FACTORS INFLUENCING FOOD SECURITY, ADEQUATE CARE AND ENVIRONMENTAL QUALITY IN THE CONTEXT OF CLIMATE CHANGE IN RUDEWA-MBUYUNI, KILOSA DISTRICT

BY

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ABSTRACT

Under-nutrition is a multifaceted problem and of recent, climate change-related factors are suspected as additional frustration to intervention efforts. A cross sectional study was conducted to determine factors influencing food security, care and environmental quality in a changing weather pattern. Face-to-face household interviews using structured questionnaire and FGD using check lists was conducted. Nutrition status was assessed using anthropometric measurements. A sample comprising 256 households was obtained through multistage random sampling. The prevalence of stunting, underweight and wasting for children below the age of five years were 39, 15 and 1.7% respectively. The prevalence of under-nutrition in women (low BMI) was 5.8% and that of obesity was 7.1%. Factors influencing nutrition security included food consumption level, availability of food in the household, quality of care and sanitation. Food consumption diversity and annual household income variables explained 21% of the observed variation in women BMI. About 32% of observed variation in children's weight-for-age z-score was explained by income, feeding practices and sanitation. Income was significantly correlated with meal diversity score (r=0.2, p<0.001). Care was characterized by improper infant feeding, insufficient time the mother had for providing quality care due to burden of workload and insufficient support availed by spouses and other household members. Only 12% of children below five years of age were fed more than three meals a day, 32.8% got parents attentive care and 49.7% of men do not provide support to wives during pregnancy. Prevalence of exclusive breastfeeding for first 6 months was 16% and nutritional quality of complementary foods was low. A high proportion (63.5%) of mothers observed that breast milk was no longer sufficient for a child above three months. Living environment was unhealthy for most (66%) households; 11% of the households had no toilets; 75% of households do not treat drinking water for safety. Insufficient rainfall was a farming risk for 31.3% of farmers and dry spell was experienced by 32.5%

of farmers. Insufficient maternal and child care emanating from competing demand on household members' time coupled with income poverty and low diet diversification were concluded as main factors contributing to under-nutrition. Recently, climate change-related weather pattern has been experienced with negative impact on food productivity, climate change factors of importance according to this data set were delayed onset of rainfall, early ending of rainfall and unexpected dry spells during the rain season. Male involvement in reproductive health education is recommended for improving care and multi-sector collaboration with policy backing to address wide spectrum of malnutrition contributive factors including climate change factors.

DECLARATION

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

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DEDICATION

To my wife (Zion) and children (Timothy, Dorcus, Glory and Debora). They always trusted and encouraged me, showed high level of patience and understanding of circumstances that surrounded my work. I thank Almighty God for his grace and for bestowing me with necessary energy for doing this work.

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CHAPTER ONE

1.0   INTRODUCTION

1.1   Background

Food and nutrition insecurity contribute in health deterioration and hence reduce overall well-being of humans. This fact is not only widely documented but also increasingly getting more attention as a development agenda. However, formulation of health and nutrition intervention strategies needs to be refined for effectiveness. One of the gaps has been failure to take into consideration wide spectrum of determinant factors.

Overview of under-nutrition problem globally and in Tanzania

Under-nutrition means insufficient food intake and/or repeated infections for the subject or population. Under-nutrition has continued to be a significant public health and development concern around the world. It is one of the world`s most serious but least addressed socioeconomic and health problem (Horton *et al.,* 2009; FAO, 2010) to a large extent because of weaknesses in intervention strategies. The human and socioeconomic cost of under-nutrition is enormous given the situation and it falls hardest on the poorest, especially on women and children (SCN, 2010). According to the conceptual framework of analyzing malnutrition in humans, it is directly caused by inadequate dietary intake and or infectious diseases and indirectly by food insecurity, inadequate maternal and child care, poor access to health services and an unhealthy environment (UNICEF, 2013).

Under-nutrition as an outcome of many factors

Despite the understanding of causes of under-nutrition, they do vary from one community to the other due to cultural and environment related differences hence necessitating establishment of specific and clear linkages of factors in a specified

community. This is important for informing effective intervention strategies formulation. In each intervention situation, the strategies need to be specifically addressing the factors most relevant in a particular area. Locally, specific intervention strategies imply among others, identification of specific reasons behind observed under-nutrition. For instance it is important to elucidate the realities of village situation surrounding overworked mothers, who are struggling to earn a living, care for their children in an infectious disease risk environments, at the same time wondering about household food availability.

Ecological factors are among factors overlooked compared to food factor. Food security is obviously an important factor but not the only one. Available evidences indicate that neither economic growth nor improvements in household food security is able to directly improve nutrition status, especially of women and children (Hackett *et al.,* 2009; de Pee *et al.*, 2009; Kadiyala *et al.,* 2014;) though it is known that poor nutrition due to chronic energy deficiency and low quality of habitual diets occur in poor households (FAO, 2010; FAO, 2012; Herforth *et al.,* 2012). This is because of strong influence of other factors which are not necessarily directly connected to food (Darnton-Hill and Cogill, 2010). Reduction in dietary quality and an increase in micronutrient deficiencies and concomitant increases in infectious disease morbidity are some of them. On the other hand, new challenges have increasingly undermined efforts to address under-nutrition. These new challenges include energy crisis and climate variability and change.

Food and economic crises and economic downturn have also magnified the challenge (Horton *et al.*, 2009; Herforth *et al.,* 2012). Climate change challenge could be most relevant as far as under-nutrition is concerned because there is limited information

pertaining to its impacts on nutrition and respective adaptation measure needed (IPCC, 2012). Bloem *et al.* (2010) documented effects climate change will have on food and nutrition security and viewed food insecurity and morbidity as major pathways basing their argument on worsened environmental quality. However, it is not clear the extent to which communities are aware about existence of climate change, its causes and its likely consequences.

Overview of climate change and its effects on food and nutrition security

The intergovernmental panel on climate change (IPCC) regularly predicts the likely evolutions of climate. According to the fourth assessment report of the international panel on climate change (IPCC) and a special report of group I & II, climate change and variability is expected to have significant impact on food security and malnutrition (IPCC, 2012). It has been predicted that climate change will lead to more intense and longer droughts than have been observed over wide areas since the 1970s, particularly in the tropics (Roudier *et al.*, 2011; IPCC, 2012). The question of available options at community level for reducing changes or coping with them is pertinent.

1.2   Context of the Research

Empirical data showing the linkages of nutrition to a number of ecosystem factors are needed for informing intervention strategies formulation in a specific situation. The current study presents specific linkages of multiple factors influencing nutrition status in a specific rural environment in the context of varying weather pattern. Specifically the study focused on determination of factors influencing food and nutrition security and their interrelationships.

1.3 Research Problem Statement and Justification

Nutrition is a fundamental determinant of human health and under-nutrition is known as a multifaceted problem (UNICEF, 2013). Despite intense efforts to reduce under-nutrition, too little progress has been made (UNICEF, 2013) and the looming impact of climate change on food production and human livelihoods adds further challenges to these efforts (SCN, 2010; Roudier *et al.*, 2011; IPCC, 2012).

The production, consumption and biological utilization of food are linked by complex chain of events that can be interrupted at many points. Consequently, nutrition interventions that ignore the larger context in which they are delivered are much less likely to succeed. Unfortunately, nutrition interventions taking into account holistic and trans-disciplinary approaches are few (World Bank, 2013). Therefore this has been one of the weaknesses in intervening. In most cases, distal factors influencing nutrition status of household members are overlooked (Ruel and Alderman, 2013) when formulating nutrition interventions. Moreover, there is insufficient information relating to linkages of factors influencing nutrition status in specific localities and contexts (Schonberg, 2010). The available information does not show multi-factorial nature of the problem and relates more to national and global perspectives with too little evidence of farmers' perception on climate change existence and consequences and demonstration of its management (FAO, 2008; Mboera *et al.*, 2011). Extent to which communities are aware about existence of climate change, its causes and likely consequences are not known with certainty. More evidence is required for informing decision making and policy formulations/reviews especially with regard to long term weather variation influences on households' food availability and adaptation.

The multifaceted nature of under-nutrition call for quantification of factors contribution and meaning of each factor influence need to be qualified as meanings are context specific i.e vary with context. Therefore the current study quantifies contributions of multiple determinant factors of nutrition status of household members in a specific culture in a rural environment and a changing weather pattern context.

Factors missing most in the previous studies received special attention in this study by covering them thoroughly. These factors are environmental quality and care. In this study specified aspects of environmental quality were the focus, namely environmental sanitation and quality of vegetative cover. Care here refers to adequacy of maternal and child care.

1.4   Objectives of the Research

1.4.1 General objective

The general objective was to examine factors influencing food and nutrition security, adequate care and environmental quality in Kilosa district.

1.4.2 Specific objectives

The specific objectives were:

i)   To assess community perceptions on climate change and their consequences

ii)   To assess climate variability in Kilosa and its influence on food availability

iii)   To examine determinants of household food availability

iv)   To assess adequacy of maternal and childcare

v)   To examine determinants of nutrition security and their relationships in a changing weather pattern\

1.5   Research Plan, Conceptual Framework and Organization of the Thesis

1.5.1   Research plan

This research established long term weather variation, linked the trend to the observed food availability and determined factors influencing nutrition status of household members in the context of changing weather.

1.5.2   Conceptual framework

The theoretical framework used in this study was an adaptation of the framework used by Food and Agriculture Organization of the United Nation (FAO) in 2007 for studying inter-linkages of ecological factors, food and nutrition security and climate change. The FAO framework projects impacts of climate change on food security by showing how climate change–driven changes in food production processes and patterns could affect food security at local and global levels. Three major modifications were made before adaptation of the framework namely focusing it on local level (omitting the global components), focusing it on few climate change components (drought, flood and temperature) and adding care aspect to qualify nutrition security. The framework (Fig. 1) therefore depicts the components and determinants of nutrition status in the changing weather pattern.

Increased frequency and intensity of extreme weather events and weather variability	Change in Agricultural based livelihood and non-farm livelihood	Change in production, productivity and consumption	Change in food availability and accessibility

POOR ACCESS TO QUALITYHEAL TH SERVICES

INADEQUATE CARE TO HOUSEHOLD MEMBERS

INADEQUATE FOOD IN HOUSEHOLD

Deteriorating environmental sanitation

DISEASES

INADEQUATE FOOD INTAKE

Change in eating pattern

UNDER-NUTRITION

Figure 1: Theoretical linkages of environment, food security, care and nutrition in a changing weather.

Source: Adopted from FAO (2007) and SCN (2010) and modified by Author

1.5.3 Analytical framework of the study

Potential determinant factors and their relationship were hypothesized with the following assumptions:

(i) Poor sanitation (unsafe drinking water, uncontrolled contact of wastes with food, improper waste disposal, collapsed toilet facilities or unhygienic toilet or their absence and poor personal hygiene) significantly contribute to under-nutrition in household members

(ii) Inadequate care is an important cause of under-nutrition in children and women. Analytical framework for elucidating linkages of factors influencing nutrition status in a changing weather was formulated and is as shown in Fig. 2.

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           ┌─────────────────────────────┐
           │   Extreme weather events    │
           │  (rainfall and temperature) │
           └─────────────┬───────────────┘
                         │
                         ▼
           ┌─────────────────────────────┐
           │ Poor household food production │
           └─────────────┬───────────────┘
                         │
                         ▼
           ┌─────────────────────────────┐
           │  Household food insecurity  │
           └─────────────┬───────────────┘
                         │
┌──────────────┐        │        ┌──────────────┐
│ Inadequate   │        │        │  Diseases    │
│ care and     │        │        │              │
│ food intake  │        │        └──────────────┘
└──────┬───────┘        │         │
       └──────┐         ▼     ┌───┘
          ┌─────────────────────────────┐
          │       UNDER-NUTRITION       │
          └─────────────────────────────┘
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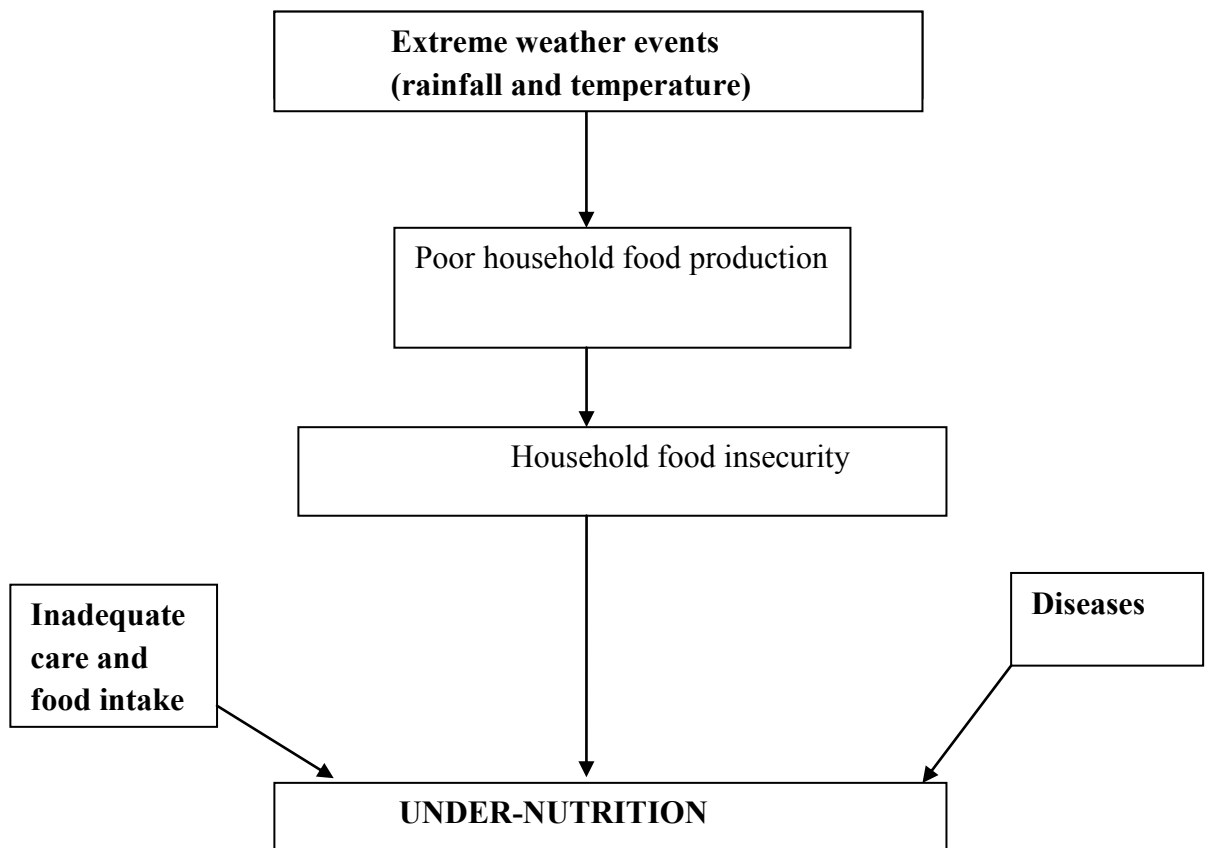
Figure 2: Hypothesized flow of contributions of extreme weather events, diseases related to sanitation, inadequate care and food intake to under-nutrition.

From the analytical framework, several independent variables were selected for the intended analysis as follows:

i) Environmental quality (environmental sanitation score and prevalence of sanitary related diseases)

ii) Maternal and child care (infant and child feeding practices and antenatal care provision).

iii) Household food availability

Dependent variables used were nutritional status indices (stunting for preschool children and BMI for non-pregnant women) and food consumption levels.

1.5.4 Organization of thesis

This thesis presents factors influencing food security, care and environmental quality in Kilosa in a changing weather. Chapter one is providing the background and an overview of food and nutrition security, climate change and its influence on food and nutrition, defining research problem and outlining objectives. It also shows relevance of the study and drawing relevant frameworks.

Chapter two provides an extensive review of relevant literature on factors influencing food and nutrition security, adequate care and environmental quality. Chapter three presents the research design, methods of data collection and analysis. The statistical tools used in analyzing and establishing linkages are also presented in this chapter. Chapter four presents results and finally chapter five presents discussion of findings in light of the research questions.

1.6 Research Questions

For the qualitative research part, three key questions shaped the work as follows:

    (i)   Do community members perceive any climate change in the area?

    (ii)   Do they (community members) perceive climate change effects?

    (iii)   What is the perception of community on conventional (advocated) care to children and women over years?

Quantitative research part established community nutrition status and its determinants through household survey (face-to-face interviews and anthropometric measurements). Relevant secondary data (meteorological data for the last 40 years and corresponding production and productivity data) were also examined and their link to food and nutrition security established.

Three key questions for quantitative research part were:

(i) What are major determinants of nutrition status in the study population?

(ii) To what extent does each determinant factor contribute to observed under-nutrition?

(iii) How do environmental sanitation, care and food availability inter-link among each other to influence nutrition status in a varying weather?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Terms

Under-nutrition

Under-nutrition exists when insufficient food intake and/or repeated infections result in wasting, underweight, stunting or functional deficiency in vitamins and/or minerals (FAO, 2002; SCN, 2010).

Food security

The most recent definition of food security stated it as a condition in which all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002). At the household level food security is possible when there is adequate food either produced by the household or available to the household and an adequate income capacity for the purchase of the available food (FAO, 2012).

Adequate care

Adequate care is defined as provision of sufficient time, attention, support and skills in the household and in the community to meet the physical, mental and social needs of growing children and other members of the household (FAO, 1997).

Environmental quality

Environmental quality literally means quality of external conditions in which people live or work and its standard definition is "a state of environment condition expressed in terms of indicators or indices related to its standards. It refers to a set of properties and

characteristics of environment, either generalized or local as they impinge on human being and other organism (WHO, 2008a). The context of this study restricts environmental quality to environmental sanitation, drinking water safety and trees cover status. Environmental sanitation refers to infectious disease prevention mostly by proper faeces and garbage disposal and cleanliness of surrounding of human settlement (WHO, 2008b; OECD, 2011).

Nutrition security

Nutrition security exists when food security is combined with a sanitary environment, adequate health services, and proper care (including adequate intake of both energy and nutrients) for a healthy life for all household members (FAO, 2002; SCN, 2010). Nutrition security is achieved when every individual has the physical, economic and environmental access to balanced diet that includes the necessary macro and micronutrients and safe drinking water, sanitation, hygiene, primary health care and education so as to lead a healthy and productive life (FAO, 2009).

Climate variability and change

Climate variability refers to variation in the prevailing state of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system or to variation in anthropogenic (human driven) external forcing. On the other hand, climate change is a change that is attributed directly or indirectly to human activity that alters the composition of global atmosphere, and that is in addition to natural climate variability over comparable time period (Levina and Tirpak, 2006; IPCC, 2012). For this study weather elements were the focus and weather is defined as the state of the atmosphere at a specific time in a specific place (IPCC, 2012).

2.2 Prevalence of Under-nutrition in Preschool Children and Determinant Factors

Available data show that under-nutrition is a public health problem in Tanzania and causes are multiple varying with groups. The most recent national data showed that 42, 16 and 5% of the children below five years of age were below -2 z-score for height-for-age, weight-for-age and weight-for-height respectively (NBC and ICF Macro, 2011). The same data source showed that, child full immunization has increased from 71% in 2004 to 75% in children age 12-23 months, according to vaccination cards or mother's report. About 3% of children did not receive any vaccination at all. On childhood illness, acute respiratory infection; fever and diarrhea were common symptoms in preschool children (NBS and ICF Macro, 2011).

For the infants, exclusive breastfeeding for the first six months is not widely practiced. Exclusive breastfeeding for six months is recommended (WHO, 2009; World Health Assembly, 2012), but only 50% of infants under 6 months are exclusively breastfed in Tanzania (NBC and ICF Macro, 2011). Regarding non-food factors, scanty evidence is available from household surveys undertaken in the country especially on contributions of non-food factors to under-nutrition (Kadiyala *et al.,* 2014).

Complementary feeding starts early than recommended at 6 months-time and quality of complementary food is poor. Around 81% of infants under the age of 2 months in the country receive breast milk only while 51% of infants aged 2-3 months received breast milk only. About 23% of infants aged 4-5 months receive breast milk and complementary food while about 10% of children in 6-8 months were denied complementary food (NBC and ICF Macro, 2011).

2.3 Prevalence of Malnutrition in Women

An adult with Body mass index (BMI) of less than 18.5 is considered undernourished (WHO, 1995). In Tanzania, 11% of women are under-nourished (fall below this cut off-point) while 22% weigh more than they should (15% overweight and 6% obese). On the other hand, about 43% of pregnant women met the recommended number of antenatal care visits which is set at a minimum of 4 times spread well in the 9 months period of pregnancy (NBC and ICF Macro, 2011). All these deficits have negative implication on nutrition status of women. Therefore, they need to be thoroughly examined in specified context and locality and factors associated with them be elucidated to inform intervention strategies formulation.

2.4 Interventions Undertaken to Reduce Maternal and Child Under-nutrition

Interventions to address nutritional problems in the country have registered encouraging success. The percent of stunted children has been dropping from 44% in 1999 to 38% in 2004 and 42% in 2010 as a result of interventions. Registered reduction is still far from set goals and acceptable levels (WHO, 1995; NBS and ICF Macro, 2011). Areas of strength in the past intervention strategies were stress on length of breastfeeding, infectious disease management, de-worming, vitamin A supplementation, iron and folic acid supplementation. Weakest areas included quality of breastfeeding (particularly low proportion of exclusively breastfed children) and knowledge of proper diversification of diets using locally available food resource (Namugumya, 2012; World Bank, 2013).

2.5 Under-nutrition in the Context of Climate Change

The link between climate change and food security is clear and strong (Thomson *et al.,* 2010). Impacts on availability component of food security are by far the best researched compared to other dimensions of food security. Accessibility has also been examined to

some extent but too little work has been directed on linkages to other nutrition-related factors.

Extreme weather events like drought and floods magnifies seasonal stress that induces multiple risks including less food being produced and stress on livelihood, hence reduced food intake. Moreover, climate change affects environmental quality and health (change in range of infectious disease vectors and an increase in diarrhea). Food insecurity could result into unforeseen changes in food-health relationship, causing micronutrient deficiencies as well as general malnutrition and hunger (Chiu *et al.,* 2010). However, the precise nature varies considerably from area to area therefore necessitating establishment of full information on local condition and environments behind any observed food insecurity. Study done recently in Tanzania, documented the influence of weather on mortality in rural areas (Mrema *et al.,* 2012). Moreover, in semi-arid areas of the country (Meatu and Iramba), inter-annual anomally (deviation from long term mean temperature and rainfalls) and seasonal variability that could influence food security in the area have been recorded (Kabote *et al*., 2013). This calls for establishment of weather variability influence on nutrition in the study area.

Humans are exposed to climate change directly through changing weather patterns and indirectly through changes in water, air, food quality and quantity, ecosystems, agriculture and economies. During 1970 – 2000 at least 160 000 deaths and 5 000 000 disability-adjusted life years occurred from only four factors: malaria, diarrhea, flooding, and malnutrition (Meek, 2011). Confolonieri and other workers in 2007 suggested malnutrition as one of most important consequences of extreme weather events. However their base for that suggestion was a number of people affected only (Confolonieri *et al.,* 2007). It is now well known that climate change has a bearing on

food security in vulnerable communities of semi-arid areas and Tanzania is not exempted especially in inter-annual variability (Roudier *et al.,* 2011). Frequent dry spells have also resulted into reduced yields and increased food shortage (Lema and Majule, 2009). Since climate variability is differentiated by geographical location (Moyo *et al.,* 2012), there is a need for clear understanding of the situation in other areas of the country   (apart from semi-arid areas that has been subjects of sufficient research) including Kilosa district. This is important in order to inform decision making process to address the imminent impacts.

Gradual changes in temperatures or rainfalls have to be considered along with changes in the timing and length of rainfall seasons or the incidence of extreme weather shocks (FAO, 2008). Available information shows that in Kilosa, the problem of rainfall variability manifests in 3 dimensions namely erratic amount, untimely onset and unreliable end-dates (Kijazi and Reason, 2012). Onset and end dates refer to when the rainfall starts and ends in a particular growing season. The amount dimension has two extreme situations of too little (drought and dry spell) and too high rainfall (flood). Unreliability of onset and end-date jeopardizes expected spacing of the rainfall in the growing season. In the context of variation, smallholder farmers face higher fluctuations of the yield and income as they fail to foresee when it will certainly rain, its duration and its end (Lema and Majule, 2009). Yet, nutrition status of the subsistence farmers or peasant's household members is highly dependent on own food production as well as power to purchase goods and services. The extent at which this own food production capacity and income are reduced by unreliability of rainfall is not known with certainty.

2.6   Determinants of Nutrition Status of Household Members

2.6.1 Food security

Food security which is a key determinant of nutrition status has four dimensions at household level which are physical availability of food, economic access to food, utilization and stability of the other three dimensions over time. Stability of food implies that the food availability is not affected by any shocks or risks affecting food production at all times. Income, educational level and households sizes are known to affect household food security as they directly affect economic access and sustenance of such access (FAO, 2010). Purchasing power is necessary to access food and nutrition security (Bonis *et al.,* 2011). Thus poor tend to be more undernourished than the rich. However, malnutrition is not confined only to poor people. FAO estimated that rising prices have plunged an additional 75 million people below the hunger threshold (FAO, 2012). However, recent findings indicate that without other ecosystem components (safe drinking water and health care) accessibility factor alone may not significantly impact nutrition (Herthforth *et al.,* 2012).

Duration of food insecurity could be either chronic food insecurity or transitory food insecurity (short-term and temporary). Causes of chronic food insecurity in most cases are inability to meet their minimum food requirements over a sustained period of time and extended period of poverty, lack of assets and inadequate access to productive or financial resources. For transitory food insecurity it occurs when there is sudden drop in the ability to produce or access enough food to maintain a good nutrition status, and results from short-term shock and fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices, and household incomes (FAO, 2002).

Literature shows that while enhanced agricultural productivity is an important development goal, mere producing more food does not necessarily or automatically ensure food security or improve nutrition (Herforth *et al*. 2012; FAO, 2012). Implication brings the question reflected in the current frameworks suggesting that focusing on dietary adequacy in the context of improved health is also needed for enhancing nutrition. However, the term 'adequate' need to be qualified as its meaning had been changing over time and varying with context. Such factors like intra-household resource control, eating or diet arrangement for members of the household, disease-nutrient interaction and sanitation acquire the importance that way. Gillespie *et al*. (2012) suggested other key issues namely dietary choices, seasonality, health and education or relevant knowledge. Therefore examining multiple factors is pertinent.

2.6.2 Environmental sanitation

Poor environmental sanitation, unavailability of water and toilet facilities may expose children and other members of the households to bacterial contamination and other diseases vectors responsible for causing diseases (OECD, 2011; UNICEF, 2012; WHO, 2012). It may also create an environment where these bacteria and disease vectors can grow and thrive. Diseases are known to contribute to poor nutrient utilization in the body and can lead to under-nutrition (Arimond and Ruel, 2004; Muthoke *et al.,* 2013). There have been conflicting findings on empirical evidence of sanitation contribution to under-nutrition due to variation in methods employed as well as standards used to classify sanitation components like toilet facilities in a household (Butteheim, 2008; Benerjee and Morella, 2011). The previous studies concentrated on interviews and gave fair conclusions. However more insight could be gained by adding physical observation method on toilet presence, use and management (observation by researchers) in the

households as suggested by Benerjee *et al*., in 2008 rather than depending on interview alone.

2.6.3 Caring practices

Key caring practices include care for women, breastfeeding, feeding of young children, and psychosocial care for young children, hygiene practices and care for children during illness (Mayer, 2007; UNICEF, 2012). Determination of contributions of each of these factors to the observed nutrition status through empirical data is scanty. Few studies have explored reasons for inadequate care in Tanzania. In urban setting, maternal employment and educational characteristics have been identified as major constraints to good child-care practices and alternative caregivers are taking a more important role in child care as mothers join the work force (Kulwa *et al*., 2006; UNICEF, 2012). Situation for the rural setting is not known with certainty.

Breastfeeding is universal in Tanzania as 97% of women do breastfeed their children and some children are breastfed up to their second year, but exclusive breastfeeding is a problem as highest prevalence recorded so far is 50% (NBS and ICF Macro, 2011). Changes in wording of questions across surveys have lowered the quality of available data on breastfeeding practices particularly failing to give reasons for the observed practice (UNICEF/WHO, 2010). Gijsbers *et al.* (2005) and Synontt *et al.* (2007) observed that the introduction of solids foods for most women depended on physical characteristics or behavioral action of the infant. They categorized this attitude as evidence of perceived milk insufficiency rather than real insufficiency and pinpointed knowledge and attitude gap as major contributive factor.

The current evidence support strongly the understanding gap among women regarding importance of breastfeeding and how to overcome faced frustrations surrounding practicing it effectively. Breast milk contains immune factors that are protective and is unlikely to be contaminated, hence decreasing infant morbidity and mortality. That is why exclusively breastfed children are at much lower risk of infections from diarrhea and acute respiratory infection than children who receive other foods before six months (WHO, 2009; World Health Assembly, 2012). Insufficient breastfeeding coupled with other feeding deficits like poor complementation inevitably results into under-nutrition. Complementary feeding is the process of introducing other foods and liquids into the child diet when breast milk alone is no longer sufficient to meet nutritional requirements and therefore other foods are needed along with breast milk. Timely introduction of appropriate complementary foods promotes good nutrition status and growth in infants (WHO, 2009; Pantoja-Mendoza *et al.,* 2015).

Despite of all these facts being known, inter-linkages of determinant factors of adequate care need to be explored sufficiently for concrete guidance to health service providers' daily work.

2.7 Ecological Situation Surrounding Under-nutrition in Tanzania and Kilosa District

Prevalence of stunting among preschool children is a proxy indicator of chronic under-nutrition in a community. Prevalence of stunting in preschool children in Kilosa district is 39% while the national prevalence is 42% (NBS and ICF Macro, 2011). Prevalence of anemia in Kilosa district is 65% among women of reproductive age and 83% among children under the age of five years exceeding the national prevalence which is 48% for women and 69% for children under age of five years (SUA, 2008).

Post natal growth faltering is thought to contribute more to the observed deviation from normal than intrauterine growth retardation for most communities and this is due to many factors including non-food factors (Kamau-Thuita *et al*., 2002; Nita *et al.,* 2004; Engel *et al*., 2011). Non-food factors include those which are ecological in nature like quality of environment and mothers' education. Normally, children can become malnourished in infancy even if their nutrients intake is adequate, if they suffer from poor food absorption caused by disease, especially diarrhea. This is obvious in Tanzanian situation where 53% of households do not have good toilet facilities (NBS and ICF Macro, 2011). However, empirical evidences have been scanty.

Contribution of distal ecological factors like energy crisis to the observed under-nutrition is also thought to be significant as energy for cooking is derived from firewood and /or charcoal. Mode of acquisition of these basic energy sources involves collecting dried branches from woodlots and or cutting trees to prepare the charcoal. With increased population pressure, the rate of cutting trees has increased far more than the rate of planting trees and/or of allowing the natural woods to rejuvenate. Therefore, the distance to the woodlots has also increased tremendously with far reaching consequences in terms of dietary patterns in the affected areas. It is presumed that as the environment continues to be degraded, and woodlots disappearing, households tend to consume foods that require less energy and time to prepare. Thus, dietary diversity in a degraded environment could be threatened through such changes leading to inadequate nutrient intake. Linkages of climatic factors to environmental degradation in form of depletion of vegetative cover and consequent nutrition implication are subjects of research in this study.

Kilosa physiogeography, climate and resultant historical perspective of community nutrition status

According to the unpublished report of Kilosa district council of 2011, the district is divided into three physiogeographic units which constitute different agro ecological zones (Kilosa district council, 2011). These units are elevated (2,200m. above sea level) western areas, moderately elevated (1 100 m. above sea level) northern areas and central/southern flood plains standing at 40 m. above sea level. The report further shows that in all these areas, there is intensive land use mostly for maize production and livestock keeping. The intensity of the land use plus vulnerability of soils have caused severe soil degradation in some areas (Kilosa district council, 2011; Hieronimo *et al.*, 2010). Scarcity of resources coupled with prolonged drought has been reported to trigger clashes/conflict on land use between pastoralists and crop farmers (Mutabazi *et al.,* 2014).

Regarding, water and sanitation available data suggest significant gaps (Kilosa district council, 2011). The proportion of Kilosa population with access to clean and safe water is 50% and sanitation is poor including insufficient number of toilet facilities. The same report attributed the poor sanitation to two factors namely low level of education and poverty (about 30% reported to live below poverty line according to 2002 assessment). Regarding health and nutritional implication of this situation, available data on infant and under-fives mortality rates (Kilosa district council, 2011) and nutritional survey data (SUA, 2008) suggest serious gaps. However, from the efforts made through several health and nutrition programs implemented in the area, statistics have been improving over years. Infant mortality statistics have changed from 112 per 1 000 live births in 1985 to 101 per 1 000 live births in 2002). A similar reduction was reported for the same period for mortality in children below five years of age (from 180 per 1 000 live

birth to 166 per 1 000 live birth). National statistics for mortality reduction for this group was from 137 in 1996 to 112 in 2005 (NBS and ICF Macro, 2011). Health facility based data show that reduction in underweight in Kilosa was from 36% to 8.7% within 22 years period (Kilosa District Council. 2011).

CHAPTER THREE

3.0 METHODOLOGY

This chapter presents the description of the study area, research design (sampling techniques and sample size), data collection methods and analytical tools used in data analysis.

3.1 Overview of Methods

Both quantitative as well as qualitative methods have been used in this study to collect intended data. Structured household interviews were the main technique used. The combination of methods helped in illuminating the reasons behind the food and nutrition problems/deficits that prevailed in the study area. Focus groups discussion was a qualitative method chosen because it is predominantly suited to the study of perceptions and attitudes towards specific topics (Vermeire *et al.,* 2002; Adler and Clark, 2008) and also it allowed for an in-depth exploration of issues than is possible with other techniques (McKinley *et al.*, 2005; Blackstone, 2015). The method was used to gain insight into community members' perception on quality of their environment, perceived changes in weather for the last 40 years and effects of these changes on food availability. Community perception on adequacy of care accorded to women and children was also explored. Main tools used for assessing adequacy of care were household interview questionnaire and observation of mothers' activity schedule for a subsample. For environmental quality (environmental sanitation and vegetation cover) three instruments were employed namely household interview questionnaire, observing physically and counting charcoal/bricks furnace and production volumes for specified period of time.

Collection of secondary data was the first step, followed by focus group discussions and finally household interviews. Questionnaires to be used in the household interviews and check lists were developed based on the conceptual framework and the clue obtained after examining secondary data. These secondary data were on weather, major food crops cultivated in the area and facility based nutrition status data for infants and children.

3.2 The Study Area and Population

3.2.1 Geographical location and its climatic condition

The study area is located between 292 443 E to 305 426 E and between 925 9910N to 9 267 948 N UTM co-ordinates. It has a total area of 3 265 ha (Fig. 3). The area is characterized by dry tropical climate of semi-arid type and has a bimodal rainfall pattern. This rainfall pattern is characterized by two rain seasons in a year with dry season separating the short rains locally known as *vuli* from October to December and long rains locally known as *masika* from March to May. The area is dominated by flood plain (flat topography with a slope gradient between 0 to 0.55%), mostly grassland.

3.2.2 Socioeconomic activities in study area

Agriculture is the main economic activity and source of livelihood whereby rice, maize, pigeon peas, beans and peanut are the major crops grown. Animals are kept by few households mostly chicken with limited number of cattle. The major ethnic groups in this village are Sagara, Kaguru, Pogoro and Gogo.
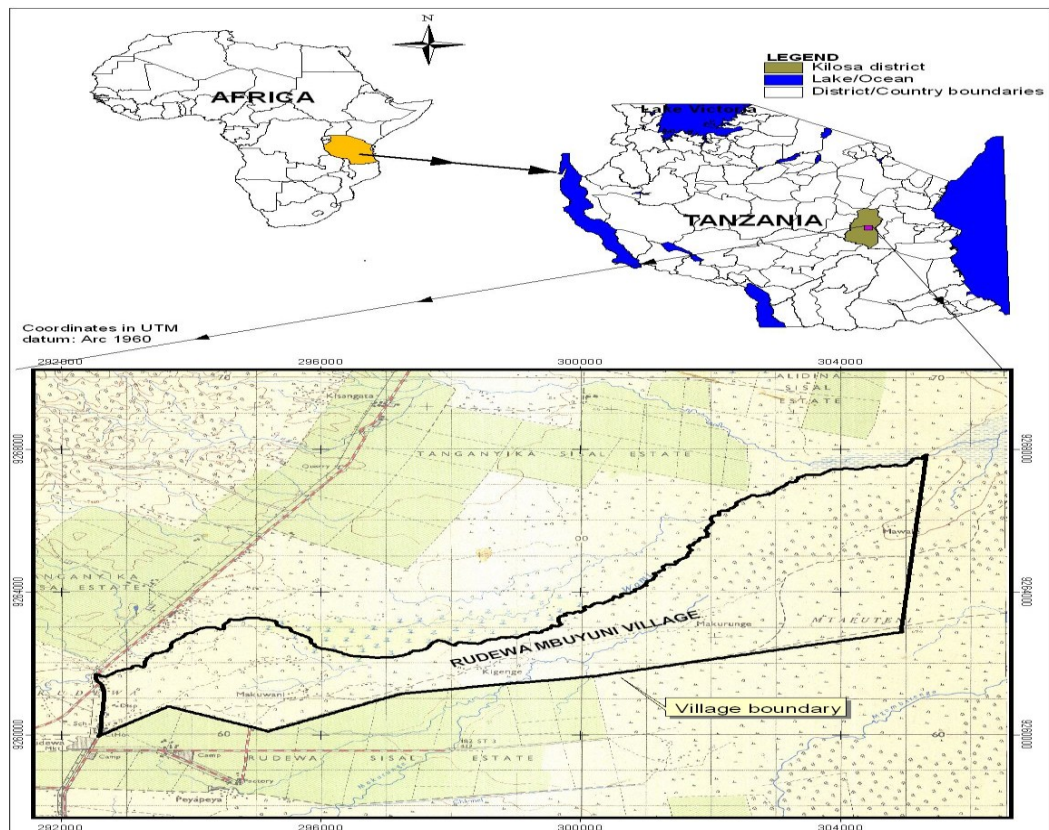
Figure 3: A map showing the location of Rudewa-Mbuyuni village.

Source: Hieronimo *et al.* (2010)

Study population, inclusion and exclusion criteria

Kilosa district had a population of 438 175 people according to 2012 population census (NBS, 2012) and is divided into 9 divisions, 37 wards and 161villages. The study population was all pre-school children and women of child bearing age (15 – 49 years). All women and children out of that age range were excluded in the interviews. The same applied to women or pre-school children who were seriously sick during the interviews.

3.3   Research Design, Data Needed and Methods Used

Cross-sectional study design was employed, meaning that parameters were observed at one time. Time series data were also included (weather elements and food production data).

Data needs and sources

In order to assess peoples' perceptions on weather pattern over a long time period and its effect on socioeconomic situation in the area, focus group discussions with three different types of community members (man, women and elderly) were conducted, each composed of 12 people. Meteorological records from a nearby station were also collected in that respect to complement peoples' perceptions.

In order to better understand the household food and nutrition security in the area, food availability and accessibility data was collected (own production, incomes and assets). Also, habitual food intake, feeding practices, sanitation and morbidity assessment coupled with anthropometric assessment gave status of health and nutrition in the studied population.

3.4   Sampling Procedure and Sample Size

This was a district representative sample, obtained using multistage sampling procedure

Sampling procedure

A multistage sampling was done right from the district level to obtain the division, ward and village where the survey was to be carried out. This was done by listing all division in the district and selecting one division randomly. Then listing all the words in the selected division was done and one ward was selected randomly. Finally a list of all villages in the selected ward was made and one village selected. In this way, Kimamba division, Rudewa ward, and finally Rudewa-Mbuyuni village were selected. A village in Tanzania is a conglomeration of hamlets. A hamlet can have about 50 to more than 200 households depending on population density of the area hence needed proportionate consideration. The number of households in each hamlet was obtained using

proportionate sampling from village registers. This involved listing number of households in each hamlet irrespective of method of ordering of the hamlets. Then, systematic sampling was done to obtain the appropriate number of households from the cumulative totals. The actual numbers selected did not refer to individual households but rather indicated the total number of households to be selected from each hamlet. The sampling interval was worked out by dividing the total number of households in a hamlet by the study sample size (N). Then, with a random start, successive increment of the sampling interval (total population in the hamlet / N) was made till complete sample size was attained (from all hamlets involved in the study).

Sample size

Formula by Hulley and Cummings (1988) was used to get preschool children sample size as follows:

$N = 4Z\alpha^2\ pq/d^2$

where:

N = desired sample size

$Z\alpha$ = standard normal deviate (i.e. 1.96)

p = proportion of preschool children estimated to be stunted which was estimated at 35%(national prevalence of 2010)

q = 1 − p = proportion of children estimated to be well nourished

d = degree of accuracy desired = total width of 0.1; 95% confidence level

N = 4 X 1.96² X 0.35 X 0.65 / 0.01 = 3.4958/0.01 = 349 preschool children, assuming 1.5 children per household, the formula gave 233 and adding 10% to take care of no response approximate the sample to 256 households.

3.5 Methods of Data Collection

Primary data are essentially the data collected from respondents and not from records. Therefore, for this study primary data came from household survey (using questionnaire and taking anthropometric measurements), observation of mothers' activities in a day and focus group discussions.

3.5.1 Primary data

3.5.1.1 Household survey

Structured questionnaire was administered through face-to-face interviews with respondents from each household. The questionnaire had three parts (Appendix 1). The first part covered information on demographic characteristics of household members; characteristics of households' dwelling unit (materials used for building the house in which they live); assets or durable goods possessed (land, agricultural devices, animals, furniture, mobile phones, TVs, transport gears and houses), household income, sanitation and source of water. Part two covered information on food availability in the household, food consumption, antenatal care, postnatal care, immunization, infant and young child feeding practices. Part three covered opinion on climate change and land degradation. Anthropometric measurements were also taken and these were, weight and height/length and intended indices were computed. Anthropometric indices intended were height-for-age, weight-for-height and weight-for-age in children. BMI was used to measure thinness or obesity in women. This is defined as weight in kilogrammes divided by height squared in metres (kg/m^2). Table 1 presents criterion for classifying nutrition status.

Table 1: Classification and interpretation of nutrition status

BMI values	Interpretation or indication
30	Obesity
25.0 – 30.0	Overweight
18.5 – 24.9	Normal nutrition status
16.0 – 18.4	Acute under-nutrition or thinness
<16.0	Severe under-nutrition

Source: WHO (1995)

3.5.1.2 Standard methods used for anthropometric measurements

a) Instruments

A stadiometer specially produced for use in survey setting by Shorr (Shorr Productions 17 802 Shorley Bridge, Maryland) was used for height measurements. Electronic (SECA, Hamburg) scale was used for measuring weights.

b) Length

Recumbent length was taken for children of less than two years of age. The stadiometer was positioned on a hard flat surface, and with the mother's help the child was placed on the board facing upward with the head towards the fixed end and the body parallel to the long axis of the board. Child's knees were pressed onto the board such that the legs were straight and the toes pointed directly upwards, the movable footboard was brought to rest firmly against the heels and measurement taken to the nearest 0.1centimetres.

c) Height

The stadiometer was placed against a wall and the child above 2 years of age or an adult was asked to stand straight with the head positioned such that the Frankfurt plane was horizontal, feet together, knees straight and heels, buttocks and shoulder blades in contact with the surface of the height board, hands hanging loosely with palms facing the thighs. The movable headboard was then lowered until it touched the crown of the head. Height was recorded to the nearest 0.1centimetres.

d) Weight

Weights were taken without shoes on and with minimum clothing. The scale was placed on a hard flat surface ensuring that the display window is blank. Thereafter the scale was turned on and given time (5 seconds) to adjust to zero. To measure an adult, a person was asked to step on the scale and stand still to allow for weight to be displayed. Then the measurement was recorded to the nearest 0.1kilogrammes. After measuring weight of an adult this electronic weighing scale is able to store the weight of adult in memory if tarring is done. Therefore, by simply tarring and handling an infant or young child to the adult while she/he was still standing on the weighing scale the weight of infant or young child held by adult was measured. Measurements were recorded to the nearest 0.1kilogrammes.

e) Methods used for assessing food consumption, food availability and accessibility

Twenty four hour recall (24-h recall) and food frequency questionnaire (FFQ) methods were used to determine adequacy of food consumption in the households. Respondents were first asked to recall what they ate during the previous 24 hours. Then, a food frequency questionnaire that was previously developed with the assistance of a local informant was administered to the same respondent to capture habitual food intake. Then both outcomes were scored on a 4-point scale purposely devised for facilitating comparison among respondents. Scoring also enabled relating variation in food intake to other variables (socioeconomic, food availability, care and sanitation related variables).The 24-hour recall is suitable for determining average food intake and scoring system used primarily combined meal frequency with diversification of meals to get an impression of adequacy of diets (Table 2).

Table 2: Scoring system of meal frequency and diversification of meals employed to assess adequacy of food consumption

Observation	Allotted points
Less than three meals a day and single type of meal	1
Two types of meals and two meals a day	2
Two types of meals and three meals a day	3
More than two types of meals and meal frequency exceeding three per day	4

Food frequency questionnaire (FFQ) is suitable for determining habitual food intake. The local informant had provided a list of all commonly consumed foods in the area few weeks before the household interviews and this was used to prepare the FFQ. The questionnaire had daily, weekly, monthly or rarely categories. Mothers were asked how often they consumed each item of food. A similar scoring system used for 24-hour recall was used to score responses for FFQ (Table 3).

Table 3:   Scoring system of food frequency questionnaire responses employed to assess adequacy of habitual food intake

Observation	Allotted points
Rarely or yearly	1
Monthly	2
Weekly	3
More frequent than weekly	4

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The respondents were also asked whether they had food to carry them through to the next harvest and give an estimate of household annual food production size and income.

f)   Standard techniques used for assessing respondents perceptions

Respondent perceptions were assessed using summated (Likert) scale technique. Several issues were assessed including long term weather variation and community attitude towards conventional care.

i)   Long term weather variation

Summated scale technique was used to assess peoples' perception on climate variability and change. Summated scales are normally developed by utilizing the item analysis approach whereby a particular item is evaluated on the basis of how well it discriminates between those persons whose total score is high and those whose score is low. Those items or statements that best meet this sort of discrimination test are therefore included in the final instrument. Based on the dimension of the current study concept which was judgment of presence or absence of weather pattern change, indicators inscribed in the questionnaire responses were used to measure average opinion of the community on the aspect. In this case, index was formulated using 5-point summated scale (Likert type scale). The scale consisted of number of statements (Appendix 4) which expressed either a favorable opinion or unfavorable opinion on long term weather change occurrence which the respondents were asked to react to. Respondents were asked to indicate their agreement or disagreement with each statement in the instrument. Each response was given a numerical score and the scores were totaled to measure the opinion. From ten statements presented (see Appendix 4) to respondents they had five possible responses which were as shown in Table 4.

Table 4: Criteria used for indexing summated scale responses

Observation	Awarded points
Strongly agree	5
Agree	4
Undecided or neutral	3
Disagree	2
Strongly disagree	1

Maximum possible points was 50 (5 times 10) and minimum was 10 (1 times 10) and classification used to judge perception or opinion was therefore pegged on 30 meaning that >30 points meant agreeing with the opinion that climate has changed, seasons have shifted and resultant land degradation has occurred i.e. 10- 20 is disagreeing, 21- 30 is neutral and 30-50 is agreeing.

Respondents' opinion on presence or absence of seasons shift and consequences were scored on this 5-point summated scale based on 10 statements (Appendix 4) relating to changing climatic condition in the village; presence of long dry spells more frequently now than in the past; presence of diseases related to environment sanitation more frequent now than in the past; abundance of natural resources like firewood, forest products and water resource.

ii) Community attitudes towards conventional care

The same summated scaling used for assessing perception on weather variation was employed to assess attitude towards recommended care in broad sense (holistic) by presenting to the respondents ten statements (see Appendix 4) relating to care and responses were scored. The aspects of care covered were support given to pregnant women, workloads, family planning, age appropriate care for toddlers, awareness on psychomotor, affective and cognitive domains of growth and corresponding care needs and child rights.

g) Observation method

This was employed in monitoring mothers' activities schedule in a day for a sub-sample of 42 households. It was also used for assessing quality of toilets and monitoring trees felling for charcoal making and mud bricks burning.

3.5.1.3 Questionnaire formulation and pre-testing

The questionnaire was formulated (Appendix 1 and 2) and pre-tested in order to ensure the relevance of the questions and bring to light the weaknesses of the tool like clarity of questions. Thereafter it was revised accordingly before use.

3.5.2 Focus group discussions

Focus group discussion was used to collect information relating to perception of community members on weather variability and its effects, quality of maternal and child care in this community over time and household eating arrangement. Three separate sessions of FGD were conducted for elders, men and women. Participants were purposively selected in order to get the type of participants targeted. This was done with the assistance of a recruited research assistant from the village and community leaders were requested to arrange and invite them to the meetings.

Twelve men who have been residents in this village for at least 10 years formed the first group. The second group of 12 women was invited using the same criterion but ensuring they were not related to the first group of participants. The third group was formed by inviting 12 elders (>60 years) who had resided in the area for at least 40 years. The three focus group discussions were conducted separately in two different communal meeting places on three different dates and were conducted in local (Swahili) language. They were audio tape-recorded with the verbal consent of the participants. It was explained to

all participants that all focus group discussions would remain confidential. A local person assisted with recording, notes taking as well as clarifying some of the issues that could not be understood easily in Swahili. Check list of relevant questions and probes were developed (see Appendix 3). These were pretested for clarity, comprehension and suitability few weeks before the study commenced and adjusted accordingly.

3.5.3 Secondary data collection methods

Secondary data on weather from nearby (15 kilometres from Rudewa) Ilonga meteorological station were collected for the last 40 years. This was in consideration that fair examining of long teIrm weather data is 30 years and above period. Corresponding food production data (the same period) were collected. The data collected were temperature, rainfall and relative humidity and records for every day was availed by the Ilonga meteorological station office without missing value. Food production and nutrition status data for the corresponding period was requested from district agricultural office, health facilities, village government and non government organization working in the area. The availed data were not as complete as that for weather data because some of the old records have already been destroyed under the assumption that no one is interested in such an old record. The only available long term production data in the area was found with District agricultural office and covered the last 15 years only. All available production records were examined and related to weather data to establish trends over that period.

3.6 Data Processing and Analysis

Qualitative and quantitative methods complemented each other for a sound data management and interpretation.

3.6.1 Data Processing

Data processing involved several steps and several scoring system were devised.

3.6.1.1 Hygiene and sanitation

Hygiene was assessed based on hand-washing practices covering all points that need hand washing namely before eating, before feeding babies, after cleaning baby's bottom and after going to the toilet. Mothers were asked to tell when they do wash hands. Toilet facility availability, quality and use were assessed by observing in each household and categories of observation were given points as shown in Table 5.

Table 5: Criteria used for assessing access to toilet facility and management

Category	Allotted
No toilet	0
Temporary toilet	1
Semi-permanent toilet with unroofed structure	2
Permanent toilet but dirty	3
Permanent toilet and clean	4

Overall household sanitation was assessed by combining hand washing practices and toilet score.

3.6.1.2 Weather

The 1996 was set as a dividing period between past and recent times, based on the fact that 30 years is normally used as the period over which accurate estimates of long term weather can be obtained. It was therefore thought proper to divide years between past and recent at 15 years (half of that period after counting from 2011, the year of data collection backwards). In examining meteorological data, mean monthly rainfall less

than 10 millimetres was defined as dry spell (Mutabazi, 2007) and annual mean temperature above 31 ^{o}C was defined as extreme.

3.6.2 Analysis

WHO Anthro (3.1) software was used to compute nutritional indices (z-scores for underweight, wasting and stunting in preschool children). Indicators for stunting (height-for-age), wasting (weight- for-height) and underweight (weight-for-age) were used to assess nutrition status. For adults, BMI was used. Stunting and wasting are anthropometric indicators of nutrition status based on height, weight, age and gender. Stunting compares a child's height with international standard distribution of height for children of same gender and age in months (in this case NCHS/CDC/WHO International reference population was used). Children whose height-for-age z-score is less than two standard deviations below the median of reference population for children of the same gender are classified as stunted. Thus if the z-score for height-for-age is below -2.0, the child is categorized as stunted.

The SPSS version 16 software was used to analyze data and statistical tests for associations between variables were set at 95% level of significance. Key variables were demographic variables (household size, age, and sex); socioeconomic variables (mothers' education level, household income and assets); food consumption variables; care variables (health care, maternal care, infant and child feeding practices); sanitation variables; nutrition status variables (women BMI, z-scores for preschool children).

The hypothesized associations between independent variables and the dependent variables (nutrition status indices) were evaluated by the bivariate approach. Factors

found to be significant in the bivariate correlations were further analyzed in multiple regression models to determine contributions of variables.

The model for the hypothesis that nutrition status is a function of multiple factors was applied under the following conditions:

(i)   Variables associated with under-nutrition were identified and their relationship explored and a factor was classified as determinant if it was significantly associated with dependent variables derived from the regression analysis

(ii)   Contribution of various variables to nutritional status was computed using the equation:

$Y = b_0 + bv$ where Y is dependent variable, b_0 is a constant and b is coefficient and v is independent variable……………………………………………………………..(1)

Y in the equation is nutrition status index (BMI or weight-for-height z-score or food consumption adequacy score), b is regression coefficient, b_o is intercept and v is explanatory variables.

Content analysis suggested by Weber in 1990 using pre-determined semi-structured guide for topics elucidated was employed to analyze focus group information and come up with key findings. Feelings of the majority and relevant or direct quotation from the participant best describing the feelings are presented.

CHAPTER FOUR

4.0   RESULTS

This chapter presents demographic and socioeconomic characteristics of the study population, long term weather variations in the area and the impacts of these variations on food availability in the household. The chapter also presents nutrition status of household members, factors associated with under-nutrition and relationships among factors influencing nutrition status.

4.1   Demographic and Socioeconomic Characteristics of Sampled Households

A sample of 250 households was used in this study. The proportion of households with low socioeconomic status (SES) was high with most of the households having low quality houses with earth floor (93.8%), grass roofing (57.0%) and galvanized iron sheet (42.0%). Burnt bricks were used in construction of 64% of houses and 23% of the houses have been constructed using poles (Table 6). Close to 50% of the respondents had attained primary school education, 29.7% had no formal education and only 11.5% attained education level above primary school.

Annual incomes accrued from sales except food selling and assets owned by households were used as bases of estimating purchasing power of the households. According to the respondents' estimates, annual household incomes ranged from 76 000 to 17 400 000 (median of 390 000 or 244 US dollars). Asset ownership was low. Many households own bicycles and hoes. Bicycles, radio and mobile phones were owned by 79.8, 73.1 and 66.2% respectively. Ownership of assets such as push cart, gas cooker, television set, house for rent and motorcycle was very low. They were owned by 1.0, 1.4, 2.0, 5.0 and 7.8% respectively.

Table 6: Proportions of respondents in various socioeconomic and demographic characteristics groupings

Variable	%	n
Children below five years of age (male)	51.7	250
Children below five years of age (female)	48.3	250
Households with grass roofing	57.0	250
Household with poles walls	23.0	250
Household with earth floor houses	93.8	250
Household with reliable water	70.2	250
Household with toilet facility	89.3	250
Farming household	93.4	170
Respondents with salary employment	1.3	170
Pastoralists	0.5	170

Table 7 presents mean for various socioeconomic attributes of the households and nutrition status indices. Mean household size was 4.4 ±2. A high proportion of respondents were peasant farmers with small plots of land and crop productivity was low compared to expected yields under optimum inputs and husbandry. Similarly, incomes were rated very low as were estimated at an average of 0.03USD per day (excluding sales of produced food).

Table 7: Mean for various socioeconomic attributes of the households and nutrition status indices (n=250)

Attribute	Mean+SD
Household size	4.4±2
Size of land cultivated in acres	2.8±3
Cereal yield in kg for the last 5 yrs:	
Maize	388.2±314
Paddy	259.4± 782
Annual income in Tshs outside farming	18 460±164 782
Nutrition status indices	
Weight-for-height z-score	0.04±1.3
Weight-for-age z-score	-0.32±1.3
Height-for-age z-score	-0.71±1.8
Women BMI	22.8±4.6

4.2 Perception of Community on Climate Change as Obtained from FGD

Opinion of the participants of FGD on seasons' shift and environment degradation

In general, all groups perceived a clear trend of environment degradation in the village. Results showed agreement of the three separate groups (elders, men and women) on key aspects investigated except that each group was more explicit in aspects affecting them most as a group. Elders were more explicit on description of trends of weather variation over years, environment degradation over years and deterioration of quality of care to children over generations. Women were good in explaining about recent changes in quality of care to pregnant women, deterioration of quality of social services including healthcare and burden brought by deforestation. They declined to answer questions relating to causes of the observed changes. Men were good in explaining about seasons' shift and their impacts on food production and quality of life. Two key issues were identified as concern or outstanding factors behind the environment degradation namely deforestation and overstocking. Overstocking in this village is unique in the sense that

cattle are not coming from within but rather from neighboring Maasai and Barbaig pastoralists hence more of a land dispute between crop farmers and pastoralists than overstocking.

Dissatisfaction with the ongoing deforestation was shown by statements like that narrated by one of the participants: *As a result of exhaustion of trees and communal forest, we are in a serious trouble nowadays; even firewood collection has become a menace as we are obliged to go far away, sometime one is lost on the way and depletion of trees has even caused migration of baboons that used to inhabit this area. On the other hand, charcoal making for Dar es Salaam market is another cause of trees depletion in Rudewa, even traditional and ritual forest believed to harbor ancestors' spirits, hence protected forest is not spared from depletion nowadays!"* Another narrated *"You should realize that population in this village has doubled within a short period of time and most of us have no alternative source of income except harvesting of trees in form of charcoal or burning of mud bricks.*

Another evidence of degradation and human economic activities transforming the environment from stable one to fragile orientation is seen in Table 8 and in the two maps of the same place which reflect two different historical times, 1965 and 2010 in Appendix 7.

Table 8: **Evidence of shift in weather pattern and associated food production reduction as revealed in the focus group discussions**

Content	Typical comments
Weather shift evidence	'We used to have two cropping seasons in the past but nowadays, not only *vuli* but also *masika* has become unreliable' (elders focus group)
	'*Vuli* has acquired names like erratic mango rainfalls and pigeon pea rainfalls meaning may rain only once and lightly' (men focus group)
Description of pattern	*Masika* rainfall may luckily start in March otherwise mostly April and normally lasts for only two months (not beyond June), then *vuli* rainfalls are twice if lucky enough otherwise only once (around September or October); then there is almost useless rainfall around Christmas (once or twice) followed by famous January – February dry spell (men focus group)

4.3 Long-term Weather Variability in Kilosa and its Effects

4.3.1 Weather shift over the last 40 years (1970 – 2013) as recorded by the Ilonga meteorological station

It was observed that reliability of rainfall has been gradually diminishing over the last 40 years, although the amount of rainfall has not changed much over the same period.

(i)   Rainfall

Figure 4 shows that extraordinarily high rainfalls occurred in 1992 and 1997 (119.0 mm and 135.0 mm respectively). There has been a slight decrease in the average annual

rainfall and an increasing fluctuation with time (slightly higher fluctuations in the recent years compared to the past). The duration of dry spells has been increasing and rainfall amounts were diminishing.
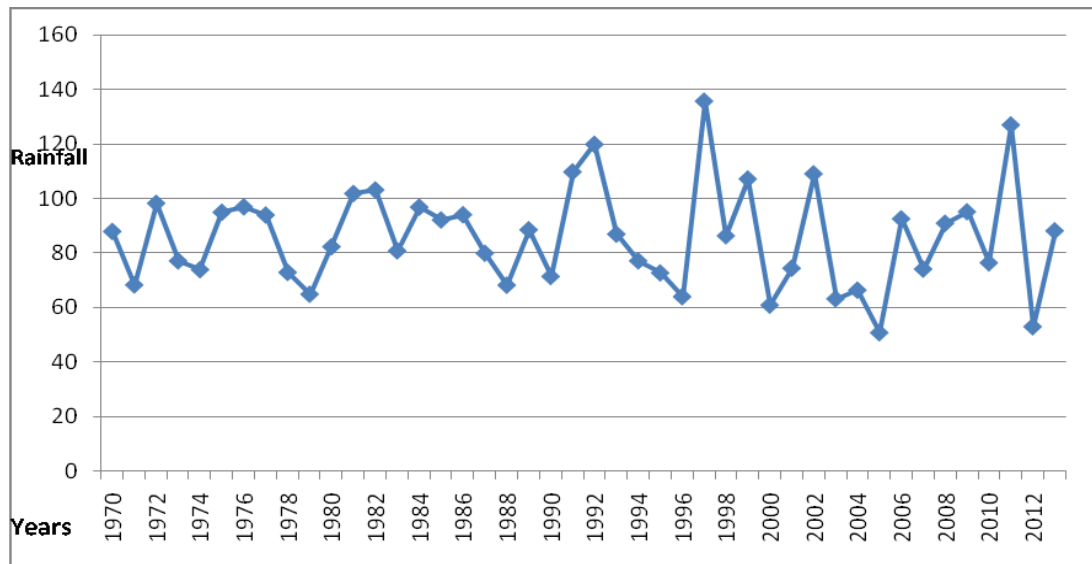
Figure 4: Average annual rainfall in millimetres from 1970 to 2013 in Rudewa.

Applying the assumption set for distinguishing past from present enabled examining distribution of rainfall over past and present time. The 1996 was set as a dividing period between past and recent times, based on the fact that 30 years is normally used as the period over which accurate estimates of long term weather can be obtained hence 1996 divided the period by half (15 years each). There was a clear difference between the two periods (recent and past). It was observed that in the past (before 1996) years, extreme weather used to happen roughly after every seven to sixteen years but recently it has been happening more frequently (an interval of less than seven years) – this is to say that years with rainfall below average have occurred more frequently recently than in the past.

The year 1971 had annual rainfall below average and 4 months of dry spell, it recurred in 1979 (7 years after) and finally in 1996 (after another 16 years) with 3 months of dry spell. Recent occurrence of years with rainfall below average was in 2000 and had 3 months of dry spell. It happened again in 2003 (2 years after), this time with 1 month of dry spell then in 2005 (after another 1 year) with 7 months of dry spell and in 2012 with 5 months of dry spell (Table 9).The remaining years had normal rainfalls (with no extreme rainfalls) all above 70 mm and dry seasons (months with less than 10mm of rainfall) duration of less than 4 months. Moreover, floods occurred in 2008/09 and 2013/2014.

Table 9: Occurrence of extreme low rainfalls and dry spells over the last 40 years

Category of study period	Year	Interval (Yrs)	Rainfall (mm)	Dry seasons duration (months)
PAST	1971		68	4
	1979	7	60	4
	1996	16	59	3
RECENT	2000		56	3
	2003	2	58	1
	2005	1	50	7
	2012	6	54	5

Table 10 presents details of rainfalls onset and end-dates and shows how short (*vuli)* rains have been unreliable to the extent of disappearance in some recent years unlike in the past. Before 1996 there were two years (1982 and 1984) with rainfall throughout the year. Also years without short rains were not observed before 1983 but were several in

recent period. This occurred in 1983, 1992, 1993, 1998, 2000, 2001, 2005, 2010 and 2012.

Table 10: Onset and end-date trends of rainfalls in Rudewa as recorded by meteorological station

Years	Masika-ending	Vuli on-set	Number of months with rainfall < 10mm (dry)	Period of rainfall > 10mm
1970	June	September	2 (July, Aug)	Sept- June
1971	May	October	4(Jun,July,Aug,Sept)	Oct- May
1972	June	August	1 (July)	Aug- June
1973	May	September	3 (June, July, Aug)	Sept-May
1974	June	September	2 (July, Aug)	Sept-June
1975	June	September	2 (July, Aug)	Sept-June
1976	May	October	4(June,July,Aug,Sept)	Oct-May
1977	June	October	3 (July, Aug, Sept)	Oct-june
1978	June	September	2 (July, Aug)	Sept-June
1979	May	October	4(June,July,Aug,Sept)	Oct-May
1980	May	September	2 (June, July)	Sept-May
1981	July	September	1 (August)	Sept-July
1982	Throughout year	Throughout	Raining throughout the year	Raining throughout
1983	July	December	4(Aug,Sept,Oct, Nov)	Dec-July
1984	Throughout year	Throughout	Raining throughout the year	Raining throughout
1985	June	September	2 (July, Aug)	Sep-June
1986	May	August	2 (June, July)	Aug to May
1987	May	July	1 (June)	July-May
1988	June	August	1 (July)	Aug-June
1989	June	August	1 (July)	Aug-June
1990	May	October	4(June,July,Aug,Sept)	Oct-May
1991	May	July	1(June)	July-May
1992	June	November	3 (July, Sept, Oct)	Nov-June
1993	May	November	5(June,July,Aug,Sept, Oct)	Nov-May
1994	May	October	3 (June, July, Sept)	Oct- May
1995	May	October	3 (June, July, Sept)	Oct- May
1996	May	September	3(June, July, Aug)	Sep-May
1997	August	October	3 (July, Nov, Dec)	Oct-Aug
1998	June	January	3 (July, Nov, Dec))	Jan-June
1999	June	August	1(July)	Aug-June
2000	September	November	1 (Oct)	Nov-Sept
2001	June	November	4 (July, Aug, Sept, Oct)	Nov-June
2002	May	August	2 (June, July)	Aug-May
2003	July	September	1 (Aug)	Sept-July
2004	June	September	2 (July, Aug)	Sept-June
2005	May	November	5(June,July, Aug,Sept,Oct)	Nov-May
2006	June	Aug	1(July)	Aug-June
2007	August	October	1(Sept)	Oct-Aug
2008	June	October	2 (July, Sept)	Oct-June
2009	June	October	3 (July, Aug, Sept)	Oct-June
2010	May	December	6 (June, July, Aug, Sept, Oct, Nov)	Dec-May
2011	May	September	3 (June, July, Aug)	Sept-May
2012	May	November	5(June, July, Aug, Sept, Oct)	Nov-May
2013	May	September	3(June, July, Aug,)	Sept-May

Fig. 5 shows that number of dry months in a year has an increasing trend over the 43 years examined. The number of dry months in a year was highest in 2010 and lowest number was recorded in 1972.
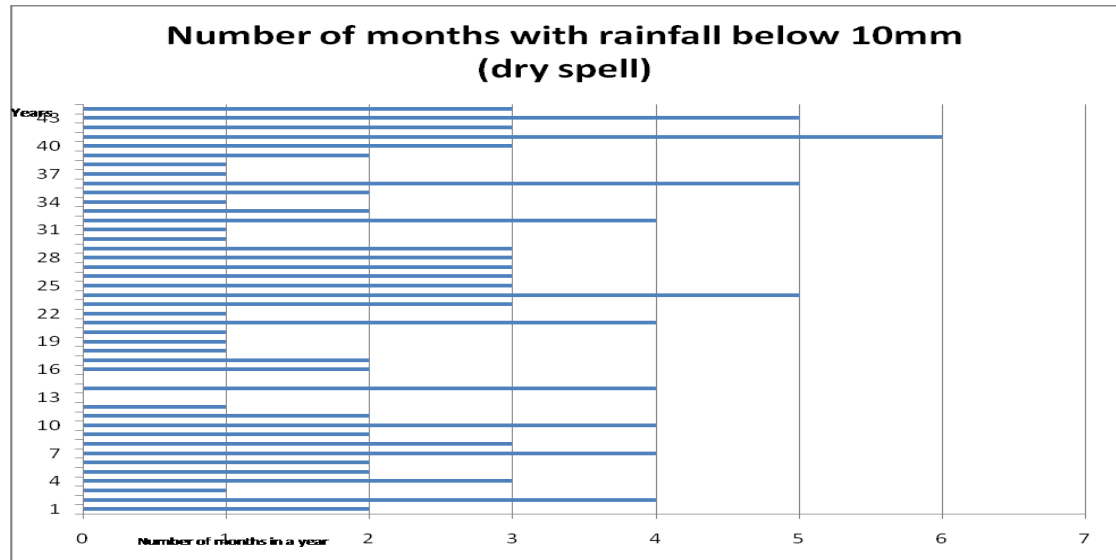
Figure 5: Number of months with rainfall below 10mm (dry spell) in each year for the period of 43 years examined.

(ii) Humidity

Before 1995 there was not significant change of relative humidity recorded. A marked jump occurred from 1999 to 2000 when relative humidity increased from 50 to 70% (Fig. 6). Thereafter it has been increasing up to 75 in 2013. Monthly variation was high and most of the rain season months had a decreasing trend over time. The most humid month was June and showed a decrease from 88% in 1989 to 48% in 1994. June 1989 was the highest (88%) of all the 40 year period and the lowest was recorded in December 1993 which was 35%.
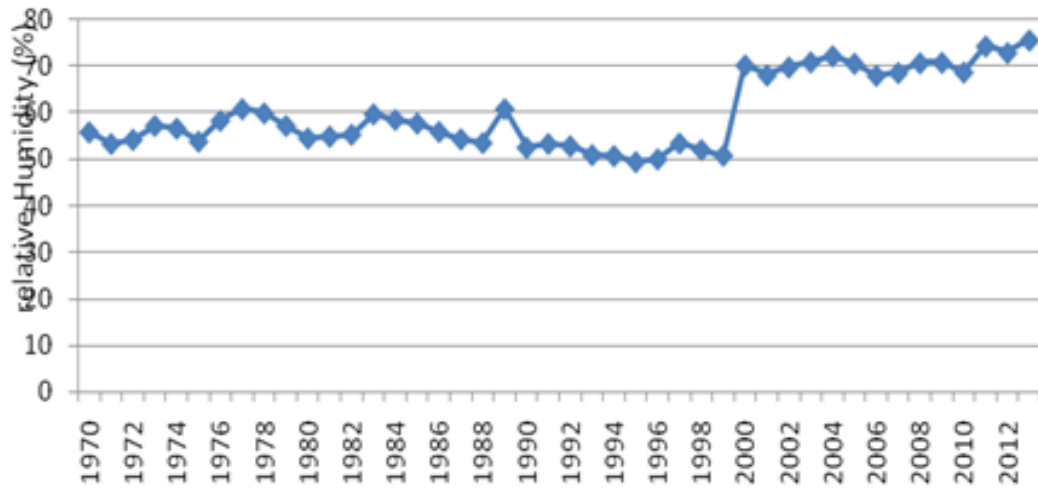
Figure 6: Average relative humidity from 1970 to 2009 in Rudewa.

(iii)   Temperature

Temperature has been increasing gradually over the last 40 years. The maximum annual temperature has increased by 1.8 ^{o}C during that period and the minimum annual temperature by 2.0^{o}C. The lowest maximum temperature was recorded in 1970, which was 29.8 ^{o}C and highest maximum temperature was recorded in 1983, which was 31.6^{o}C (Fig. 7). The average maximum annual temperature for that period was 30.7^{o}C while the minimum annual temperature was 19.8^{o}C.
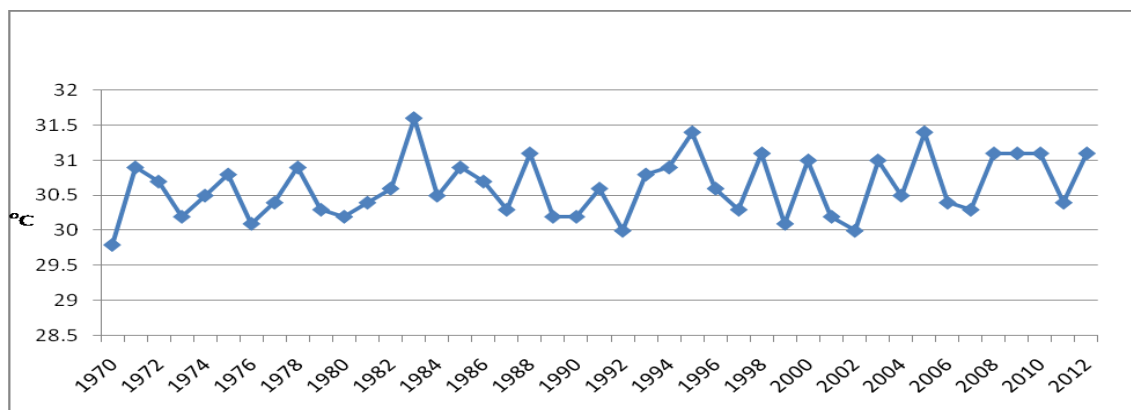
Figure 7: Average maximum temperatures in ^{o}C in Rudewa.

Maximum temperature above 31°C was assumed extreme as suggested by Mutabazi in 2007 (Mutabazi, 2007) and hence employed that assumption to identify years with extremely high temperatures. These extremely high temperatures were not observed before 1983. There has been an increasing trend of occurrence of high temperatures with time and the intervals in between have been 12, 3, 8 and 2 years respectively. These happened in 1983 (with 31.6°C), 1995 (with 31.4 $^{\circ}$C), 1998 (with 31.1°C), 2006 (with 31.4°C) and 2008 (with 31.1°C). Likewise, extreme high average monthly temperatures were more evident recently than in the past and none was observed before 1982. Records show that out of 12 months of extreme temperatures, five occurred between 1970 and 1990 (spread over twenty year period), seven occurred between 1994 and 2009 (spread over fifteen year period), of which five of them occurred after 2003 (in the last six year period).

4.3.2 Climate change and environment degradation

Using a 50-point scale to determine community perceptions on climate change and consequences on livelihoods, an overall score of 31 points out of 50 points was recorded. Table 11 presents details of respondents' opinion for each question asked. Respondents were of the opinion that weather pattern has changed, rainfall reliability is diminishing over time, trees are diminishing in the area together with forest products like firewood. According to them, weather related diseases have not increased over time nor water scarcity.

Table 11: Observed distribution of various scores for each statement relating to climate change and consequences as scored by respondents

Statement	n	Proportions of various scores		
		Agree scores (4 & 5)	Disagree scores (1 & 2)	Undecided score (3)
Changing weather patter	245	84.9	11.0	4.1
Dry spells more common now	247	77.0	17.0	6.1
Trees are fewer now than in the past	244	83.6	12.7	3.7
Presence of diseases related to climate	243	25.5	50.0	24.3
Traces of desert threat in the area	240	33.7	50.8	15.4
Charcoal making should continue	244	27.5	61.1	11.5
No shortage of forest product/resource	244	33.6	51.6	14.8
Water resource is abundant	243	63.7	35.0	1.2
Firewood availability not a problem	238	35.7	60.9	3.4
Firewood accessible in the vicinity	246	28.0	62.6	9.3

4.3.3 Significance of the perceived weather change on peoples livelihoods

Respondents were asked about perceived economic wellbeing (to rate their satisfaction) in relation to farming in the last five years and results showed that 51% of them were of the opinion that their economic wellbeing has diminished. Causes of the perceived diminishing of benefits accrued from their farming and other sources of livelihood cited were:

(i) use of hand hoe farming technology and insufficient use of farming inputs (44.1%), namely fertilizers and insecticides

(ii) unreliability of weather (26.5%)

(iii) insufficient social services (19.6%) namely health care services, education and credit facilities.

In addition, respondents were asked about risks faced in their crop farming operations and numerous farming risk sources were identified.

(a) Farming risks identified by respondents

All of the respondents were of the opinion that their farming operations have been impacted at various levels by risks (about 60 % claimed severely and 40% rated it moderate). According to their opinion, the risk sources included human related risks like morbidity/ailments, soil related risks, pests related risks and weather related risks. Weather related risk factors collectively formed the main (63.8%) risk of crop failure (Table 12). Unreliability of rainfalls, long dry spells and diseases were observed as most important threats to their livelihoods. Respondents were also required to rank the incidences to get an impression of order of importance by scoring their responses in a 100-point scale and a similar distribution of contribution of various factors was obtained.

Table 12: Sources of farming risk perceived by farmers and their ranking (n=130)

Risk factor	Households perceiving it as risk factor (%)	Ranking score in 100-point scale
Insufficient rainfall	31.3	22
Dry spells	32.5	24
Crop pest/disease	14.7	21
Loss in store	13.7	23
Human disease	7.8	10

Respondents were also asked to estimate duration of rainfalls for the last eight years and judge whether they were sufficient or not. Generally it was observed that rainfall was sufficient for sustaining farming in most (74.4%) of the seasons especially in the most recent years although rainfall duration was generally short. Rainfall duration which dominated was four months (observed by 37.5% of respondents), followed closely by three months (observed by 36.3% of respondents). Table 13 combines trend of rainfall for the recent years with other related aspects and shows that there was improvement in rainfall amount over recent five years with a steady increase of non-farm income over the period but food production (in kg per season) in the households did not change much over the period.

Table 13: Farmers weather rating, annual yield of cereals in kg (maize and paddy), annual incomes (excluding sales of cereals and pulses) and prevalence of under-weight in infants (<1year) over the last 8 years

Year	WR*	RD**	Maize	Paddy	Incomes+sd	N	Underweight %)	N
201/12	G	5	342	152	18 460±164 782	130	0.0	52
2010/11	G	4	436	352	12 883 ±38 048	130	2.5	55
2009/10	G	4	387	513	10 290 ± 26 982	130	3.7	53
2008/9	G	3	401	142	8 777 ± 23 916	130	2.0	50
2007/8	P	3	375	138	7 766 ± 20 853	130	3.2	95
2006/7	G	3	na	na	na	na	3.0	66
2005/6	P	4	na	na	na	na	3.5	85
2004/5	P	4	na	na	na	na	10.2	68

*WR= weather rating of a season as judged by respondents (P stands for poor and G stands for good rainfalls)
**RD= rainfall duration in complete months for the two seasons (*vuli* and *masika)*
Na =not available

On coping with the observed unreliability of weather 43.1% of the respondents indicated that they shifted their dependence on crop farming as main source of livelihood to other activities (Table 14). The alternative sources of livelihood have been labour selling (53.0%) and petty business (47.0%), mainly local brewing, food vending, bricks making and charcoal making.

Table 14: Farmers' adaptation strategies for experienced drought (n = 130)

Strategy Action	%
Changing crop husbandry	16.7
Changing crops cultivated	40.2
Changing livelihood	43.1

4.3.4 Significance of weather change on productivity of major crops in Kilosa district for the last 15 seasons

Examining the last twenty years district food production data (1995 to 2013) revealed a gradual declining trend in productivity (Fig. 8). Productivity reduction for paddy and pulses was consistent with reduction in rainfall for the period as the lowest productivity was observed in the poorest season (2004/2005). Other low productivity for paddy and beans were observed in 1996 and in 2000 which were the years with extreme low rainfalls as well. Lowest productivity for maize and other pulses were recorded in 2009 for reasons that could not be established.
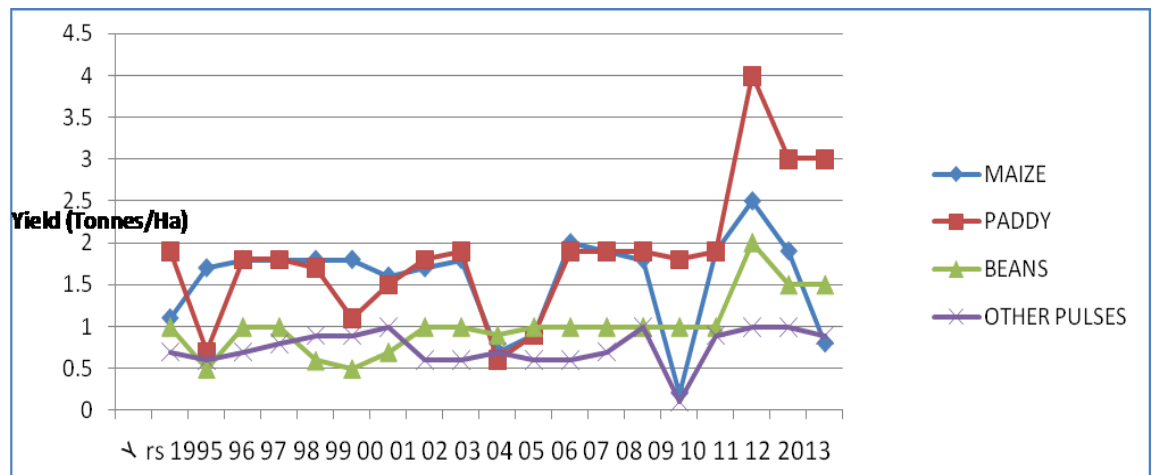
Figure 8: **Productivity level (in Metric Tonnes per hectare) for major food crops in Kilosa district for 1994/95 to 2008/9 seasons**

4.4 Factors Influencing Food Availability

Information was sought on means of accessing food, size of land cultivated by household, types of crops cultivated, yields and adequacy of food produced. About 57% of the households depended on their own production as main source of food; hence risky because having more than half of the household depending on cash to buy foods is not a healthy situation for a rural community.

In the season prior to the study they cultivated sorghum, maize, pigeon pea, paddy, beans, cowpea, sunflower and peanut as major crops. Table 15 shows that number of acres cultivated ranged from 0 acre to 34 acres and mean was 2.8±3 acres. Yields ranged from 1kilogramme recorded for pigeon pea to 3 000 kilogrammes recorded for maize and most (62%) of the households reported food shortage. There was a positive correlation between the size of farm cultivated by household and availability of food in the household throughout the year (r=0.25; p<0.05).

Table 15: Yields of food crops produced per household in the season preceding the interview

Food crop	N	Median of yield(kg)	Range
Maize	210	474.5	4 – 3 000
Paddy	156	164.0	12 – 1 800
Sorghum	6	49.0	6 – 2 500
Beans	72	60.0	10 – 270
Pigeon pea	69	40.0	1- 1 800
Cowpea	48	22.5	2 – 400
Peanut	52	22.5	3 – 180
Sunflower	48	45.0	6 – 300

4.5 Nutrition Security

Nutrition security is an outcome of many factors therefore not all were examined in this study. Food consumption, morbidity, hygiene and sanitation were major aspects examined in addition to food availability. Nutrition status was assessed and factors influencing it identified. A variety of scoring system was developed to assess food intake and sanitation. Anthropometric measurement was the method used to assess nutrition status of household members.

4.5.1 Food consumption in the households

Results of 24-h recall showed that the mean number of meals consumed per day was 2.9 ± 0.6 and diversification of diets was low (meal diversity score had a mean of 2.4 out of 4-point scale). Proportion of respondents with lowest score (1) was 15.5% and proportion with best score (4) was 50.8%.

Habitual food consumption as assessed by FFQ showed dominance of maize, rice and cassava as they scored 3.8, 3.1 and 3.0 respectively out of 4-point scale. This was followed by banana and sweet potatoes with 2.8 and 2.0 scores, respectively. Consumption of animal source foods (ASF) was low as the only substantial consumption was that of sardines which was eaten weekly (score of 3.0). Beef, fish and milk were consumed rarely scoring 2.3, 2.2 and 2.1 respectively. The same low consumption was found in fruits where highest score were that of banana, pawpaw and citrus which were 2.8, 2.4 and 2.1 respectively. Vegetables and legumes were frequently consumed, beans and amaranth scoring 3.5 and 3.4 respectively. Sweet potato leaves scored 3.2 and cowpea leaves scored 3.0. Low consumption was recorded for other leafy vegetables (2.7). Other substantial frequency of consumption was found with vegetable cooking oil which scored 3.7 out of 4.0 points, while coconut milk and groundnuts were rarely consumed (2.7 and 2.2 scores respectively).

4.5.2 Nutrition status of children

A total of 234 pre-school children were assessed, of which 121 were boys and 113 girls with varying age categories as shown in Table 16.

Table 16: Distribution of number of preschool children in age categories and sex

Age categories(months)	Boys		Girls		Total	
	n	%	N	%	n	%
0-5.99	7	5.8	6	5.3	13`	5.6
6-11.99	8	6.6	8	7.1	16	6.8
12-23.99	23	19	32	28.3	55	23.5
24-35.99	35	28.9	24	21.2	59	25.2
36-47.99	24	19.8	26	23.0	50	21.4
48-59.99	24	19.8	17	15.0	41	17.4
Total	**121**	**100.0**	**113**	**100.0**	**234**	**100.0**

Table 17 shows that out of 234 children under the age of five years who were assessed, 39% were stunted. Prevalence of stunting in children under five years of age varied by hamlets and family size (p = 0.003, X^2=25).The highest prevalence of stunting was observed in Mkoroshini (47.6%), followed closely by Kigenge (46.7%) and the lowest was in Muungano hamlet (30.0%) while being in household with between 3 and 6 members meant higher risk of being undernourished than in any other category (p<0.05, X^2=29).

Table 17: Household characteristics and prevalence of stunting in children below five years of age by hamlets

Particular	Shuleni		Muungano		Kigenge		Mkoroshini		All	
	n	%	n	%	n	%	n	%	n	%
Family size										
Below 3	9	20.9	12	23.1	6	16.2	10	21.7	37	20.8
3 – 4	11	25.6	19	36.5	10	27.0	16	34.9	56	31.5
5 – 6	11	25.6	16	30.7	17	46.0	14	30.4	58	32.5
7 and above	12	27.9	5	9.7	4	10.8	6	13.0	27	15.2
Stunting	30	37.0	15	30.0	38	46.7	20	47.6	91	39.0

There was no significant difference between boys and girls nutrition status but the difference was huge among age categories and among hamlets and about 4 percent of all children under the age of five years were obese. Stunting increased with age, climaxing before the age of three and dropping thereafter. Before six months of age undernourishment was not evident (Fig. 9).
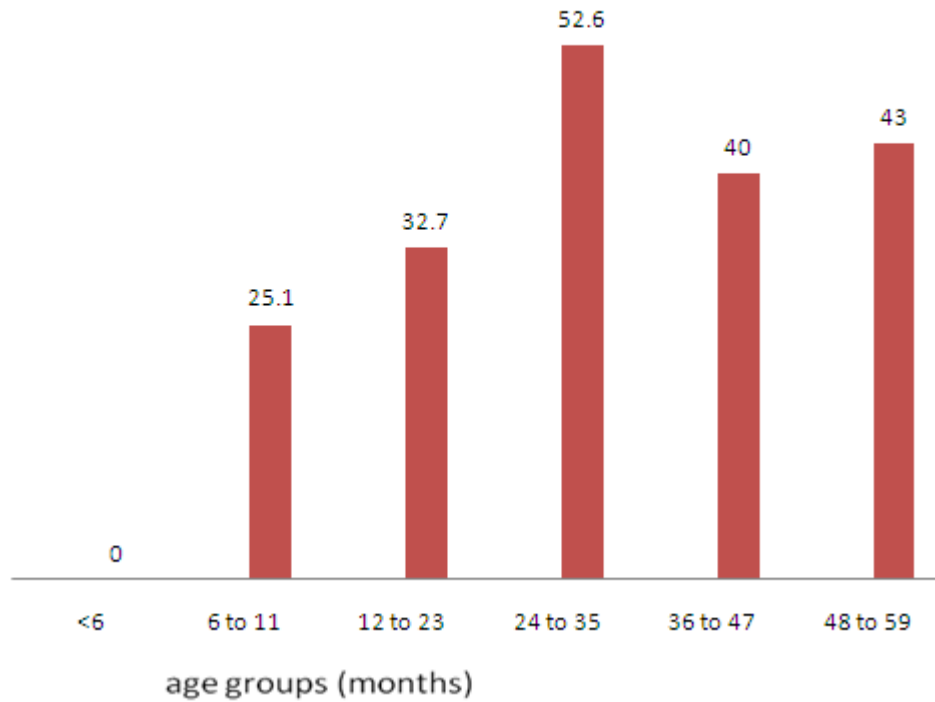
Figure 9: Stunting by age categories.

Children aged 24-35.9 months had a significantly (p=0.03, X^2=25 df 9) higher proportion of stunted children compared to other age groups (Table 18).

Table 18: Nutritional status of children (using height-for age index) by age categories

Nutrition status	Age categories (Months)											
	0-5.9		6-11.9		12-23.9		24-35.9		36-47.9		48-60	
	n	%	n	%	N	%	n	%	N	%	n	%
Moderate stunting	0	0.0	3	18.8	8	14.5	23	39.0	15	30.0	13	31.0
Severe stunting	0	0.0	1	6.3	10	18.2	8	13.6	5	10.0	5	12.0
Normal nutrition status	13	100	12	75.0	34	61.8	27	45.7	28	56.0	22	54.0
Total	**13**	**100.0**	**16**	**100.0**	**55**	**100.0**	**59**	**100.0**	**50**	**100.0**	**41**	**100.0**

Apart from sample survey data, there were facility based data (secondary data) collected over years and used by community health worker to monitor trend and deliver health and nutrition service in the village. According to these facility based data, there was a declining trend of under-nutrition in infants for the last six years from 10.2% in 2005 to 3.0% in 2013 (Table 19).

Table 19: Prevalence of under-nutrition (using weight-for-age index) in children under the age of 1 year for the last nine years based on clinic records

Year	Number of children assessed	Prevalence (%)
2013	40	5.0*
2012	52	0.0*
2011	55	2.5
2010	53	3.7
2009	50	2.0
2008	93	3.2
2007	66	3.0
2006	85	3.5
2005	68	10.2

***Note that examining clinic records revealed anomaly in keeping of records for recent years (2012 and 2013), questionable figures were obtained because some books were missing (all the rest were well organized)**

Table 20 presents data collected from the village reproductive and child health clinic by village health worker and normally used to guide routine advisory services delivered by the health worker. According to this data set, similar improvement was observed over recent years when compared to the past and this affirms success in reducing global acute

malnutrition. The highest prevalence of underweight was recorded in 1991(42.0%) and the lowest was recorded in 2012 (6.9%).

Table 20: Prevalence of under-weight in children under-five years of age based on routine village health worker records

Year	Quarter 1		Quarter 2		Quarter 3		Total	
	n	%	n	%	N	%	n	%
2013	515	7.7	511	7.4	410	8.4	1436	7.8
2012	305	9.1	312	4.8			617	6.9
2011	310	8.6	294	11.6	285	5.9	889	8.7
2001							1 283	20.8
1999							370	30.5
1996							354	34.3
1994							348	36.4
1993							230	33.9
1992							363	24.5
1991							264	42.0
1988							312	36.4

4.5.3 Nutrition status of women

Prevalence of under-nutrition in women was 5.8% while prevalence of moderate overweight was 22.7%. Prevalence of obesity was 7.1% (Table 21).

Based on women BMI, this population had malnutrition characterized by high prevalence of both under-nutrition and obesity.

Table 21: Nutrition status of women and their children in Rudewa-Mbuyuni village

Group	n	%
Children under five years		
Stunted	91	39.0
Underweight	35	15.0
Wasted	4	1.7
Obese	11	4.7
Normal	93	39.6
All children	234	100.0
Adult (women)		
Low BMI (less than18.5)	9	5.8
Moderate over-weight 25.0 -30.0)	35	22.7
Obese (BMI above 30)	11	7.1
Normal(18.5 – 24.9)	99	64.4
All women	154	100.0

4.5.4 Morbidity

Respondents reported about occurrence of any illness in the household for the past two weeks preceding the interview. Almost 47% of the households reported illness in the reference period. Diseases commonly afflicting this community were malaria with prevalence of 45.0% in children and 43.3% in adults, followed by diarrhea with prevalence of 23.6% in children and 23.3% in adults.

4.5.5 Hygiene and sanitation

Hand-washing practices were assessed by asking mothers when they normally wash hands and their responses were judged based on coverage of critical points that need hand washing namely before eating, before feeding babies, after cleaning baby's bottom and after using the toilet. Mothers were also asked how they dispose off baby' faeces

and garbage from households and whether they treat drinking water to ensure safety. Results are presented in Table 22.

Table 22: Proportion of respondents practicing hygienic and sanitation measures (water treatment and hand-washing)

Assessed aspect	N	%
Water treatment		
Households boiling as water treatment	249	5.2
Households adding water-guard	249	0.8
Households letting water to settle as water treatment	249	18.9
Households applying no treatment	249	74.8
Hand-washing practice		
Not washing hands before eating	250	3.6
Not washing hands after using the toilet	250	49.2
Not washing hands after cleaning baby bottom	250	72.8
Not washing before feeding baby	250	56.0

Time taken to and from the water source had mean of 27.6 ± 11.6 minutes. Access to water influenced hand-washing as time taken to and from water source was strongly correlating with hand-washing practices score. Sanitation quality had mean score of 2.3 ± 0.8 out of 4-point scale and prevalence of sanitary related disease was 72%. Households with low hygiene and sanitation score had significantly higher reported sanitary related disease occurrence ($p<0.001$).

Assessment of availability of toilet facility, its type and cleanness was done by observing and assigning points accordingly based on the devised criteria. Results of this observation revealed that the proportion of households with toilet facilities were 87.3%. Only 11.8% of households had good, clean, and permanent toilets while 14.5% had temporary toilets. A big proportion (52.7%) of toilets was unroofed and 30% of the toilets were dirty. Moreover, quality of toilet was correlating with income (r=0.30), although income had no influence on hand-washing practice. Plate 1 shows a typical pit latrine found in most of the households in the study area.

Plate 1: Typical unroofed toilet in Rudewa-Mbuyuni village

4.6 Maternal and Child Care

Both focus group discussion and structured interviews were used to assess adequacy of care for women and children in the households. Aspects covered were antenatal care and spouse support, infant feeding, child feeding, psychosocial support and stimulation, immunization and health care services.

Results from FGD

General perception of the community is that economic activities (farming and petty business) are priorities over all other activities done by women. Men narration presented view with connotation that *additional care to pregnancy as unnecessary and unacceptable attention seeking.* Even the women group had the general perception that economic activities should be priorities over women welfare. They are somehow satisfied with what they are getting as care and support during pregnancy because they believe it is in line with culture and norms. The only difference observed in women group is their opinion that men (particularly young men) are nowadays becoming irresponsible when it comes to care. Reasons given include globalization and income poverty. They believe that care quality among young couples has dwindled partly due to adoption of foreign lifestyle evidenced by early and unexpected pregnancies and weak marriage bonds. One participant in the women group said: *Globalization has increased teenage pregnancies and weak marriage bonds and all these have led to maternal care neglect compared to the past. Attentive child care is lacking nowadays partly because this by nature is a costly responsibility requiring discipline and patience which is beyond what our youths can comprehend because they are leisure and amusement minded! Who cares for the needy today! There is none.*

It was further noted that child care is a sole responsibility of mothers and they are not expected to leave children at home in case they travel unless it is an emergency. Men normally spend most of their time outside home.

On eating arrangement in the households, serving of food was reported to consider gender and age. Men normally eat alone or with elder boys and get first priority whereas young children normally eat with their mothers.

4.6.1 Maternal care (findings of qualitative survey)

Results from household interviews showed that about 50% of the women had opinion that spouse support during pregnancy was insufficient. Major causes of insufficient support provided to women during pregnancy were related to traditions.

4.6.1.1 Attendance to antenatal care

Women were asked about frequency of the attendance to antenatal care during their last pregnancy and understanding on the importance of antenatal care. Although most (94.6%) of them attend antenatal care at least once, diversity was high in terms of numbers of visits whereby about half of them fulfilled the number of visits (>4) recommended for whole pregnancy period.

Table 23 presents proportions of pregnant women attending antenatal care disaggregated by duration of attendance in months. This gave actual impression of what happened because attendance schedules in clinics are planned on monthly basis. They were also asked about birth outcomes (birth weights of their babies verified using the clinic cards) and whether they ever had any still birth.

Table 23: Proportions of pregnant women attending antenatal care disaggregated by duration of attendance in months categories (N=136)

Number of months attended	N	%
<3	4	3.0
3 – 4	76	56.2
5 – 6	35	25.5
>6	21	15.3

Table 24 shows the number of visits in relation to gestation age. About 48% of pregnant women made their first visit when they were more than 4 months of pregnancy, the time considered late attendance according to the WHO recommendations.

Table 24: Proportions of various antenatal care (ANC) visit categories and distribution of the visits in nine months period of pregnancy (gestation age)

Number of visits	%	Gestation age (months)	%
None	6.4	No antenatal care	6.4
1	1.6	<4	46.1
2-3	46.0	4-5	46.0
4+	46.0	6-7	1.0
		6-9	0.5
Total	100	Total	100

Mothers knew why they should attend antenatal care throughout the schedule but the practice did not match this understanding (knowledge). Gestation age for the first visits was   3.16 $\pm$0.9. About 6% of the women did not attend antenatal clinics for the entire pregnancy period. Generally birth weights were good with 3.1$\pm$ 0.4. However, some still births were reported (Table 25) indicating poor outcome.

Table 25: Duration (in months) of antenatal care attendance, women perceptions on the right timing and observed birth weights (n = 136)

Assessed aspects	Mean $\pm$ SD
Duration of attending ANC	$4.6 \pm .1$
Gestation age perceived by respondents as proper for first visit to ANC	3.16 ± 0.9
Birth weight in kg. (from RCH cards)	3.15 ± 0.4
Number of still birth (in the life of respondents)	1.63 ± 1.1

4.6.1.2 Community perception on maternal care and support

Almost all of the participants viewed economic activities (farming and petty business) as more important compared to caring activities. Women are somehow satisfied with care and support they are getting during pregnancy because they believe it is in line with culture and norms.

Men were of the opinion that additional care to pregnant women is unnecessary. About half of them viewed mother-in-law as the one responsible for caring for pregnant women, accompanying her to ANC, delivery and postnatal care. Most men never thought that it is their responsibility and the tendency of male spouses to accord too little weight or importance to care were also reflected in the financial resource they normally allocate to expenses related to pregnancy care up to delivery. About 25% of them do not allocate any financial resource to pregnancy and post delivery care. The main reason for not allocating financial resource to pregnancy and delivery care was men's belief that it is not a priority or not necessary.

4.6.2 Child care

Significant variation was observed as far as child care is concerned, with diverse reasons given for observed low quality of feeding and insufficient time to attend to child needs. Generally, mental and social needs of young children were known by few respondents.

4.6.2.1 Infant and child feeding

Mothers were asked about the status of breastfeeding of the last child whereby 59% indicated that they initiated breastfeeding immediately after delivery (within the first hour after delivery), about 36% initiated breastfeeding beyond one hour and 4.5% initiated one day after delivery. Only 15.5% of infants below the age of 6 months are exclusively breastfed. Reason given by the majority (63.5%) for not breastfeeding exclusively for that long related to mothers' assumption that breast milk was no longer sufficient for the infant at age beyond 3 months. Others (13.1%) reported to have suffered abnormalities and ailments and cultural barriers or norms were reasons for 12.4% of respondents. About 10% were of the opinion that economic activities are more pressing (women's workload and prioritization) making introduction of solids early inevitable for them. Thus, heavy workloads burden on lactating mothers is one of the major factors (details presented in Appendix 8) followed by insufficient knowledge of proper feeding and negative attitudes towards toddlers care.

Introduction of foods to infants was based on baby's behavior rather than professional guidance. Foods were often introduced when the baby showed interest in foods or was crying extraordinarily. Porridge made from maize flour was the most common complementary food used by most (58%) of respondents. Other complementary foods were mashed potato and vegetables. Results of assessment of child feeding practices show inadequacy of feeding as they fell short of what is recommended by WHO as

feeding frequency for children under the age of five years which is 5-6 times a day. The mean feeding frequency for children under the age of five years was 2.5+0.9. About 88% of children in the age of complementation (6 months) were fed less than 4 times a day.

4.6.2.2 Time devoted to care by household members

To further explore details on care, mothers were asked to estimate time they spent to stay with toddlers and time spent by other members of the household. It was observed that mean time spent by mothers to stay with young children was 2.6 +1.7 hours per day compared to that used by sibling which was 5.1 + 1.1 hours per day. According to the schedule of activities of women monitored for two months (August and November, 2011), time spent on caring for children was about three hours per day while most of the time was spent on farm work (See Appendix 8). Despite the fact that for the period monitored, some days fell in month of Ramadhan, in total women who got extra time apart from farming and household core (food processing, cooking, fetching water, washing and cleaning) during that monitored period were about 75% of the sample. When respondents in Ramadhan fasting category were excluded in the sample, women with extra time diminished to 63% hence about 37% were overwhelmed with heavy workloads. They depended solely on siblings to care for toddlers.

4.6.2.3 Community attitudes towards recommended or conventional care

Assessment of community attitudes towards recommended holistic (physical, mental and social coverage) care showed that they do not comply as they scored 29 out of 50-point scale. However they believed that pregnant women are overworked in their community though the connection of this situation to pregnancy outcomes was not obvious to them. They were also in favour of recommended family planning and against

harsh punishments. They disagreed with recommended child freedom, early stimulation and attentive care to elder children beyond 2 years of age (Table 26).

Table 26: Distribution of scores among agreement, disagreement and neutral scores for conventional care

Statement presented scores	n	Proportions of various scores		
		Agree scores (4&5)	Disagree scores (1&2)	Undecided score (3)
Caring is for children, not for wives	245	21.6	74.3	4.1
Care equally for all children	245	59.6	33.0	7.4
Provision of care covering, psychomotor, affective and cognitive development are important	245	32.2	60.8	6.9
Talking to infants stimulates developmental faculties	244	17.5	74.2	8.3
Responding to questions asked by children a necessity	243	52.4	35.7	11.9
Harsh punishment necessary	243	30.1	67.1	2.9
Liberty to children detrimental for their future	244	76.6	19.3	4.1
After 2 years of age no more worry for child care needs	241	71.4	24.9	3.7
No need of family planning	242	30.1	64.1	5.8
Pregnant women are overworked	243	79.1	14.4	6.5

4.6.2.4 Mental and social needs of young children (Psychosocial stimulation and support to growing children)

Children need time to play and stimulate or exercise their intellectual faculty and child activities need to be guided by care providers especially for young children by allocating sufficient time for guided or monitored playing. In the present study it was found that only 33% of the respondents allocated time for children to play. About half of the respondents did not participate in children play. Lack of time, not necessary and unable

to cope with children activities were reasons given by 55, 24 and 17%, of respondents respectively.

4.6.3 Health services seeking behavior

Community members believed that health care services provision is far from adequate and that quality of services has been deteriorating over time. Main reasons given for the deterioration over time was population growth that is not accompanied with increased services therefore compromising accessibility. Apart from poor accessibility, quality of services was low and service seeking behavior was poor. About half (52%) of the respondents do not normally send their sick children to the health facility. About 8% of respondents use medicine without prescription and about 4% are regular users of traditional healer's services (Table 27). Medicine supply was the most important constraint identified by respondents (51.2%), followed by lack of money to pay for the services (24.2%) and arrogant/unacceptable conduct of the health service providers (23.0%).

4.7 Relationships among Factors Influencing Household Food and Nutrition Security

Relationships among factors influencing household food and nutrition security were examined. Table 28 shows that notable relationships were the observed significant correlation between nutrition status as shown by BMI, WAZ, WHZ indices and paddy production (r=0.50) and food consumption (r=0.20).

Table 27: Health care service seeking behavior and perception of respondents on quality of health care services provided, constraints faced and attitude towards professional advice

Item assessed	n	%
Health service seeking behavior (n=206)		
Regular seekers of conventional medicine services	181	87.8
Self medication practices	17	8.3
Regular users of alternative medicine (traditional)	8	3.9
All	**206**	**100**
Respondent's perception on constraints (n=325)		
Affordability by respondent as perceived constraint	80	24.2
Medicine supply as perceived constraint	169	51.2
Personnel shortage/conduct as received problems	76	23.0
All	**325**	**100**
Source of health and nutrition advice / Outcome (n=104)		
Source		
Relatives	51	50.4
Health/Nutrition professionals		
Neighbors	44	42.4
Others	7	6.2
All	2	1.0
	104	100
Outcome		
Home deliveries (including TBAs homes)		
	14	13.4
Gvt hospital facilities deliveries		
	86	82.8
Other facilities deliveries	4	3.8
All	**104**	**100**

Table 28: Correlation matrix of selected variables

	BMI	Consumption-adequacy score	HH income	Hand-washing score	Toilet quality score	Maize production	Paddy production	Beans production	Household farm size	Z-score for children WAZ HAZ WHZ
BMI										
Consumption-adequacy score	0.20**									
HH income	0.25*	0.3**								
Hand-washing score	0.2*	0.05	-0.02							
Toilet quality score	0.20*	0.22**	0.31*	0.38**						
Schooling years	0.07	0.01	0.0	0.0	0.0					
Maize production	0.20	0.25**	0.22**	0.0	0.0					
Paddy production	0.5**	0.15*	0.21*	0.1	0.0	0.31**				
Beans production	0.1	0.0	0.17	0.0	0.0	0.37**	0.37**			
Household farm size	0.1	0.25*	0.34**	0.0	0.16	0.34**	0.31**	0.02		
Z-score for children										
WAZ	0.20	0.28*	0.1	0.1	0.0	0.1	0.1	0.0	0.0	
HAZ	0.0	0.20	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
WHZ	0.22	0.27*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

** - Significant at $p<0.01$ * - Significant at $p<0.05$

Income also had strong influence on size of farm cultivated (r=0.34), cereal production levels (r=0.22), food consumption levels(r=0.30) and sanitation quality (r=0.31).

4.7.1 Influence of agricultural factors on food consumption

Substantial number of respondents cultivated cereals (82% of respondents cultivated maize, 61% of respondents cultivated paddy) in the season preceding the study. However, although cereal production significantly correlated with income and food intake, their contribution to nutrition status (z-score index) was minimal (Fig. 10). Farm size was positively and significantly ($p<0.05$) correlated to food consumption score (r=0.25) and households with higher yield of maize and higher yield of paddy were more likely to have adequate number of meals per day (r=0.25, $p<0.01$ and r=0.14, $p<0.05$ respectively). Moreover, households with food all year round had significantly higher food consumption (r=0.30, $p<0.001$). It is obvious that influence of agricultural factors on food consumption was huge but insignificant contribution to nutrition status of children.
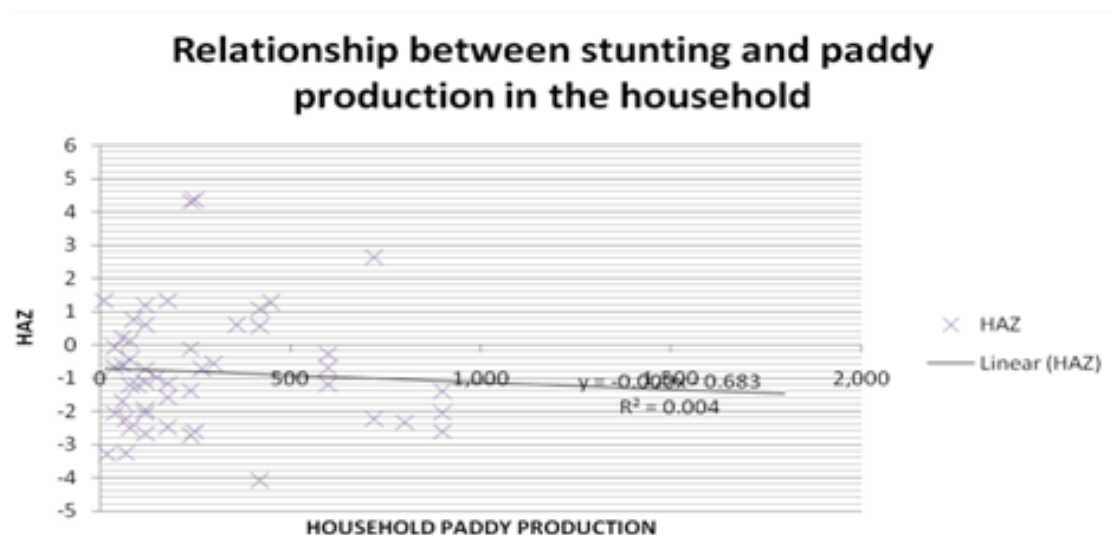
Figure 10: Regression line and equation for contribution of household production of paddy in kilograms to nutrition status of children.

The same relationship that prevailed for children under five years of age was observed for nutrition status of women (Fig. 11). There was inverse relationship between household paddy production and nutrition status of women (non pregnant women BMI index).

Relationship between nutrition status and paddy production

$y = -0.010x + 26.47$

$R^2 = 0.249$
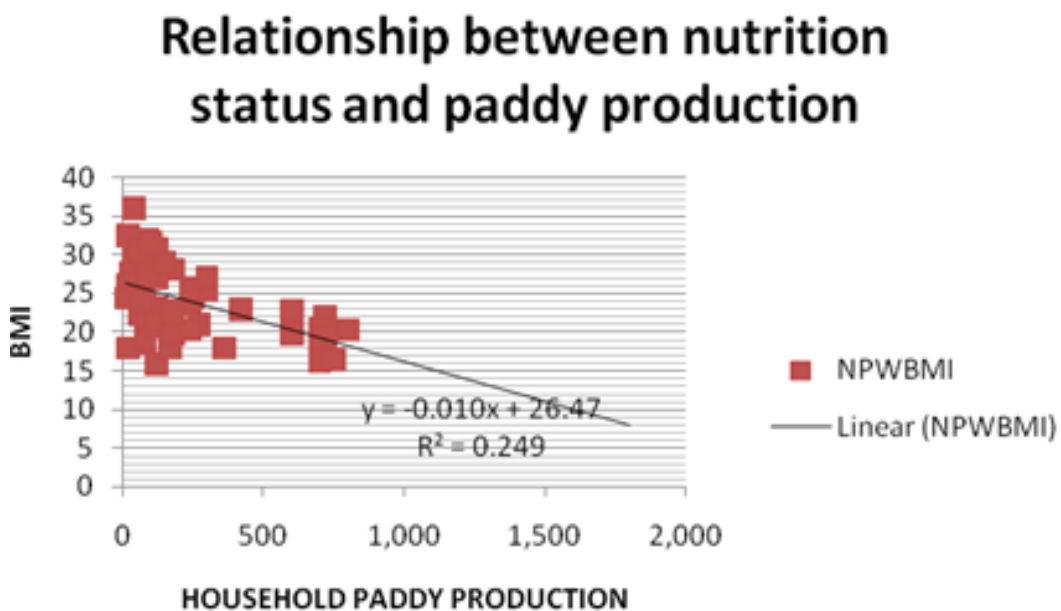
Figure 11: Regression line and equation for contribution of household paddy production to women BMI.

4.7.2 Influence of income on food factor and hence nutrition status

Food factors appear to work synergistically with household income as food consumption score was positively and significantly ($p<0.01$) correlated to household income ($r=0.28$, $p<0.05$). Also, households with higher income were more likely to have adequate number of meals per day ($r=0.2$ $p<0.01$). Fig. 12 shows this relationship in regression equation form whereby not much contribution was recorded. Coefficient of determination (R^2) was small (0.049 for income to meal frequency).
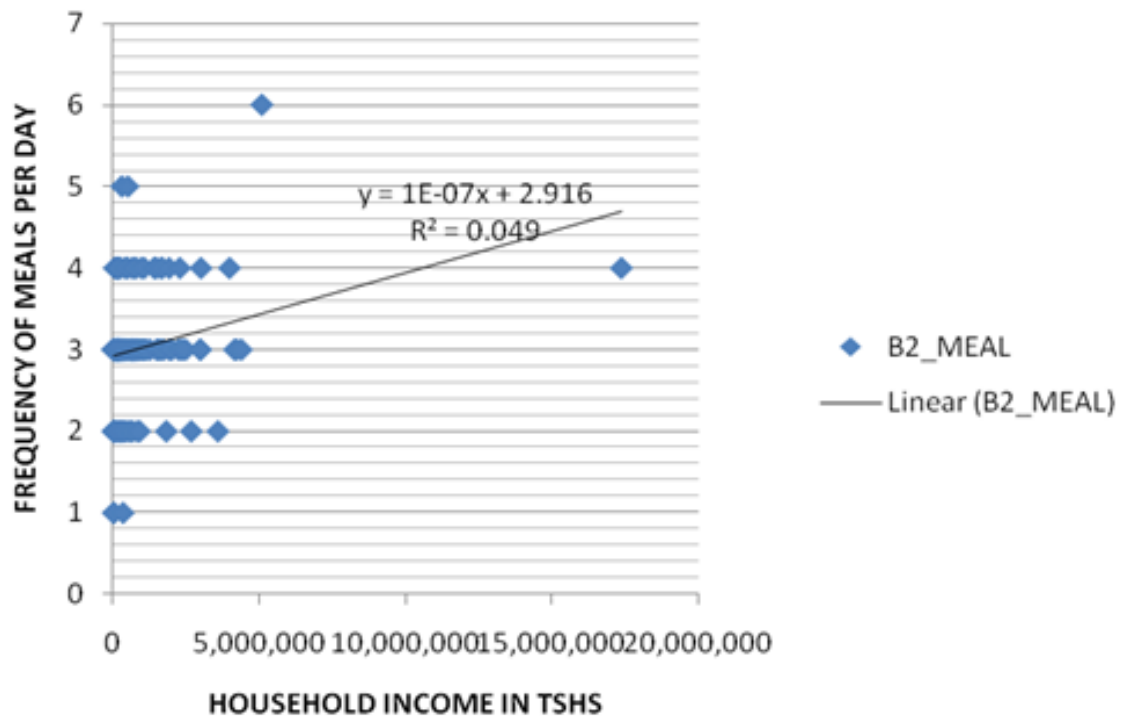
Figure 12: Relationship between meal frequency per day and household income

Further exploration of relationship between nutrition status indices and determinant factors revealed a negative relationship between BMI and food frequency per day. Although there was a positive relationship between food consumption levels and income, this did not translate into nutrition status as there was a negative relationship between women BMI and meal frequency. Fig. 13 presents this relationship in regression equation form.

BMI

$$y = -1.897x + 28.77$$
$$R^2 = 0.113$$
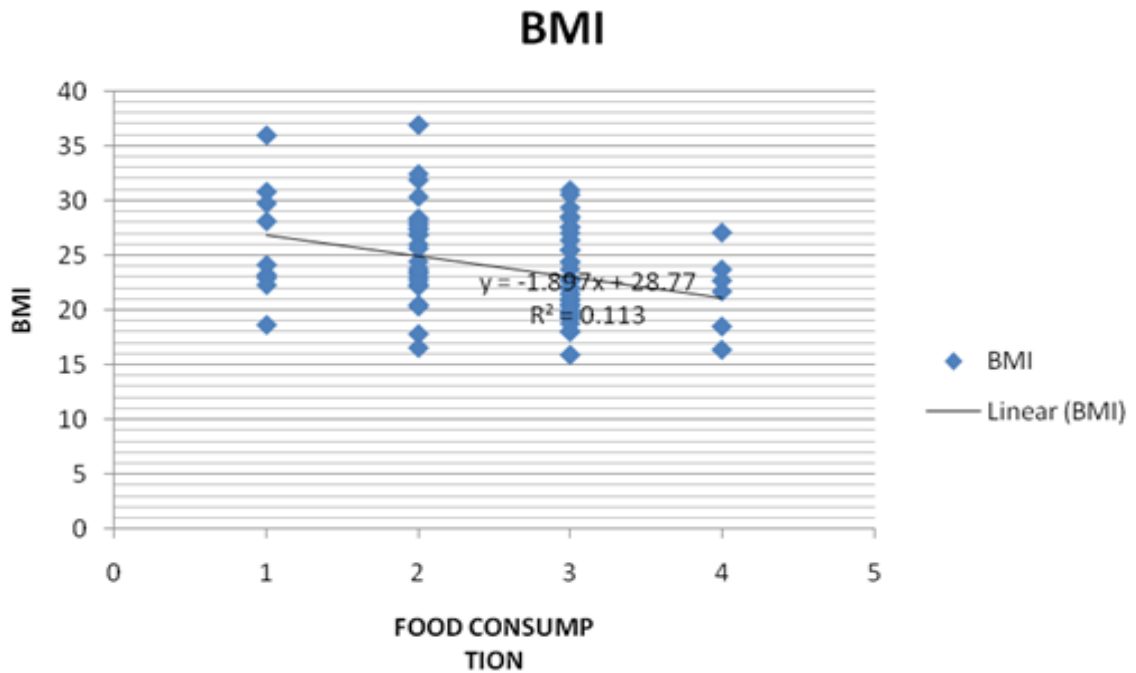
Figure 13: Relationship between household meal frequency and non-pregnant women BMI

4.7.3 Influence of socioeconomic characteristics on nutrition status

Socioeconomic factors had significant contribution to the observed under-nutrition in the household. Women with secondary school education and above were more likely to seek antenatal care than those with no formal education ($p<0.05$). Educated women were more likely to comply with ANC attendance schedule ($p<0.05$). Correlation of attendance duration with women BMI was 0.32 ($p<0.05$) and with years of schooling was 0.26, ($p<0.05$).

Households from low socioeconomic category had significantly ($p<0.05$) lower BMI. Annual income reported by respondents (in Tanzanian shillings per annum) positively and significantly correlated ($r=0.2$) with reported number of meals per day ($p<0.001$).

Given the low income and association of low income with low BMI brings another dimension namely influence of income poverty to under-nutrition.

4.7.4 Influence of care on nutrition

This culture is dominated by extended family arrangement whereby siblings provide care to toddlers (in about 56% of the households). Households depending on mothers alone to care for toddlers were about 33% of interviewed households. Mean time spent by mothers to stay with children was 2.6 ± 1.7 hours and sibling care was availed most (a mean of 5.1 ± 1.1 hours per day was observed). Although, importance of care provision by mothers was one of the emphases in nutrition education sessions which are normally conducted by nurses during monthly clinic visits by mothers, they do not seem to influence change because main source (51%) of advice/information was reported to come from relative hence strong influence of traditions. Moreover, results of assessment of perception of respondents on conventional care showed community members disagreed (29 point score out of 50) with the currently advocated care.

Correlation between nutrition status of children under five years of age and number of months of exclusive breastfeeding was fairly significant (r=0.28; p<0.05). Time taken by mothers to stay with children was also found to be associated with quality of feeding (r = 0.17, p < 0.05) which means the longer the time taken by mother to care for child the better was the quality of care received by the child.

4.7.5 Influence of food availability and sanitation on nutrition

Food availability contributed significantly (p<0.05) to nutrition status as shown in Table 29. According to the regression analysis results, change in BMI tripled for each unit change in food consumption as shown below:

BMI = 16.195 + 2.78food consumption (t =2.9, p =0.004)…………..…………… (1)

Food consumption adequacy score = 3.051 + 0.260 income – 0.328 food

shortage……………………………………………………………….....……..… (2)

In this data set, a unit change in sanitation score resulted in unit change in BMI as shown

in the regression equation below:

BMI = 21.122 + 1.03Sanitation (t = 2.2, p = 0.02)……………………....…… (3)

Table 29: Contribution of food availability, food consumption and sanitation to women BMI

Independent variable	Regression coeff.	Intercept (a)	Confid. Level for (b) %
Food consumption score	2.78	16.195	>95*
Sanitation	1.03	21.122	>95*
Food shortage score	-0.328	16.195	>95*

* Significant at 0.05

4.7.6 Influence of sanitation on morbidity in the household

Sanitation contributed significantly (p<0.01) to the observed variation in morbidity (Table 30). This is according to regression analysis done to determine contribution of various factors to the observed disease prevalence. Contribution of sanitation related factors namely toilet quality and hygiene (including hand washing) was significant. The same applied for income factor.

Table 30: Key variables contributing to prevalence of disease in the household

Variable	Mean sum of square	F-statistic	Confidence Level %
Overall sanitation	3.636	21.039	>99*
Household toilet quality	1.822	10.485	>99*
Household annual income	1.217	6.964	>99*

*Significant at 0.01

By regressing morbidity on in the household against all factors of interest, it was revealed that the most important factor as far as morbidity is concerned was sanitation. This was demonstrated by the significant ($p<0.001$) contribution of quality of toilet the household had and overall sanitation score to the observed diseases prevalence (Table 31).

Table 31: Regression of morbidity (disease prevalence) in the household against various independent variables

Ind. Variables	Regrcoeff (b)	R square	Std error	Intercept (a)	t	sig
Sanitation score	0.294	0.1	0.06	0.790	4.5	.000
Quality of toilet the household has/use	0.299	0.1	0.03	0.805	4.3	.000

Morbidity = 0.79 - 0.294 x sanitation score + 0.008 toilet quality……..... (4)

Looking at collective contribution of factors to nutrition status indices revealed that significant ($p<0.05$) contribution were coming from household income, availability of food in the household (Table 32). Availability of food in the household and annual income collectively explains 29% of the variation in the observed food consumption level.

Table 32: Contribution of household annual income, food shortage and sanitation to the observed food consumption levels

Ind. Variables	Regr. Coeff(b)	Intercept (a)	Confidence level for (b) %
Household annual income	0.260	2.861	>95*
Food shortage	-0.328	-3.051	>95*
Overall sanitation	0.036	2.705	<20

R^2= 29%; *Significant at 0.05

Food and income factors collectively explain 21% of the observed variation in women BMI while about 32% of the observed variation in weight-for-age z-score for children below five years of age came from household income, food intake, sanitation and breast feeding practices (Table 33).

Table 33: Contribution of key explanation variables to nutrition status as measured through BMI and z-score

Dependent variable	Explanation variables	B	Std error	T	p-value
Women BMI					
1	Food consumption score	2.78	0.73	2.11	0.004*
2	Household income	0.26	0.4	2.1	0.112
3	Sanitation	1.03	0.4	1.4	0.198
Weight-for-age					
1	Food consumption score	0.78	0.2	2.88	0.007*
2	Household income	2.2E-7	0.0	2.57	0.014*
3	Environ sanitation	0.9	0.4	2.02	0.051
4	Breastfeeding quality	0.05	0.4	1.34	0.188

*Significant at 0.05

CHAPTER FIVE

5.0 DISCUSSION

This study has determined key factors influencing nutrition in the study population and quantified contribution of these factors to the observed under-nutrition. The major determinants of under-nutrition in this population relate to food, income poverty and associated socioeconomic status. Factors linkages in a varying weather pattern are here discussed.

5.1 Demographic and Socioeconomic Characteristics of Study Population

Physical characteristics of households are known to contribute to standard of living and used as indicators of socioeconomic status (NBS and ICF Macro, 2011; Benzanson and Iseuman, 2012; Nikoi and Anthamatton, 2012; World Bank, 2013). In this study, physical characteristics variables of interest were source of drinking water, type of flooring, walls and roof.

The studied population is dominated by low socioeconomic status households and literacy rate is low hence impacts negatively on nutrition. The high illiteracy rate among women normally undermines their ability to adopt new behaviors that can prevent disease, ensure fast treatment of sick children, improves breastfeeding quality and other care choices (Shi and Zhan, 2011). Therefore, socioeconomic factors namely education, income and quality of dwelling unit were important factors behind the observed under-nutrition in the study area. Notable correlation was that between education of women and their antenatal care attendance ($r=0.26$, $p<0.05$).This is consistent with the national situation as the national survey conducted in 2004 observed that women in the poorest quintile had least education and had least influence on decision making (NBS and ORC

Macro, 2005). A study done in 2006 showed strong association of socioeconomic factors with nutrition status in Tanzania (Buchi, 2010; Nikoi and Anthamatton, 2012).

5.2 Long Term Weather Variation in the Area and Effects

Observed shift in weather elements (rainfall, temperature and humidity) have occurred more in recent years than in the past. Farmers' perceptions on shift of seasons are supported by meteorological data implying demonstration of richness of farmers' indigenous knowledge of weather patterns. The observed changes do frustrate farming by reducing yields and hence resulting into negative consequences including food and nutrition insecurity. Normally when there is a dry spell of more than 14 days at 30% of occurrence probability for majority of months and when average rainfall in a season is below 18 millimeters, there is a high possibility of crop failure due to water stress (Mutabazi, 2007). Moreover, in seasonally dry and tropical region, crop productivity has been projected to decrease when there is an increase in temperature above $1^{o}C$ and even slight warming ($1\text{-}2^{o}C$) will reduce yield (Easterling *et al.*, 2007; IPCC, 2012).

Results from the current study surpass the $1^{o}C$ shift in temperature; therefore reduction of yield is likely. Recorded increase for the period examined was $1.8 - 2.0\ ^{o}C$. as shown in Fig. 7. Therefore, this shift may have contributed to the observed shaky productivity of food crops observed (Fig. 8).

The fourth assessment report of Intergovernmental Panel on Climate Change (IPCC) predicted that climate change and variability will lead into a more intense and longer extreme weathers than have been observed in the past which was the case shown by Fig. 5, 6, 7, 8, 9 and Tables 8, 9 and 10. The current study findings demonstrate local evidence of climate change-related weather pattern and are consistent with projected

yield reduction (Tables 12, 13 and Fig. 11). Impact becomes huge when reduction in rainfall amount is combined with dry spells. Moreover, the most unfavourable weather in the last 15 years coincided with the lowest staple food crop productivity (maize and pulses) in the area, so weather factor cannot be ignored as have contribution to the observed under-nutrition. This brings in effects of ecological factors.

5.3 Ecological Factors Link to Nutrition

Peoples' perceptions are related to empirical data in that season shift with almost disappearance of short rain season known as *vuli* was perceived and meteorological data support the perception. They also felt that periodic drought and occasional floods has lowered land quality.

Degradation of resources occurs through excessive use of land resource and is worsened by inability of the poor to maintain or restore protective work, especially after damage and disruption from extreme weather event like drought and flood (Mutabazi, 2014; Wesche and Chan, 2010).

Another dimension of distal ecological factors influences on overall livelihood and hence community nutrition relates to immerging pastoralism crisis, surfacing in the study area in form of disputes between farmers and pastoralists. Although available literature attributes the crisis to several causes, those that relate to loss of grazing land and prolonged drought are more significant (Hieronimo, 2010; Rowhani *et al.*, 2011).

5.4 Magnitude of under-Nutrition in the Study Area

Stunting (low height- for- age) in preschool children is the most prevalent (39%) form of under-nutrition in the area. Low height- for- age is an indication of chronic under-

nutrition, which is frequently associated with poor overall economic conditions and or repeated exposure to adverse conditions. The high prevalence of stunting in preschool children in the area was associated with feeding ($r = 0.17$, $p < 0.05$) and overall socioeconomic situation, hygiene and sanitation were insufficient (Table 22 and 27). Food shortage was evident in 62% of households and this contributed significantly to the observed under-nutrition (Table 29). Probably, lack of adequate storage facilities, pressing basic needs (including medical services and school fees) led to selling of excess produce during the harvest period hence aggravating food shortage in the household.

5.5 Influence of Care on Nutrition Status of Children

The study community has a care system which is strongly influenced by traditions as shown in Table 27 and findings of the FGD. The outcome of the dependency on traditions and belief values that conflict with standard care were poor caring practices which include infant and child feeding, health seeking behaviors and support to mothers during pregnancy (Table 26 and 27) and these definitely increased risk of under-nutrition in children through feeding and support deficits. Attitude is a complex mental state involving beliefs, feelings, values and dispositions with regards to what has been sensed or observed and is normally shaped by long run experience and processes by the subject (Blackstone, 2015). Therefore, its change may require long term investment in advocacy campaign in societies implying among others substantial time period to be able to change observed negative behaviors.

5.5.1 Child feeding practices

The proportion (36%) of mothers who delay initiation of breastfeeding between 1 hour and 23 hours could not be ignored and this may affect production of milk negatively.

Also, another implication of improper breastfeeding relates to increased infant and child morbidity risk.

The main weakness of complementary feeding in the current study was the tendency to introduce food based on child behavior (when the baby was hungry or crying or when the baby show interest in foods) rather than observing professionals guidance. Traditions overshadowed professional guidance and mothers were too busy (heavy workloads) with other obligations. Feeding frequency was low (mean of 2.5 ± 0.9) and quality of complementary foods was poor hence increasing under-nutrition risk. Similar results regarding poor child feeding practices particularly improper breastfeeding and too early introduction of complementary foods have been reported in previous studies in the country (NBS and ICF Macro, 2011). The exclusive breastfeeding has also been reported as rare in South Western-Tanzania (Poggensee *et al*., 2004) and that poor quality of overall feeding coupled with contaminated complementary foods contributed significantly to persistent under-nutrition. However, for some few aspects the current findings differ from the national statistics. These are observed low proportion (15.5%) of children under 6 months exclusively breastfed compared to the national average of 50.0%.

Apart from nutritional benefits (physical growth and reduced susceptibility to infectious diseases), appropriate child feeding practices stimulate bonding with the caregiver and psycho-social development (Kieling *et al*., 2011; Milteer *et al*., 2012). Therefore, the other dimension of this study care findings is the possibility of child psycho-social development gap that may compromise their future socioeconomic development with regards to cognitive component of child development.

5.5.2 Children psychological needs and adequacy

Children need time to play and stimulate or exercise their intellectual faculty and these child activities need to be guided by care providers by allocating sufficient time for guided or monitored playing. The fact that in the present study only 33% of the respondents allocated time for children to play implies reducing likelihood of developing them to their maximum potential physically, cognitively and socially. This is consistent with the previous studies findings done elsewhere (Shore, 1997; O'gara *et al.,* 1999; Milteer, *et al.,* 2012).

Conclusion from previous studies (Shore, 1997; Milteer *et al*., 2012) has been that development and learning in humans depends critically and continually on the interplay between nature (an individual's genetic endowment) and nurture (nutrition, surroundings, care, stimulation and teaching) that are provided or withheld. The ways that parents, families and other caregivers relate and respond to their young children and the ways that they mediate their children's contact with the environment, directly affect the formation of neural pathways. Strong and secure attachment to a nurturing caregiver are known to have a protective biological function, helping a growing child withstand the ordinary stresses of daily life (O'gara *et al*., 1999; Milteer *et al.,* 2012). The reason is that brain function hinges on the rapid passage of signals from one part of the brain to another based on an organized network formed by building blocks of neurons (brain cells) and synapses (connections). These synapses are the ones which link up to form neural pathways. As an individual interact with the environment including reactions to stimuli new signals race along these neural pathways i.e. they are activated (Shore, 1997; Kieling *et al.,* 2011). From this scientific line of argument, the implications of the observed practices suggest insufficient early stimulation that has negative impact on child future as well as community/nation that invests on the child. Also the implication

of the negative attitude towards maternal and child care observed in the current study include false start of their childhood for most of children in the area and this adds to the same need for filling attitude gap by changing peoples' behaviour for better children future.

5.5.3 Deficit in care and support during pregnancy and lactation

Maternal care is important for the health of both the mother and the infant. Antenatal care can be most effective in avoiding adverse pregnancy outcomes when it is sought early in the pregnancy and continues through to delivery. WHO recommends that a pregnant woman without complications have at least four ANC visits to provide sufficient care (WHA, 2012). On the contrary, not many were fulfilling the WHO guide. This gap plus the observed insufficient support to pregnant women by their spouses suggest significant risk of adverse pregnancy outcomes. The fact that only half of women population meets this recommendation suggests a serious gap to address pregnancy related mortality which is extremely high (454 for each 100 000) in the country (NBS and ICF Macro, 2011).

Weaknesses identified with service seeking behavior in this study had links to poor knowledge and negative attitude towards kinds of services availed as most (52%) of the respondents do not normally send their sick children to the health facility, some (8%) use medicine without prescription. This is partly due to low level of education as about half of the respondents were illiterates. There is a need for rectifying the situation in order to improve care elements for health and nutrition of women and children which include access to health facilities. Conduct of heath care providers is an important factor as trained providers have critical role of monitoring of pregnancy in order to minimize risks of delivery complications hence safety of mother as well as the newborn.

5.5.4 Sanitation influence on nutrition

Hygiene and sanitation (represented by quality and management of toilet facility and hand-washing practice) was associated with nutrition status (Table 28). It appears hygiene and sanitation influenced nutrition status through elevation of morbidity risk (Table 30 and 31). The pathway could be that the observed high (47%) prevalence of infectious diseases emanated from the prevailing unhygienic condition mostly malaria and diarrhea and this have contributed to the observed under-nutrition as households with low hygiene and sanitation score had significantly ($p<0.01$) higher reported disease occurrence. This is consistent with the previous study findings (Butteheim, 2008; Bernajee and Morella, 2011; Bowen *et al.,* 2012). The poor sanitation observed in this study is similar to the national statistics which showed that sixteen percent of households in rural areas had no proper sanitation facilities (NBS and Macro, 2005). A child's environment (at least in terms of disease agents' exposure) is largely shaped by the behavior of others in the household and the surrounding (Butteheim, 2008). Therefore any attempt to control child under-nutrition in this community should include strategies able to improve personal hygiene and environmental sanitation (for reduction of disease risk).

5.5.5 Influence of socioeconomic factors on nutrition

Under-nutrition in women was significantly ($p<0.05$) associated with lower socioeconomic status and food shortage, which implies that income and availability of food in the household contribute significantly to the observed under-nutrition. Household income positively and significantly correlated ($r=0.2$) with the reported number of meals per day ($p<0.001$). Normally, income influences the quantity (frequency) and quality (variety) of meals.

Poor nutrition status is affected by household income, level of education and health services. In the current study, women with secondary school education and above were more likely ($p<0.05$) to seek antenatal care than those with no formal education and households with more educated mothers were likely to have more income and assets than those with less educated mothers, giving them access to more and better food, shelter and protection from hazards. Income had significant influence on toilet construction by the household and its quality or management (Table 28) and strong/significant influence on nutrition status (Table 28, 32 and 33). The pathways through which income influences nutrition status are multiple, care quality inclusive. This is because care depends on the availability, accessibility and use of resources (Muthoke *et al.,* 2013). These include time, money, access to safe water and access to health care facilities. Previous study using household-levels data found mother's education to be positively associated with a number of measures of infant and child nutrition status (Ayieko and Midikila, 2010) and another one showed that the mothers' educational level (formal education) had a significant effect on children nutrition status (UNICEF, 2012). This is obvious as education can serve as means of adopting new health beliefs, gaining general knowledge and applying specific knowledge about health and nutritional practices that promote child health.

Mother's education can affect choices about antenatal care and about child feeding, hygiene and health care (Shi and Zhang, 2011). Socioeconomic determinants thus affect health and nutrition of household members through a set of intermediary mechanisms that encompass household composition, dietary, intake, health care services and sanitation. Furthermore, women's education can also affect child health because more education is linked with higher household income, which in turn strengthens ability to handle adverse economic or environmental shocks, finance health care needs and afford

more balanced diets. According to study by Sharma and Nagar (2006) in India and Buchi in Mozambique (2010), giving proper education (on aspect of care) to mothers enabled the majority of them to negate poor care practices.

5.6 Factors Linkages and their Implications

In the current study, insufficient amount of rainfall, longer dry spells and shorter rain seasons were evidences of weather problems and seasons unreliability reported by respondents and supported by meteorological data. Observed stunting in preschool children could be an outcome of many factors working together including climate related factors like unfavorable weather as stunting is frequently associated with poor overall economic conditions. There is also sufficient agreement between weather unpredictability trend and cereals production trend hence proximally influencing nutrition. On the other hand, incomes, education level, food consumption, care and sanitation were associated with nutrition status.

Insufficient care was attributed to poor knowledge of health and nutrition including proper child feeding knowledge and insufficient support to pregnant women. Serious negative implications were observed from six month of age to 35 months implying that child feeding at the age of six months to two years is a critical window of weakness that needs to be corrected for prevention of the observed stunting in this community. The observed low meal frequency (mean of 2.5) and poor quality of complementary foods (mainly unfortified maize porridge) collectively compromised child nutrition status. Correlation between care and food consumption was positive and significant ($r = 0.17$, $p < 0.05$) implying that maternal and child care was important contributor to food consumption levels.

A child's chance of survival and well-being drops dramatically when deprived of a mother's care. Stunting is normally a characteristic of low socioeconomic status hence an outcome of consistent failure to receive adequate nutrition over time - normally associated with poor overall economic conditions, chronic or repeated infections and consistently inadequate nutrient intake. This study demonstrated a pathway with synergy of several factors working together to explain the observed under-nutrition. Inattentive care of young children coupled with unhygienic condition and unhealthy environment had an upper hand for children under-nutrition in the study population. The fact that most of the time young children are cared by sibling and not mothers implies that quality of care was poor. This was also reported for urban population of Dar es Salaam by Kulwa *et al.* (2005) and Buchi *et al.* (2010) in Mozambique that the benefit of having alternative caregiver is outweighed by the quality of child care he or she can provide. Also, the fact that majority (87%) of households do not treat drinking water to ensure safety and significant proportion (11%) do not have toilets make unsanitary environment and related infectious diseases serious issues in the area. Moreover significant proportion (22%) of households does not observe proper hygiene (hand-washing). No wonder poor sanitation in the households contributed significantly to the observed disease prevalence (Table 26). Increased morbidity definitely increases under-nutrition risk.

5.7 Key Findings Summary

The study area has experienced climate change-related weather patterns with negative consequences on nutrition particularly on food crops productivity hence increased food insecurity risk. Extreme weather events such as extended dry spells, shorter rain seasons and extremely high temperatures as observed in the study area, negatively affected household food production. In order to minimize under-nutrition risk, communities in

the area need support to improve their adaptability to climate change. This will be possible through the assistance of Extension Agents, working closely with farmers to tap on their indigenous knowledge in relation to climate change and adaptation.

Sufficient agreement between farmers' perception and meteorological records observed in this study suggest that the community has rich indigenous knowledge on climate. Communities have demonstrated ability to interpret the changing weather patterns, adjusting their farming operations accordingly but these efforts need to be guided and supported. Therefore farmers' involvement in formulation of adaptation strategies to climate change is imperative for good outcomes. Adaptation to climate change is necessary if the ongoing efforts to reduce malnutrition are to be safeguarded. Adaptive capacity building and environmental quality improvement components need to be included in all agricultural and nutritional intervention strategies as a way of coping with additional challenges brought by climate change.

Competing demand on household members' time has compromised attentive care including ability to secure, prepare and serve food in the household. Therefore, attitude, knowledge and practice gaps need to be filled to enable devotion of more time on improving care. Insufficient maternal and child care coupled with low food diversity particularly diet diversification are main factors contributing to under-nutrition in the area and of recent, climate change-related weather patterns have significantly disrupted cropping seasons exacerbating under-nutrition risk. For effective intervention, there is a need for focused health and nutrition education to impart knowledge and skills to adolescents (future mothers and fathers) and couples on care and child feeding (breastfeeding and complementary feeding) and this should be accompanied with

behavior change campaigns. Moreover, focusing reduction of women' workload on farming technology improvement to support women would be necessary.

5.8 Limitation of the Study

Major limitations in this study relate to data collection methods and data accessibility. Recall bias and incompleteness of data were main limitations. Food consumption results could be affected by recall bias inherent in 24-h recall method used. Therefore in order to minimize this, attempt was made to do thorough probing during the interviews. Completeness of records kept by district agricultural office is another limitation (secondary data missing values) and that of children nutrition kept over years in the health facilities. Missing data may reduce reliability of data therefore several trips to the district agricultural office were made to ensure that every bit of available information was examined and relevant data collected as single visit could not achieve much**.**

CHAPTER SIX

6.0   CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The major factors influencing nutrition status in Kilosa are availability of food in the household, especially own production closely tied to cultivated land; quality of care and quality of environment (surrounding). Influence of changing weather pattern on both food crops production and productivity was high hence elevating under-nutrition risk. In course of four years of research work (2010 – 2014), floods disaster that called for national support in terms of support to displaced household happened twice (2009/2010 and 2013/2014 cropping seasons) in Kilosa while drought in form of extended dry spell happened once (2011). Extreme weather events were on increase in the last 40 years examined with some impacts on food production. Food consumption was far from adequate in the households. The same applied for care for mothers and children, access to health care services and sanitation facility (including safe water). Environmental sanitation influenced disease prevalence in the same way women's workload influenced ability of the household to produce and consume, eventually both influencing nutrition status.

From care view point, overburdened woman (about 25% according to schedule presented in Appendix 8) will not only fall in poor nutrition status but also her capacity to produce food for her household is negatively impacted as she plays pivotal role in that. Also competing demand on household members' time has compromised attentive care including ability to secure, prepare and serve food in the household.

Poverty contributed significantly to the food and nutrition insecurity and when combined with insufficient knowledge of nutrition, poor infant and child feeding practices, inadequate access to sanitary environment and health care services consequences are detrimental. Serious efforts to improve woman's nutrition must experiment redress of her access to resources, control in decision-making process and norms regarding her social status. The factors involved in precipitating the observed under-nutrition are multiple ranging from food consumption factors (quantity and variety of food) to environmental factors (weather related and infectious disease related) with maternal and child caring practices factors in between as vital factors. The causes of infections related to hygiene and sanitation like diarrhea are multiple including unsafe water, unsanitary environment and poor hygienic practices. From ecological view point, extreme weather events (extended dry spells, shorter rain seasons and extremely high temperatures) observed had negative impact on nutrition.

6.2 Recommendations

Based on these results and conclusions, the study recommends support to farmers in order to better adapt to climate change. This is based on the fact that farmers' involvement in formulation of adaptation strategies is imperative for better results. Available local knowledge which farmers have on climate change and corresponding adaptation strategies need to be consolidated. The district authorities should use meteorological data to create awareness and provide education regarding the interpretation of such data. One of the recommended strategies for adaptation could be adjusting the planting dates and crop varieties for various crops to enhance food security in the households.

On nutrition intervention, the study recommends filling knowledge gap through training. Educating people would promote their knowledge. Strategy to improve attitude about food, dietary customs and care including maternal care is imperative, hence elaborate social and behavior change communication strategy is recommended. It is important also to ensure women have access to income generating opportunities, appropriate farming technologies, extension and credit. Even at minimum food resource availability, enhanced nutritional knowledge may increase variety of food in meals hence enhancing nutrition.

6.2.1 Recommendation regarding adaptation to unreliable rainfall and extreme weather events

As a step towards strengthening community resilience with meaningful health and nutrition benefits, it is recommended to review policies relating to health, nutrition, food security and agriculture to address challenges relating to environmental quality issues and adverse effects of climate change as follows: i) Incorporate in the policies communities' capacity building to adapt to climate change ii) Create public awareness on the essential linkages of the environment, health and nutrition iii. Formulate appropriate packages of technologies that will best suit adaptation in specific localities taking into consideration the observed income poverty.

6.2.2 Recommendations regarding improvement of care and food intake

Based on the findings of the current study, the following are areas of emphasis in taking action: i) Women's workload reduction and support to pregnant women. Pregnant women need adequate rest, psychological and nutritional support, but all these are poorly provided. ii) Infant and Children need psychosocial support, quality breastfeeding (early initiation of breastfeeding, exclusive breastfeeding during the first 6 months of

life, continued breastfeeding up to age 2 and beyond), timely introduction of complementary feeding, adequate feeding frequency with diverse food groups and sanitation (to control for infectious diseases).Appropriate complementary feeding promotes growth and prevents stunting among children 6-24 months. Appropriate complementary feeding involves a combination of practices to maintain breast-milk intake and at the same time improve the quantity and quality of foods children consume.

Caregivers should be helped to understand the relationship between specific behaviors they undertake (such as feeding practices) and under-nutrition through training and promote proper feeding and psychosocial support to children because there is significant gap relating to behavioral factors. Efforts to improve nutrition will require sustained changes in food-related behaviours, therefore existing norms that affect behavior and motivational constraint must be addressed together with filling knowledge gap related to combination of available food resources for balanced diets.

6.2.3   Recommended future studies

   (i)   Determine effects of the current (observed) insufficient attention and psychosocial stimulation in child development and competence particularly cognitive competence in the context of national development

   (ii)   Test nutritional impacts of specific agricultural technologies devised for reducing farming workloads on women and determine their suitability for scaling up

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APPENDICES

Appendix 1: Household questionnaire to assess adequacy of care, environment quality, food and nutrition security in a changing weather pattern in Kilosa district

SECTION A: Demographic and socioeconomic information

1. Hamlet: _____
2. Interview Date: _____ Name of interviewer _____   Household No…..
3. Name of respondent _____
4. Household information

House	Relationship with Household head 1.Husband 2.Wife 3.Father 4.Mother 5.Child 6.Relative 7.Household head himself or herself 8. Others (e.g. housegirl)	Sex 1.Male 2.Female	Age Years	Household Head 1.Yes 2.No	Marital Status 1.Single 2.Married 3.Separated 4.Widow 5.Cohabit 6.Child 7.Others (specify)	Education 1.No formal 2.Partial primary 3.Pre-primary 4.Primary 5.Secondary 6.University 7.Others (Specify)	Occupation 1.Employed 2.Self employed 3.Dependant 4.Others (Specify)	Livelihood Groups 1.Salary Earner 2.Petty Trader 3.Crop Farmer 4.Livestock 5.Trader 6.Selling Labour 7.Fisher folk 8.Others (Specify)
a) Main source of light used in the house								
b) Main source of power for cooking in the house								
c) Source of potable water								
d) Reliability of source of water								
e) Water treatment to make it safe for drinking								
g) Does your household have a toilet?								
h) If no what do you use								
i) Quality of toilet the household has/use								
j) Whether the toilet is shared with another household								
k) If no access to toilet, what is the main reason								
l) Distance between latrine and water source								
m) Maintain basic hygienic hand washing practices (e.g. before eating, feeding the baby,; after cleaning the baby's bottom; etc)?								
n) Qualification fromygiene score								
o) Methods of garbage disposal								
p) Infants and child faeces disposal								
q) What do you do after cleaning baby bottom?								
r) If not using soap what washing agent do you use (for baby bottom washing etc)?								
House hold Member No.								

1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

5.0 Attributes of the house in which the household member live

6. What are your major sources of income and approximate monthly earnings from the source?

Source   Earning

……………………… …………………………………………

……………………… ……………………………….……

……………………… …………………………………………

……………………… ………………………………………..

……………………… …………………………………………

7.Which petty business do you do to get income for the household?

i. brick making ii. food vending iii. Selflabouriv. charcoal selling v. local brewing

vi. others (mention)………

SECTION B: Assets, food consumption pattern and household food security

B0. Assets

S/N	Item	Ownership (1.YES 2. NO)	Quantity in number
	Bed		
	Bicycle		
	Chairs		
	Cup boards		
	Fishing nets		
	Functioning mosquito nets		
	Functioning radio		
	Functioning telephone		
	Gas cooker		
	Hoes		
	Houses		
	House for renting		
	Land (acre)		
	Motorcycle		
	Push cart		
	Tables		
	TV		
	Others		

B1. Food production and consumption pattern

i. What is the main source of food for your household? (multiple response allowed) 1. own production 2. purchase 3. Aid

ii. How many acres do you cultivate…………………acres

iii. Does your household produce enough food to last all year round?   Y/N

iv. Which crop did you harvest / buy last year

Crop	Local measure	Kg
Maize		
Sorghum		
Paddy		
Pegion pea		
Cow pea		
Pea nut		
Beans		
Sunflower		
Sweet potato		
Taro		
Sugar cane		
Coconut		
Cassava		
Others (specify)		

v. Which livestock do you keep in your household

Livestock	Number
Chicken/ Ducks	
Goats / Sheep	
Cattle	
Pigs	
Donkleys	
Others (specify)	

B2 Food frequency questionnaire (FFQ) and 24-h recalls
FFQ

	Wt (g)	Medium amount	Frequency D W M Y N	Portion S M L	Frequency per day	Grams per day
Fruits Citrus Mangoes Bananas Pineapples Pawpaw Indigenous fruits						
Vegetables Cabbage Kale leaves Cowpea leaves Amaranth Sweet potato leaves Cassava leaves Pumpkin leaves Spinach Eggplant African eggplant Carrot Wild collected						
Eggs/meats/fishes Beef Pork Chicken Sardines Large fish Eggs Offal's Gamemeat *Legume* Beans Pegion peas Peas Cowpeas Green gram Groundnuts						
Cereals and tubers Maize Sorghum Finger millet Rice Cassava Sweet potato Green banana						
Dairy products Milk Yogurt						
Oil and fat Purchased type like korie Margarine Coconut Palm oil *Mixed dishes*						

24-h recall form

Round number_____ Day of recall_____

Meals	Description	Score or quantification

SECTION C: ADEQUATE CARE

Care for children

Feeding

1. What is the age of your last child_____months
2. What is the sex of you last child I F 2 M
3. What is the name of your last child_____
4. Is this child still breastfeeding?_____1 Yes 2 No
5. If yes, when did you start breastfeeding your child after delivery? i. Immediate after ii An hour later iii. A day later vi. Other (specify)
6. If no, at what age did this child stop breastfeeding_____(months)
7. For how long did you breastfeed exclusively without water, gripe water, fruit juice, porridge or any other foods besides mother's milk?_____(months)
8. What are reasons for not exclusively breastfeeding i. Breast milk is not sufficient for the baby ii. Mother busy with other activities iii. Cultural norms iv Other (specify)….
9. For how long do you normally breastfeed entirely? _____months
10. What was the first complementary food you gave to your child? i. porridge ii. Canned cereals / other foods ii. Vegetable (e.g. mashed potato, carrot etc) iii. Fruits iv. Adult / family foods v. Others (specify)_____
11. If the answer to question 13 is (i), what was the composition of the flour
   _____
   _____
12. What did you add to this food?_____i. Groundnuts ii. Beans iii. Sugar iv. Sardines v. Oil vi. Other (Specify)
13. How many times per day do you give this food to this child?_____
14. Who is responsible for feeding the child?_____i. Mother ii. House maid iii. Other siblings iv. Father v. Other (Specify)_____

Immunization and Morbidity (For children Under Five Years of age)

	Child 1	Child 2	Child 3	Child 4
Household member number				
Name				
Sex				
Birth date				
Source Card Mother Other relative				
Birth weight				
Vaccination Yes No				
BCG				
BCG scar Yes No				
DPT3				
OPV3				
Measles				

Hygiene and Prevention of Illness

1. Who looks after small children?_____i. Mother ii. Father iii. Grandmother iv. Siblings v. Aunties vi. Other (Specify) ___

2. Who is responsible for the personal hygiene of the children? (bathing, hand washing, use of toilet facilities)_____i. Mother ii. Father iii. Grandmother iv. Siblings v. Aunties vi. Father vii Other (Specify)___

3. How much time do the following members of the household spend with children (Mother, Father, Grandmother, Siblings, Relatives, Father and others?)

	<1	1-3	4-6	7-9	10-12	At night
Mother						
Father						
Sibling						
G'mother						
G'father						
Maid						
Relative						
Stepmother						
Other						

4. Do you allocate time for children to play? (i) Yes (ii).No
5. Do you play with children? (i) Yes (ii). No
6. If no, why (i) No time (ii) Not important (iii) Cannot cope (iv) Not able
7. Do you allocate time for teaching your children to do household/production activities (i) Yes (ii) No
8. How do you teach them (i) Stick and carrot (ii) Instructions (iii) Instruction and Punishment (iv) By requests (v) By others

Care for women (questionnaire for women only)

1. If you are pregnant, or when you were last pregnant, did you attend antenatal clinic (ANC)? 1. Yes 2 No
2. If yes, did you see a professional? 1. Yes 2. No
3. If no, why (i) Too far to service (ii) Don't think I needed to attend (iii) Don't like the trained staff (iv) Inadequate services (specify)_____(v) Other (specify)
4. For how many months in total did you attend an ANC during your last/this pregnancy?_____no. of months, don't know is 99 and check cards records)
5. At what months of pregnancy should women first go to an ANC or see a TBA_____(don't know is 99)
6. How many months pregnancy were you when you went for your first ANC visit?_____(no. of months) (don't remember is 99)
7. Whom did you see on your first visit? (i) Doctor (ii) Nurse/Midwife (iii) Clinical officer (iv). Can't remember (v) Other (specify)___

Husband's/partner's questionnaire

1. Has your (wife name) ever been pregnant?i. Yes ii. No
2. Is she pregnant nowi. Yes ii.No (go to question 5) iii. Not sure
3. How many times in total has your wife been pregnant_____
4. Did any of the pregnancies end in a baby that was born deadi. Yes ii. No
5. If yes how many pregnancies_____
6. Do you usually accompany your wife to ANC?i. Yes ii. No
7. If not why?
   (i) ANC is for women (ii) I don't have time (iii) Culture (iv) Resources (v) Not important (vi) Others (Specify)

8. Have you discussed with your wife where she will deliver the baby and who will assist with the delivery? (i) Yes (ii) No(iii) Don't know
9. Who do you expect will assist her with delivery of this baby? (i). Doctor (ii) Nurse/Midwife (iii) Clinical officer (iv) Don't know (v) Other (Specify)
10. Where do you expect will deliver this baby? (i). Public /GvtHospital (ii) Health centre (iii) Dispensary (iv). Home (v) TBAs home (vi) Don't know (vii) Other (Specify)
11. Do you know who will accompany her to the facility? (i) No one (ii) Respondent (iii) Mother in-law (iv). Father in-law (v)Other specify _____

12. Who will take care of her after delivery? (i) No one (ii) Respondent (iii) Mother in-law (iv) Father in-law (v) Other specify _____
13. Do you set aside any resources (financial) to cater for delivery expenses? (i) Yes (ii) No

SECTON D: ENVIRONMENTAL SANITATION AND HYGIENE

i. *Observe food hygiene practices in the household and the ask to confirm* (Do you wash fruits and other foods before eating)   Y/N

ii. *Observe use of drying racks to dry utensils after washing before asking to confirm* Y/N

iii. Are you satisfied with the cleaning of the surrounding environment where you reside? (solid or liquid waste, drying of stagnating water)   Y/N

iv. Has it happened any time of the year for any member of your household to suffer from diseases related to unsanitary environment (water related or hygiene related diseases like eye, abscesses, scabies, diarrhea and malaria)?   Y/N

ANTHROPOMETRY FORM

S/N	SEX	AGE	WEIGHT	HEIGHT / LENGTH
1				
2				
3				
4				
5				
6				
7				

Appendix 2:Household questionnaire for assessing respondents' opinion on rainfall variation over the past ten years (2001 – 2011) in Rudewa-Mbuyuni and its effects on food availability, accessibility and quality of life

A. **Identification and background information**
Number of household………………. Name…………… ………………………….
Age……………………………Sex…………Date……………………………
Interviewer…………………………

Were you born in this village?   1/2   1 is yes, 2 is no
In case you were not born in this village, fill in the following table

Where migrated from (village, district) Reasons	Years of migration

Codes for reasons
1= marriage 2=accompanied parents 3=farming 4=employment transfer 5=searching for wage work 6=others (specify)

B. **Shocks and consequences**
i.   Shocks effects over time and responses

Nature, effect and response to shocks	Livelihood situation now compared to the past 5 years	
Event/shock when effect response	During the past 5 years, how is the livelihood situation for your household? 1=improving 2=worsening 3=the same	What are reasons for such livelihood situation

Event/shock: 1=drought 2=flood 3=theft (specify) 4=illness 5=death of important family member 6=disease/pest outbreak 7=strong wind/hurricane
Effect: 1=hunger 2=loss of crop 3=loss of animal 4=house damage 5=others (specify)
Response: 1=sale of harvests/animals 2=exchange 3=relief help (specify source) 4=remittance from relatives/friends 5=sale of land 6=renting out land 7=sale of household durables 8= borrowing from others 9=spend cash servings 10=seek wage work for cash 11=seek wage work for food 12=household members migration

C. Rainfall pattern (onset, end-date and amount), shocks and household opinion or response to them

(i). Rainfall amount, onset and end-date recalls and occurrence of drought, poor rainfall and flood

Yr	Onset	End-date	Interpretation
2012			
2011			
2010			
2009			
2008			

ii. Please indicate whether the following climate change sources of risks are major, rank them and verify impact and coping/resilience mechanisms

Risk and vulnerability sources	Is it a major risk? ½	Rank major risk	Impact to your household 1=not a problem 2=small problem 3=big problem	How do you cope with it? 1= changing crop husbandry 2= changing crops 3=changing livelihood 4=other(specify)
Too much rainfall Stormy rainfall Too low rainfall Intermittent dry spell Hurricane Erosion Soil fertility Pests Post-harvest loss Human disease				

D. Yields over time

i.   cassava, sweet potato, sunflower)

Year/Crop	Paddy	Maize	Sorghum	Pigeon pea	Beans	Root/Tubers
2012						
Local	……………………………………………………………………					
Metric	..………………………………………………………………					
2011						
Local	………………………………………………………………….					
Metric	……………………………………………………………					
2010						
Local	………………………………………………………………….					
Metric	………………………………………………..…………………					
2009						
Local	……………………………………………………..………………..					
Metric	………………………………………………………………….					
2008						
Local	………………………………………………………………………..					
Metric	………………………………………………………………….					
2007						
Local	……………………………………………………………………					
Metric	………………………………………………………………..					
2006						
Local	……………………………………………………………………..					
Metric	……………… .………………………………………………..					
2005						
Local	……………………………………………………..……………………					
Metric	………………………………………………………………….					

.

E.   Incomes over time

i. Please quantify the income sources for the past 5 years from off farm activities and associated constraints

Source of income	Gross incomes (TAS/year)				
	2012	**2011**	**2010**	**2009**	**2008**
Livestock					
Business					
Petty business					
Remittance (monetized and in kind)					
Wage/salary					
Other (specify)					

Appendix 3: FGD Checklist to assess peoples ' perceptions on weather patterns, environmental quality, food security and quality of care over time

Attitude and perception on past and present situations:

Weather pattern

    (i)   Rainfall onset

    (ii)   Rainfall amount

    (iii) Rainfall duration

    (iv) Environment

    (v)   Deforestation

    (vi) Diseases related to environmental sanitation

Food security

    (i)   availability

    (ii) accessibility

    (iii) sufficiency

Adequate care

    (i)   past

    (ii) contemporary

Appendix 4: Statements used in assessing perceptions

Assessing perceptions on climate variability and environmental degradation

Climatic conditions in this village have been changing

Long dry spells are more common nowadays than in the past

There are fewer trees now than there were 10 years ago

Diseases related to environmental sanitation are more common now than before

There is an obvious desert threat in the area

There is no harm to continue freely with the current charcoal making as is beneficial

We do not have shortage of natural resources like forest products in our village

Water resource in this area is abundant

Firewoods have never been in short supply in this area

Firewoods are fetched from within the vicinity and will continue to to be abundant

Assessing attitude towards conventional maternal and child care

    (i)   Infant as well as child up to 5 years of age equally need attentive care

    (ii)   A child of 4-5 asks a lot of questions, responding to all is necessary for their development

    (iii)   Talking to a young child however young, is beneficial for child development and learning

    (iv)   Attention needed for children of the 4 – 5 years age category include providing for physical needs and parents' participation in their play

    (v)   Pregnant women in this community are overburdened by household core and farming, hence a need to rectify the situation

    (vi)   Attention of father in care should be directed to children rather than spouses

    (vii)   Children in the age of   2 years and more no longer need attentive care

    (viii) Punishing children (especially with sticks) is necessary

    (ix)   Liberty to children is detrimental to their future

    (x)   There is no need of family planning as children are blessings to every family regardless of socioeconomic status

Appendix 5: Deforestation related activities in Rudewa-Mbuyuni village for the 2010/2011 season: Bricks making, charcoal making and estimated volumes of trees cut and used in the furnaces and in the households as firewood

Hamlet/S/N Number of tree cut	Number of bricks/charcoal bags	Estimated
1	20 000	6`
2	5 000	2
3	6 000	2
4	6 000	2
5	5 000	2
6	7 000	3
7	10 000	4
8	7 000	3
9	6 000	2
10	5 000	2
11	6 000	2
12	6 000	2
13	4 000	1
14	10 000	4
15	6 000	2
16	Variety	120 (mainly for charcoal)
17	15 (charcoal bags)	110 shuleni
18	20 000	
19	7 000	3
20	7 000	3
21	4 000	1
22	8 000	3
23	5 000	3
24	6 000	2
25	7 000	3
26	7 000	3
27	7 000	3
28	6 000	2
29	4 000	1
30	6 000	2
31	7 000	3
32	7 000	3
33	6 000	2
34	6 000	2
35	6 000	2
36	6 000	2
37	6 000	2
38	8 000	3
39	6 000	3
40	50 (charcoal bags)	100
41	Variety	150 (mainly for charcoal)
42	Variety	104 (mainly for firewood)
43	Variety	52 (mainly for firewood)

Kigenge		
44	6 000	2
45	4 000	1
46	70 charcoal bags)	150
47	50 (charcoal bags)	105
48	40 (charcoal bags)	90
49	15(charcoal bags)	35
50	65 (charcoal bags)	145
51	25	55
Mikoroshini		
52	5 000	2
53	8 000	4
54	10 000	5
55	Variety	96 (mainly for firewood)
56	Variety	160 (mainly for firewood)
57	Variety	90 (mainly for firewood
Makurunge		
58	53 (charcoal bags)	102
59	72 (charcoal bags)	155
60	28 (charcoal bags)	74
61	24 (charcoal bags	74

Appendix 6: Regression analysis output

Regression analysis output

Variables Entered/Removed(b)

Model	Variables Entered	Variables Removed	Method
1	Sanitation score(a)	.	Enter
2	Quality of toilet the household has/use(a)	.	Enter
3	Total Annual Household Income(a)	.	Enter

a All requested variables entered.

b Dependent Variable: Morbidity(diseases occurrence in the household)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.330(a)	.109	.104	.416
2	.331(b)	.109	.099	.417
3	.331(c)	.109	.094	.418

a Predictors: (Constant), N Sanitation

b Predictors: (Constant), N Quality of toilet the household has/use

c Predictors: (Constant), N, Quality of toilet the household has/use ,Total Annual Household Income

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients				
		B	Std. Error	Beta	T	Sig.		
1	(Constant)	.790	.107		7.398	.000		
	N	.294	.064	.330	4.587	.000		
2	(Constant)	.805	.125		6.424	.000		
	N	.299	.068	.336	4.375	.000		
	Quality of toilet the household has/use	-.008	.038	-.017	-.218	.827		
3	(Constant)	.793	.139		5.716	.000		
	Quality of toilet the household has/use	-.006	.040	-.012	-.151	.881		
	Total Annual household Income		N		.299	.069	.336	4.363	.000

a Dependent Variable: Morbidity(diseases occurrence in the household)

ANOVA(d)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.636	1	3.636	21.039	.000(a)
	Residual	29.726	172	.173		
	Total	33.362	173			
2	Regression	3.644	2	1.822	10.485	.000(b)
	Residual	29.718	171	.174		
	Total	33.362	173			
3	Regression	3.651	3	1.217	6.964	.000(c)
	Residual	29.711	170	.175		
	Total	33.362	173			

a Predictors: (Constant), N
b Predictors: (Constant), N, Quality of toilet the household has/use
c Predictors: (Constant), N, Quality of toilet the household has/use, Total Annual Household Income
d Dependent Variable: Morbidity(diseases occurrence in the household)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.524(a)	.275	.219	3.61702

a Predictors: (Constant), Score or quantification, VAR00003

ANOVA(b)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	128.955	2	64.478	4.928	.015(a)
	Residual	340.154	26	13.083		
	Total	469.109	28			

a Predictors: (Constant), Score or quantification, VAR00003
b Dependent Variable: BMI

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.195	2.989		5.418	.000
	VAR00003	.179	.507	.059	.354	.726
	Score or quantification	2.728	.877	.520	3.112	.004

a Dependent Variable: BMI

Table 19: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.210(a)	.044	.039	.763
2	.333(b)	.111	.101	.738

a Predictors: (Constant), B1_III i.e. score of worries to run short of food in the household

b Predictors: (Constant), B1_III, Q6_Total Annual Income for the household

ANOVA(c)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.082	1	5.082	8.725	.004(a)
	Residual	110.663	190	.582		
	Total	115.745	191			
2	Regression	12.814	2	6.407	11.764	.000(b)
	Residual	102.931	189	.545		
	Total	115.745	191			

a Predictors: (Constant), B1_IIIi.e. score of worries to run short of food in the household

b Predictors: (Constant), B1_III, Q6_Total Annual Income for the household

c Dependent Variable: Score or quantification

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	3.051	.183		16.693	.000
	B1_III	-.328	.111	-.210	-2.954	.004
2	(Constant)	2.861	.184		15.569	.000
	B1_III	-.278	.108	-.177	-2.566	.011
	Q6_Total Income	.000	.000	.260	3.768	.000

a Dependent Variable: Household food consumption quality score

Appendix 7: Vegetation covers of the study area (a) before 1966map (b) recently

drawn map of the area
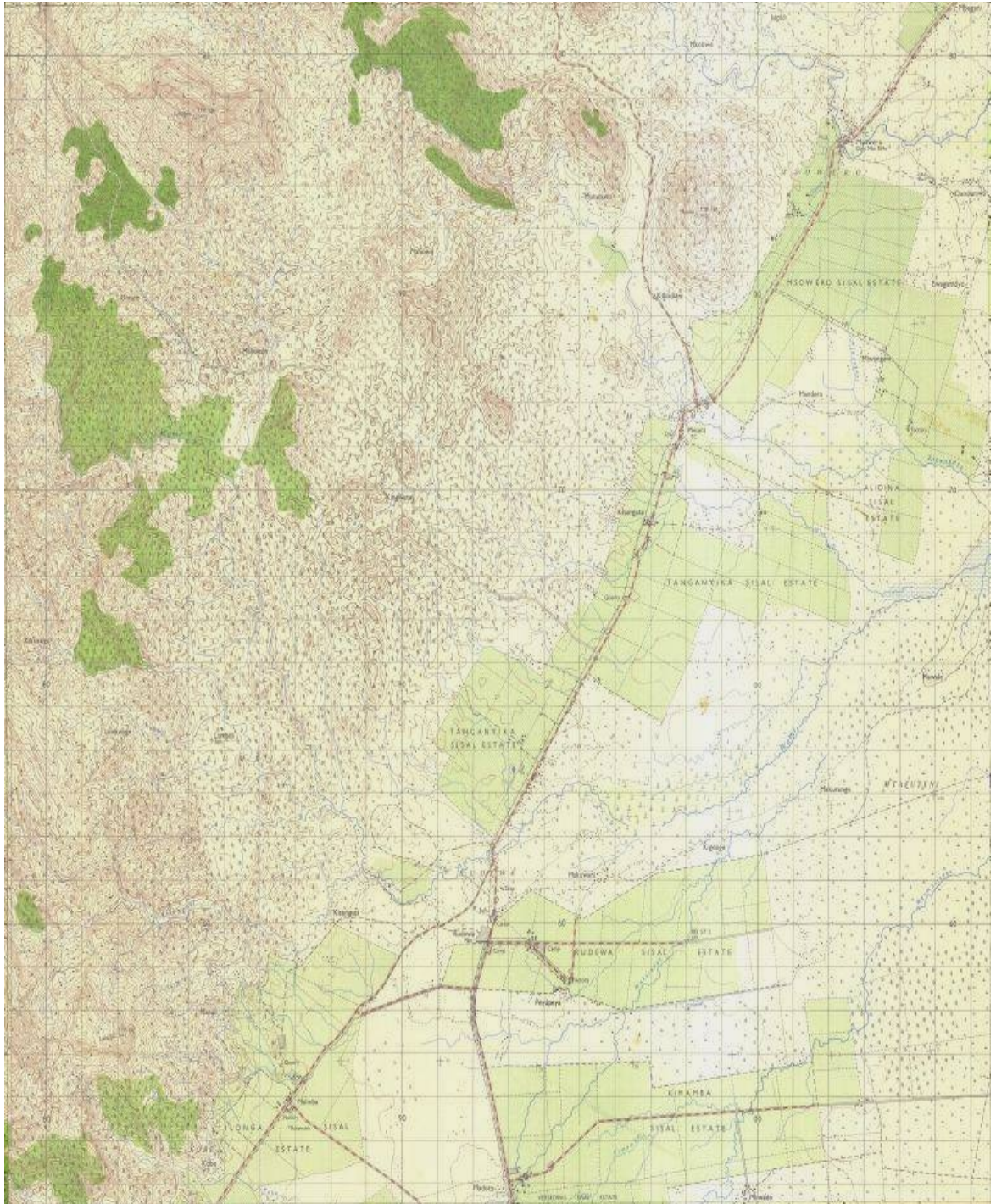
(a) 50,000 scale map drawn in 1966
(b) Recently drawn map at village scale to show details of land cover and use (Layout of Biodiversity)
Source: Ministry of Land, Housing and urban development

A MAP SHOWING LAND USES IN RUDEWA VILLAGE

KEY

Land uses

General Land (Ardhi ya kawaida

Primary court (Mahakama)

Village Office (Eneo la Ofisi)

Primary School (Eneo la Shule ya Msingi)

Bricks making (Eneo la Tofali)

Dispensary (Zahanati)

Cultivation (Eneo la Kilimo)

Settlements (Makazi)

Cemetry (Maziko)

Shrubs and Scattered Cultivation (Miti na Kilimo Mtawanyiko)

Woodlands (Mataji wazi)

● Biodiversity assesment plots

2,400 1,200   0   2,400 Meters

Source: Hieronimo *et al.,* 2010

Appendix 8: Mothers activities schedules for various type of days (normal days, holydays and Ramadhan) in Rudewa-Mbuyuini as observed by researcher during the study period (August and November 2011)

Case/Mother 1: Mrs. Habiba Said
Type of day: Ramadhan

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.50 – 7.47	57	Cleaning household compound
7.48 - 7.57	9	Emptying garbage bin
7.58 – 8.10	12	Cleaning in the house
8.11 – 9.04	55	Dish washing
9.05 - 10.02	56	Fetching water
10.03 – 3.30	5 hours	Farm work (cultivate)
3.31 – 4.00	29	Processing foodstuff
4.01 – 6.30	2 hours	Cooking *futari*

Case/Mother 2: Mrs. Hadija Mkudu
Type of day: Ramadhan

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.15 – 6.25	10	Cleaning household compound
6.26 - 6.36	10	Cleaning cows pen
6.37 – 6.57	20	Boiling water for milking
6.58 – 7.39	35	Milking cow
7.40 - 9.14	1 .5 hour	Distributing milk to customers
9.15 –9.45	30	Fetching water
9.46 – 9.54	8	Cleaning
9.55 – 10.13	8	Garbage bin emptying
10.14 – 10.54	39	Dish washing
10.55 – 11.55	1 hour	Laundry work
11.56 – 4.02	4 hours	Resting
4.03 - 4.30	27	Preparing foodstuff for *futari*
4.31 – 5.10	39	Cooking *futari*
5.11 – 5.52	41	Milking cow
5.53 – 6.03	8	Selling milk
6.04 – 6.24	18	Preparation for cooking
6.25 – 6.30	5	Cooking porridge for breaking the fast

Case/Mother 3: Mrs. Tausi Msondo
Type of day: Ramadhan

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.37 – 7.43	1 hour	Cleaning outside house
7.45 - 7.47	2	Emptying garbage bin
7.48 – 7.50	2	Burning garbage
7.52 – 8.22	30	Cleaning inside of the house
8.23 - 8.39	16	Peeling potatoes
8.40 – 8.50	10	Cooking potatoes
8.51 – 9.32	41	Dish washing
9.33 – 10.13	31	Harvesting pigeon peas
10.14 – 10.52	39	Resting
10.54 – 12.24	1.5 hours	Attending public meeting
12.25 – 2.33	2 hours	Harvesting cassava
2.34 – 4.23	2 hours	Preparing and cooking
4.24 – 6.30	2 hours	*futari* Peeling pigeon pea

Case/Mother 4: Mrs. R. Mwichande
Type of day: Normal (lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.03 – 7.17	14	Cleaning outside the household (surrounding)
7.18 - 7.33	14	Cleaning inside
7.34 – 7.37	2	Personal hygiene
7.38 – 8.20	40	Dish washing
8.21 - 9.14	57	Preparing breakfast taking it and resting
9.15 – 10.9	1 hours	Laundry work
10.10 – 11.07	52	Cooking
11.08 – 11.20	11	Dish washing
11.21 – 11.37	16	Sorting vegetables and fruits
11.38 – 2.13	3 hours	Harvesting pigeon peas
2.14 – 2.45	29	Cooking lunch
2.46 – 2.57	11	Taking lunch and resting
2.58 – 3.15	16	Dish washing
3. 16 – 4.17	1 hour	Harvesting pigeon peas
4.18 – 4.43	20	Peeling pigeon pea
4.44 – 5.01	45	Resting
5.02 – 6.30	1.5 hour	Preparations and cooking dinner

Case/Mother 5: Mrs. M. Kilimbike
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.45 – 7.30	39	Cleaning outside the household and inside
7.31 - 7.38	7	Fetching water
7.39 – 8.30	51	Dish washing
8.38 – 8.48	10	Fetching water
8.49 - 9.14	57	Preparing breakfast taking it and resting
9.15 – 1.15	4 hours	Shamba work (weeding)
1.16 – 1.40	24	Cooking
1.41 – 4.20	2 hours	Resting
4.21 – 5.37	1 hour	Peeling cassava
5.38 – 6.13	46	Going to the market
6.14 – 6.30	14	Cooking dinner

Case/Mother 6: Mrs. Amina Songoro
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.30 - 7.40	10	Cleaning
7.41 – 8.01	17	Fetching water
8.02 – 2.48	6 hours	Shamba work (weeding)
2.49 - 3.10	20	Taking shower
3.11 – 3.30	20	Preparing lunch and eating
3.31 – 5.00	1.5hour	Resting
5.01 – 6.10	2 hours	Dish washing
6.10 – 6.30	20	Cooking dinner

Case/Mother7: Mrs. S. Kalinga
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.00 - 7.10	10	Cleaning
7.11 – 7.26	10	Preparing breakfast
7.27 – 7.40	12	Taking breakfast
7.41 - 2.30	7 hours	Shamba work (harvesting)
2.31 – 2.54	22	
2.55 – 3.30	35	Taking shower
3.31 – 5.44	2 hours	Cooking lunch
5.45 – 6.30	45	Taking lunch and resting
		Preparation and dinner cooking

Case/Mother 8: Mrs. Fatuma Julius
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.33 - 6.40	7	Cleaning
6.41 – 7.01	20	Fetching water
7.02 – 7.23	20	Preparing breakfast
7.24 - 7.40	16	Taking breakfast
7.41 – 8.00	29	Dish washing
8.01 – 3.18	7 hours	Shamba work (harvesting)
3.19 – 3.35	14	Taking shower
3.36 – 4.00	19	Cooking lunch
4.01 – 4.21	2 0	Taking lunch and doing shopping
4.22 – 4.30	18	Sorting beans
4.31 – 4.50	19	Fetching water
4.51 – 5. 30	39	Pounding
5.31 – 6.02	30	Dinner cooking
6.03 – 6.30	30	Washing kids

Case/Mother 9: Mrs. O. Mnyate
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.03 - 7.10	7	Cleaning the house
7.11 – 7.30	9	Cleaning the compound
		Fetching water
7.31 - 7.54	19	Dish washing
7.55 – 8.10	20	Preparing breakfast
8.11 – 8.34	23	Peeling cassava
8.35 - 8.46	9	Taking breakfast and resting
8.47 - 10.30	43	Dish washing
10.31 – 11.01	30	Gardening work (harvesting)
11.02 – 12.33	1.5 hour	Pounding cassava leaves
12.34 - 1.03	30	Cooking lunch, eating and resting
1.04 –2.36	1.5 hour	Taking shower
2.37 - 3.01	24	Going to the market
3.02 – 5.08	2 hours	Dish washing
5.08 – 5.30	22	Resting
5.31 – 6.09	38	Dinner cooking
6.10 – 6.30	20	

Case/Mother 10: Mrs. M Sume

Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.44 -6 .58	12	Cleaning the compound
6.59 – 7.09	10	Cleaning the house
7.10 - 7.38	28	Fetching water
7.39 – 8.00	21	Preparing breakfast
8.01 – 4.44	8 hours	Shamba work
4.45 -5.15	30	Taking shower
5.16 – 5.46	31	Dish washing
5.47 – 6.16	29	Pounding cassava leaves
6.17 – 6.30	30	Cooking

Case/Mother 11: Mrs. B. Mpoto

Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.06 -6 .30	24	Fetching water
6.31 – 7.01	28	Cleaning
7.02 - 8.36	34	Preparing breakfast
8.37 – 9.20	53	Taking breakfast
9.20 – 9.40	20	Taking shower
9.45 - 10.15	30	Resting
10.16 – 2.30	3.5 hour	Going to town
2.31 – 3.06	35	Fish processing
3.07 – 4.40	1.5 hour	Cooking lunch
4.41 – 5.08	16	Having lunch
5.09 – 5.40	30	Dish washing
5.41 – 6.00	19	Fetching water
6.01 – 6.30	29	Cooking dinner

Case/Mother 12: Mrs. A. Lipongo
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.06 - 7.24	18	Fetching water
7.25 – 7.50	24	Preparing tea
7.51 – 8.13	22	Taking tea
8.14 – 1.44	4.5 hours	Shamba work
1.45 - 1.59	14	Taking shower
2.00 - 2.24	24	Sorting vegetables for lunch
2.25– 3.39	1 hour	
3.39 – 4.16	46	Preparing lunch
4.17 – 4.38	20	Taking lunch and resting
4.39 – 5.43	1 hour	Dish washing
5.44 – 6.02	15	Doing shopping
6.03 – 6.30	29	Food processing
6.01 – 6.30		Cooking dinner and baby washing

Case/Mother 13: Mrs. Agatha Martin
Type of day: Normal (Lean)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.23 – 6.36	13	Fetching water
6.37 – 6.48	10	Cleaning the compound
6.49 – 7.04	13	Cleaning the house
7.05 - 7.33	18	Preparing tea
7.34 – 7.46	12	Taking tea
7.47 – 3.33	8 hours	Shamba work
3.34 – 4.44	1hour	Preparing lunch, taking lunch and resting
4.45 - 4.59	14	Dish washing
5.00 – 5.28	28	Taking shower
5.29 – 5.45	15	Resting
5.46 – 6.03	17	Cooking relish
6.04 – 6.30	26	Fetching water

Case/Mother 14: Mrs. J. Mavukilo
Type of day: Normal (heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 - 7.14	9	Cleaning the house
7.15 – 7.33	18	Cleaning the compound
7.34 – 7.40	6	Preparing firewood
7.41 – 7.56	15	Preparing tea
7.57 - 8.18	21	Taking tea
8.19 – 5.06	9 hours	Shamba work
5.07 - 5.24	17	Taking shower
5.25 – 5.46	20	Resting
5.47 – 6.03	15	Fetching water
6.04 – 6.30	26	Cooking and washing babies

Case/Mother 15: Mrs. S. Mtuasara
Type of day: Normal (Leisure day)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.40 – 7.01	21	Cleaning
7.02 - 7.36	34	Fetching water
7.37 – 8.04	27	Peeling cassava
8.05 – 8.58	43	Cooking
8.59 – 9.24	25	Having breakfast
9.25 - 9.41	26	Dish washing
9.42 – 9.52	10	Taking shower
9.52 – 2.08	5 hours	Resting
2.09 – 3.11	1 hour	Preparation for cooking and cooking
3.12 – 3.26	14	Having lunch
3.27 – 3.57	30	Dish washing
3.58 – 5.33	35	Saloon
5.34 – 6.30	1 hour	Preparation for cooking and cooking dinner

Case/Mother 16: Mrs. E. Ruvumero
Type of day: Normal (Lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.03 - 7.14	11	Cleaning
7.15 – 7.34	19	Fetching water
7.35 – 8.01	26	Preparing breakfast
8.02 – 8.26	24	Having breakfast
8.27 - 3.08	6.5 hours	Shamba work
3.09 – 3.26	13	Taking shower
3.27 – 3.57	30	Cooking
3.58 – 5.04	1hour	Taking lunch and resting
5.05 – 5.35	30	Dish washing
5.36 – 6.09	34	Fetching water
6.10 - 6.30	20	Cooking and attending to kids (washing/shower)

Case/Mother 17: Mrs. R. Mlangwa
Type of day: Normal (Lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 - 7.20	15	Cleaning the compound
7.21 – 8.10	49	Cleaning the house(inside)
8.11 – 8.30	19	Peeling cassava
8.31 - 9.20	49	Cooking
9.21 – 9.40	19	Having breakfast
9.41 – 10.05	24	Dish washing
10.06 – 3.10	5 hours	Shamba work
3.11 – 3.21	10	Taking shower
3.22 – 4.05	43	Pounding cassava leaves
4.06 - 4.30	24	Cooking lunch
4.31 – 5.07	36	Taking lunch and resting
5.08 – 5.20	12	Winnowing
5.21 – 5.47	26	Collecting firewood
5.48 – 6.30	42	Cooking and attending to kids(washing/shower)

Case/Mother 18: Mrs. Mwanaisha Mwarabu
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.01 - 6.06	5	Cleaning livestock pen
6.07 – 6.20	13	Cleaning the house
6.21 – 6.39	19	Fetching water
6.40 - 7.05	25	Preparing breakfast
7.06 – 7.30	19	Having breakfast
7.31 – 8.01	30	Dish washing
8.02 – 5.15	9 hours	Shamba work
5.16 – 5.25	9	Taking shower
5.26 – 5.36	10	Cooking
5.37 - 5.37	10	Taking lunch
5.38 – 6.07	30	Taking care of livestock
6.08 – 6.30	26	Cooking and attending to kids(washing/shower)

Case/Mother 19: Mrs. Halima Mohamed
Type of day: Normal (Leisure day)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.07 – 7.20	13	Cleaning
7.21 – 7.45	24	Fetching water
7.46 – 10.30	3 hours	Preparing and cooking buns
10.30 – 10.50	15	Preparing tea
10.51 – 11.29	39	Having breakfast
11.30 – 1.15	1.25 hours	Shopping
1.16 – 1.29	15	Taking shower
1.30 – 2.37	1 hour	Preparing and cooking lunch
2.38 – 2.50	12	Taking lunch
2.51 – 3.05	14	Dish washing
3.06 – 5.07	1 hour	Resting
5.08 – 6.00	52	Preparing for cooking dinner and cooking
6.00 – 6.30	30	Attending to kids(washing/shower)

Case/Mother 20: Mrs. Asha Juma
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.08 – 7.15	7	Cleaning
7.16 – 7.30	14	Fetching water
7.31 – 7.50	19	Preparing breakfast
7.51 – 8.07	16	Having breakfast
8.08 – 4.20	12	Dish washing
8.21 – 5.15	9 hours	Shamba work
5.16 – 5.29	12	Taking shower
5.30 – 5.40	10	Cooking lunch
5.41 – 5.50	9	Taking lunch
5.51 – 6.11	10	Dish washing
6.12 – 6.30	18	Cooking dinner and attending to kids(washing/shower

Case/Mother 21: Mrs. Teresia Nyangara
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.10 – 7.25	15	Cleaning
7.26 – 7.35	24	Preparing breakfast
7.36 – 7.45	9	Having breakfast
7.46 – 7.55	9	Dish washing
7.56 – 4.05	8 hours	Shamba work
4.06 – 4.16	10	Taking shower
4.17 – 4.29	12	Cooking lunch
4.30 – 4.40	10	Taking lunch
4.41 – 4.50	9	Dish washing
4.51 – 6.10	1 hour	Dehulling rice
6.11 – 6.30	19	Cooking dinner and attending to kids(washing/shower)

Case/Mother 22: Mrs. K. S. Nduli
Type of day: Normal (Lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 – 7.40	35	Cleaning
7.41 – 7.55	14	Fetching water
7.56 – 8.45	49	Preparing breakfast
8.46 – 9.11	14	Having breakfast
9.12 – 9.40	28	Dish washing
9.41 – 2.05	4 hours	Shamba work and laundry work
2.06 – 3.05	1 hour	Preparation for cooking and cooking
3.06 – 3.20	14	Taking lunch
3.21 – 3.41	20	Dish washing
3.42 – 4.00	18	Taking shower
4.01 – 5.30	1.5 hour	Resting
5.31 – 6.30	1 hour	Cooking dinner and attending to kids(washing/shower)

Case/Mother 23: Mrs. M.A. Mlangwa
Type of day: Normal (Lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.10 – 7.35	25	Cleaning
7.36 – 8.02	24	Fetching water
8.03 – 8.15	12	Chopping firewood
8.16 – 8.45	31	Preparing breakfast
9.46 – 9.01	15	Having breakfast
9.02 – 9.15	12	Dish washing
9.16 – 12.18	3 hours	Dispensary
12.19 – 12.25	6	Taking shower
12.26 – 12.45	19	Cooking lunch
12.46 – 1.30	44	Having lunch
1.31 – 3.00	29	Salon
3.01 – 5.30	2.5 hours	Resting
5.31 – 6.30	1 hour	Cooking dinner and attending to kids(washing/shower)

Case/Mother 24: Mrs. N. Mbuguni
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.01 – 6.30	29	Cleaning
6.31 – 7.05	34	Fetching water
7.06 – 7.50	44	Preparing cassava for breakfast
7.51 – 8.05	14	Cooking porridge
8.06 – 8.15	11	Having breakfast
8.16 – 8.25	9	Dish washing
8.26 – 4.27	8 hours	Shamba work
4.28 – 4.38	10	
4.29 – 4.40	11	Taking shower
4.41 – 5.01	10	Cooking lunch
5.02 – 5.40	38	Having lunch
5.41 – 6.00	19	Taking care of livestock
6.01 – 6.30	29	Cooking dinner Attending to kids(washing/shower)

Case/Mother 25: Mrs. A. Said
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.05 – 6.30	29	Cleaning
6.31 – 6.50	20	Preparing breakfast
6.51 – 7.05	14	Taking breakfast
7.06 – 7.15	9	Dish washing
7.16 – 2.15	7 hours	Shamba work
2.16 – 2.26	10	Taking shower
2.27 – 2.45	17	Cooking lunch
2.46 – 3.00	14	Having lunch
3.01 – 5.30	2.5 hours	Attending a meeting
5.31 – 6.17	44	Preparation for dinner cooking and cooking
6.18 – 6.30	12	Attending to kids(washing/shower)

Case/Mother 26: Mrs. I. Mavele
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 – 7.30	25	Cleaning
7.31 – 8.05	34	Fetching water
8.06 – 8.18	12	Burning garbage
8.19 – 8.35	16	Peeling cassava
8.36 – 9.15	39	Preparing breakfast
9.16 – 9.36	10	Taking breakfast
9.37 – 10.26	49	Dish washing
10.27 – 3.25	5 hours	Shamba work
3.26 – 3.40	14	Cooking lunch
3.41 – 4.05	24	Having lunch
4.06 – 4.17	11	Taking shower
4.18 – 5.00	42	Preparation for dinner cooking (vegetable sorting and pounding)
5.01 – 5.30	29	Cooking dinner
5.31 – 6.30	29	Attending to kids(shower)

Case/Mother 27: Mrs. P. Karago
Type of day: Normal (Heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.40 – 6.49	9	Taking care of livestock Cleaning
6.50 – 7.20	30	Chopping firewood
7.21 – 7.37	16	Preparing breakfast
7.38 – 8.05	27	Having breakfast
8.06 – 8.15	9	Dish washing
8.16 – 8.25	9	Shamba work
8.26 – 4.15	8 hours	Taking shower
4.16 – 4.25	9	Preparation lunch
4.26 – 4.45	19	Having lunch
4.46 – 5.10	24	Dish washing
5.11 – 5.25	14	Taking care of livestock
5.26 – 6.00	34	Cooking dinner and
6.01 – 6.30	29	attending to kids(shower)

Case/Mother 28: Mrs. A. Debe
Type of day: Normal (light workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.49 – 7.51	3	Garbage disposal
7.52 – 8.17	35	Cleaning
8.18 – 9.20	1hour	Fetching water, dish washing and chopping firewood
9.21 – 9.41	20	Preparing and having breakfast
9.42 – 10.30	47	
10.31 – 1.32	3 hours	Going to the market
1.33 – 2.19	46	Shamba work
2.20 – 4.30	2 hours	
		Laundry work
		Taking shower, having
4.31 – 6.30	2 hours	lunch and resting
		Preparation for cooking, cooking and taking care of baby

Case/Mother 29: Mrs. R. Mdonde
Type of day: Ramadhan

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.49 – 7.03	13	Cleaning the compound
7.04 – 7.19	15	Cleaning the house
7.20 – 9.36	16	Fetching water
7.35 – 4.17	9 hour	Gardening
4.18 – 4.38	20	Going to the market
4.39 – 5.52	1 hours	Preparation for cooking, cooking and resting
5.53 – 7.00	1 hour	Taking care of baby (shower) and breaking the fast

Case/Mother 30: Mrs. O. Mnyate
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.05 – 7.19	14	Cleaning
7.20 – 7.40	20	Preparing tea
7.41 – 8.42	1 hour	Resting and taking breakfast
8.43 – 9.20	32	
9.21 – 10.45	1.5 hour	Garbage disposal
		Dish washing and laundry work
10.46 – 1.20	1 .5 hour	
1.21 – 1.51	30	Seeing the sick in hospital
1.52 – 2.50	1 hour	
2.51 – 3.50	1 hour	Cooking lunch
3.51 – 5.20	1.5 hour	Taking lunch and resting
5.21 – 6.00	39	Winnowing
6.01 – 6.30	29	Resting
		Preparing dinner
		Taking care of baby (shower)

Case/Mother 31: Mrs. R. Mlangwa
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.22 – 8.42	20	Cleaning
7.43 – 9.20	1.5 hour	Preparing tea, drinking tea and washing dishes
9.21 – 1.56	4 hours	Cooking lunch, taking lunch and resting
1.57 – 2.59	1 hour	Processing groundnuts
3.00 – 3.49	49	Resting
3.50 – 4.00	10	Going to mosque (pray)
4.01 – 4.20	19	Resting
4.21 – 6.30	2 hours	Preparing dinner and taking care of baby (shower)

Case/Mother 32: Mrs. K. Nduli
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.55 – 8.16	20	Cleaning
8.17 – 9.28	1.5 hour	Preparing tea, drinking tea and fetching water
9.29 – 10.00	30	Dish washing
		Cooking lunch, taking lunch and resting
10.01 – 4.00	6 hours	Harvesting pigeon pea
4.01 – 5.30	1.5 hour	Resting
5.31 – 6.30	1 hour	Preparing dinner and taking care of kids(shower)

Case/Mother 33: Mrs. M Sume
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.00 – 7.30	30	Cleaning the compound
7.31 – 8.02	30	Cleaning the house
8.03 – 8.48	45	Dish washing
8.49 – 9.15	27	Fetching water
9.16 – 11.15	2 hours	Cooking breakfast, taking breakfast and resting
11.16 – 1.40	2 hours	Paddy harvesting
1.41 – 2.39	1 hour	Gardening
2.40 – 3.26	48	Cooking and taking lunch
3.27 – 4.00	33	Dish washing
4.01 – 5.00	1 hour	Winnowing and grinding cereals
5.01 – 6.30	1.5 hour	Resting and preparing dinner

Case/Mother 34: Mrs. R. Kaseka
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.04 – 7.10	6	Cleaning
7.11 – 7.29	18	Fetching water
7.30 – 8.00	30	Preparing tea and taking
8.01 – 3.30	7.5 hours	B/fast
		Shamba work
3.31 – 4.00	29	
4.01 – 6.00	2 hour	Preparing lunch and taking
6.01 – 6.15	14	lunch
6.16 – 6.30	15	Going to the market
		Seeing patient in hospital
		Preparing dinner and washing babies

Case/Mother 35: Mrs. Hadija Mkindu
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 – 7.30	25	Cleaning the compound
7.31 – 7.50	19	Cleaning the house
7.51 – 8.10	20	Cooking breakfast
8.11 – 8.32	22	Taking breakfast and resting
8.33 – 10.00	1.5 hours	
		Dish washing and laundry
10.11 – 1.10	3 hours	work
1.11 – 1.54	44	Shamba work
1.55 – 2.10	15	Lunch preparation and eating
2.11 – 5.20	4 hours	
5.21 – 6.30	1 hour	Dish washing
		Going to the market
		Preparing dinner and washing kids

Case/Mother 36: Mrs. S. Omar
Type of day: Normal day (light)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.15 – 7.00	45	Fetching water
7.00 – 7.30	30	Cleaning the compound
7.31 – 7.45	15	Preparing breakfast
7.46 – 7.49	14	Taking breakfast
7.50 – 2.15	6 hours	Shamba work
2.16 – 2.46	30	Taking shower and resting
2.47 – 3.13	25	Preparing lunch
3.14 – 3.30	30	Taking lunch
3.31 – 4.30	1 hour	Resting
4.31 – 5.00	29	Cooking
5.01 – 5.34	34	Fetching water
5.35 – 5.59	24	Dish washing
6.00 – 6.30	30	Taking care of kids And preparing dinner

Case/Mother 37: Mrs. Halima I Mluwa
Type of day: Normal day (heavy workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.30 – 7.40	10	Fetching water
7.41 – 8.15	34	Cleaning the compound
8.16 – 8.30	29	Preparing breakfast
8.31 – 8.50	9	Taking breakfast
8.51 – 9.10	19	Dish washing
9.11 – 4.15	7 hours	Shamba work
4.16 – 5.10	54	Preparation and cooking of food
5.11 – 5.50	39	
5.51 – 6.30	39	Eating and resting Washing kids

Case/Mother 38: Mrs. Hadija Selemani
Type of day: Normal day (lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
7.05 – 7.30	25	Cleaning
7.31 – 8.15	43	Preparing breakfast
8.16 – 8.30	15	Taking breakfast
8.31 – 8.45	15	Dish washing
8.46 – 3.00	6 hours	Shamba work
3.01 – 3.21	20	Taking shower
3.22 – 3.45	23	Cooking
3.46 – 4.10	24	Eating and resting
4.11 – 6.15	1 hour	Resting
6.15 – 630	15	Cooking dinner and taking care of kids

Case/Mother 39: Mrs. L. Lukokoi
Type of day: Normal day (lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.04 – 7.10	6	Fetching water
7.11 – 7.30	19	Cleaning the house
7.31 – 8.00	29	Cleaning the compound
8.01 – 8.25	25	Preparing breakfast
8.26 – 8.40	15	Taking breakfast
8.41 – 9.00	20	Dish washing
9.01 – 4.00	7 hours	Shamba work
4.01 – 4.26	25	Taking shower and cooking
4.27 – 4.40	13	Eating
4.41 – 5. 50	1 hour	Resting
5.51 – 6.30	40	Cooking dinner and taking care of kids

Case/Mother 40: Mrs. Y. Mapembe
Type of day: Normal day (lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.00 – 7.30	.1.5 hour	Cleaning
7.31 – 8.10	39	Preparing breakfast
8.11 – 8.30	19	Taking breakfast
8.31 – 8.45	14	Dish washing
8.46 – 12.30	3 hours	Shamba work
12.31 – 1.15	44	Taking shower&rest
1.16 – 2.10	55	Going to the market
2.11 – 3.20	51	Cooking lunch
3.21 – 6.00	3hours	Eating and resting
6.01 – 6.30	29	Cooking dinner and taking care of kids

Case/Mother 41: Mrs. Mwajuma Yusuf
Type of day: Normal day (lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.10 – 7.30	.20	Cleaning compound
7.11 – 8.10	39	Cleaning the house
8.11 – 8.30	19	Preparing breakfast
8.31 – 8.50	19	Taking breakfast
8.51 – 9.10	19	Dish washing
9.11 – 3.30	6 hours	Shamba work
3.31 – 4.06	35	Preparation for cooking Cooking lunch
4.07 – 4.37	21	Eating and resting
4.38 – 6.10	1.5 hour	
		Cooking dinner and taking
6.11 – 6.30	20	care of kids

Case/Mother 42: Mrs. Cheka Salum
Type of day: Normal day (lean workload)

Time of the day	Duration of activity (minutes/hours)	Activity done by mother
6.44 – 7.00	.16	Fetching water
7.01 – 7.12	11	Cleaning
7.13 – 7.45	32	Preparing and taking breakfast
7.46 – 12.10	4.5 hours	Shamba work
12.11– 2.00	2 hours	Taking shower, cooking & rest
2.01 – 4.40	2.5 hours	
4.41 – 5.00	19	Taking lunch&rest
5.01 – 6.10	1hour	Fetching water
6.11 – 6.30	20	Resting Washing kids