinga n =32		Lungo n 31		Mhonda n = 37		Total n = 100		n= 60		Significance
Cabbage	No.	%	No.	%	No.	%	No.	%	No.	%	P -value
Madizini market/shop	25	78.1	23	74.2	2	5.4	50	50	60	100	0.000
Own production	2	6.2	2	6.5	4	10.8	8	8	0	0	
Within the village	5	15.6	6	19.4	31	83.8	42	42	0	0	
Spinach											
Madizini market/shop	26	81.2	22	71	2	5.4	50	50	58	96.7	0.000
Own production	2	6.2	4	12.9	5	13.5	11	11	2	3.3	
Within the village	4	12.5	5	16.1	30	81.1	39	39	0	0	
Chinese cabbage											
Madizini market/shop	23	71.9	21	67.7	1	2.7	45	45	54	90	0.000
Own production	4	12.5	3	9.7	9	24.3	16	16	6	10	
Within the village	5	15.6	7	22.6	27	73	39	39	0	0	
Amarantha											
Madizini market/shop	10	31.2	6	19.4	0	0	28	28	48	80	0.000
Own production	18	56.2	18	58.1	19	51.4	44	44	12	20	
Within the village	4	12.5	7	22.6	18	48.6	28	28	0	0	
Nightshade/Mnavu											
Madizini market/shop	8	25	13	41.9	0	0	21	21	41	68.3	0.000
Own production	20	62.5	12	38.7	26	70.3	59	59	19	31.7	
Within the village	4	12.5	6	19.4	11	29.7	20	20	0	0	
Pumpkin leaves											
Madizini market/shop	4	12.5	9	29	0	0	13	13	37	61.7	0.000
Own production	26	81.2	20	64.5	30	81.1	86	86	23	38.3	
Within the village	2	6.2	2	6.5	7	18.9	11	11	0	0	
Sweet potato leaves											
Madizini market/shop	4	12.5	5	16.1	0	0	9	9	34	56.7	0.000
Own production	26	81.2	25	80.6	32	86.5	83	83	26	43.3	
Within the village	2	6.2	1	3.2	5	13.5	8	8	0	0	
Cassava leaves											
Madizini market/shop	5	15.6	5	16.1	0	0	10	10	33	55	0.000
Own production	25	78.1	24	77.4	35	94.6	84	84	27	45	
Within the village	2	6.2	2	6.5	2	5.4	6	6	0	0	

4.2.3 Availability and accessibility of other vegetables in households

The results (Table 9) summarize availability and accessibility of other vegetables apart from dark leafy vegetables. It was surprising to find out that in both hinterland villages and Madizini township purchasing either at Madizini market or within the village was the main source of accessing onion, eggplant, sweet pepper, African eggplant and carrot. This indicates that own production was very low especially in Madizini township in which none of respondent reported to have own production of tomato, sweet pepper, carrot or eggplant.

Table 9: Availability and accessibility of other vegetables

	Immediate hinterland villages								Madizini township		
Vegetable/source	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n = 32		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
Onion	No.	%	No.	%	No.	%	No.	%	No.	%	**p-value**
Madizini market/shop	29	90.6	29	93.5	4	10.8	62	62	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	3	9.4	2	6.5	33	89.2	38	38	0	0	
Tomato											
Madizini market/shop	29	90.6	27	87.1	3	8.1	59	59	60	100	0.000
Own production	1	3.1	0	0	3	8.1	4	4	0	0	
Within village	2	6.2	4	12.9	31	83.8	37	37	0	0	
Eggplant											
Madizini market/shop	27	84.4	21	67.7	2	5.4	50	50	60	100	0.000
Own production	3	9.4	4	12.9	5	13.5	12	12	0	0	
Within village	2	6.2	6	19.4	30	81.1	38	38	0	0	
Sweetpepper											
Madizini market/shop	27	84.4	22	71.0	2	5.4	51	51	60	100	0.000
Own production	1	3.1	3	9.7	1	2.7	5	5	0	0	
Within village	4	12.5	6	19.4	34	91.9	44	44	0	0	
African eggplant											
Madizini market/shop	28	87.5	17	54.8	1	2.7	46	46	59	98.3	0.000
Own production	0	0	5	16.1	8	21.6	13	13	1	1.7	
Within village	4	12.5	9	29.0	28	75.7	42	42	0	0	
Carrot											
Madizini market/shop	29	90.6	25	80.6	3	8.1	57	57	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	3	9.4	6	19.4	34	91.9	43	43	0	0	

4.2.4 Availability and accessibility of roots and tubers in households

As it was expected from the results, with the exception of round potato, accessibility of sweet potato, yams, cassava and unripe banana by own production was higher in the hinterland villages than in Madizini township (Table 10). Over half (52%, 52%, 57% and 44%) of respondents in hinterland villages reported to produce sweet potato, yams, cassava and unripe banana, respectively. In Madizini township, only 6.7%, 11.7% and 26.7% of respondents produced yams, cassava and unripe banana, respectively, for family consumption, while majority of them purchased at Madizini market/shops.

Table 10: Availability and accessibility of Roots and Tubers

	Immediate hinterland villages								**Madizini township**		
Roots &tuber/source	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n = 32		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
Sweetpotato	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
Madizini market/shop	25	78.1	4	12.9	0	0	29	29	60	100	0.000
Own production	3	9.4	17	54.8	32	86.5	52	52	0	0	
Within village	4	12.5	10	32.3	5	13.5	19	19	0	0	
Roundpotato											
Madizini market/shop	30	93.8	24	77.4	2	5.4	56	56	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	2	6.2	7	22.6	35	94.6	44	44	0	0	
Yams											
Madizini market/shop	2	6.2	12	38.7	0	0	14	14	56	93.3	0.000
Own production	22	68.8	7	22.6	23	62.2	52	52	4	6.7	
Within village	8	25	12	38.7	14	37.8	34	34	0	0	
Cassava											
Madizini market/shop	9	28.1	6	19.4	0	0	15	15	53	88.3	0.000
Own production	14	43.8	14	45.2	29	78.4	57	57	7	11.7	
Within village	9	28.1	11	35.5	8	21.6	28	28	0	0	
Unripe banana											
Madizini market/shop	3	9.4	26	83.9	2	5.4	31	31	44	73.3	0.000
Own production	27	84.4	5	16.1	17	45.9	49	49	16	26.7	
Within village	2	6.2	0	0	18	48.6	20	20	0	0	

4.2.5 Availability and accessibility of cereals in households

With the exception of sorghum and millet, accessibility of maize and rice by own production was higher in the hinterland villages than in Madizini township (Table 11). About 71% and 61% of respondents in hinterland villages reported to have own production of maize and rice, respectively. Only about one third of respondents in Madizini township reported to have own production of maize and rice. However different situation was observed for sorghum and millet in hinterland villages, where over half (58% and 61%) of respondents reported to purchase sorghum and millet, respectively, at Madizini market/shops.

Table 11: Availability and accessibility of Cereals

	Immediate hinterland villages								Madizini township		
Cereals/source	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n = 32		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
Maize	No.	%	No.	%	No.	%	No.	%	No.	%	**p-value**
Madizini market/shops	12	37.5	8	25.8	0	0	20	20	42	70	0.000
Own production	20	62.5	21	67.7	30	81.1	71	71	18	30	
Within village	0	0	2	6.5	7	18.9	9	9	0	0	
Rice											
Madizini market/shops	11	34.4	10	32.3	0	0	21	21	40	66.7	0.000
Own production	16	50	18	58.1	27	72.9	61	61	20	33.3	
Within village	5	15.6	3	9.7	10	27.1	18	18	0	0	
Sorghum											
Madizini market/shop	29	90.6	28	90.3	4	10.8	61	61	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	3	9.4	3	9.7	33	89.2	39	39	0	0	
Millet											
Madizini market/shops	25	78.1	27	87.1	6	16.2	58	58	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	7	21.9	4	12.9	31	83.8	42	42	0	0	

4.2.6 Availability and accessibility of legumes in households

Again, own production was the main source of procuring legumes (beans, peas, cowpeas and pigeon peas) in all hinterland villages, while in Madizini township purchasing was the main source of procuring legumes for family consumption. Results (Table 12) indicate that 75% of households in Manyinga, 64.5% in Lungo and 86.5% in Mhonda villages had own production of beans. Similar situation was observed for peas, cowpeas and pigeon peas whereby the majority in Madizini township (95% for peas, 90% for cowpeas and 93.3% for pigeon peas) reported to purchase at Madizini market/shops.

Table 12: Availability and accessibility of Legumes

	Immediate hinterland villages								Madizini township		
Legumes/source	**Manyinga n = 32**		**Lungo n =31**		**Mhonda n = 37**		**Total n = 100**		**n = 60**		**Significance**
Beans	No.	%	No.	%	No.	%	No.	%	No.	%	**p-value**
Madizini market/shops	3	9.4	8	25.8	2	5.4	13	13	53	88.3	0.000
Own production	24	75	20	64.5	32	86.5	76	76	7	11.7	
Within village	5	15.6	3	9.7	3	8.1	11	11	0	0	
Peas											
Madizini market/shops	6	25	7	22.6	0	0	13	13	57	95	0.000
Own production	20	56.2	18	58.1	29	78.4	67	67	3	5	
Within village	6	18.8	6	19.4	8	21.6	20	20	0	0	
Cowpeas											
Madizini market/shops	7	21.9	8	25.8	0	0	15	15	54	90	0.000
Own production	21	65.6	19	61.3	31	83.8	71	71	6	10.0	
Within village	4	12.5	4	12.9	6	16.2	14	14	0	0	
Pigeon peas											
Madizini market/shops	4	12.5	4	12.9	0	0	8	8	56	93.3	0.000
Own production	22	68.8	21	67.7	33	89.2	77	77	4	6.7	
Within village	6	18.8	6	19.4	4	10.8	16	16	0	0	

4.2.7 Availability and accessibility of animal products in households

Results (Table 13) summarize availability and accessibility of meat (beef, chicken and goat), eggs, milk and fish in hinterland villages and Madizini township. It is not surprising that own production was the main source of meat for family consumption especially chicken meat in all hinterland villages and beef meat in Lungo village. Majority (82%) of respondents in hinterland villages reported that own production especially chicken meat was their main source for family consumption. The distributions were as following: Lungo (93.5%), Mhonda (89.2%) and Manyinga (62.5%). Similar situation was observed for eggs but not for milk as high availability of milk was observed only in Lungo village. In Madizini township majority of respondents reported to purchase meat, eggs and milk at Madizini market/shops. Different situation was observed for fish in both hinterland villages and Madizini township as majority of respondents reported to purchase fish at Madizini market/shops.

Table 13: Availability and accessibility of meat/animal products/fish

	Immediate hinterland villages								Madizini township		
Animal products/fish	**Manyinga**		**Lungo**		**Mhonda**		**Total**				
	n = 32		**n = 31**		**n = 37**		**n = 100**		**n = 60**		**Significance**
Meat (beef, chicken, goat)	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
Madizini market/shops	8	25	0	0	0	0	8	8	45	75	0.000
Own production	20	62.5	29	93.5	33	89.2	82	82	15	25	
Within village	4	12.5	2	6.5	4	10.8	10	10	0	0	
Eggs											
Madizini market/shops	8	25	1	3.3	0	0	9	9	45	75	0.000
Own production	18	56.3	21	67.7	33	89.2	72	72	15	25	
Within village	6	18.7	9	29	4	10.8	19	19	0	0	
Milk											
Madizini market/shops	27	84.4	0	0	0	0	27	27	55	91.7	0.000
Own production	2	6.2	18	58.1	6	16.2	26	26	5	8.3	
Within village	3	9.4	13	41.9	31	83.8	47	47	0	0	
Fish											
Madizini market/shops	29	90.6	29	93.5	7	18.9	65	65	60	100	0.000
Own production	0	0	0	0	0	0	0	0	0	0	
Within village	3	9.4	2	6.5	30	81.1	35	35	0	0	

4.2.8 Availability and accessibility of health services related to nutrition

The study also assessed the availability and accessibility of health services related to nutrition. The health services considered in this study were medical treatment as well as clinic, maternal delivery, counseling, family planning, immunization and nutrition education services. This was assessed by asking questions to respondents whether the health services were available within village, Madizini township or in another area i.e. far away from their own residential areas.

Results (Table 14) indicate that, with exception of delivery services, most of respondents in hinterland villages reported to get the health services either within their village or in another area far away from their own residential area. Most of respondents in Madizini also reported to get the health services at Madizini township. However, for delivery services, most of respondents in hinterland villages (Lungo 96.8%, Mhonda 62.2%) and 93.3% in Madizini township reported to get delivery service in another area i.e. Bwagala Hospital located in Manyinga village. This was the commonly mentioned hospital by most of women in hinterland villages and Madizini township because it is so far the Mvomero district's referral hospital especially for maternal delivery services.

Table 14: Availability and accessibility of health services related to nutrition

	Immediate hinterland villages								Madizini township		
Health services	**Manyinga n =32**		**Lungo n = 31**		**Mhonda n = 37**		**Total n = 100**		**n = 60**		**Significance**
Treatment services	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
Madizini township	2	6.2	5	16.2	5	13.5	12	12	19	31.7	0.000
Within village	28	87.5	0	0	23	62.2	51	51	0	0.0	
In another area	2	6.2	26	83.8	9	24.3	37	37	41	68.3	
Clinic services											
Madizini township	1	3.1	1	3.2	3	8.1	5	5	51	85	0.000
Within village	30	93.8	27	87.1	31	83.8	88	88	0	0	
In another area	1	3.1	3	9.7	3	8.1	7	7	9	15	
Delivering services											
Madizini township	1	3.1	0	0	0	0	1	1	4	6.7	0.000
Within village	28	87.5	1	3.2	14	37.8	43	43	0	0	
In another area	3	9.4	30	96.8	23	62.2	56	56	56	93.3	
Counseling services											
Madizini township	3	9.4	4	12.9	0	0	7	7	44	73.3	0.000
Within village	28	87.5	22	71.0	30	81.1	80	80	0	0	
In another area	1	3.1	5	16.1	7	18.7	13	13	16	26.7	
Family planning services											
Madizini township	2	6.2	3	9.7	0	0	5	5	50	83.3	0.000
Within village	29	90.6	25	80.6	32	86.5	86	86	0	0	
In another area	1	3.1	3	9.7	5	13.5	9	9	10	16.7	
Immunization services											
Madizini township	3	9.4	3	9.7	0	0	6	6	60	100	0.000
Within village	29	90.6	28	90.3	37	100	94	94	0	0	
In another area	0	0	0	0	0	0	0	0	0	0	
Nutrition education											
Madizini township	2	6.2	1	3.2	0	0	3	3	60	100	0.000
Within village	30	93.8	30	96.8	37	100	97	97	0	0	
In another area	0	0	0	0	0	0	0	0	0	0	

4.3 Household Dietary Diversity

According to Food and Agriculture Organization (FAO) dietary diversity score (DDS) categorization, consumption of less than 3 food groups is classified as poor dietary diversity, 4-5 food groups is classified as Medium dietary diversity and greater or equal to 6 food groups is classified as high dietary diversity. The results of assessment in this study show that nearly half (45.2%) of households in Lungo village had dietary diversity score of less than 3 food groups compared to Manyinga and Mhonda villages as well as in Madizini township (Table 15). Of the three hinterland villages and Madizini township, Mhonda village had the highest mean DDS (2.72± 0.07), followed by Manyinga village (2.65± 0.08) and Madizini township (2.61±0.06) (Table 16). Lungo village had the lowest mean score (2.33±0.09), which was significant lower than other villages in hinterland as well Madizini township.

Table 15: Household dietary diversity in hinterland villages and Madizini township

	Immediate hinterland villages								**Madizini township**		
	Manyinga n = 32		**Lungo n =31**		**Mhonda n = 37**		**Total n = 100**		**n = 60**		**Significance**
DDS	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
<3 Food groups	5	15.6	14	45.2	2	5.4	21	21	7	11.7	0.005
4-5 Food groups	6	18.8	5	16.1	8	21.6	19	19	16	26.7	
>6 Food groups	21	65.6	12	38.7	27	73.0	60	60	37	61.7	

Table 16: Mean DDS in hinterland villages and in Madizini Township

	Immediate hinterland villages		Madizini township	
	Manyinga	**Lungo**	**Mhonda**	**Madizini**
Sample size	n=32	n=31	n=37	n=60
Mean DDS	2.65±0.08 [B]	2.33±0.09[C]	2.72±0.07[A]	2.61±0.06[B]

[A], [B] and [C]: Similar letters denote lack of significant difference, and vice versa

4.4 Food Consumption Pattern

The most commonly consumed food groups in both hinterland and Madizini township were cereals (bread, biscuits, rice, wheat or any other foods made from maize, e.g. ugali), other vegetables (e.g. tomato, onion, eggplant), oil and fats (oil, fats used for cooking) (Table 17). Other commonly consumed foods included dark green leafy vegetables (e.g. cassava leaves), legumes (e.g. beans) and vitamin A rich vegetables (carrots, or orange fleshed sweet potatoes). On the other hand, eggs, fish, flesh meat (e.g. beef, pork, lamb, goat, wild game, chicken), organ meat (e.g. liver, kidney and heart), milk and milk products were least consumed. Other food stuffs in this category included other fruits (e.g. watermelon, ripe banana, orange, etc) and vitamin A rich fruit (e.g. ripe mangoes).

Table 17: Percentage of households consuming different food groups on a single day recall

	Immediate hinterland villages			Madizini township
	Manyinga	Lungo	Mhonda	
Food groups	%	%	%	%
Cereals	100	100	100	100
Vitamin A rich vegetable	62.5	41.9	43.2	51.7
Dark green leafy vegetables	59.4	58.1	81.1	53.3
Other vegetables	100	96.8	94.6	100
Vitamin A rich fruits	25	6.5	13.5	10
Other fruits	31.5	6.5	35.1	21.7
White tubers and roots	40.6	9.7	73	26.7
Organ meat (iron reach meat)	12.5	12.9	18.9	3.3
Flesh meat (beef, goat, chicken)	3.1	22.6	16.6	18.3
Eggs	3.1	3.1	0	1.7
Fish	28.1	6.5	24.3	20
Legumes (beans), nuts and seeds	68.8	67.7	48.6	75
Milk	25	16.1	0	16.7
Oil and fats	100	96.8	100	100

4.5 Nutritional Status of Surveyed Women

According to WHO (2004), BMI value of less than 18.5 is classified as underweight, 18.5-24.9 is classified as normal, 25-29.9 is classified as overweight and 30-34.9 is classified as 1st class obese. Majority (71%) of women in hinterland villages had normal BMI compared to only 40% of women in Madizini township (Table 18). Mean BMI value of women in all the three hinterland villages were significantly lower than that of Madizini township (mean BMI = 26.41) at $p<0.05$ and was accompanied with higher prevalence of overweight (36.7%) and 1st class obese (21.7%) (Table19). The mean BMI valueS for the hinterland villages were 22.37 (Lungo), 22.70 (Mhonda) and 22.10 (Manyinga) as shown in Table 19.

Table 18: Distribution of body mass of women of reproductive age in hinterland villages and Madizini township

	Immediate hinterland villages								Madizini township		
	Manyinga		Lungo		Mhonda		Total				
	n = 32		n = 31		n = 37		n = 100		n = 60		Significance
BMI classification	No.	%	No.	%	No.	%	No.	%	No.	%	p-value
<18.5 under weight	3	9.4	3	9.7	3	8.1	9	9	1	1.7	0.001
18.6-24.9 normal	23	71.9	21	67.7	27	72	71	71	24	40	
25-29.9 over weight	4	12.5	6	19.4	7	18.9	17	17	22	36.7	
30-34.9 1st obese	2	6.2	1	3.2	0	0	3	3	13	21.7	

Table 19: Mean BMI of women of reproductive age in hinterland and in Madizini township

	Manyinga	Lungo	Mhonda	Madizini
Sample size	n=32	n=31	n=37	n = 60
Mean BMI	22.10±0.63[B]	22.37±0.53[B]	22.7±0.56[B]	26.41± 0.58 [A]

[A] and [B] Similar letters denote lack of significant difference, and viceversa.

4.6 Nutritional Status of Children

4.6.1 Stunting/chronic malnutrition (Height- for- age)

Findings of this survey showed that levels of stunting were higher in hinterland villages than in Madizini township whereby 35% of children from hinterland villages had chronic malnutrition (moderate + severe stunting) compared to 28.4% in Madizini township (Table 20). In hinterland villages stunting was observed in all age groups of children below five years of age while in Madizini township stunting appears to cease after attaining 48 months of age.

4.6.2 Underweight

About two thirds of children from hinterland villages and Madizini township (65% and 68.3%, respectively) had the right weight for age. Nine percent and 2% of children from hinterland villages were moderately and severely underweight respectively compared to only 6.7% and 1.7% of children in Madizini township (Table 20). There was no statistical significant difference ($P>0.05$) between one age group and another.

4.6.3 Wasting/Acute malnutrition

Six percent and 5% of children in the hinterland villages were moderately and severely wasted compared to 6.7% and 3.1% in Madizini township, respectively (Table 20). On the other hand, more than 70% of the children in both hinterland villages as well as in Madizini township were having normal height-for-weight.

4.6.4 Relationship between dietary diversity and nutritional status

Coefficient of correlation (r^2) was used to test for relationship between dietary diversity scores of households, BMI values of women and z-scores of children. The results showed that there were no significant correlations among the three sets of variables in the hinterland villages ($p\geq0.05$). However, significant correlations were noted in Madizini township between dietary diversity scores and weight for age ($r^2 = 0.030$) and height for age ($r^2 = 0.051$).

Table 20: Distribution of the WHZ, HAZ and WAZ for children below five years in hinterland villages and Madizini township according to age

Location/Age	Normal		Mild		Moderate		Severe		Total	
Weight-for-Age (Underweight)										
Hinterland villages (n = 100)	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
12-23month	22	22	7	7	3	3	0	0	32	32
24-35month	13	13	5	5	4	4	1	1	23	23
36-47month	19	19	6	6	2	2	0	0	27	27
48-59month	11	11	6	6	0	0	1	1	18	18
Total	**65**	**65**	**24**	**24**	**9**	**9**	**2**	**2**	**100**	**100**
Madizini township (n = 60)										
12-23month	9	15	3	5	0	0	0	0	12	20
24-35month	11	18.3	5	8.3	0	0	0	0	16	26.7
36-47month	15	25	4	6.7	2	3.3	0	0	21	35.0
48-59month	6	10	2	3.3	2	3.3	1	1.7	11	18.3
Total	**41**	**68.3**	**14**	**23.3**	**4**	**6.7**	**1**	**1.7**	**60**	**100**
Height-for-Age (Stunting)										
Hinterland villages (n = 100)										
12-23month	17	17	6	6	4	4	5	5	32	32
24-35month	6	6	5	5	7	7	5	5	23	23
36-47month	13	13	5	5	3	3	6	6	27	27
48-59month	8	8	5	5	4	4	1	1	18	18
Total	**44**	**44**	**21**	**21**	**18**	**18**	**17**	**17**	**100**	**100**
Madizini township (n = 60)										
12-23month	6	10	3	5	1	1.7	1	1.7	12	20
24-35month	7	11.7	2	3.3	3	5	4	6.7	16	26.7
36-47month	8	13.3	7	11.7	6	10	3	5	21	35.0
48-59month	3	5	4	6.7	0	0	0	0	11	18.3
Total	**26**	**43.3**	**16**	**26.7**	**10**	**16.7**	**7**	**11.7**	**60**	**100**
Weight-for-Height (Wasting)										
Hinterland villages (n = 100)										
12-23month	23	23	4	4	1	1	0	0	32	32
24-35month	18	18	3	3	1	1	0	0	23	23
36-47month	22	22	2	2	3	3	4	4	27	27
48-59month	14	14	3	3	1	1	1	1	18	18
Total	**77**	**77**	**12**	**12**	**6**	**6**	**5**	**5**	**100**	**100**
Madizini township (n = 60)										
12-23month	10	16.7	2	3.3	0	0	0	0	12	20
24-35month	11	18.3	2	3.3	2	3.3	1	1.7	16	26.7
36-47month	15	25	4	6.7	1	1.7	1	1.7	21	35.0
48-59month	7	11.7	3	5	1	1.7	0	0	11	18.3
Total	**43**	**71.7**	**11**	**18.3**	**4**	**6.7**	**2**	**3.1**	**60**	**100**

4.7 Discussions

This section presents discussion of the findings of the study. The discussion is organized according to the research objectives focusing on household availability and accessibility of food items, household dietary diversity, food item consumption pattern and nutritional status of women and children.

4.7.1 Household dietary diversity

Moving from a less diversified diet to one containing more diverse range of food items has been shown to increase intake of energy as well as micronutrients in developing countries (Gina *et al*., 2007). The observed low dietary diversity in Lungo village (mean DDS of 2.33 ±0.09 in Table 16) is therefore an indication that individuals in that village are more likely that they are not meeting the micronutrient requirements. The results of this indicator is also pointing that Lungo village is likely to be poorer than the other villages, including Madizini township.

Studies from other part of Africa (Oldewage-Theron and Kruger, 2008 and Labadarios *et al.,* 2011) have reported mean DDS values for South Africans to be 4.02 and 3.41 respectively. Both values are higher than those observed in the current study (Table 16). Also studies from other developing countries (Kennedy *et al.*, 2009b) in Filipino, Burkina Faso, Laos and Northern Uganda have reported mean DDS values of 4.9, 4.6, 5.2 and 3.3 respectively. However, all these studies were conducted in big cities while the current study was based in an emerging urban centre where the socio-economic characteristics are quite different.

A study in Kenya (Onyango *et al.*, 1998) indicated that a dietary diversity of greater than five groups was more important for growth among children who were no longer breastfeeding compared to those who were still breastfeeding. Other studies by Hatloy *et al.* (2000) and Hoddinot and Yohannes (2002) established that an increase in dietary diversity is associated with socio-economic status and household food security.

4.7.2 Food consumption pattern

The high consumption of food items from the cereals and roots and tubers group confirms that diets in both hinterland and Madizini urban are predominantly based on starchy staples. The consumption of vegetables (dark leafy and other vegetables) was also high in both hinterland and Madizini township. Legumes (e.g. beans) and vegetables especially indigenous vegetables were found to be a major part of diet and usually accompanying a main meal made from maize flour locally called ‘ugali’. Consumption of fruits (vitamin A rich and other fruits), animal, milk, eggs and fish in hinterland villages and Madizini township was observed to be low (Table 17).

These findings corroborate other studies conducted in South Africa, Kenya, Burundi and DR Congo. In South Africa, Labadarios *et al.* (2011) reported high consumption of cereals, roots and tubers, vegetables (other than vitamin A rich), meat, fish and dairy products. Eggs, vitamin A rich fruits and vegetables were the least consumed. Similarly, in Kenya, Ekesa *et al.* (2008) reported high consumption of cereals, roots and tubers and vegetables. In Burundi and DR Congo, Ekesa (2009) reported high consumption of roots/tubers and vegetables. However, consumption of meat, fish

and dairy products reported by Labadarios *et al.* (2011) were higher than observed in the current study (Table 17).

However, despite the high consumption of vegetables observed in this study, it is likely that the nutrients in the vegetables are not sufficiently bio- available due to poor cooking methods that mostly involve boiling for prolonged periods. Several studies have associated prolonged cooking with significant decrease of nutrients in vegetables (Lyimo *et al.*, 1991; Mosha *et al.,* 1995). It is therefore probable that much of the water soluble vitamins such as vitamin C and the B-complex are lost during the cooking process.

4.7.3 Nutritional status of women

Today it is well recognized that in developing countries, women are one of the most vulnerable population groups in terms of their health and nutrition (Nestle and Marion, 2001). Different socioeconomic and cultural factors result into unfavourable nutritional outcomes for many women, and this may in turn seriously affect their health and overall quality of life (Smith *et al.,* 2003). Women in poor countries have limited or no access to nutritious food, education, employment or adequate health care, and therefore are more vulnerable to nutritional deficiencies (Burke *et al.,* 2005; Torheim *et al.,* 2010). Nevertheless, information about the nutritional status among women of reproductive age in particular is still scarce (Kusin, 2000).

It was observed that the extent of chronic energy deficiency (BMI <18.5) among women was higher in hinterland villages (9%) than in Madizini township (1.7%).

On the other hand, overweight and obesity were higher in Madizini township (36.7% and 21.7%) than in hinterland villages (17% and 3% respectively). Comparable findings to the current study include Arimond *et al.* (2010b) in the Philippine where-by women in urban area had higher mean BMI than in rural areas and was accompanied by higher prevalence of overweight (33%) compared to 27% in rural areas. The mean BMI among women in Madizini township found in this study (26.41±0.58) is higher than in Burkina Faso (20.8± 3.5) reported by Savy and Martin-prevel (2005) and in Nigeria reported by Sanusi (2010) which is (23.34± 4.8). Other findings in Tanzania that are comparable to the current study include, Temu (2009) who observed that overweight and obesity were higher in urban areas than in rural areas (21% and 7% respectively) in Iringa district.

Although it is believed that underweight is more prevalent than overweight in developing countries, especially in the rural areas, the current study demonstrates the opposite. As shown in Table 18, the prevalence of overweight was almost 2-times higher compared to underweight in hinterland villages. Villamor (2006) reported that, among women of reproductive age in urban Tanzania, trends in obesity have rapidly increased while underweight and wasting have slightly decreased or remained constant between 1995 and 2004. A similar observation has been made by Mendez *et al.* (2005) in different developing countries, whereby prevalence of overweight/obesity has exceeded that of underweight in more than half of the countries studied. The Tanzania Demographic and Health Survey of 2010 (NBS and ICF Macro, 2011) has shown that prevalence of total overweight or obesity in urban and rural areas was 36% and 15% respectively, while underweight rates was 8%

and 13% respectively. When comparing these values with those in the current study, the prevalence of overweight/ obesity in Madizini township as well as in hinterland villages is higher, which is 58.4% and20% respectively. On the other hand prevalence of underweight in Madizini township and hinterland villages is lower (1.7% and 9%) (Table18). However, it should be remembered that while the Tanzania Demographic and Health Survey did include the general population, the current study was focusing on women of reproductive age and having children of below five years of age.

The obesity epidemic has rapidly been increasing around the world over recent decades, affecting virtually all social and age groups in both developed and developing countries (Jeffery *et al.,* 1996). The higher rate of overweight and obesity is mostly due to the difference between calories consumed and calories used which results into positive energy balance. This positive energy balance can be attributed to change in life style including change in eating habits, cultural factors, as well as increase in household income and change in the nature of income generating activities. This situation in Madizini township depicted all these potential factors.

Change in life style had drastically caused change in body physiology (Jaffery *et al.,* 1996). Technological advances had resulted to decreased physical activities and increasing consumption of energy dense foods (Beaglehole, 2005). Introduction of commuter buses and motorbike had caused people to walk less even within a place of short distance. This kind of transport was common in Madizini township. Reduced walking distance cause reduction on physical activity hence increase risk of

becoming overweight and obese. The effect of reduced physical activity as a result of technology has also been reported (Maletnlema, 2001; Beaglehole, 2005).

Furthermore, due to an increased complexity of life where people have to go away from home to look for jobs so as to sustain life, eating at home is becoming rare. People have to eat near to their work places hence increased eating of junk foods e.g. potato chips and bread. This composition is even worse since it promotes development of chronic diseases (Skalar, 2005; Noriko *et al.,* 2009). In this study, 23.3% and 36.7% of women in Madizini township were employed in formal and informal sectors, respectively. This might make them to be far from home place or make them busy to the extent that they don't have time to prepare food at home.

The cultural factors which influence overweight and obesity include keeping indoors of lactating mothers soon after delivery for a period of 3 months while eating high calorie dense meals to ensure sufficient production of milk for the baby (WHO, 2002). In Tanzania the trend of keeping indoors of lactating mothers is very common in urban areas than in rural areas as a result lactating mother simply become obese. Additionally, in low and middle income countries, residents of areas officially designated as rural may have access to infrastructure and services that facilitate them to have urbanized lifestyles that may increase risk of obesity, such as access to energy-dense foods and motorized transportation (WHO, 2003). This was also the case in the current study area.

4.7.4 Nutritional status of children

In this study the severe forms of malnutrition depicted by underweight, stunting and wasting were common in the second year of life and continued to the third year. It is possible that in infancy and first year of life due to universal breast-feeding habit, children grow normally up to the age of 12months, thereafter improper complementary foods and high rate of infections result in growth retardation and subsequent increase in the prevalence of malnutrition (URT/UNICEF 1990; Mamiro *et al.,* 2004). Children of 24-35 months of age are highly affected because they are in the active growth stage and if their diet is inadequate to meet their physiological needs they end up being malnourished (WHO, 1999). Other reports in Tanzania (TFNC, 1997a; NBS and ICF Macro, 2011) have also observed a similar trend in children of 3 years old. It can be noted that the critical period of growth retardation coincides with the weaning period implying that there is inadequacy either in quantity or quality of complementary foods. Frequent illnesses such as malaria diarrhoea, respiratory infections and worms are likely to exacerbate the problem of under nutrition in such children (Laura *et al*., 2006).

(a) Underweight

Underweight (low weight-for-age) is an indicator of either acute or chronic under-nutrition. The prevalence of underweight (moderate + severe) in both hinterland villages and Madizini township (Table 20) is lower compared with the average Morogoro Regional of 16% (moderate) and 3.1% (severe) reported by NBS and ICF Macro (2011). From these results it implies that the problem of underweight is slightly lower in the study area than for the average of Morogoro Region.

Children between 24-35 months in hinterland villages show the highest prevalence of low weight-for-age (5%). This is the age group that is more susceptible to illnesses such as malaria, diarrhoea, respiratory infections and worms (Stoltzfus *et al.,* 1997). Poor quality complementary foods may result into a deficit tissue and fat mass particularly after illness. Therefore, timely and proper complementary feeding is important in ensuring child health and normal growth (Kirsten *et al.*, 2001).

(b) Stunting

The height-for-age (stunting) reflects achieved linear growth. Stunting is when a child's height-for-age is below –2SD from the median of the reference population (WHO, 2004). Apart from other physical and physiological dimensions, stunting usually results from prolonged inadequate intake of food as well as diseases making infants to have low height for their age (Lartey *et al*., 1999). The prevalence of stunting (moderate and severe) in both hinterland villages and Madizini township is lower (Table 20) compared with the average Morogoro Regional of 44.4% (moderate) and 18% (severe) reported by NBS and ICF Macro (2011). Again the prevalence of stunting was observed in all age groups of children in Madizini township and hinterland villages (Table 20). This observation suggests that nutritional problems start at very early age and therefore appropriate nutritional efforts need to be focused at much earlier age.

(c) Wasting

Wasting is a measure which is indicated by weight-for-height of below -2SD. The results of this study show that percentage of children wasted in hinterland villages is

higher than the average for Morogoro Region reported by Tanzania Demographic and Health Surveys of 2010, which was 5.3% moderately wasted and 2.2% severely wasted (NBS and ICF Macro, 2011). On the other hand, in Madizini township percentage of wasted children is lower than the average for Morogoro Region (Table 20). Wasting indicates deficit in tissue and fat mass compared with amount expected in a child of the same height or length and may result either from failure to gain weight or from actual weight loss (TFNC, 1997b). This high percentage of wasting observed in hinterland villages might have been due to failure to receive adequate nutrition or recent episodes of illnessess causing loss of weight.

Generally, it has been observed in this study that, children from hinterland villages had higher levels of malnutrition especially stunting and underweight compared to their counterparts in urban (Madizini township). These results concurred with studies conducted in Mali in which level of stunting was higher in rural than urban (Hatloy *et al.*, 1998*)*. It has also been reported by other studies (Ruel *et al.*, 1998 and Ruel, 2001) that, urban children generally have a better nutritional status than their rural counterparts particularly for linear growth (stunting) and for underweight. The observed high levels of child malnutrition in hinterland villages than in Madizini township could be due to unfavourable underlying conditions such as household economic situation (which tend to influence availability and access to food), care for women and children and quality of health and environment. All these factors are less favoured in rural areas compared to urban. Smith *et al.* (2005) reported that, better nutritional status of children in urban is probably due to more favourable underlying determinants of child nutritional status. These determinants are more favoured in

urban than in rural area, which, in turn, seem to lead to better caring practices for children and their mothers. The determinants are fundamental to a child dietary intakes and health status, which are more immediately related to nutritional status (UNICEF, 1998; Darnton-Hill and Cogill, 2010). The underlying determinants are separated into two groups. The first, termed proximal determinants are closely related to biological functions (of both mothers and children) or to specific maternal practices related to food intake, health, and care giving. They are mother's nutritional status, prenatal and birthing care for mothers, and caring practices for children. The second group, the socioeconomic determinants, represents the resources necessary for achieving adequate food security, childcare, and a healthy environment (WHO/FAO, 2001). They are maternal education, women status, access to safe water and economic status. Women's nutritional status influences children's nutritional status in a variety of ways, both during pregnancy and early childhood (WHO, 2006). Women who are malnourished are more likely to deliver smaller babies, who, in turn, are at increased risk of poor growth and development (Garrett and Ruel, 1999). Additionally, malnourished women may be less successful at breastfeeding their children, have lower energy levels, and have reduced cognitive abilities, all of which hamper their ability to adequately care for their young babies (Engle *et al*., 1997).

With regard to the care of children, feeding practices are known to be a key to health, nutrition, and development. These include initiation of breastfeeding immediately after birth and exclusive breastfeeding for the first six months of life (Darnton *et al.,* 2010). By six months, high quality complementary foods should be

introduced, and breastfeeding should be continued into the second year of a child's life. Since young children have relatively high nutrient requirements but are limited by their small gastric capacity, they need to be fed frequently (Garrett and Ruel, 2005).

Turning to the socioeconomic determinants of child nutritional status, study have consistently reported that maternal education is a critical resource for child health, nutrition, and survival (Armar-Klemesu *et al.,* 2000). More educated women are better able to process information, acquire skills, and model positive caring behaviours. They tend to be better able to use health-care facilities, interact effectively with health-care providers, comply with treatment recommendations, and keep their living environment clean (Engle *et al.,* 1997). Women's status is defined as women's power relative to that of men in the households, communities, and nations in which they live (Smith *et al*., 2003). Compared to their higher status counterparts, women with low status especially in rural areas tend to have weaker control over household resources; tighter constraints on their time; more restricted access to information and health services; and poorer mental health, self-confidence, and self-esteem Torheim *et al.,* 2010). All of these factors are closely tied with women's own nutritional status and the quality of care they receive and, in turn, children's birth weights and the quality of care provided to children (Menon *et al.,* 2000). Additionally, lack of access to safe water, and poor environmental sanitation due to unsanitary waste disposal are considered important causes of infectious diseases, especially diarrhoea and intestinal parasites hence poor nutritional status of children (UNICEF, 1998).

4.7.5 Rural-urban complementarities, sources of food and food expenditure

(a) Expenditure on food

The food system in Madizini urban centre and its hinterland villages is rapidly changing due to change in the social system, including income growth, urbanization, and employment that drive dietary changes. Changes are taking place in the patterns of food consumption and expenditure in terms of market purchases versus own production. Changes in the food system are expected to have nutritional implications for the general population, particularly for the children and women of reproductive age (Garrett and Ruel, 1999). These changes can be linked in part to changing diets often termed the nutrition transition (Monteiro, 2009b; Bloem *et al.*, 2010). People are consuming more fats, energy-dense foods, and highly processed foods compared to traditional diets (Sanusi, 2010). The transition is also characterized by increased consumption of foods away from home, such as street foods. All these are known to result into increase in household cash expenditure on food (Dixon *et al*., 2007).

On the other hand, allocation of household income per month for food in Madizini township and the two hinterland villages (Manyinga and Lungo) was above 50%, spending between 50 000- 200 000 TZS (Table 5). So, more than two-thirds of the income earned per month is spent on food (Table 4), the remaining 30% can barely meet the other necessities of life as economic aspect may focus not only on food but also on other material needs, typically including the necessities of daily living such as clothing, shelter, energy and safe drinking water (World Bank, 2003) (Table 6). It was not surprising to find high allocation of household income on food expenditure in Madizini and the two hinterland villages, as it was observed that most of the

households were not engaged in producing own food. The high allocation of household income on food in Madizini township and hinterland villages (Manyinga and Lungo) is due to change in social system and livelihoods which result in change of food system i.e. change from own production to market purchase. The change in food system can be conceptualized as affecting diet by altering the availability, prices, and preferences of foods (Friel *et al*., 2007).

(b) Sources of food in households

There is a general consensus that households access food mainly through three sources. These are the markets, subsistence production and transfers from public programmes (Ruel *et al*., 1998). These sources are also referred to as entitlements categories: production, exchange (barter or purchase) and transfers (Sen, 1982).The respondents were asked to identify the sources of food items for household consumption, whether home produced, bought within village or bought from Madizini market/shops. Of the three hinterland villages, Mhonda is the only village in which most food items were procured through own production (Tables 7- 13). A study done in Bangladesh by Shantana *et al.* (2003) reported that rice and maize had high level of home production or local procurement in rural areas (57%) compare to slum urban areas. Other locally produced/procured food in rural areas were eggs (52%), leafy vegetables (56-61%), and to some extent milk (33-49%).

Historically, rural households produced most of their own food, whereas urban households purchased most of their food (Ruel, 2003b).Surprisingly, market dependence was high in the two hinterland villages (Manyinga and Lungo) as well as in Madizini township for the most food items e.g. fruits, exotic vegetables

(spinach, cabbage and Chinese cabbage) other vegetables (onion, tomato, eggplant, sweet pepper, African eggplant and carrot), fish and round potato. These food items were purchased principally from Madizini market/shops (Tables 7-10 and 13). A study by Maxwell *et al*. (1998) also reported an increase in dependence on market purchases on both urban and rural households. The observed high dependence on market in the two hinterland villages could be due to change in livelihoods as people are looking for diverse opportunities to increase and stabilize their incomes away from the agricultural farming. Therefore rural livelihoods are based not solely on agriculture but on a diverse array of activities and enterprises (Chapman and Tripp, 2004).

It appears that, becoming less reliant on agriculture is an important part of the process of poverty reduction. Evidence from rural villages in Tanzania (Ellis and Mdoe, 2003; Chapman and Tripp, 2004) shows that, on average, half of household income comes from crops and livestock and the other half from non-farm wage employment, self-employment and remittances. Ellis and Mdoe (2003) reported that, the number of households engaging in subsistence agriculture as a main source of food and income is declining, while there is a rise in the number of households engaging in agricultural production as just an extra source of food. While subsistence production has been shown to be important for household food security, the productivity of smallholder agricultural production is quite low and, in some cases, is given as the reason for the abandonment of agricultural production by both urban and rural households and their reliance on non-farm sources of income (Ruel *et al*., 1998; Frayne and Pendleton, 2009).

4.7.6 Rural- urban complementarities and its effect to nutritional status

Nutrition transition is described as decreases in consumption of staple foods rich in starch and dietary fiber, increases consumption of foods from animal origin rich in total fat and saturated fatty acids, decreases in plant protein sources such as legumes, and increases in energy-dense snack foods, carbonated sweetened beverages, commercially available alcoholic beverages, as well as added sugar, fats and oils in preparation of food (Villamor, 2006). Urban areas, and especially in big cities in Tanzania, are known to undergo nutrition transition (Njelekela *et al.,* 2002; Maletnlema, 2002). However, it should be remembered that, the current study has focused on small emerging urban centres and its hinterland villages, but of which the important features of nutrition transition has also been observed. For example, availability of highly processed foods such as bread, fats and energy-dense-foods, which was accompanied by change in life-style.

The changing life-style was evidenced by increased tendency to eating away due to the nature of income generating activities that are commonly being undertaken, and reduced physical activity because of presence of commuter buses and motorbikes. All these factors do bring changes to food and nutrient intakes and therefore influence the nutrition outcome. The nutrition transition, however, is not simply an urban phenomenon; it is strongly associated with rapid economic growth and positive change in household income (Popkin, 2006). One consequence of nutrition transition has been a decline in under nutrition accompanied by a rapid increase in obesity. A study by Keding *et al.* (2011) in rural parts of Tanzania reported that consumption of highly processed foods e.g. bread, doughnuts, chapatti, *maandazi* or

half cakes was high, which indicated that the nutrition transition was taking place. They argue that, although the nutrition transition is often thought to be characterized by a sharp rise in meat and milk consumption, the spread of junk foods and soft drinks, and rising food consumption away from home were already happening. The early stages are usually known to be characterized by increased use of cheap vegetable oils such as palm and sunflower, which are rapidly becoming integrated into local diets in rural Tanzania (Brinkman *et al.*, 2010).

The nutrition transition, accompanied by decreased physical activity, leads to increases in overweight and obesity (Popkin and Gordon-Lersen, 2004). Overweight and obesity during the nutrition transition are associated with increased risk of non-communicable diseases such as stroke, ischemic heart disease, and diabetes (WHO 2003). Many countries in Africa are facing a double burden of nutrition-related diseases, with a co-existence of under- and over-nutrition in same households or communities (Kruger *et al.*, 2001). This appears to be the case in the study area whereby high prevalence of overweight and obesity among women was evidenced. (Popkin (2003) argue that these changes are occurring at a very rapid rate in developing countries and at early stages of economic and social development.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

From the literature review, it is clear that dietary diversity improves dietary quality and the likelihood that individuals will meet their daily nutrient requirements, especially essential micronutrients. Findings of this study have shown that among the three hinterland villages and Madizini township, Lungo village was observed to have lower mean DDS implying lower dietary diversity than the rest of the study areas. The observed low dietary diversity in Lungo village suggests that individuals in that village are relatively more food insecure and are most likely not meeting the micronutrient requirements hence are nutrition insecure.

Food consumption pattern in both hinterland villages and Madizini township indicated that consumption of fruits, meat of all types, milk and milk products, eggs and fish was low. The low consumption of these food items indicates that, the diets of household members in Madizini township and hinterland villages are generally of poor quality and therefore the occurrence of both over nutrition (obesity and overweight) and under-nutrition is not unexpected. Overweight and obesity among women of reproductive age was higher in Madizini township compared to hinterland villages. On the other hand, there was higher prevalence of chronic energy deficiency among women of reproductive age in hinterland villages than in Madizini township. This indicates that, a double burden of malnutrition in the study areas is a problem calling for urgent-multidisciplinary interventions.

Market dependence for food procurement was generally observed to be high in the study areas (except for Mhonda village). Much of the purchased food was secured from the markets in Madizini township. It is likely that the number of households engaging in subsistence agriculture, even in the hinterland villages is declining.

5.2 Future Research and Recommendations

i. This study should serve as the foundation for future research in household dietary diversity and nutritional status of children below five years old and women of reproductive age in other emerging urban centre in Tanzania.

ii. The low dietary diversity (less than 3 food groups) observed in Lungo village and less diversified meals in both study locations call for education program which will increase public awareness and aid in empowering the community members to eat better and live healthier lives.

iii. A double burden of malnutrition observed in this study suggests that nutrition transition is taking place which call for nutrition education to increase public awareness on factors contributing to overweight/obesity e.g. cultural factors, change in lifestyle due to technological advances and change in the nature of income generating activities.

iv. Childhood stunting observed in this study invites joint efforts from the stakeholders, development partners, civil society organization and government to join hands to combat by launching maternal nutrition education programs. The programs should focus on maternal nutrition and child care practices.

v. Government and development partners should think of ways to support households with low economic status by either providing financial support or food aids to enhance their purchasing power. This will help households to increase their budget on food and to have more food diversification and hence food and nutrition secure.

REFERENCES

Amodu, A. D., Sani, I. and Solomon, D. (2009). Infant practices and nutritional status of children in north western Nigeria. *Asian Journal of Clinical Nutrition* 1:12-22.

Arimond, M. and Ruel, M. (2004). Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. *Journal of Nutrition* 134: 2579–85.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M. C., Deitchler, M., Fanou-Fogny, N. and Torheim, E. L. (2010a). Developing Simple Measures of Women's Diet Quality in Developing Countries: Methods and Findings. University of North Carolina, U.S.A. *Journal of Nutrition* 140:2059-2069.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M., Deitchler, M., Fanou-Fogny, N., Kennedy, G., Martin-Prevel, Y. and Torheim, L. E. (2010b). Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. *Journal of Nutrition* 140 (11): 2079-2093.

Armar-Klemesu, M., Ruel, M. T., Maxwell, D. G., Levin, C. E. and Morris, S. S. (2000). Poor maternal schooling is the main constraint to good childcare practices in Accra. *Journal of Nutrition* 130 (6): 1597-1607.

Azadbakht, L., Mirmiran, P. and Azizi, F. (2006). Variety Scores of food groups contribute to the specific nutrient adequacy in Tehranian women. *European Journal of Clinical Nutrition* 59 (11): 1233 – 40.

Azadbakht, L. and Esmaillzadeh, A. (2010). Dietary diversity score is related to obesity and abdominal adiposity among Iranian female youth. *Public Health Nutrition* 14:62-69.

Bailey, A. (1998). Survey Research Methods.2nd edition.Wardsworth, Publishing Company, California. 445pp.

Beaglehole, R. (2005). The global rise in chronic diseases. [http://www.cdc.gov/nccdphp/dnpa] site visited on 20/2/2012.

Bernal, J. and Lorenzana, A. P. (2003). Dietary diversity and associated factors among beneficiaries of 77 child care Centers: Central Regional, Venezuela. *Journal of Clinical Nutrition* 53(1): 52-81.

Bezerra, H. and Sichieri, P. (2011). Household food diversity and nutritional status among adults in Brazil. *International Journal of Behavioral Nutrition and Physical Activity* 58: 222-234.

Bloem, M. W., Semba, R. D. and Kraemer, K. (2010). An introduction to the impact of climate change, the economic crisis, and the increase in the food prices on malnutrition. *Journal of Nutrition* 140:132–5.

Brinkman, H. J., de Pee, S., Sanogo, I., Subran, L. and Bloem, M. W. (2010). High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *Journal of Nutrition* 140:153–61.

Burke, A., Shileds, D. and Wayne, M. (2005). Millennium development goals: slow movement threatens women's health in developing countries. *Contraception* 72: 247-49.

Chapman, R. and Tripp, R. (2004). Rural livelihoods diversity and agriculture in Transkei area, South Africa. *Development Institute of Agricultural Research and Extension* 24(4): 539–551.

Cleaver, K. and Okidegbe, N. (2006). Agriculture and Rural Development: Hunger and Malnutrition. World Bank Seminar Series: Global Issues Facing Humanity. Washington, DC: The World Bank. pp24-43.

Daniel, M. C., Adair, L. S., Popkin, B. M. and Truong, Y. K. (2009a). Dietary diversity scores can be improved through the use of portion requirements: an analysis in young Filipino children. *European Journal of Clinical Nutrition* 63:199–208.

Daniels, M. C. and Melissa, T. (2009b). "Dietary Diversity as a Measure of the Micronutreint Adequacy of Women's Diets: Results from Metropolitan Cebu, Philippines. *European Journal of Clinical Nutrition* 64: 230-241.

Dannhauser, A., Bam, R. and Joubert, G. (1999). Iron status of pregnant women attending the antenatal clinic at Pelonomi Hospital, Bloemfontein. South African. *Journal of Clinical Nutrition* 12: 8-16.

Darnton-Hill, I. and Cogill, B. (2010). Maternal and young child nutrition adversely affected by external shocks such as increasing global food prices. *Journal of Nutrition* 140:162–9.

De Onis, M. and Frongillo, E. A. (2000). Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. *Bulletin of the World Health Organization* 78:1222-33.

DeHaan, A. (2000). Urban Livelihoods and Labor Markets. Achieving Urban Food and Nutrition Security in the Developing World. *International Food Policy Research Institute.* Washington, DC. pp13: 3-9.

Dixon, J., Omwega, A., Friel, S., Burns, C., Donati, K. and Carlisle, R. (2007). The health equity dimensions of urban food systems. *Journal of Urban Health* 84:118–29.

Drewnowski, A. and Henderson, S. A. (1997). The Dietary Variety Score: assessing diet quality in healthy young and older adults. *Journal of American Diet Association* 97: 266-71.

Dwyer, J. (2006). Starting Down the Right Path: Nutrition Connections with Chronic Diseases of Later Life. *American Journal of Clinical Nutrition* 61(3) : 4155-4205.

Eduardo, R., Gernard, M., Willy, U., Paul, P., Donna, S., David, J. H. and Wafaie, W. F. (2006). Trends in obesity, underweight and wasting among women attending prenatal clinics in urban Tanzania. *American Journal of Clinical Nutrition* 83 (6): 1387-1394.

Ekesa, B. N. (2009). Agricultural practices, dietary diversity, Nutrition and health status of small holder communities in Gitega-Burundi and Butembo-DR Congo. [www.cialca.org]. site visited on 12/9/2012.

Ekesa, B. N., Walingo, M. K. and Abukutsa-Onyango, P. L. (2008). Influence of agricultural biodiversity on dietary diversity of preschool children in Matungu division, Western Kenya. *African Journal of food, Agriculture, Nutrition and Development* 8: 142-178.

Ellis, F. and Mdoe, N. (2003). Livelihoods and rural poverty reduction in Tanzania. *World Development* 31(8): 1367–1384.

Engle, P., Menon, P. J., Garrett, J. and Slack, A. (1997). Urbanization and caregiving: A framework for analysis and examples from Southern and Eastern Africa. *Environment and Urbanization* 9 (2): 253-270.

Ergin, F., Okyay, P., Atasoylu, G. and Beser, E. (2007). Nutritional status and risk factors of chronic malnutrition in children under five years of age in Aydin, a western city of Turkey. *The Turkish Journal of Pediatrics* 49 (3): 283–9.

Ezzati, M., Vander Hoorn, S., Lawes, C. M., Leach, R., James, W. P., Lopez, A. D. (2005). Global patterns of nutritional risks in relation to economic development. *Public Library of Science Medicine* 360:1347-1360.

Fischer, A. A., Laing, J. E., Stockel, J. E. and Townsend, J. W. (1991). *Handbook for Family Planning Operations Research Design*. Population Council, New York. 45pp.

FAO (2007). Guidelines for measuring household and individual dietary diversity Version no 3 pp50-52.

FDA (2010a). Using the nutrition facts label, how-to guide for older adults. [http://www.fda.gov/food/labelingnutrition/consumerinformation/default.htm] site visited on 12/9/2011.

FDA (2010b). *Overweight human resistance to weight reducing effects.* Annual Report. University of Marburg, Marburg, Germany. 10pp.

Foote, J. A., Murphy, S. P., Wilkens, L. R., Basiotis, P. P. and Carlson, A. (2004). Dietary variety increases the probability of nutrient adequacy among adults. *Journal of Nutrition* 134: 1779-1785.

Frayne, B. and Pendleton, W. (2009). Urban food security in Ekurhuleni Municipality, Southern Africa. *African Food Security Urban Network* (AFSUN). 46pp.

Friel, S., Chopra, M. and Satcher, D. (2007). Unequal weight: Equitable policy responses to the global obesity epidemic. *British Medical Journal* 335: 1241–43.

Garrett, J. L. and Ruel, M. T. (2005). Stunted child overweight mother pairs: Prevalence and association with economic development and urbanization. *Food and Nutrition Bulletin* 26: 209–21.

Garrett, J. and Ruel, M. T. (1999). Are determinants of rural and urban food security and nutritional status different? Some insights from Mozambique. *World Development* 27 (11): 1955-1975.

Gina, L. K., Maria, R. P., Chiara, S., Guy, N. and Inge, B. (2007). Dietary Diversity Score Is a Useful Indicator of Micronutrient Intake in Non-Breast-Feeding Filipino Children. *The Journal of Nutrition* 137:472-477.

Hatloy, A., Hallund, J., Diarra, M. M. and Oshaug, A. (2000). Food variety, socioeco-nomic status and nutritional status in urban and rural areas in Koutiala, Mali. *Public Health Nutrition* 18 (3): 57-65.

Hatloy, A., Torheim, L. E. and Oshaug, A. (1998). Food variety a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. *European Journal of Clinical Nutrition* 52: 891–898.

Hillbrunner, C. and Egan, R. (2008). Seasonality, Household food Security and nutritional Status in Dinajpur, Bangladesh. *Food and Nutrition Bulletin* 29 (3): 221-31.

Hoddinott, J. and Yohannes, Y. (2002). Dietary diversity as a food security indicator. Food Consumption and Nutrition Division Discussion Paper No. 136. International Food Policy Research Institute, Washington, D.C. International Conference on Poverty, Food and Health in Welfare, in non-breast-feeding Filipino children. *Journal of Nutrition* 137: 472–477.

Hoffman, J. D. and Soo- Kyung, G. (2005). Prevalence of Wasting, but not Stunting, has Improved in the Democratic People's Republic of Korea. *The American Society for Nutritional Sciences.* 42 (4): 452-456.

IOM (2011). Dietary reference Intakes of Calcium and vitamin D. National academy of sciences, Washington DC. pp 1132.

Jayne, T. S. and Rubey, L. (1993). Maize Milling, Market Reform and Urban Food Security in Zimbabwe. *World Development* 21(6): 975-988.

Jeanene, J., Fogli, C. J., Marjorie, L. M., Lisa, M. T. and Paul, F. J. (2006). The 2005 dietary guidelines for Americans Adherence Index: Development and Application. *Journal of Nutrition* 136: 2908-2915.

Jee-Hyan Rah, N., Akhter, R. D., Semba, S., de Pee, M. W., Bloem, A. A., Campbell, R., Moench-Pfanner, K., Sun, J., Badham, L. and Kraemer, K. (2010). Low dietary diversity is a predictor of child stunting in rural Bangladesh. *Sight and Life*. Basel, Switzerland. pp145-159.

Jeffery, S., Richard, P., Edward, A. and Frongillo, J. R. (1996). Rural-urban differences in obesity. *Journal of Rural Sociology* 61 (2): 289-305.

Josney-Hernich, M. L. and Carriquiry, A. (2010). A measurement error approach to assess the association between dietary diversity, nutrient intake and mean probability of adequacy. *Journal of Nutrition* 140:2094–2101.

Keding, G. B., Msuya, J. M., Maass, B. L. and Krawinkel, M. B. (2011). Dietary patterns and nutritional health of women: The nutrition transition in rural Tanzania. *Food and Nutrition Bulletin* 32(3):218-225.

Kennedy, G., Fanou–Fogny, N., Seghieri, C., Arimond, M. and Koreissi, Y. (2007a). Adequacy of diets: Tehran Lipid and Glucose Study. *Asia Pacific Journal of Clinical Nutrition* 13: 56-60.

Kennedy, G. L., Pedro, M. R., Seghieri, C., Nantel, G. and Brouwer, I. (2007b). Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. *Journal of Nutrition* 137: 472–477.

Kennedy, G. L., Pedro, M. R., Seghieri, C., Nantel, G. and Brouwer, I. D. (2009a). Evaluation of dietary diversity scores for assessment of micronutrient intake and food security in developing countries. *Journal of Public Nutrition* 2: 15-32.

Kennedy, G. L., Pedro, M.R., Seghieri, C., Nantel, G., Brouwer, I. D. (2009b). Evaluation of dietary diversity scores for assessment of micronutrient intake and food security in developing countries. *Journal of Clinical Nutrition* 42 (7): 105-121.

Kennedy, G., Fanou–Fogny, N., Seghieri, C., Arimond, M., Koreissi, Y., Dossa, R., Kok, F. J. and Brouwer, I. D. (2010). Food groups associated with composite measure of probability of adequate intake of 11 micronutrients in the diets of women in urban Mali. *Journal of Nutrition* 140: 2070-2078.

Kennedy-Oji, C., Coutsoudis, A., Kuhn, L., Pillay, K., Mburu, A., Stein, Z. and Coovadia, H. (2001). Effects of vitamin A supplementation during pregnancy and early lactation on body weight of South African HIV-infected women. *Journal of Health Population Nutrition* 19(3): 167-176.

Kinabo, J., Mnkeni, A. P. and Nyaruhucha, C. N. M. (2006). Feeding frequency and nutrient content of foods commonly consumed in the Iringa and Morogoro regions in Tanzania. *International Journal of Food Science and Nutrition* 57: 9–17.

Kirsten, B. S., Simondon, F., Costes, R., Delaunay, V. and Diallo, A. (2001). Breastfeeding is associated with improved growth in length, but not weight, in rural Senegalese toddlers. *American Journal of Clinical Nutrition* 73: 959-967.

Kruger, M., Dhansay, M. A. and Van Staden, E. (1994). Anaemia and iron deficiency in women in the third trimester of pregnancy receiving selective iron supplementation. South Africa. *Journal of Food Science and Nutrition* 6: 132-137.

Kusin, J. A., Kardjati, S., Renqvist, U. H. (2000). Chronic undernutrition among women of reproductive age. *American Journal of Clinical Nutrition* 3: 623-26.

Labadarios, D., Steyn, N. P. and Nel, J. (2011). How diverse is the diet of adult South Africans? South Africa. *Journal of Nutrition* 10: 233-245.

Labadarios, D., Steyn, N., Maunder, E., Gericke, G., Swart, R., Huskinson, J., Dannhauser, A., Voster, H. H., Nesamvuni, A. E. and Nel, J. H. (2005). The National Food Consumption Survey (NFCS), South Africa, *Public Health Nutrition* 8(5): 533-543.

Lartey, A., Manu, A., Brown, K. H., Peerson, J. M., Dewey, K. G. (1999). A randomized, community-based trial of the effects of improved, centrally processed complementary foods on growth and micronutrient status of Ghanian infants from 6-12 months of age. *American Journal of Clinical Nutrition* 70:391-404.

Laura, E. C., Stephanie, A., Richard, J., Rivera, A., Philip, M. and Black, E. (2006). Stunting, wasting and micronutrient deficiency disorders.World Bank. Geneva, Switzerland 150pp.

Leyna, G. H., Mmbaga, J. E., Mnyika, K. S., Hussain, A. and Klepp, K. (2010). Food insecurity is associated with food consumption patterns and antropomentric measures but not serum micronutrient levels in adults in rural Tanzania. *Public Health Nutrition* 13(9): 1438 – 1444.

Love, P., Maunder, E., Green, M., Ross, F., Smale-Lovely, J. and Charlton, K. (2001). South African food- based dietary guidelines: Testing of the preliminary guidelines among women in KwaZulu-Natal and the Western Cape, South Africa. *Journal of Clinical Nutrition* 14: 9-19.

Lyimo, M. H., Nyagwegwe, S. and Mnkeni, A. P. (1991). Investigation on the effect of traditional food processing, preservation and storage methods on vegetable nutrients. A case study in Tanzania. *Plant Foods for Human Nutrition* 41(1): 53-57.

Maletnlema, T. N. (2001). A Tanzania perceptive on the nutrition transition and its implicationonhealth.[http://www.cpc.unc.edu/nutrition_transition/private/papers/PHNTTanzania-Maletnlema.pdf.] site visited on 22/2/2012.

Maletnlema, T. N. (2002). Tanzanian perspective on the nutri-tion transition and its implications for health. *Public Health Nutrition* 5:163–8.

Mamiro, P., Kolsteren, P., van Camp, J., Roberfroid, D., Tatala, S. and Opsomer, A. (2004). Processed complementary food does not improve growth or hemoglobin status of rural Tanzanian infants from 6 to 12 months of age in Kilosa District, Tanzania. *Journal of Nutrition* 134: 1084-1090.

Martorell, R., Khan, L. K. and Schroeder, D. G. (1994). Reversibility of stunting: epidemiological findings in children from developing countries. *European Journal of Clinical Nutrition* 48: 45–57.

Maunder, E. M. W., Matji, J. and Hlatshwayo-Molea, T. (2001). Enjoy a variety of foods-Difficult but necessary in developing countries. South Africa. *Journal of Clinical Nutrition* 14 (3): 147-158.

Maxwell, D., Levin, C., Armar-Klemesu, M., Ahiadeke, C., Ruel, M. and Morris, S. (1998). Urban livelihoods, food and nutrition security in greater Accra. Research report 112. Washington, DC: *International Food Policy Research Institute* 250pp.

Mazengo, M. C., Simell, O., Lukmanji, Z., Shirima, R. and Karvetti, R. L. (1997). Food consumption in urban and rural Tanzania. *Plant Foods for Human Nutrition* 68 (3): 313-326.

Melgar-Quinonez, H. R., Zubieta, A. C., Mknelly, B., Nteziyaremye, A., Gerardo, M. F. and Dunford, C. (2006). Household food insecurity and food expenditure in Bolivia, Burkina Faso, and the Philippines. *Journal of Nutrition* 136: 1431–1437.

Mendez, M. A., Monteiro, C. A. and Popkin, B. M. (2005). Overweight exceeds underweight among women in most developing countries. *American Journal of Clinical Nutrition* 81 (3): 714-721.

Menon, P., Ruel, M. T. and Morris, S. (2000). Socio-economic differentials in child stunting are considerably larger in urban than rural areas: Analysis of 10 DHS data sets. *Food and Nutrition Bulletin* 21 (3): 282-289.

Mirmiran, P. and Azadbakht, L. (2004). Dietary diversity among food groups: an indicator of specific nutrient adequacy in Tehranian women. *Journal of the American College of Nutrition* 25: 354-61.

Mirmiran, P., Azadbakht, L., Esmaillzadeh, A. and Azizi, F. (2006). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health of Nutrition* 9:644–650.

Monteiro, C. A. Moura, E. C. Conde, W. L. and Popkin, B. M. (2004). Socioeconomic Status and Obesity in Adult Populations of Developing Countries: *Bulletin of World Health Organization* 82(12): 940-946.

Monteiro, C. A. (2009a). Nutrition and health. The issue is not food, nor nutrients, so much as processing. *Public Health Nutrition* 12:729-731.

Monteiro, C. A., Conde, W. and Popkin, B. M. (2009b). The Burden of Disease from Under nutrition and Over nutrition in Countries Undergoing Rapid Nutrition Transition. Brazil. *American Journal of Public Health* 94(3): 433-4.

Mosha, T. C., Pace R. D., Adeyeye, S., Mtebe, S. and Laswai, H. (1995). Proximate composition and mineral content of selected Tanzania vegetables and effect of traditional processing on the retention of ascorbic acid, riboflavin and thiamine. *Plant Foods for Human Nutrition* 48 (3): 235-245.

NBS and ICF Macro. (2011). Tanzania Demographic and Health Survey 2010. Dar es Salaam, Tanzania. 161-184pp.

NBS and MoPEE (2002).The United Republic of Tanzania, 2002 Population and Housing Census. Dar es Salaam, Tanzania pp166-167.

Nestle, D. A. and Marion, L. (2001). Nutrition and women's health: the politics of dietary advice. *Journal of the American Medical Women's Association* 56 (2): 42-43.

Njelekela, M., Kuga, S., Nara, Y., Ntogwisangu, J., Masesa, Z., Mashalla, Y., Ikeda, K., Mtabaji, J., Yamori, Y. and Tsuda, K. (2002). Prevalence of obesity and dyslipidemia in middle-aged men and women in Tanzania. *Journal of Nutrition Science* 48:352–8.

Noriko, S., Makiko, S., Ryutaro, O. and Makhan, M. (2009). Gender differences in "luxury food intake" owing to temporal distribution of eating occasions among adults of Hindu communities in lowland Nepal. *Asia Pacific Journal of Clinical Nutrition* 18 (3):441-446.

Ogle, B. M., Hung, P. H. and Tuyet, H. T. (2001). Significance of wild vegetables in micronutrient intakes of women in Vietnam: An analysis of food variety. *Asia Pacific Journal of Clinical Nutrition* 10: 21–30.

Ohna, I. L. (2007). Food, Culture and Livelihood in Malinzanga village, Tanzania. The Department of International Environment and Development Studies, Norwegian University of Life Sciences (UMB) (Noragric). *Journal of Clinical Nutrition* 18: 1-43.

Oldewage-Theron, W. and Kruger, R. (2008). Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpeville, South Africa. *Journal of Nutrition* 27(1-2): 101-133.

Oldewage-Theron, W. H., Dicks, E. G., Napier, E. C. and Rutengwe, R. (2005). Situation analysis of an informal settlement in the Vaal region Development. South Africa. *Journal of Epidemiology* 22(1):13-26.

Onyango, A., Koski, K. and Tucker, K. (1998). Food Diversity Versus Breastfeeding Choice In Determining Anthropometric Status In Rural Kenyan Toddlers. *International Journal of Epidemiology* 27:484-489.

Pollitt, E., Gorman, K. S, Engle, P. L., Rivera, J. A. and Martorell, R. (1995). Nutrition in early life and the fulfillment of intellectual potential. *Journal of Nutrition* 125: 1111–1118.

Popkin, B. and Gordon-Larsen, P. (2004). The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants. *International Journal of Obesity* 28: 2 – 9.

Popkin, B. M. (1996). A comparison of dietary trends among racial and socioeconomic groups in the United States. *England Journal of Medicine* 335:716-20.

Popkin, B. M. (2003). The nutrition transition in the developing countries. *Development of Policy Review* 21(5): 581-597.

Popkin, B. M. (2006). Global nutrition dynamics; the world is shifting rapidly toward a diet linked with non-communicable diseases. *American Journal of Clinical Nutrition* 84(2): 289-298.

Rana, A., Qureshi, F. A., Hansotia, M. F., Randell, J., Rasheed, S. and Khan, I. A. (2006). Global patterns of nutritional risks in relation to economic development. *Public health and Community Medicine* 15 (6): 321–50.

Rani, V., Arends, D. E. and Brouwer, I. (2010). Dietary diversity as an indicator of micronutrient adequacy of the diet of five to eight year old Indian rural children. *Food Science and Nutrition* 40 (5): 466-476.

Rikimaru, T. (2000). Nutrition and poverty: study on food consumption patterns and nutritional economic value of common foods in Dar es Salaam. *Journal of nutrition 3*: 252-263.

Roche, M. L., Creed-Kanashiro, H. M., Tuesta, I. and Kuhnlein, H. V. (2008). Traditional food diversity predicts dietary quality for the Awajun in the Peruvian Amazon. *Public Health Nutrition* 11:457–65.

Ruel, M. T. (2003a). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *Food and Nutrition Bulletin* 24: 231–232.

Ruel, M. T. (2003b). Operationalizing dietary diversity: a review of measurement issues and research priorities. *Journal of Nutrition* 133:3911–3926.

Ruel, M. T. (2001). The natural history of growth failure: Importance of intrauterine and postnatal periods. *Nutrition Workshop Series, Pediatric Program*. *Journal of Nutrition* 47: 123-158.

Ruel, M. T., Garrett, J. L., Morris, S., Maxwell, D., Oshaug, A., Engle, P., Menon, P., Slack, A. and Haddad, L. (1998). Urban challenges to food and nutrition security: a review of food security, health, and care giving in the cities. Evidence from Accra, Ghana. *Food Consumption and Nutrition Division*. Washington, DC 51pp.

Rutasitara, L. (2002). Researching Poverty in Tanzania. Mkuki and Nyota Publishers Limited, Dar es Salaam. 200pp.

Sanusi, R. A. (2010). An Assessment of Dietary Diversity of Women in Six Nigerian States. Department of Human Nutrition, College of Medicine, University of Ibadan. Ibadan, Nigeria. *African Journal of Biomedical Research* 13: 161 -167.

Savy, M. and Martin-Prevel, Y. (2005). Use of variety/diversity score for dietary quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. *European Journal of Clinical Nutrition* 59 (5):703-16.

Sawadogo, P. S., Martin-Prevel, Y., Savy, M., Kameli, Y., Traissac, P. and Traore, A.S. (2006). An infant and child feeding index is associated with the nutritional status of 6-23month-old children in rural Burkina Faso. *Journal of Nutrition* 136: 656–663.

Sen, A. (1982). *Poverty and famines: an essay on entitlement and deprivation*. Oxford University Press. New York: 691pp.

Shantana, H., Ian, U. and Proloy, B. (2003). Pattern and trends in food consumption in poor urban and rural households in Bangladesh. *Nutrition Research and Evaluation Division* 28:132-139.

Skalar, A. (2005). Obesity: Science and Society. [http://serendip.brynmawr.ed/bb/neuro05/web2/asklar.htm] site visited on 23/11/2012.

Smith, L. C., Ramakrishan, U., Ndiaye, A., Hadad, L. and Martorell, R. (2003). The importance of women's status for child nutrition in developing countries. Washington, DC: *International Food Policy Research Institute* 47pp.

Smith, L.C., Ruel, M. T. and Ndiaye, A. (2005). Why is child malnutrition lower in urban than rural areas? Evidence from 36 developing countries. *World Development* 33(8):1285-1305.

Spigelski, D. L. (2004). Dietary diversity and nutrient adequacy in women of childbearing age in a Senegalese peri-urban community. MSc Thesis, McGill University, Montreal, Canada. pp 56-68.

Steyn, N.P., Nel, J. H., Nantel, G., Kennedy, G. and Labadarios, D. (2006a). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health Nutrition* 9 (5): 644-650.

Steyn, N. P., Maunder, E. M. W., Labadarios, D. and Nel, J. H. (2006b). Foods and beverages that make significant contributions to macro and micronutrient intakes of children in South Africa do they meet the food based dietary guidelines? South Africa. *Journal of Clinical Nutrition* 19: 66-76.

Sthapit, B. R. (2004). Biocultural diversity in the sustainability of developing country food systems. *Food and Nutrition Bulletin* 25: 143–155.

Stoltzfus, R. J., Chwaya, H. M., Albonico, M., Schulze, K. J., Savioli, L. and Tielsch, J. M. (1997). Serum ferritin, erythrocyte protoporphyrin and haemoglobin are valid indicators of iron status of school children in a malaria-holoendemic population. *Journal of Nutrition* 127: 293-298.

Swindale, A. and Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for measurement of household food access: *Food and Nutrition Technical Assistance (FANTA) project, Academy for educational Development*, Washington, DC. 1-9 pp.

Swindale, A. and Bilinsky, P. (2005). Household Dietary diversity Score (HDDS) for Measurement of Household food Access: Food and Nutrition Technical Assistance. *The Journal of Nutrition* 138(12): 2448-53.

Tacoli, C. (2002a). Changing rural-urban interaction in sub-Saharan Africa and their impact on livelihoods. Working paper series on rural-urban interactions and livelihoods strategies No. 7. London, United Kingdom. 29pp.

Tacoli, C. (2002b). Rural-Urban Interdependence. Achieving Urban Food and Nutrition Security in the Developing World. 2020 Vision Focus no.3, Briefs 3 of 10 .Washington, DC. pp103-06.

TFNC (1997a). Nutritional Status Among Children Aged 6-59 Months in Nzivi Village Kisarawe, Tanzania. *Food and Nutrition Centre, TFNC report No. 1817.* Dar es salaam; Tanzania. 7-45 pp.

TFNC. (1997b). Rapid Assessment of Household Food Security and Nutrition in Drought Affected Areas in Tanzania Mainland. *Tanzania Food and Nutrition Centre, TFNC report No. 1386*. Dar-es-Salaam, Tanzania. 2-19pp.

Temu, A. G. (2009). Needs and Possibilities for Improving Maternal Nutrition in Rural Tanzania. Thesis for Award of PhD Degree at Giessen University, German. pp31-73.

Thorne-Lyman, A. L., Valpiani, N., Sun, K., Semba, R. D., Klotz, C. L. and Kraemer, K. (2010). Household dietary diversity and food expenditures are closely linked in rural Bangladesh, increasing the risk of malnutrition due to the financial crisis. *Journal of Nutrition* 140:182–188.

Torheim, L. E., Barikm, I., Parr, C. L., Hatloy, A., Ouattara, F. and Oshaug, A. (2003). Validation of food variety as an indicator of diet quality assessed with a food frequency questionnaire for western Mali. *European Journal of Clinical Nutrition* 57: 1283-1291.

Torheim, L. E., Ouattara, F., Diarra, M. M., Thiam, F. D., Barikmo, I. and Hatloy, A. (2004). Nutrient adequacy and dietary diversity in rural Mali. Association and determinants. *European Journal of Clinical Nutrition* 58: 594–604.

Torheim, L. E., Ferguson, E., Penrose, K. and Arimond, M. (2010). Women in resource-poor settings are at risk of inadequate intakes of multiple micronutrients. *Journal of Nutrition* 140:2051–8.

Tucker, K. L. (2001). Eat variety of healthful foods: old advice with new support. *Nutrition Reviews* 59:156–158.

UNICEF (1998). The State of the World Children. Oxford University Press, New York. 98pp.

UNICEF (2006). Progress for children: Assessment of the risk of zinc deficiency in populations and options for its control. New York. *Food and Nutrition Bulletin* 25: 99-199.

URT (2005). Concept and Definition for Official Statistics in Tanzania Mainland. Government Printers, Dar es Salaam, Tanzania.42pp.

URT/UNICEF (1990). The Situational Analysis of Women and Children in Tanzania, Dar es salaam, Tanzania. 140-154 pp.

Vandevijvere, S., De Vriese, S., Huybrechts, I., Moreau, M., and Van Oyen, H. (2010). Overall and within-food group diversity are associated with dietary quality in Belgium. *Public Health Nutrition* 134: 211-9.

Villamor, E. (2006). Trends in obesity, underweight, and wasting among women attending prenatal clinics in urban Tanzania, 1995–2004. *American Journal of Clinical Nutrition* 83(6) 1387-1394.

Visser, M. E., Maartens, G., Kossew, G. and Hussey, G. D. (2003). Plasma vitamin A and zinc levels in HIV-infected adults in Cape Town, South Africa. *British Journal of Nutrition* 89(4): 475-482.

Weinsier, G. and Morgan, W. L. (1993). Prevalence of overweight and obesity continues to increase in the New York. *European Journal of applied physiology 28:* 53-55.

World Bank (2003). World Development Report, World Bank Press, Washington DC, U.S.A. 30pp.

WHO (1995). Physical Status, the Use and Interpretation of Anthropometry. World Health Organization Expert Committee. Technical Report Series No 854.Geneva, Switzerland. 125pp.

WHO (1999). Complementary feeding of young children in Africa and the Middle East.*World Health Organization*, Geneva. 426pp.

WHO (2002). Reducing risks, promoting healthy life. *World Health Organization* Geneva, Switzerland. 230 pp.

WHO (2003). Diet Nutrition and the preventive of Chronic Disease. Report of Joint WHO/FAO expert Consultation. Technical Report Series No. 916. *World Health Organization.* Geneva, Switzerland. 280 pp.

WHO (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies.157-163pp.

WHO (2006). Child Growth Standards: Methods and Development. *World Health Organization*: Geneva, Switzerland. 19pp.

WHO/FAO (2001). Is Malnutition declining? An analysis of changes in levels of child malnutrition since 1980 *Bulletin of the World Health Organization* 78: 122-123.

APPENDICES

Appendix 1: Questionnaire for assessing household dietary diversity and nutritional status of children and women of reproductive age

SECTION ONE

A. Household Identification

Name of the division…… Name of the ward……

Name of the village/mtaa.....Name of respondent……

Date of interview……

B. Household Composition

1. Name of head of household**……** 2. Gender of head of household.....

3. Age of woman**…….** 4. Marital status of woman **……**

5. Number of members in the household**…….**

6. Relation with the head of household**……**

7. Education level of women attained**……**

8. Main occupation of women**…….**

9. Location of occupation of women**……..**

C. Income earned per month from different income generating activities in household

10. On average how much do you earn in total per month from your income generating activities.....?

11. During the last month how much did you spend in total for buying food……..?

12. During the last month how much did you spend in total for buying goods and services….?

a. health services (TZS……) b. Farming activities (TZS…….)

c . Communication (TZS……) d. Water/electricity services (TZS……)

e. Building material (TZS……..) f. Entertainment

(TZS.....) g. Other expenditure (TZS…….)

SECTION TWO

Availability and accessibility of food items and health services in household

A. Availability of food in household

13. Consider availability of different food items, then tell me the place where your household obtains these food items

Food item	code	Food item	code	Food item	code
FRUITS		Mnavu		**LEGUMES**	
Oranges		Sweet potato leaves		Beans	
Pineapples		Pumpkin leaves		Peas	
Mangoes		Cassava leaves		Cowpeas	
Ripe bananas		**OTHER VEGETABLES**		Pigeon peas	
Watermelon		Onions		**CEREALS**	
Cucumber		Tomatoes		.Maize	
Jack fruit/mafenesi		Eggplant/bilinganya		Rice	
Papaya/pawpaw		Sweet pepper/hoho		Sorghum	
Guava/mapera		African egg plant		Millet	
VEGETABLES		Carrot		**ANIMALS FOOD**	
Cabbage		**ROOTS &TUBERS**		Meat	
Spinach		Sweet potato		Fish	
Chinese cabbage		Round potato		Eggs	
Amarantha		Cassava		milk	
Nightshade/Mnavu		Yams			
		Unripe banana			

Coding categories: 1. Purchased from Madizini market/shop 2. Own production

3. Purchased within village 4. Purchased from Morogoro town 5. Not applicable

B. Availability of health Services related to Nutrition and Health

14. Where do you get different services related to nutrition and health?

Health services	code
Treatment-consulting a health professional	
Clinic services-prenatal and post-natal	
Counseling services for various health issues	
Family planning services	
Immunization services	
Nutrition and health education training	
Delivering (giving birth)	

Code: 1 = Madizini 2 = Within the village 3= In another area 4 = Far away (e.g. Morogoro)

SECTION THREE: Dietary intake (24 hour recall)

15**.** Could you please describe the foods (meals and snacks) that your family ate yesterday? Start with the first food eaten in the morning and tell me the primary source for obtaining food for your household

TIME	food/drinks	ingredients	primary source for obtaining food for your household 1= Own production, gathering, hunting fishing 2= Purchased
Breakfast			
Snack			
Lunch			
Snack			
Dinner			
Snack			

SECTION FOUR: NUTRITIONAL ASSESMENT

16. Anthropometric indices for children below five years of age

No. of children	Weight (Kg)	Height/Length (cm)	Birth date
1			

17. Anthropometric measurement for non pregnant women

No. of women	Weight (Kg)	Height (cm)	BMI
1			

END OF INTERVIEW THANK YOU FOR YOUR TIME

Appendix 2: Household dietary diversity

Question number	Food group	Examples	YES=1 NO=0
1	CEREALS	Bread, noodles, biscuits, cookies or any other foods made from millet, sorghum, maize, rice, e.g. ugali, porridge or other locally available grains	
2	VITAMIN A RICH VEGETABLES AND TUBERS	Pumpkin, carrots, squash, or sweet potatoes that are orange inside + other locally available vitamin-A rich vegetables(e.g. sweet pepper)	
3	WHITE TUBERS AND ROOTS	White potatoes, white yams, cassava, unripe banana or foods made from roots/tubers.	
4	DARK GREEN LEAFYVEGETABLES	Dark green/leafy vegetables, including wild ones + locally available vitamin-A rich leaves such as cassava leaves, pumpkin leaves, sweet potato leaves, amarantha, spinach, Chinese cabbage, etc. other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	
5	VITAMIN A RICH FRUITS	Ripe mangoes, pawpaw, carrots etc. or other locally available vitamin A-rich fruits	

6	OTHER FRUITS	Watermelon, ripe banana, guava etc. or other fruits, including wild fruits	
7	ORGAN MEAT (IRON-RICH) FLESH MEATS	liver, kidney, heart or other organ meats or blood-based foods beef, pork, lamb, goat, rabbit, wild game, chicken, duck,	
8	EGGS		
9	FISH	fresh or dried fish or shellfish	
10	LEGUMES AND NUTS	Beans, peas, cowpeas, pigeon peas nuts, seeds or foods made from these.	
11	MILK AND MILK PRODUCTS	Milk other milk products	
12	OILS AND FATS	Oil, fats or butter added to food or used for cooking	