EFFECTS OF FOOD INSECURITY AMONG PASTORALIST FAMILIES IN THE CHANGING CLIMATE OF IRINGA RURAL DISTRICT, TANZANIA

MARY MDACHI

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN PUBLIC HEALTH AND FOOD SAFETY OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

2014

ABSTRACT

Dietary intake measures are useful for assessing nutritional status of an individual. Dietary intake depends on the availability of healthy foods, as well as on resources available to an individual, allowing them to purchase or access foods. This study was carried out in 20 villages in Iringa Rural District, between July and September 2013 to assess effects of food insecurity among pastoralist women and their infants. Interviews were used to gather information on food insecurity and food frequency in pastoralist households. Anthropometric measurements and haemoglobin (Hb) concentrations of the participants were also collected. A total of 200 women and 30 infants were included in the study. The results indicated that majority (75.8%) of women's diet was of plant origin. Approximately 75% of women had food shortages, defined as having at least one meal per day composed of limited food groups and quantities. All children were given meals mainly composed of carbohydrates (40%) once a day with no consistent pattern of types of foods or feeding times. Data on the nutritional status of children indicated that 6.6% of the Barbaig children experienced wasting while 10% of the Sukuma children were stunted. For women, 28% were underweight, while 7% were obese. Haemoglobin data indicate that 87.5% of children were anaemic while 42% of women were anaemic. It is concluded that most women and children had food insecurity and poor nutritional status which partly would be caused by climate change. It is recommended that nutritional education programs should be introduced in health facilities and in schools so as to improve the knowledge on nutrition. Also education should be given to the heads of households on how to utilize livestock in improving their livelihood/income and strategies to climate change adaptations.

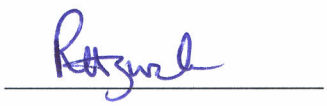
DECLARATION

I, Mary Mdachi, do hereby declare to the Senate of 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.

05/11/2014

Mary Mdachi — Date

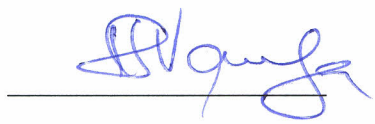
(MSc. Candidate)



05/11/2014

Prof. Rudovick R. Kazwala — Date

(Supervisor)



05/11/2014

Dr. Hezron E. Nonga — Date

(Supervisor)

COPYRIGHT

ACKNOWLEDGMENTS

The successful accomplishment of this dissertation is a result of cooperation between Health for Animals and Livelihood Improvement (HALI) project, a collaborative project between Sokoine University of Agriculture (SUA) and the University of California, Davis. USAID's Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change, administered by Colorado State University, provided funding for this research.

Much appreciation goes to my supervisors Prof. Rudovick R. Kazwala, Dr. Hezron E. Nonga of Sokoine University of Agriculture and Prof. Beth Yakes-Jimenez of New Mexico University in United States for their help, support and brilliant supervision from the beginning of this work (writing proposal) until the end (writing this dissertation). I express my sincere gratitude to my fellow research assistants in Iringa and all HALI staff in Morogoro and Iringa for their support during data collection, also I owe special thanks to Dr. Mwemezi Kabululu and Mr. Rashid Idrissa for their moral and material support in one way or another in making this work successful.

DEDICATION

I dedicate this work to my late parents Mr. and Mrs. Mdachi who passed away during the time I was doing data collection. I wish they could see their daughter achieving this stage they were wishing for. Their love, support and guidance throughout my early academic stages gives me strength and wisdom to go further. May their souls REST IN ETERNAL PEACE. Also I dedicate this work to my beloved son Alvin.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

BMI	Body Mass Index
FAO	Food and Agriculture Organization
HALI	Health for Animals and Livelihood Improvement
Hb	Haemoglobin
HC	Head Circumference
IDA	Iron Deficiency Anemia
MUAC	Mid Upper Arm Circumference
NIMR	National Institute for Medical Research
SUA	Sokoine University of Agriculture
TDHS	Tanzania Demographic Health Survey
TMA	Tanzania Meteorological Agency
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Nutritional status is the condition / measurement of how well the nutrients in a diet (dietary intake) are meeting the physiological needs of the body (Konley, 2011). Nutritional status is influenced by the intake and utilization of nutrients in the body and is a major determinant of one's health and survival (Nyaruhucha *et al.,* 2006). The Food and Agriculture Organization of the United Nations, (FAO) defines food insecurity as a situation that exists when people, at a certain time, have no physical access to sufficient, safe, and nutritious food that could meet their dietary intake needs and food preferences for an active and healthy life (FAO, 2010).

In Tanzania, common pastoralist tribes are the Maasai, Barbaig and Sukuma. Pastoralists are livestock keepers who rely directly or indirectly on livestock for food and income. The animals are managed under an extensive husbandry system; they graze animals in areas with low agricultural productivity (Sadler *et al.*, 2010). Pastoralists' dietary intake traditionally consists mainly of animal products with little addition of foods of plant origin (Sadler *et al.*, 2010). As their diets are mainly from animal source foods, their nutritional status will be a reflection of the health status of their livestock. The pastoralists' diet varies a lot between geographic regions, ethnic groups, climate season and recently the effects of climate change.

Paavola (2004) defines climate change as "a systematic change in the key dimensions of climate including average temperature, wind and rainfall patterns over a longer period of time". Climate change affects agriculture and food production. Changes in temperature

and precipitation associated with continued emissions of greenhouse gases cause changes in land suitability and crop yields (Nguvava *et al.*, 2009). Droughts can dramatically reduce crop yields, livestock numbers, production and reproduction performance. That is, it is very likely that climate change increases the number of people at risk of hunger. The impact intensity of climate change on food insecurity differs across regions, and over time it also depends on the overall socio-economic status of the community concerned (SMART, 2006).

Food insecurity is a common problem in Tanzania and contributes to poor dietary intake in most of Tanzania's communities. Smith *et al.* (2006) found that food insecurity can be measured by the variety and quality of food eaten or the percentage of people in a population group who do not consume sufficient diets. Household food insecurity happens when people at a certain time do not have access to sufficient, safe and nutritious food to meet their dietary needs (Knueppel *et al.*, 2009). Accessibility of food, in terms of quality and quantity in a period of time influences maintenance of the nutritional status of the individual (Smith *et al.*, 2006). Muthaya (2009) found that apart from diseases, food insecurity also causes nutrient deficiencies, and therefore, under nutrition.

Previous research on food insecurity in pastoralist communities in Tanzania indicates widespread inadequate dietary intake and nutrient deficiencies (Nyaruhucha *et al.*, 2006). A study by Sellen (2000) found that approximately 50% of pastoralist women in Kilimanjaro region had chronic energy deficient and almost half of the children had growth retardation due to nutrient deficiencies. Temu (2009) also found that 55% of 296 women interviewed in Ruaha reported to have food insecurity at one point during the year.

Another common nutrient deficiency disorder in Tanzania is iron deficiency anemia (IDA), which indirectly has adverse effects on the nutritional status of children (Mosha *et al.*, 2000). IDA affects body immunity and thus increases the host susceptibility to infections (Muthaya, 2009). In Tanzania IDA is estimated to be present in about one third of the population. Hospital records indicate that anemia is among the top ten reasons for admission in obstetric as well as in pediatric wards (Tatala *et al.*, 2007). Anaemia is regarded as a major risk factor for premature labour and low birth weight (Kayunze and Mwageni, 2013). Schellenberg *et al.* (2003) revealed that usually anaemia is asymptomatic and even when symptoms arose they were non-specific and rarely identified as a serious illness. Tatala *et al.* (2007) showed that there is a strong relationship between anaemia, diseases like malaria, parasitic infections (e.g. hookworms and schistosomiasis) and food iron intake. That is socio-economic factors, low bioavailability of plant source dietary iron accounts for more than half the total number of anaemia cases. Based on these associations and the high prevalence of IDA, micronutrient supplementation programs and educational interventions to increase iron-rich food intake were expected to reduce the prevalence of anemia among women of child-bearing age and children under 5 years. Tanzanian antenatal clinic policy includes free provision of daily iron and folic acid tablets, and weekly prophylactic anti-malaria tablets to pregnant women (Kayunze and Mwageni, 2013).

1.2 Problem Statement and Justification of the Study

Food insecurity and poor nutritional status is of recent increasingly becoming a problem in many rural poor communities in developing countries. This problem is more pronounced in African countries like Tanzania where majority of the people depend on agriculture (crop and livestock production) for their livelihood and sources of food. The climate change in recent years has influenced the rainfall pattern such that incidences

of prolonged drought are high. This further reduces crop yields and influences production and reproduction performance of livestock (Paavola, 2004). This study is a continuation of a previous study which was done in the same study area (HALI-Project 2006-2010). The study was about "Socioeconomics and Gender Roles in Pastoralist Households in the Ruaha Landscape" of which there was a concern of climate change impacts on pastoralists' livelihoods. The main concern about climate change is its manifestations. Changes in the mean temperature, rainfall patterns and rainfall variability are likely to prolong dry seasons and to increase the severity of periodic droughts (Paavola, 2004). Drought and water shortages for irrigation, livestock and domestic uses are among the effects of climate change that would have a negative impact on the livelihoods of the people through decreased crop production, food insecurity, and livestock production (Nguvava *et al.*, 2009). Hence climate change can lead to decreases in food production and may contribute to inadequate dietary intake within the community, which leads to nutrient deficiency.

The 2010 Tanzania Demographic Health Survey data show that nutrient deficiency among children under age 5 years is a common problem in Tanzania. Based on anthropometric scores (stunting, wasting and underweight whereby stunting is the measurement of height/length for age, wasting is measurement of weight for length/height and underweight is weight for age) 42% of children under age of 5 years old were stunted (height/length for age < -2), 17% were severely stunted (height/length for age <-3), 5% were wasted and 16% were underweight (weight for age z-score <-2) in Tanzania by the year 2009. Apart from malnutrition, anaemia is also a serious health problem that usually results from poor dietary intake of iron or due to infections. The 2010 Tanzania Demographic and Health Survey (TDHS) reported the national prevalence of anaemia to be 59% among children under 5 years, and 43% among pregnant women.

Outcomes of climate change especially drought and water shortage contributes much to transhumance lifestyle of pastoralists (shifting cattle from one grazing locations to the other in search for better pastures). A study by Nyaruhucha *et al.* (2006) in Simanjiro indicated that most of the children under-five years of age in pastoral communities had poor nutritional status and were predisposed to many infectious zoonotic diseases. Iringa rural district has been occupied by pastoralists for many years. The previous study indicates that there was climate change which affects livestock and agriculture (HALI-Project 2006-2010) but there has been no study on how climate change can lead to food insecurity of which have an impact on the nutritional status and dietary intake of the pastoralist families in Iringa rural.

The current study intended to bridge this gap by exploring nutritional status of women and children, and the magnitude of food insecurity among pastoralist households as outcomes of climate change in Iringa rural. Data on prevalence of poor nutritional status and inadequate dietary intake among pastoralist women and children will serve as baseline information for devising intervention measures. The Tanzanian health and nutrition policy aims to improve the health and wellbeing of all people in need with emphasis on the most vulnerable groups, which are women and children. The National Road Map Strategic Plan to accelerate reduction of maternal, new-borns and child deaths, it was found that under-nutrition and anemia were widely prevalent in Tanzania especially among children less than 5 years. Furthermore Tanzania Development Vision/ national health policy identifies health as one of the priority sectors whereby its main objectives is achievement of high quality livelihood for all Tanzanians. Therefore, the government through the Ministry of Health and Social Welfare and other health and nutrition stakeholders, may use the generated information to develop strategies to improve nutritional status and dietary intake among pastoralist communities in Tanzania.

Meanwhile, the prevalence data will provide baseline information for the evaluation of an educational intervention which will be provided to pastoralist communities related to animal health and human nutrition.

1.3 Objectives

1.3.1 Overall objective

To assess impact of food insecurity on nutritional status and dietary intake of pastoralist women and infants in Iringa Rural district, Iringa Tanzania.

1.3.2 Specific objectives

Specific objectives of this study are:

(i) To establish the magnitude of food insecurity among pastoralist households.

(ii) To establish the prevalence of poor nutritional status among pastoralist women and infants.

(iii) To determine the prevalence of indicators of health status among pastoralist women and infants.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Climate Change in Relation to Livestock Health and Pastoralists Nutrition

Climate change (e.g. extended periods of drought or sudden floods) always stress livestock and decrease forage availability, leading to disease outbreaks and consequently decreases in animal production which directly impact pastoralist health status (Galvin *et al.*, 2004). Hence pastoralists become vulnerable to inadequate livestock diets as they depend much on livestock as source of food (Galvin, 1992). For the past several years, Iringa experienced change in climate. This changing in climate may have been attributed by human's activities like deforestation, farming and grazing along river Ruaha. Such activities contributed to decrease of river water hence low precipitation of which led to low rainfalls. A study done by Nguvava *et al.* (2009) in the Iringa rural District found that pastoralists' livelihoods and their livestock were seriously threatened by impacts of climate change. The alterations in variability and intensity of rainfall have direct impacts on livestock productivity through shortage of water and pastures, and also indirectly impact on disease dynamics.

Dinar *et al.* (2008) found that pastoralist communities have started practicing crop production as a means to diversify the limited supply of food from animals, which is thought to be caused by climate change. Sadler *et al.* (2010) noted that the main nutritional challenge for pastoralists is obtaining sufficient food, and therefore most pastoralists supplement their livestock-based diets with grains to maintain food supply during the dry season when milk yields fall. Other study has quantified inadequate levels of energy provided by pastoralist diets related to unavailability of milk and animal source foods and have linked this to high levels of under nutrition (Dror *et al.*, 2011).

2.2 Anthropometric Measurements in Relation to Nutritional and Health Status

Anthropometric measurements serve as guidance in assessing individual health status. Caulfield *et al.* (2004) showed that one of the key inputs in assessing under nutrition is weight, where low weight-for-age is attributed to under nutrition status of the individual. In the study done in pastoralist communities in Simanjiro by Nyaruhucha *et al.* (2006) anthropometric measurements were employed to assess nutritional and health status of children. A study by Taleb *et al.* (2011) assessed nutritional status of pregnant women where weight and height were measured as the key features in deriving Body Mass Index (BMI). In addition Temu (2009) employed anthropometric measurements as a means to assess health status of women in Ruaha ecosystem. From all these studies they indicated the importance of anthropometric measurements as a tool to assessing individual's nutritional status and health status.

2.3 Pastoralists and Nutritional Status

The livelihood for pastoral communities mostly depends on livestock. The pastoralists are spread in different areas in Tanzania, especially where they are assured of grazing land and water supply for their animals. They are mostly involved in shifting cattle from one grazing location to the other in search of better pastures (Fratkin *et al.,* 1999; Fratkin, 2001). Sadler *et al.* (2010) reported that raw milk, meat and sometimes blood are the staple foods for pastoralists to meet their nutritional requirements. The reason why pastoralists depend on milk versus meat is that milk is a renewable resource available daily during certain seasons while meat is available only sporadically when animals are slaughtered (Barret and Luseno, 2004).

However, the supply of food sometimes is inadequate and this may predispose them to low food intake and are not able to provide the entire nutritional requirement for the body

(Fentaw *et al.*, 2013). Homewood (1999) found that the Maasai took only 70% of recommended daily calories while Nyaruhucha *et al.* (2006) determined that approximately one third of pastoralist children in Simanjaro district were malnourished and stunted due to inadequate dietary intake.

The Maasai and other pastoral communities are related in terms of their lifestyles. They practice polygamous marriages with young, uneducated girls. Nyaruhucha *et al.* (2006) found that personal characteristics of the mother, such as age, educational level, and marital status are all related with the nutritional status of their under five children (Nyaruhucha *et al.*, 2006). Children of the younger mothers were more likely to be undernourished than those of older mothers. From the same study they found half of the children of the mothers who were under 20 years of age were either severely or moderately undernourished; also children from mothers who did not receive formal education were more likely to be undernourished than educated mothers.

On the other hand, mothers who were in polygamous marriages were more likely to have undernourished children than either the monogamously married or unmarried ones because of larger families (Nyaruhucha *et al.*, 2006). Large households were more likely to have undernourished children than smaller households as it is likely that large family size tends to strain food budgets, resulting in inadequacy of food needed to meet daily requirements. In such situations, when children are not given preferences in household food distribution, they are likely to be the especially vulnerable (Fentaw *et al.*, 2013). Also Nyaruhucha *et al.* (2006) has revealed that under-nutrition of children under five years old is an important public problem and several factors appear to influence the resulting nutritional status including household food insecurity and feeding practices. Households' food insecurity is related to long durations of rain shortage in tropical and

sub-tropical regions. The major factor influencing availability of milk, a major component of children's diets, is rainfall. Hence pastoral dietary patterns must accommodate the impacts of seasonal changes in availability of milk (Sadler *et al.*, 2010).

2.4 Socio-economic Status Affects Nutritional and Health Status of Pastoralists

Socioeconomic status and children's nutrition and health outcomes are closely linked (Paul *et al.*, 2011). A study by Arimond *et al.* (2004) found that diversity of children's diets is associated with household socioeconomic status. That is, a household that is financially stable will have varieties of food for the family and the children too. Pastoralists' access to milk depends on climate regime and the individual pastoralist family wealth status (Nalitolela *et al.*, 2001). Since most pastoralist communities depend on livestock as a source of income and food, with the majority having low economic status, socioeconomic status and feeding practices/nutrients intake in pastoralist communities are highly correlated (Leroy and Frongillo, 2007).

Pastoralists' choice of livestock to rear also varies within communities according to individual family socioeconomic circumstances. Poor pastoral families may rely more on small stock like sheep and goats which are easier to feed and herd, and reproduce faster than large stock, as well as being cheaper to purchase (Sadler *et al.*, 2010). Small stock however generally produce much less milk than the large livestock species like cattle that richer pastoralists may be able to keep in their herds. Large livestock species need more capital to manage and that's why it is more difficult for poor pastoralists to own, even though they produce more milk (Sadler *et al.*, 2010).

Social composition of the household accounts for the consumption and nutritional status of the household. Pastoralists have to portion milk between their dependents and their

calves. A poor woman has little choice in taking more milk from her few milking cows for human use and leaving less for the calves. A wealthy woman will get a larger quantity of milk by taking less from each of her larger number of milking cows as well as feeding her dependents (Homewood, 1999). Childhood under nutrition is prevalent in low and middle-income pastoral communities. According to Imdad *et al.* (2011) an estimate, 20% of children less than 5 years of age in these communities were underweight in 2005.

2.5 Education Interventions/Strategies on Improving Nutrition Status Among Pastoralists

A number of strategies have been proposed to improve nutritional status and dietary intake among pastoralists. Nyaruhucha *et al.* (2006) concluded that nutritional and hygiene education, environmental sanitation and livestock disease prevention practices are required in pastoralist communities to improve nutritional status. Increasing livestock extension education, promoting food safety, and preventing outbreaks of livestock diseases can increase nutritional status (Scoones and Wolmer, 2006). Agricultural interventions have been shown to have a positive impact on child nutritional status (Masset *et al.*, 2012). Furthermore Sahoo and Panda (2006) suggested that apart from nutritional education there is a need for popularizing cultivation of low cost crops especially green vegetables in each household to improve their dietary intake. Animal husbandry interventions have significant potential to improve the nutritional status of women and children, as animal-source foods are concentrated dietary sources of macro and micronutrients such as iron and zinc, which promote growth, development and health of children and healthy pregnancy (Dror *et al.,* 2011). In addition, interventions that prevent outbreaks of livestock disease also increase pastoralist wealth (Scoones and Wolmer, 2006).

Animal-source foods are a rich source of iron, vitamin A, zinc, and iodine, source of energy and protein. Milk supplies children with multiple micronutrients important for growth and development. Dror *et al.* (2011) found that public education on the importance of milk as nutritious food and other food of animal source helps to improve anthropometric indices, reduces the prevalence of nutritional deficiencies and reduces morbidity and mortality.

2.6 Improvement on dietary intake among pastoralist children

Nguvava *et al.* (2009) and Imdad *et al.* (2011) found that provision of nutritional counseling to mothers helps to promote healthy feeding practices, while provision of complementary foods and supplementation with foods either fortified with multiple micronutrients or with increased energy content can improve nutritional status of the individuals.

Education about complementary feeding, provision of food and other strategies like education for mothers promotes nutritional status of infants. The impact of such interventions depends on factors such as the prevalence of under-nutrition, the degree of household food insecurity and the availability of micronutrient-rich local foods (Dewey *et al.*, 2008). Therefore, it is essential to evaluate which strategies for improving nutritional status of infants are most effective at preventing malnutrition and enhancing growth and development of infants and young children (Dewey *et al.*, 2008). Imdad *et al.* (2011) revealed that education about feeding practices to mothers and caregivers in their homes had a significant impact on improving child nutritional status.

Complementary feeding interventions are usually targeted at the age range of 6–24 months, which is a time of important growth, during which micronutrient deficiencies and

infectious illnesses limit child growth in developing countries. Caulfield *et al.* (1999) indicated that from six months a child should continue to be breastfed and in addition a child should be fed safe, nutritious and adequate amount of complimentary foods. It is more difficult to reverse the effects of under nutrition, and some of the functional deficits may be permanent above 2 years of age (Dewey *et al.*, 2008). Complementary feeding for infants refers to the timely introduction of safe and nutritional foods in addition to breast-feeding i.e. clean and nutritionally rich additional foods introduced at about six months of infant age (Imdad *et al.*, 2011).

According to the World Health Organization (WHO), the complementary feeding should be timely, meaning that all infants should start receiving foods in addition to breast milk from 6 months onwards; adequate, meaning that the nutritional value of complementary foods should fulfill the needs of the rapidly growing child; and appropriate. A previous review of complementary-feeding strategies concluded that appropriately designed interventions can have a positive effect on feeding practices (Bhutta *et al.*, 2008). Promotion of breastfeeding with or without provision of food supplements, micronutrient interventions to improve nutritional status and reduction of disease burden showed a large effect on family and community nutrition (Bhutta *et al.*, 2008).

CHAPTER THREE

3.0 Materials and Methods

3.1 Description of the Study Area

This study was conducted with pastoralist women and infants in Pawaga and Idodi divisions, which lie within the Ruaha ecosystem in Iringa Rural District, Iringa, Tanzania. Iringa Region is one of the 25 regions in Tanzania Mainland. The region lies between latitude 7° 05° 32° and 12° South, and longitudes 33° 47° 32° and 36° East with altitudes reaching 1581 meters above sea level. Iringa region is bordered by Dodoma and Singida regions in the north, Mbeya region to the west, Morogoro Region in the east and Njombe region in the south (Fig. 1). Iringa Region has four districts namely, Iringa Rural, Iringa Urban, Kilolo and Mufindi. Villages involved in the study were Idodi, Isele, Ilolompya, Itunundu, Magozi, Magombwe, Mafuluto, Malizanga and Mboliboli. Others are Makifu, Mapogoro, Mbuyuni, Mkombilenga, Nyamahana, Kimande, Kitisi, Kisanga, Kinyika, Mahuninga and Luganga. The natives of these areas are Maasai, Sukuma, Barbaig, Gogo and Hehe. Maasai, Sukuma and Barbaig are the major pastoralists in these divisions. This study involved pastoralist women 18 to 48 years old and children aged between 6 and 9 months.

Figure 1: A map of Iringa districts specifically indicating the study district, Iringa Rural (arrow) where Ruaha ecosystem is located. (Insert: A map of Tanzania which indicates the location of Iringa region.

Source (http://www.google.com)

3.2 Study Design and Sampling Methods

The study design was a cross-sectional study whereby simple random sampling was used to recruit households from 20 participating villages to participate in the baseline prevalence survey.

3.3 Village inclusion criteria

The inclusion criteria used in the selection of study villages included: the village lying within Pawaga or Idodi division, the village having at least ten pastoralist households, must have at least one pastoralist ethnic group (Maasai, Sukuma, Barbaig) and the village must have a dispensary or should be near a health center (within one kilometer distance).

3.4 Study Population

Ten randomly selected households from each village were considered in the study. The inclusion criteria for the women and children to participate in the study were: women had to be from a pastoralist household and to be between 18 to 48 years old, her ethnic group should either be a Maasai, Sukuma, or Barbaig. Children enrolled had to be between six and nine months of the pastoralist women aged 18 to 48 years.

3.5 Sample size

Study sample size was calculated from a formula given by Kothari (2004). For an unknown population, the formula $N = t2\ (pq)/d2$ was used to calculate the study sample size, where t=standard normal deviate set at 1.96 corresponding to the 95% confidence interval, p=proportion in the target population estimated to have similar characteristics, q=1-p (expected population not having particular characteristics/non-prevalence and d=degree of accuracy set at 0.05.

3.6 Data Collection Tools

The data collection tools employed in the study included structured questionnaires with open and close-ended questions (Appendix 1 to Appendix 6). The main information collected in the questionnaire included demographic characteristics of the respondents, such as age, ethnicity and sex of the children. Similar information were also collected from the participating women. Other information collected through the questionnaire were issues on food, food insecurity, frequency of feeding the children, and women's food intake. Other tools used in data collection included anthropometric measurements from the children and mothers. The tools used were measuring tapes for mid upper arm circumference (MUAC) and head circumference (HC), adult stadiometer, infant length board, electronic baby/child scale, adult scale and hemocue hemoglobinometer, lancets and hemoglobin microcuvettes.

3.7 Pre-testing of the Research Tools

Before commencing with data collection, pre-testing of questionnaires was done at three selected villages, which had the criteria as stated in 3.3.1 within the same geographic area and same socio-economic activities. Pretesting aimed to check for clarity and validity of questions, and to estimate the time required to interview one respondent. After testing the questionnaires, they were revised and arranged in a better order. The revised version of the questionnaires that was used in the study was translated into Swahili, the national language understood by the majority of Tanzanians. Three research assistants were trained to assist the researcher in conducting the interviews.

3.8 Data Collection Activities

The data collection work in each of the selected villages was done at the nearby dispensary or a health centre. Selected women in the study household were requested to

assemble at the health centres for interviews and collection of anthropometric measurements and haemoglobin. Before taking the women from their households the researcher explained the aim and activities of the study in presence of head of the household where under their consent they signed/finger printed the consent form to indicate they have agreed to participate in the study.

3.9 Data Collection Methods

A structured questionnaire was administered to participants through a face-to-face interview to obtain information on socio-demographic, socioeconomic, dietary intake, infant feeding frequency and food insecurity level. To collect information on dietary intake the study used a 24-hour dietary recall technique so as to get some information on energy, protein intake, and vitamin A and C consumption for both women and children (Fig. 2). Participants were asked to recall all the meals they took during the previous day. Similarly, the infant feeding and frequency information was collected by asking the mother to recall the types and frequency of foods she gave to her baby for the past 24 hours. Food security questionnaires asked respondents to recall if there were any episodes of food scarcity at the household in the past 30 days. Also they were asked to recall if any of the family members had failed to eat what she/he liked due to a food shortage.

Figure 2: Collection of information from mothers on infant feeding and frequency (A), and on dietary intake and food security level (B).

3.10 Health Status Indicators

3.10.1 Anthropometric and haemoglobin measurements

The health status of individuals was measured through anthropometric measurements: weight, height, MUAC, HC, length and Hb levels. Weight and height of participating women were taken in order to establish the body mass index (BMI). BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2) and the BMI results are interpreted as follows: underweight = <18.5, normal weight = 18.5–24.9, overweight = 25–29.9 and obese = BMI of 30 or greater (WHO, 2004).

An adult scale (SECA 276) was used to measure the weight of the participating women. Body weight was recorded in terms of kilograms (kg). Another measurement was the height of the women, which was measured using an adult stadiometer (SECA 217).

The participant was requested to take off shoes and stand fully erect on the stadiometer with the head held high and straight. The stadiometer board was then placed on top of the head where the researcher was able to read the measurement. Each measure was taken twice for accuracy. The height measurement was recorded in centimetres (cm).

3.10.2 Haemoglobin measurements in women

Haemoglobin measurement was done by a nurse or a medical laboratory technician from a health center or nearby dispensary. Hb measurement was done to check for anemia. The left hand was used for taking a drop of blood for Hb measurements. The participant was allowed to sit comfortably and the nurse explained to her the reason for taking blood for Hb measurement. The nurse massaged the finger gently and used an alcohol swab to clean it, and then dried any remaining alcohol with a cotton wool. A lancet was used to prick the finger, and the blood drop was drained into the HemoCue HB 201 Hemoglobin Microcuvettes. Hemoglobin Microcuvettes were inserted in hemocue hemoglobinometer for Hb reading. The reading was recorded in g/dL, which was compared with the cut-off points of WHO, which for non pregnant women is below 12 g/dl and for pregnant women is below 11 g/dl.

3.10.3 Anthropometric and haemoglobin measurements for children

Anthropometric measurements taken for children included weight, height, HC and MUAC, which were used to derive three health indicators: weight-for-age (underweight), weight-for-length (wasting), and height/length-for age (stunting). These are indicators of the child's nutritional status. The Hb measurement was done to assess the status of anaemia in children. The weight of children was measured using an infant scale (SECA 383). The measurements were recorded two times for accuracy; the weight was recorded in kilograms (kg). The height was measured using an infant length board

(SECA 417) because at an age of 6 to 9 months a child cannot stand on his/her own. The child was laid on the board, with the head placed on the top board while the feet were stretched and until they firmly reached the hind board. The measurement was taken twice and was recorded in centimetres (cm).

The head circumference (HC) was measured using a measuring tape. While the baby was held by her/his mother, the researcher placed the measuring tape around the child's head and read the value at the forehead of the child. The measurements were taken twice and also were recorded in terms of centimetres (cm). The MUAC was measured on the left arm using a measuring tape. The participating mother was allowed to sit and the baby was held on her lap. The left hand elbow was bent at a 90° angle and the midpoint of the arm, measured from the shoulder to the elbow. After locating the midpoint the left arm was extended to hang freely. The tape was wrapped gently but firmly around the arm at the midpoint. Then the reading was taken twice and the measurements were recorded in centimetres (cm). Hb measurement in children was done as described for mothers in 3.8.2 above. The reading was recorded in g/dL, which was compared with the cut-off points of WHO. Anemia is defined as less 12 g/dl of Hb. The mother held the baby during collection of blood for Hb measurements.

3.11 Ethical Consideration

Ethical clearance/permission number NIMR/HQ/R.8a/Vol.IX/1541 to conduct this study was obtained from the National Institute for Medical Research (NIMR) in the Ministry of Health and Social Welfare (Appendix 7). The consent forms explaining the purpose of the study, rights of the participant, contact numbers in case of any doubts or queries were translated to Swahili and were given to participant to read and understand, and for those who were unable to read the researcher read the form aloud to them. After agreement the

participant/parent of a child was allowed to sign either by writing or by fingerprint of the right-hand thumb. Participation in the study was voluntary. All the information collected from the participants and the laboratory results obtained after HB analysis were kept under the custody of the researcher as confidential and the study participants' identities were made anonymous.

3.12 Data Analysis

Data were collected and reviewed daily (to detect errors or missing data and correct any mistakes where applicable). Descriptive and inferential analysis was used to analyse quantitative data. Quantitative data from the questionnaire were collected, edited, summarised, and thereafter analysed by using the SAS/STAT statistical analysis version 9.1.3. Baseline variables on weight, height, length, MUAC, HC and Hb were compared among the ethnic groups for simple statistical description, interpretation, and also to determine the relationship between the variables. The data from the questionnaires were also supplemented by the information collected through direct observations (such as anthropometric measurements).

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic and Socio-economic Characteristics of the Respondents

Demographic characteristics of the respondents are shown in Table 1. A total of 200 women with children of 6-9 months of age and 30 children (6-9 months) were involved in the study. Women and children involved in the study were in three ethnic groups. Maasai women constituted the majority (55%); the other ethnic groups were Barbaig and Sukuma. More of the children (60%) involved in the study were boys (Table 1).

Table 1: Demographic information of women and children in Iringa rural district, Tanzania, 2013

Socio-information	Category	No. of respondents	Percentage
Women			
Ethnic group	Maasai	110	55.0
	Barbaig	32	16.0
	Sukuma	58	29.0
Age (years)	18 – 29	77	38.5
	30 – 39	33	16.5
	40 – 48	23	11.5
	Unknown age	67	33.5
Children			
Ethnic group	Maasai	13	43.3
	Barbaig	5	16.7
	Sukuma	12	40.0
Sex	Boys	18	60.0
	Girls	12	40.0
Age (months)	6	8	26.7
	7	7	23.3
	8	6	20.0
	9	9	30.0

4.2 Assessment of Food Insecurity and Primary Source of Food

Food insecurity was measured in reference to reported food shortages, number of meals per day, or food unavailability throughout the year. It was indicated that 75% of women experienced a food shortage, which means that they did not have enough food to serve the whole family in the past 30 days (Table 2).

Table 2: General responses to food shortage in Iringa rural district

Food scarcity category	Response	Percentage of respondents
Having food scarcity for the past 30 days	Yes	75
	No	25
Having limited foods for the past 30 days	Yes	60
	No	40
Having few meals per day for the past 30 days.	Yes	62
	No	38

Due to food shortages, majority (60%) of women consumed few meals and ate limited food (in terms of food groups and quantity) with members of their households in the past 30 days at the time of survey (Table 3). About (75.8%) of women sourced their food from food crops they cultivate, while 23.7% purchase their food.

Table 3: Responses to food shortage based on women ethnicity in Iringa rural district

Food shortage category	(%) of respondents		
	Maasai women	Barbaig women	Sukuma women
Food shortage (for the past 30 days)	15	63	22
Having few meals/ate limited food	16	58	26

Results on food unavailability show that food insecurity occurs from December to April, while the peak of food insecurity is in February (Fig. 3). Food scarcity was assessed in women across all ethnic groups and the differences were statistically not significant (P>0.05).

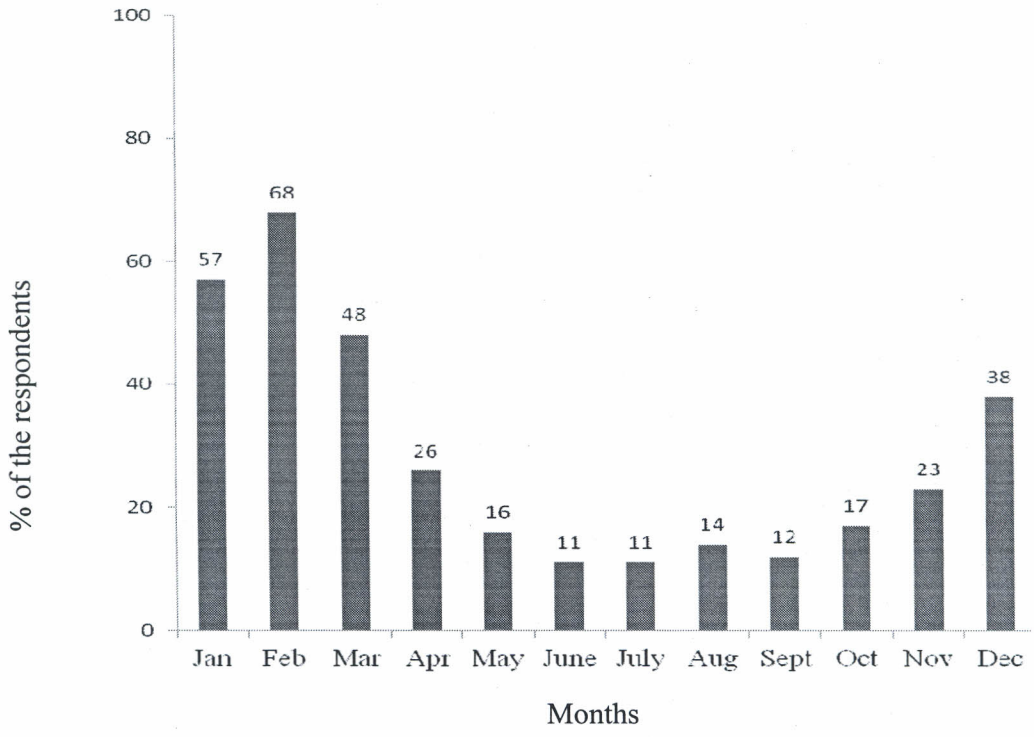


Figure 3: Months of the year pastoralist women experienced food shortage in Iringa rural district

4.3 Nutritional Status of Women and Children

4.3.1 Women dietary intake

Dietary intake of women was assessed based on composition of meals consumed (Table 4) in the study area. It was found from the study that the majority (75%) of women took two meals per day. Breakfast was mainly composed of milk or yoghurt with maize or sorghum-based stiff porridge or sweet potatoes while dinner was either maize-based stiff porridge or rice with milk or green vegetables. Meat was not frequently consumed.

On the other hand, consumption of fruits and vegetables depends on their availability. Energy foods consumption was high among women. Whereas all women consumed energy foods, only 25.2% of women consume protein foods, and 12.1% consume vitamin A foods. Additionally, 73.8% of women consume vitamin C foods, while 80% of women consume fats and oil, especially ghee.

Table 4: Food items (based in the study area) consumed by women and children

Food composition	Types of foods
Energy foods (starch)	Maize, sorghum, wheat, millet and rice.
Vitamin A	Pumpkins, squash, carrots, sweet potatoes.
Vitamin C	Dark green leafy vegetables, mangoes, papayas, passion fruits, oranges
Protein	Milk and any milk products, any meat (goat, lamb, pork, poultry or cow), eggs, dried fish or fresh fish.
Fats and oil	Sunflower oil, ghee, palm oil, butter, margarine, groundnuts oil

4.3.2 Infant Feeding Practices

All the children involved were still breastfeeding at the time of the survey. In addition, results show that all children were given solid, semi-solid or soft food for consumption (Table 5) though there was no consistent pattern related to the types of foods given to children among all three ethnic groups. Of all the children, 40% were given energy foods especially maize porridge. Other food provided to children included those rich in proteins (33.3%), vitamin A (23.3%) and vitamin C (23.3%). Despite the children involved in the study being in the age at which they were supposed to start being introduced to solid foods and having multiple feedings, the majority (36.7%) of children were fed once per day (Table 5).

Table 5: Infant feeding practices in Iringa rural district

Food category	Response	Number (%) of children
Semi-fluids food	Yes	20 (66.7)
	No	10 (33.3)
Milk in bottles	Yes	13 (43.3)
	No	17 (56.7)
Feeding frequency apart from breastfeeding	Once daily	11 (36.7)
	Twice daily	8 (27.0)
	Three times daily	7 (23.3)
	Four times daily	1 (3.3)
	Neither fed	3 (10.0)

4.4 Indicators of Health Status

4.4.1 Anthropometric measurements of women

Health statuses were represented by anthropometric measurements. For women, results are presented in Table 6. The weight and height of women were used to derive BMI, which was the index used to assess their health status. The average values for weight and height for all women were 55.9 ± 11.2 kg and 160.49 ± 6 cm respectively.

Table 6: Health indicators of the women and children in Iringa rural district

Participant category	Anthropometric parameter	Mean	Range	
			Minimum	Maximum
Women	MUAC (cm)	26.1 ± 3.98	19.7	45.4
	Weight (kg)	55.9 ± 11.2	37	109
	Height (cm)	160.6 ± 6	146	179.6
	BMI	21.5 ± 3.87	14.6	37.7
	Hb (g/dl)	11.5 ± 1.9	5	15.3
Children	MUAC (cm)	14.4 ± 1.2	12.1	16.2
	Weight (kg)	7.7 ± 1.01	6.1	9.9
	Length (cm)	67.4 ± 2.6	63.3	73.8
	HC (cm)	42.4 ± 6.6	41.3	47
	Hb (g/dl)	9.3 ± 1.8	6.4	12.7

It was found that 28% of the 200 women examined were underweight. Based on BMI classification, the prevalence of underweight was higher among Barbaig ethnic group (Table 7) while more Sukuma women were found to be overweight or obese compared to other ethnic groups. Weight and age variables for women were compared and results showed that there was a positive correlation between weight and age (r =0.05759) but the correlation was found to be not statistically significant (p= 0.5119).

Table 7: Body Mass Indices of women according to ethnic groups

BMI (kg/m²)	Number of women (%)	Ethnic groups and BMI		
		No. of Maasai women (%)	No. of Barbaig women (%)	No. of Sukuma women (%)
Underweight ≤ 18.5	56 (28.0)	34 (31.0)	14 (44.0)	8 (14.0)
Normal 18.5 – 24.9	95 (46.0)	57 (52.0)	18 (56.0)	17 (29.0)
Overweight 25-29.9	35 (18.0)	12 (11.0)	0 (0.0)	23 (40.0)
Obese 30<	17 (7.0)	4 (3.5)	0 (0.0)	10 (17.0)

4.4.2 Anthropometric measurements of children

Anthropometric characteristics of children are presented in Table 6 while the results for underweight, wasting and stunting are summarized in Table 8. It was found that Barbaig children were more wasted (40%) compared to children in the other ethnic groups. It was also found that the proportion of stunting in Sukuma children was 10%. Nevertheless, all the children had weights ranging between 6.1 to 9.9 kg, which is within the acceptable weight for children between 6 to 9 months of age. The prevalence of children wasting was higher in Pawaga division (40%) since the all of Barbaig children were from this division. Results also indicate a positive correlation between weight and age (r=0.31878) but the correlation was not found to be statistically significant (p=0.0860).

Table 8: Overview of wasting, stunting and underweight of children

Anthropometric measurements	No. of children	Mean	Range Min	Range Max
Weight for age				
Weight (kg)	30	7.70±1.01	6.05	9.9
Age (months)	30	7.53±1.2	6	9
*P = 0.31878				
P = 0.0860				
Height for age				
Height (cm)	30	67.43 ± 2.6	63.3	73.8
Age (months)	30	7.53 ± 1.19	6	9
*P = 0.31574				
P = 0.0892				
Weight for height				
Weight (kg)	30	7.70 ± 1.01	6.05	9.9
Height (cm)	30	67.43 ± 2.6	63.3	73.8
*P = 0.63996				
P = 0.0001*				

* Means significant (at 0.05 level of significance)
*P = Pearson correlation coefficient

4.4.3 Anaemia status of women and children

Anaemia was assessed by determining blood Hb level and was one of the health status indicators. Of the 200 women involved in the study only 168 (84%) women showed willingness to give blood samples for Hb measurements (Table 6), of which 42% were anaemic. The mean Hb of all participating women was 11.5 ± 1.9 g/dl. The mean Hb of Maasai women was higher (11.6 ± 1.7 g/dl, range = 7.3 – 15.3, n= 92) compared to the Sukuma women (11.4 ± 1.8 g/dl, range = 7.6 – 14.9, n= 48) and Barbaig women (11.1 ± 2.4 g/dl, range = 5.0 – 13.8, n= 28) but the difference was not statistically significant ($P > 0.05$). In children, blood samples for Hb measurements were taken from 16 children (males and females) and results indicate that the majority (87.5%) were anaemic (Table 6). The mean value of Hb for girls was 8.65 ± 1.8 g/dl (6.4 – 12.3 g/dl) while for boys mean value of Hb was 9.74 ± 1.8 g/dl (6.8-12.7 g/dl). Taking into consideration that the WHO cut-off point for Hb for anemia is less than or equal to 12 g/dl, the results indicate that the girls were more anaemic than boys.

CHAPTER FIVE

5.0 DISCUSSION

This study was aimed at assessing food insecurity, dietary intake, and nutritional status of pastoralist women and their infants in the changing climate of Iringa Rural District, Tanzania. It aimed to link the dietary intake and food unavailability within the pastoralist households as impacted by the effects of climate change. It was generally found that most women and children had food insecurity and poor nutritional status. This situation was associated with the prevailing poor climatic conditions dominated by drought caused by climatic changes.

5.1 Food Insecurity and Primary Sources of Food

Results on food insecurity indicate that most women had food shortages in their households and also consumed few meals per day, with the majority taking two meals per day. These results were similar to results obtained in the studies done by Temu (2009) and Nyaruhucha *et al.* (2006) that the majority of women had insufficient food and to some point they ate less than three meals per day. From the study it was found that majority of women were cultivating food crops for their own consumption which, under normal circumstances, would make an assurance of food availability at all times of the year. However, results indicated that food insecurity was a problem in many pastoralist households, especially between December to April and that it was critical in February. These results are in line with results obtained from the study by Temu (2009) in Iringa rural district in which the majority of the women experience food scarcity in February. There are several circumstances that could lead to food production insufficiency. According to Tanzania Meteorogical Agency (TMA), rainfall in Iringa occurs between December and April. Kangalawe *et al.* (2011) found that the crops growing seasom in

Iringa is between December and April, but that harvests are affected by low rainfall as an impact of climate changes in Ruaha ecosystem. Furthermore, Kangalawe *et al.* (2011) explain that due to climate change there is increased severity of common plant diseases, and changes in precipitation patterns, which cause shortage of irrigation water from Ruaha River. In addition to drought, low awareness and knowledge in agricultural practices (as they are pastoralists by origin) contribute to low crop harvest.

5.2 Nutritional Status of Women and Children

5.2.1 Women dietary intake

Protein food consumption was found to be low, with only about a quarter of pastoralist women (25%) consumed protein foods. A study done by Temu (2009) revealed that less than 10% of the women consumed protein foods. These findings oppose expectations about dietary composition. Since they are pastoralists, they would be expected to consume a lot of high-protein foods, especially meat, milk and eggs, but meat and milk consumption was found to be low. The reason for this was thought to that animals were grazed far away from their households because of shortage of pasture and water and access to milk was a problem. The existing drought condition was caused by climate changes accompanied with indiscriminate human activities, which destroy the environment including the water sources.

This study also found that the majority of women consumed fats and oil obtained from milk, and these results agree with the findings from the study done by Sadler *et al.* (2010) in Turkana Kenya, where 50% of women involved in that study consume fats and oil obtained from milk. This implies that pastoralist communities mainly obtain fats and oil of animal origin, which is mostly available and can be prepared and stored at the house level. Fats and oil are known to be the energy food in the body and therefore

complements the carbohydrate as energy food. According to FAO (2010), the recommended daily intake of nutrients should be at least in three groups per meal namely; starch, protein, vitamins, fats and oil. However, according to the findings of this study the majority of women were not aware of the recommended daily intake of nutrients as they ate what was available and not what was required for their health. But also due to gender inequities, food supply in the pastoralist community is skewed in favour of adult men who according to their tradition are regarded as a superior and most productive group (as per formative interviews' findings). The food taken by women may not be enough and this may be the cause of poor nutritional status, which has been reported elsewhere in the pastoralist communities (Nyaruhucha *et al.*, 2006).

5.2.2 Infant feeding practices

Feeding practices have both short and long-term impacts on nutritional status of children. This study revealed that all children were still breastfeeding at the time of survey but not all were introduced to complementary foods. It was found that 40% of children were given energy foods especially maize porridge. Also feeding frequency did not meet the minimum standard requirement; the majority were being fed once per day. The study done by Sellen (2000) in Kilimanjaro found similar results indicating that children were fed stiff maize porridge and that the consumption increased with age after 6 months. The reason why the majority of children's feeding frequency did not meet the standard is probably due to the fact that children were also included in family meals, suggesting that there was no special treatment for them. Furthermore, from formative interviews done in Pawaga division 22% of women interviewed stated they do not have the strong reasons why they choose to feed their babies the foods they give them after 6 months of age, 43% do not know what foods are the best for their babies, and 57% of women do not know what foods are the best for themselves. These findings call for provision of health and

nutritional education to the pastoralist women, which will provide them with appropriate knowledge on feeding practices. Feeding practices among the study sample do not meet the standards set by the Tanzania Demographic Health Survey (2010), which state that breastfed children are considered to be fed within the minimum standards if they consume at least three food groups and food other than breast milk at least twice per day in the case of infants of 6-9 months of age.

5.3 Health Status of Women and Children

5.3.1 Anthropometric measurements of women and children

Anthropometric measurements are used to assess health status of an individual. Measures like weight, height, length, HC and MUAC serve as good indicators of wellbeing (Caulfield, 2004). Anthropometric indicators may reflect past events and also indicate current nutritional status of an individual (Taleb *et al.*, 2011). In this study nutritional status of the children was assessed through three nutritional indicators: stunting, wasting and underweight and it was found that the prevalence of stunting, wasting and underweight was low. Similar findings have also been reported in Simanjiro where prevalence of underweight was low in children less than 1 year old (Nyaruhucha *et al.*, 2006). It may be that the prevalence of stunting, wasting and underweight is low in children less than 1 year old due to universal breast-feeding. There is possibility that the stunting, wasting and underweight will increase at the age of one year and above as most children stop breast feeding/inadequate breast feeding, improper weaning foods and disease infections.

For the women, body mass index was used to assess their nutritional status. Based on BMI classification, it was found that the prevalence of underweight was higher compared to prevalence of overweight. This may be caused by several reasons including

underfeeding, prolonged sickness and stress causing factors. Different results were obtained from the study done by Temu (2009), where prevalence of overweight was higher compared to underweight. The differences in BMI may be due to differences in ethnic groups and nutrition of participants. In the study by Temu (2009) the participants were crop farmers and may had more access to more food or different kinds of food that lead to their overweight.

In this study, prevalence of underweight was high in Barbaig women compared to other ethnic groups. These results could be due to mode of obtaining food being quite different from other ethnic groups since the Barbaig women purchased crops instead of growing them. This means there is a high possibility of underfeeding, as they depend on financial resources to determine availability of food in their households. Temu (2009) concludes that respondents who lived far from the village center and had limited access to high-energy foods and were likely to be underweight.

Some women from all three ethnic groups were overweight and obese but the majority (17%) were Sukuma. This could be due to their dietary intake. Their diets differ from the Maasai and Barbaig, and they consumed more meals per day. For instance, the Sukuma had a higher daily consumption of carbohydrate-rich foods like stiff porridge, rice and sweet potatoes, which may contribute to their higher prevalence of overweight and obesity. Temu (2009) found that there is a negative association between underweight and age and a positive association between overweight and age. That is, underweight prevalence decreases as age increases and the prevalence of overweight increases with age. In this study the majority of Sukuma women were between 30 to 44 years old, which could contribute to a higher prevalence of overweight and obesity than among Maasai or Barbaig women.

5.3.2 Anaemia status of women and children

For the case of Hb, the findings indicate that almost half (42%) of the women participating in the study were anaemic. Similar findings were obtained in the study by Kayunze and Mwageni (2013) in Rufiji whereby majority of women were anaemic. Also a recent a study by Lugodisha (2013) established about 38.4% of lactating and pregnant women in Mwanza were anaemic. According to TDHS (2010), anaemia is a common problem and estimated that more than one third of Tanzanians are anaemic. Anemia status depends partly on nutritional status of an individual. When an individual is underweight, they may be more susceptible to diseases such as malaria and worms, which likely affect the Hb level (Taleb *et al.*, 2011). Tatala *et al.* (2007) reported that low dietary iron intake may cause iron deficiency and anaemia in many parts of the developing world. The study by Tatala *et al.* (2007) further observed that in Tanzania there is a high amount of iron in cereals and vegetables consumed, however, this type of iron is usually of low bioavailability.

It was further found that the majority (87.5%) of the children were anaemic. Studies by Schellenberg *et al.* (2003) in Kilosa and Temu (2009) in Iringa Rural district also found similar results. It is has been reported by Massawe *et al.* (1999) that iron deficiency, malaria, hookworms, and other infections are major causes of anemia in many communities in Tanzania. Socioeconomic status may also affect the risk of anaemia by affecting nutritional status, family size, and birth interval, as well as intensifying problems of affordability and accessibility of preventive and curative measures (Schellenberg *et al.,* 2003). As has been observed in this study, the majority of the children were given energy foods especially maize porridge and there was no supplementation with nutritious food. It is likely that the anaemic status established in children was partially due to a diet dominated by foods deficient in iron. However,

malaria and hookworm infestations are endemic in Tanzania and are among the diseases known to cause anaemia, especially in children, which may have also caused the observed high prevalence of anaemia in children.

Furthermore, the results from this study indicate that most of anaemic children were girls. This could be due to pastoralist norms and customs that males are valued more than females. Pastoralist women may have provided more nutrition resources for infant boys than for infant girls. For instance, girls may not have been given food rich in iron. They may also have been more likely to have parasitic infections like malaria and worms. Above all, anaemia is asymptomatic so it's rarely identified as a serious illness.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Food insecurity within pastoralist households contributes to poor dietary intake, resulting in poor health and nutritional status of pastoralist women and children. The results of this study are novel and should serve as a challenge to the authorities/stakeholders concerned with providing education on appropriate nutritional guidelines to pastoralist communities that take into consideration the numerous challenges facing pastoralists. Importantly, pastoralists need both training on appropriate foods for household members, but it is also critical for education provided to these communities to address problems that communities face in accessing nutritious foods.

6.2 Recommendations

i. Food insecurity plays a big role in affecting nutritional status of pastoralist women and children. Food insecurity was due to effects of climatic changes along the river Ruaha which affects agricultural activities in villages situated along the river. Hence there are needs for education concerning water rationing in farmlands, and use of drought tolerant crops. In addition, impart some knowledge regarding climate change adaptation.

ii. Poor dietary intake among pastoralist women and children is due to food insecurity, lack of nutritional knowledge, and lack of access to nutritionally adequate food within the households. There is a need for education on appropriate feeding practices for both women and children and training on how to access nutritious foods.

iii. Anaemia and underweight is due to inadequate food availability and a lack of nutritional knowledge among the women. Hence there is a need for the government under the Ministry of Health and Ministry of Education to provide intensive nutritional education at health centres, hospitals, and dispensaries not only to the pregnant and breastfeeding women, but to the whole community. This education should also be provided to primary and secondary school children who will encourage their parents to provide appropriate nutrition for all the members of the household.

REFERENCES

Arimond, M. and Ruel, M. T. (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. *Journal of Nutrition* 134: 2579 – 2585.

Barret, C. B. and Luseno, W. K. (2004). Decomposing producer price risk: A policy analysis tool with an application to northern Kenyan livestock markets. *Food Policy* 29: 393 – 405.

Bhutta, Z. A., Ahmed, T., Black, S., Cousens, S., Dewey, K., Giugliani, E., Haider, B.A., Kirkwood, B., Morris, S. S., Sachdev, H. P. S. and Shekar, M. (2008). What works? Interventions for maternal and child undernutrition and survival. *Lancet* 371: 417 – 440.

Caulfield, L. E., Huffman, S. L. and Piwoz, E. G. (1999). Interventions to improve intake of complementary foods by infants 6 to 12 months of age in developing countries: Impact on growth and on the prevalence of malnutrition and potential contribution to child survival. *Food and Nutrition Bulletin* 20: 183 – 192.

Caulfield, L. E., Onis, M., Blossner, M. and Black, R. E. (2004). Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles. *American Journal of Children Nutrition* 80: 193 – 198.

Dewey, K. G. and Adu-Afarwuah, S. (2008). Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. *Program in International and Community Nutrition* 15: 231 – 237.

Dinar, A., Hassan, R., Mendelsohn, R. and Benhin, J. (Eds) (2008). Climate change and agriculture in Africa: *Impact Assessment and Adaptation Strategies* 34: 125 – 129.

Dror, D. K. and Lindsay, H. A. (2011). The importance of milk and other animal-source foods for children in low-income countries. *Food and Nutrition Bulletin* 32: 227 – 235.

Fentaw, R., Bogale, A. and Abebaw, D. (2013). Prevalence of children malnutrition in Agro-pastoral households in Afar Regional State of Ethiopia. *Journal of Children Nutrition* 7(2): 123 – 127.

Food and Agriculture Organization (2010). FAOSTAT: Food supply data globally. [http://faostat.fao.org/site/345/default.aspx] site visited on 20/11/2013.

Fratkin, E. M. (2001). East African pastoralism in transition: Maasai, Boran, and Rendille Cases. *African Studies Review* 44: 1 – 25.

Fratkin, E. M., Roth, E. A. and Nathan, M. A. (1999). When nomads settle: The effects of commoditization, nutritional change, and formal education on Ariaal and Rendille pastoralists. *Current Anthropology* 40: 729 – 735.

Galvin, K. A. (1992). Nutritional ecology of pastoralists in dry tropical Africa. *American Journal of Human Biology* 4: 209 – 221.

Galvin, K. A., Thornton, P. K., Boone, R. B. and Sunderland, J. (2004). Climate variability and impacts on East African livestock herders: The Maasai of Ngorongoro Conservation Area, Tanzania. *African Journal of Range and Forage Science* 21: 183 – 189.

Homewood, K. (1999). Development, demarcation, and ecological outcomes in Maasai land. *Journal of the International African Institute* 65: 331 – 350.

Imdad, A., Yakoob, Y. M. and Bhutta, Z. A. (2011). Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *Bio-Medical and Public Health* 11: 5 – 14.

Kangalawe, R., Mwakalika, S. and Masolwa, P. (2011). Climate change impacts, local knowledge and coping strategies in the Great Ruaha river catchment area, Tanzania. *Journal of Natural Resources* 2: 212 – 223.

Kayunze, K. A., and Mwageni, E.A. (2013). Illness and food security in Rufiji District, Tanzania. *Journal of Biology, Agriculture and Healthcare* 3(4): 54 – 58.

Konley, E. G., Willingham, A. L. and Randolph, T. (2011). Research approaches for improved pro-poor ccontrol of zoonoses. *Food and Nutrition Bulletin* 28: 345 – 356.

Kothari, C. R. (2004). *Research Methodology. Methods and Techniques*. (2nd Ed.), New Age international (P) Limited, New Delhi, India. 401pp.

Leroy, J. L. and Frongillo, E. (2007). Interventions to promote animal production ameliorate under nutrition. *Journal of Nutrition* 22: 2311 – 2314.

Lugodisha, G. (2013). Maternal nutrition in Ilemela District, Mwanza. Special Project for Award of Bachelor of Science Degree in Sokoine University of Agriculture, Morogoro, Tanzania, 36pp.

Massawe, S. N., Urassa, E. N., Mmari, M., Ronquist, G., Lindmark, G. and Nystrom, L. (1999). The complexity of pregnancy anemia in Dar es Salaam. *Gynecology and Obstetric Investigation* 47: 76 – 82.

Masset, E., Haddad, L., Cornelius, A. and Isaza-Castro, J. (2012). Effectiveness of agricultural interventions that aim to improve nutritional status of children: systematic review. *American Journal of Human Biology* 4: 258 – 265.

Mosha, T. C. E., Laswai, H. S. and Tetens, I. (2000). Nutritional composition and micronutrient status of homemade and commercial weaning foods consumed in Tanzania. Research Department of Human Nutrition. *Plant Foods for Human Nutrition* 55: 187 – 193.

Muthaya, J. (2009). Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Environmental Science and Policy Journal* 11(7): 642 – 654.

Nalitolela, S., Allport, R., Ndanu, H. and Shongon, L. (2001). Impact of animal health improvement on food Security of a pastoralist community in Simanjiro District. *Tanzania Veterinary Association Annual Scientific Proceedings of the 19th Conference,* Arusha Tanzania. pp. 22 – 26.

Nguvava, M., Clifford, D., Masozera, M., Copollilo, P., Sadiki, H., Erickson, J. and Mazet, J. (2009). *Capturing Women's Voices: Socioeconomics and Gender Roles in Pastoralist Households in the Ruaha Landscape, Tanzania.* Research Brief No. 3. Global Livestock Collaborative Research Support Program, University of California. 65pp.

Nyaruhucha, C. N. M., Mamiro, P. S., Kerengi, A. J. and Shayo, N. B. (2006). Nutritional status of underfive children in a pastoral community in Simanjiro District, Tanzania. *Tanzania Health Research Bulletin* 8: 32 – 36.

Paavola, J. (2008). Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Journal of Environmental Science and Policy* 11(7): 642 – 654.

Paul, K. H., Muti, M., Khalfan, S. S., Caffarella, R. H. and Stoltzfus, R. J. (2011). Beyond food insecurity: How context can improve complementary feeding interventions. *Food and Nutrition Bulletin* 32: 244 – 251.

Sadler, K., Kerven, C., Manske, M. and Catley, A. (2010). The fat and the lean: review of production and use of milk by pastoralists. *Pastoralism Journal* 2: 294 – 299.

Sahoo, S and Panda, B. (2006). A study of nutritional status of pregnant women of some villages in Balasore District, Orrissa. *Journal of human Ecology* 20(3): 228 – 231.

Schellenberg, D., Schellenberg, J. R., Mushi, A., de-Savigny, D. and Mgalula, L. (2003). The silent burden of anaemia in Tanzania children: a community-based study. *Bulletin of the World Health Organization* 81: 581 – 590.

Scoones, I. and Wolmer, W. (2006). Livestock, disease, trade and markets: Policy choices for the livestock sector in Africa. *Institute of Development Studies Working Paper* 269: 1 – 55.

Sellen, D. W. (2000). Seasonal ecology and nutritional status of women and children in a Tanzanian pastoral community. *American Journal of Human Biology* 12: 758 – 781.

SMART (2006). Measuring mortality, nutritional status and food security in crisis situations. Smart methodology. Standard monitoring assessment of relief and transitions. [http://www.smartindicators.org/SMART methodology08-07-2006.pdf] site visited 1/11/2013.

Smith, L. S., Alderman, H. and Aduayom, D. (2006). Food insecurity in sub-Saharan Africa *New Estimates from Household Expenditure Surveys* 146: 31 – 45.

Taleb, S., Kaibi, M. and Deghboudj, N. (2011). Assessment of nutritional status of pregnant women attending the city Tebessa. *National Journal of Physiology, Pharmacy and Pharmacology* 1: 97 – 105.

Tatala, S., Ndossi, G. and Mamiro, P. (2007). Effect of germination of finger millet on nutritional value of foods and effect of food supplement on nutrition and anaemia status in Tanzanian children. Tanzania Food and Nutrition Centre. *Tanzania Health Research Bulletin* 9: 77 – 80.

TDHS (2010). *Tanzania Demographic Health Survey*. National Bureau of Statistics, Dar es Salaam, Tanzania.163pp.

Temu, A. G. (2009). Needs and possibilities for improving maternal nutrition in rural Tanzania. Thesis for Award of PhD Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 159pp

World Health Organization (2010). *Child Growth Standards: Methods and Development.* World Health Organization, Washington DC. 122pp.

APPENDICES

Appendix 1: Enrollment sheet for women and children

1	Data collector identifier	
2	Village	
3	Household number	
4	Household ethnicity 1=Maasai, 2=Barabaig (Mang'ati), 3=Sukuma	|____| code
5	Assign head of household study number	|__|____|____|-1-1
6	Assign woman #1 study number	|__|____|____|-2-1
7	What is the woman's age?	|____|____| years
8	What is the woman's date of birth? (mm/yy)	|____|____|
9	If the woman has a child in the study, what is the child's study number?	|__|____|____|-|____|-|____|
10	Assign woman #2 study number	|__|____|____|-2-2
11	What is the woman's age?	|____|____| years
12	What is the woman's date of birth? (mm/yy)	|__|__|19|__|__|
13	If the woman has a child in the study, what is the child's study number?	|__|____|____|-|____|-|____|
14	Assign woman #3 study number	|___|___|____|-2-3
15	What is the woman's age?	|____|____| year
17	If the woman has a child in the study, what is the child's study number?	|__|____|____|-|____|-|____|
18	Assign child #1 study number	|____|____|___
19	Child's sex 1 = Male, 2 = Female	|____| code
20	Child date of birth (dd/mm/yy)	|__|_|__|__| 20|____|____|
21	Documentation provided for date of birth (birth certificate/health card)? 1 = Yes, 2 = No	|____| code
22	What was the child's documented (health card) birth weight?	|__|_|__|__| kg If unknown, write 99.99.
23	Assign child #2 study number	|____|____|_ _

24	Child's sex 1 = Male, 2 = Female	|____| code
25	Child date of birth (dd/mm/yy)	|____|____| / |____|____| / 20|____|____|
26	Documentation provided for date of birth (birth certificate/health card)? 1 = Yes, 2 = No	|____| code
27	What was the child's documented (health card) birth weight?	|____|____|.|___|____| kg
28	Assign child #3 study number	|____|____|____|-3-3
29	Child's sex 1 = Male, 2 = Female	|____| code
30	Child date of birth (dd/mm/yy)	|____|____| / |____|____| / 20|____|____|
31	Documentation provided for date of birth (birth certificate/health card)? 1 = Yes, 2 = No	|____| code
32	What was the child's documented (health card) birth weight?	|__|__|.|__|__| kg If unknown, write 99.99.

Appendix 2: Food security questionnaire for pastoralist women

Q	Information requested	Data
1.	Date of interview (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
2.	Woman's study number	|___|___|___|-|___|-|___|
3.	Head of household study number	|___|___|___|-|___|-|___|
4.	In the past month, did you worry that your household would not have enough food? 1 = Yes, 2 = No, 9 = Unknown *Household = People living together & dependent on the head of household and sharing resources*	|___| Code If 1, go to 5.2. If 2 or 9, go to 6.1.
5.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 =sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
6.	In the past month, were you or any household member not able to eat the kinds of food you preferred because of a lack of resources? 1 = Yes, 2 =No, 9 = Unknown *Examples of preferred foods: rice, chapatti, beans, maize, meat, milk, eggs, fruits, etc.*	|___| Code If 1, go to 6.2.If 2 or 9, go to 7.1.
7.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 =Unknown	|___| Code
8.	In the past month, did you or any household member have to eat a limited variety of foods due to a lack of resources? 1 = Yes, 2 = No, 9 = Unknown *Examples: ugali with kale instead of ugali with meat; monotonously eating ugali without changing with foods such as chapatti, rice, etc. for a long time*	|___| Code If 1, go to 7.2. If 2 or 9, go to 8.1.
9.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
10.	In the past month, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? 1 = Yes, 2 = No, 9 = Unknown *For example: eating foods such as rice porridge, thin (liquid) porridge, thin (liquid) ugali, ugali with salt only, unripe unusual fruit, wild roots, etc.*	|___| Code If 1, go to 8.2. If 2 or 9, go to 9.1.

11.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
12.	In the past month, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? 1 =Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 9.2. If 2 or 9, go to 10.1.
13.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 =sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
14.	In the past month, did you or any other household member have to eat fewer meals in a day because there was not enough food? 1 = Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 10.2. If 2 or 9, go to 11.1.
15.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
16.	In the past month, was there ever no food to eat of any kind in your household because of lack of resources to get food? 1 = Yes, 2 = No, 9 = Unknown *Note: milk is included as a food.*	|___| Code If 1, go to 11.2. If 2 or 9, go to 12.1.
17.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 =Unknown	|___| Code
18.	In the past month, did you or any household member go to sleep at night hungry because there was not enough food? 1 = Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 12.2. If 2 or 9, go to 13.1.
19.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 = sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
20.	In the past month, did you or any household member go a whole day and night without eating anything because there was not enough food? 1 = Yes,2 = No, 9 = Unknown	|___|Code If 1, go to 13.2. If 2 or 9, go to 14.1.
21.	How often did this happen? 1 = rarely (1 or 2 times/month), 2 =sometimes (3-10 times/ month), 3 = often (>10 times per month) , 9 = Unknown	|___| Code
22.	Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs? 1 = Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 14.2. If 2 or 9, stop.
23.	Which were the months in the past 12 months	January |___| Code

	during which you did not have enough food to meet your family's needs? 1 = Did not have enough food, 2 = Had enough food, 9 = Unknown *This includes any kind of food from any source, such as own production, purchase or exchange, food aid, or borrowing.* *Note to interviewer:* Do not read the list of months aloud. Place a "1" in the box if the respondent identifies that month as one in which the household did not have enough food to meet their needs. Probe to make sure the respondent has thought about the entire past 12 months. Use a seasonal calendar if needed to help the respondent remember the different months. If the respondent does not identify that month, place a "2" in the box. If the respondent is not sure, place a "9" in the box.	February |___| Code March |___| Code April |___| Code May |___| Code June |___| Code July |___| Code August |___| Code September |___| Code October |___| Code November |___| Code December |___|Code

Appendix 3: Women food intake questionnaire

Q	Information requested	Data
1.1	Date of interview (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
4	Woman's study number	|___|___|___|-|___|-|___|

Ask the woman: Please describe everything that you ate yesterday during the day or night.

a) Think about when you first woke up yesterday. Did you eat anything at that time? *If yes*: Please tell me everything you ate at that time. *Probe:* "Anything else?" until respondent says "nothing else." *If no, continue to question b).*

b) What did you do after that? Did you eat anything at that time? *If yes:* Please tell me everything you ate at that time. *Probe:* "Anything else?" until respondent says "nothing else." *Repeat question b) until respondent says she went to sleep for the night (until the morning of today).*

If the respondent mentions mixed dishes like a porridge, sauce or stew, *probe:*

c) What ingredients were in that (mixed dish)? *Probe:* "Anything else?" until respondent says "nothing else."

As the respondent recalls foods, underline the corresponding food and mark '1' in the column next to the food group. If foods are used in small amounts for seasoning or as a condiment, include them under the condiments food group.

Once the respondent finishes recalling the foods that the she has eaten, read each food group where '1' was not marked and ask the following question: "Yesterday during the day or night, did you eat/drink any (food group items)? Mark '1' if respondent says yes, '2' if no and '9' if the respondent does not know if the food was eaten.

Morning:

Between meals:

Mid-day:

Between meals:

Evening:

Between meals:

5	Ugali (maize), maize, ugali (sorghum), ugali (millet), wheat chapatti, bread, rice, vitumbua (rice buns), noodles, or other foods made from grains 1 = Yes, 2 = No, 9= Unknown	|___| Code
6	Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside 1 = Yes,2 = No, 9 = Unknown	|___| Code
7	White potatoes/chips, white yams/sweet potato, manioc, cassava, plantains/green banana, nduma (arrowroot) or any other foods made from roots 1 = Yes, 2 = No, 9= Unknown	|___| Code
8	Any dark green leafy vegetables (cowpea leaves, pumpkin leaves, kale, spinach, cassava leaves, sweet potato leaves) 1 = Yes, 2 = No, 9 = Unknown	|___| Code
9	Ripe mangoes, ripe papayas, or passion fruit 1 = Yes, 2 = No, 9 =	|___| Code

	Unknown	
10	Any other fruits or vegetables 1 = Yes, 2 = No, 9 = Unknown	|___| Code
11	Liver, kidney, heart or other organ meats 1 = Yes, 2 = No, 9 = Unknown	|___| Code
12	Any meat, such as beef, goat, chicken, pork, lamb, mutton, or duck 1 = Yes, 2 = No, 9 = Unknown	|___| Code
13	Eggs from any type of bird 1 = Yes, 2 = No, 9 = Unknown	|___| Code
14	Fresh or dried fish, shellfish, or seafood 1 = Yes, 2 = No, 9 = Unknown	|___| Code
15	Any foods made from beans, peas (cowpeas), lentils, nuts (peanuts/ground nuts, peanut butter) or seeds (pumpkin seeds, sunflower seeds) 1 = Yes, 2 = No, 9 =Unknown	|___| Code
16	Cheese, yogurt or other milk products 1 = Yes, 2 = No, 9 = Unknown	|___| Code
17	Animal milk (tinned, powdered, or fresh) 1 = Yes, 2 = No, 9 = Unknown	|___| Code
18	Any oil (sunflower oil, groundnut oil, palm oil, cotton oil), fats, cream, or butter/margarine, or foods made with any of these 1 = Yes, 2 = No, 9 = Unknown	|___| Code
19	Any sugary foods such as sweets, candies, biscuits or soda 1 = Yes, 2 = No, 9 =Unknown	|___| Code
20	Condiments for flavor, such as chilies, spices, herbs or fish powder 1 = Yes, 2 =No, 9 = Unknown	|___| Code
21	Grubs, snails or insects 1 = Yes, 2 = No, 9 = Unknown	|___| Code
22	Ask the woman: Was yesterday a celebration or feast day where you ate special foods or where you ate more, or less than usual? 1 = Yes, 2 = No, 9 = Unknown	|___| Code
23	Ask the woman: What is the primary source of obtaining food for your household? 1 = own production, gathering, hunting, fishing, 2 = purchased, 3 = borrowed, bartered, exchanged for labor, gift from friends or relatives, 4 = food aid, 5 = other _____9 = Unknown	|___| Code

Items eaten by the woman in the last month

Ask the woman: Now I would like to ask you some questions about foods you ate in the last seven days. For each food group I ask about, please tell me which days you *ate* foods from that group in the last week. (*Note:* it does not count if the woman made a sauce with meat, but did not actually eat the meat herself). Mark each day the respondent mentions. Code the number of days (0-7) OR 8 if the food was eaten, but the participant is not sure how many days OR 9 if the participant does not know if the food was eaten.

	Food group	Days that the participant ate the food in the last week							Frequency
		Mon	Tues	Wed	Thurs	Fri	Sat	Sun	

24	Any meat, such as beef, goat, chicken, mutton (pork or duck)								|___| Code
25	Liver, kidney, heart, other organ meats								|___| Code
26	Eggs from any type of bird								|___| Code
27	Fresh or dried fish, shellfish, or seafood								|___| Code
28	Cheese, yogurt or other milk products								|___| Code
29	Animal milk (tinned, powdered or fresh)								|___| Code
Open ended question (write down everything the woman says) What influences the amount of animal source foods (meat, eggs, fish, dairy products) that you can eat?									

Appendix 4: Women anthropometry sheet

Q	Information requested	Data
1	Date of measurements (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
Q	Woman's measurements	Data
2	Woman's study number	|___|___|___|-|___|-|___|
3	Woman's clothing when weighed 1 = light clothing, 2 = light clothing and sweater, 3 = heavy clothing	|___| Code
4	Is the woman pregnant? 1 = Yes, 2 = No, 9 = Unknown	|___| Code
5	Woman's mid-upper arm circumference (MUAC), #1	|___|___| . |___| cm
6	Woman's MUAC, #2	|___|___| . |___| cm
7	Woman's MUAC, #3 If values for MUAC 1 and 2 differ by >0.5 cm	|___|___| . |___| cm
8	Woman's weight, #1	|___|___|___| . |___|___| kg
9	Woman's weight, #2	|___|___|___| . |___|___| kg
10	Woman's weight, #3 If values for weight 1 and 2 differ by >0.1 kg	|___|___|___| . |___|___| kg
11	Woman's height, #1	|___|___|___| . |___| cm
12	Woman's height, #2	|___|___|___| . |___| cm
13	Woman's height, #3 If values for height 1 and 2 differ by >0.5 cm	|___|___|___| . |___| cm
14	Is the woman underweight (BMI <18.5 kg/m2)? 1 = Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 9.2. If 2, go to 10.
15	Did the woman receive treatment for underweight (explain in comments) at a health clinic after referral from study personnel? 1 = Yes, 2 = No, 9 =Unknown	|___| Code

Appendix 5: Infant feeding questionnaire administered to their mothers

Q	Information requested	Data
1	Date of interview (dd/mm/yy)	|__|__| / |__|__| / 20|__|__|
2	Child's study number	|___|___|___|-|___|-|___|
3	Did you ever breastfeed (child)? 1 = Yes, 2 = No	|__| Code If 1 continue. If 2, go to 8.1.
4	How long after birth did you first put (child) to the breast? *If respondent says she put the infant to the breast immediately after birth, circle '000' (Immediately).* *If less than 1 hour, circle '1' for hours AND RECORD '00' hours.* *If less than 24 hours, circle '1' and record number of completed hours, from 01 to 23.* *Otherwise, circle '2' and record number of completed days from 01 to...*	Immediately....*000* Hours....1 |__|__| Days....2 |__|__|
5	Was (child) breastfed yesterday during the day or night? 1 = Yes, 2 = No, 9 = Unknown	|__| Code
6	Sometimes babies are fed breast milk in different ways, for example by s This can happen when the mother cannot always be with her ba recommended by the doctor. Sometimes babies are breastfed by anothe breast milk from another woman by spoon, cup or bottle or some o happen if a mother cannot breastfeed her own baby. Did (child) consume breast milk in any of these ways yesterday during th = Yes, 2 = No, 9 = Unknown	|__| Code
6	Sometimes babies are fed breast milk in different ways, for example by s This can happen when the mother cannot always be with her ba recommended by the doctor. Sometimes babies are breastfed by anothe breast milk from another woman by spoon, cup or bottle or some o happen if a mother cannot breastfeed her own baby. Did (child) consume breast milk in any of these ways yesterday during th = Yes, 2 = No, 9 = Unknown	|__| Code
7	Did (child) have any milk (tinned, powdered, fresh animal milk) yesterday during the day or night? 1 = Yes, 2 = No, 9 = Unknown	|__| Code
8	How many times yesterday during the day or night did (child) consume any milk (tinned, powdered, fresh animal milk)?	|__|__| times
9	Did (child) have any yogurt yesterday during the day or night? 1 = Yes, 2 = No, 9 = Unknown	|__| Code
10	How many times yesterday during the day or night did (child) consume any yogurt?	|__|__| times
11	Did (child) have any tea with animal milk yesterday during the day or night?	|__| Code
12	How many times yesterday during the day or night did (child) consume any tea with animal milk?	|__|__| times
13	Did (child) drink anything from a bottle with a nipple yesterday during the day or night? 1 = Yes, 2 = No, 9 = Unknown	|__| Code

14	Did (child) eat any solid, semi-solid, or soft foods yesterday during the day or night? 1 = Yes, 2 = No, 9 = Unknown	|___| Code

Ask the mother: Please describe everything that (child) ate yesterday during the day or night, whether at home or outside the home.

a) Think about when (child) first woke up yesterday. Did (child) eat anything at that time? *If yes*: Please tell me everything (child) ate at that time. *Probe:* "Anything else?" until respondent says "nothing else." *If no, continue to question b).*

b) What did (child) do after that? Did (child) eat anything at that time? *If yes:* Please tell me everything (child) ate at that time. *Probe:* "Anything else?" until respondent says "nothing else." *Repeat question b) until respondent says the child went to sleep for the night (until the morning of today).*

If the respondent mentions mixed dishes like a porridge, sauce or stew, *probe:*

c) What ingredients were in that *(mixed dish)*? *Probe:* "Anything else?" until respondent says "nothing else."

As the respondent recalls foods, underline the corresponding food and mark '1' in the column next to the food group. If foods are used in small amounts for seasoning or as a condiment, include them under the condiments food group.

Once the respondent finishes recalling the foods that the child has eaten, tell the mother, "we don't expect that your baby will eat all of these foods in one day, but we want to ask you just to make sure that we didn't miss anything.' Then read each food group where '1' was not marked and ask the following question: "Yesterday during the day or night, did (child) drink/eat any (food group items)? Mark '1' if respondent says yes, '2' if no and '9' if unknown.

15	Ugali (maize), maize, ugali (sorghum), ugali (millet), wheat chapatti, bread, rice, vitumbua (rice buns), noodles, or other foods made from grains 1 = Yes, 2 = No, 9= Unknown	|___| Code
16	Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside 1 =Yes, 2 = No, 9 = Unknown	|___| Code
17	White potatoes/chips, white yams/sweet potato, manioc, cassava, plantains/green banana, nduma (arrowroot) or any other foods made from roots 1 = Yes, 2 = No, 9= Unknown	|___| Code
18	Any dark green leafy vegetables (cowpea leaves, pumpkin leaves, kale, spinach, cassava leaves, sweet potato leaves, amaranth leaves) 1 = Yes, 2 = No, 9 =Unknown	|___| Code
19	Ripe mangoes, ripe papayas, or passion fruit 1 = Yes, 2 = No, 9 = Unknown	|___| Code
20	Any other fruits or vegetables 1 = Yes, 2 = No, 9 = Unknown	|___| Code
21	Liver, kidney, heart or other organ meats 1 = Yes, 2 = No, 9 = Unknown	|___| Code
22	Any meat, such as beef, goat, chicken, mutton (pork or duck) 1 = Yes, 2 = No, 9 =Unknown	|___| Code
23	Eggs from any type of bird 1 = Yes, 2 = No, 9 = Unknown	|___| Code
24	Fresh or dried fish, shellfish, or seafood 1 = Yes, 2 = No, 9 = Unknown	|___| Code
25	Any foods made from beans, peas (cowpeas), lentils, nuts (peanuts/ground nuts, peanut butter) or seeds (pumpkin seeds, sunflower seeds) 1 = Yes, 2 = No, 9 =Unknown	|___| Code
26	Cheese, yogurt or other milk products 1 = Yes, 2 = No, 9 = Unknown	|___| Code
27	Any oil (sunflower oil, groundnut oil, palm oil, cotton oil), fats, cream, or butter/margarine, or foods made with any of these 1 = Yes, 2 = No, 9	|___| Code

	= Unknown	
28	Any sugary foods such as sweets, candies, biscuits, or soda 1 = Yes, 2 = No, 9 =Unknown	|___| Code
29	Condiments for flavor, such as chilies, spices, herbs or fish powder 1 = Yes, 2 =No, 9 = Unknown	|___| Code
30	Grubs, snails or insects 1 = Yes, 2 = No, 9 = Unknown	|___| Code
31	How many times yesterday during the day or night did (child) consume any solid, semi-solid or soft foods?	|___|___| times

	Food group	Days that the child ate the food in the last week							Frequency
		Mon	Tues	Wed	Thur	Fri	Sat	Sun	
32	Any meat, such as beef, goat, chicken, mutton (pork or duck)								|___| Code
33	Liver, kidney, heart, other organ meats								|___| Code
34	Eggs from any type of bird								|___| Code
35	Fresh or dried fish, shellfish, or seafood								|___| Code
36	Cheese, yogurt or other milk products								|___| Code
37	Animal milk (tinned, powdered or fresh)								|___| Code

Appendix 6: Infant anthropometry sheet

Q	Information requested	Data
1	Date of measurements (dd/mm/yy)	|___|___| / |___|___| / 20|___|___|
Q	Child measurements	Data
2	Child's study number	|___|___|___|-|___|-|___|
3	Child mid-upper arm circumference (MUAC), #1	|___|___| . |___| cm
4	Child MUAC, #2	|___|___| . |___| cm
5	Child MUAC, #3 If values for MUAC 1 and 2 differ by >0.5 cm	|___|___| . |___| cm
6	Child head circumference (HC), #1	|___|___| . |___| cm
7	Child HC, #2	|___|___| . |___| cm
8	Child HC, #3 If values for HC 1 and 2 differ by >0.5 cm	|___|___| . |___| cm
9	Child weight, #1	|___|___| . |___|___| kg
10	Child weight, #2	|___|___| . |___|___| kg
11	Child weight, #3 If values for weight 1 and 2 differ by >0.1 kg	|___|___| . |___|___| kg
12	Child length, #1	|___|___|___| . |___| cm
13	Child length, #2	|___|___|___| . |___| cm
14	Child length, #3 If values for length 1 and 2 differ by >0.5 cm	|___|___|___| . |___| cm
	Is the child malnourished (orange zone on the health card [weight for age] or MUAC < 11 cm)? 1 = Yes, 2 = No, 9 = Unknown	|___| Code If 1, go to 9.2. If 2, stop.
	Did the child receive treatment for malnutrition (explain in comments) at a health clinic after referral from study personnel? 1 = Yes, 2 = No, 9 = Unknown	|___| Code

Appendix 7: Ethical Clearance

THE UNITED REPUBLIC OF
TANZANIA

National Institute for Medical Research
P.O. Box 9653
Dar es Salaam
Tel: 255 22 2121400/390
Fax: 255 22 2121380/2121360
E-mail: headquarters@nimr.or.tz
NIMR/HQ/R.8a/Vol. IX/1541

Ministry of Health and Social Welfare
P.O. Box 9083
Dar es Salaam
Tel: 255 22 2120262-7
Fax: 255 22 2110986

03rd June, 2013

Prof. Rudovick Kazwala
Sokoine University of Agriculture
Department of Veterinary Medicine and Public Health
P.O Box 3021 MOROGORO

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Strengthening Tanzania Livestock Health and Pastoral Livelihood in a Changing Climate in Iringa, Tanzania. (Kazwala R. *et al*), has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979 PART III Section 10(2).
5. Sites: Idodi and Pawaga Divisions, Iringa

Approval is for one year: 03rd June, 2013 to 02nd June, 2014.

Name: Dr Mwelecele N Malecela

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Dr Donan Mmbando

Signature
ACTING CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL WELFARE

CC: RMO
DMO