



**COMPARATIVE STUDY ON ADAPTATION STRATEGIES BY RURAL  
HOUSEHOLDS IN RESPONSE TO FOOD SECURITY IN TANZANIA: A CASE  
STUDY OF BURUNGE WILDLIFE MANAGEMENT AREA**



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## DECLARATION

I, **Issa Moshi Kapande**, do hereby declare that this thesis is the result of my research, investigation and findings. Sources of information other than our own have been acknowledged and reference list has been appended. This work has not been previously submitted to any other university for the award of any academic degree.

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Issa Moshi Kapande

**(MSc. Agricultural Development Candidate)**

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Date

The above declaration is confirmed by:

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Prof. Martin Reinhardt Nielsen

**(Main supervisor)**

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Date

## **PREFACE**

Thanks to Almighty God for guidance and protection during the period of this study.

To the rural households of Burunge WMA (Mwada, Kakoi, Olasiti, Sangaiwe and Ngolei villages), I would like to offer my sincerest gratitude for your valuable time, knowledge, insight and opinions. Thank you for giving me the time to conduct my inquiries. May my research aid rural households of Burunge WMA to be able to offer their wisdom to others and, in particular help their community gain greater income.

I am grateful to all who those contributed to the successful completion of this work, I sincerely thank my supervisors, Professor Martin Reinhardt Nielsen and Mr. Jevgeniy Bluwstein, for their constant technical guidance, encouragement and advice, from the development of the proposal to the completion of this study.

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**July 31<sup>st</sup>, 2015**

Faculty of Science, University of Copenhagen

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## LIST OF ABBREVIATIONS AND ACRONYMS

BWMAS	Burunge Wildlife Management Speaker
ECF	East Coast Fever
et al	And others
FMD	Foot and Mouth Diseases
HDIC	Health and Development International Consultants
ha	Hectare
HH	Head of Household
Kak	Kakoi village
LMNP	Lake Manyara National Park
Mwa	Mwada village
MVC	Minjingu Village Chairman
mm	millimetre
NCA	Ngorongoro Conservation Area
Ngo	Ngolei village
NP	National Park
Ola	Olasiti village
PIMA	Poverty and ecosystem Impacts of payment for wildlife initiatives in Africa: Tanzania wildlife Management Areas
PA	Protected Area
PHC	Population and Housing Census
RMZP	Resource Management Zone Plan
San	Sangaiwe village
St	Standard
SACCOS	Savings and Credit Cooperative Society

TAWIRI	Tanzania Wildlife Research Institute
TANAPA	Tanzania National Parks Authority
TZS	Tanzanian Shillings
URT	United Republic of Tanzania
USD	United States Dollar
VEO	Village Executive Officer
VGS	Village Game Scouts
WWF	World Wildlife Fund
WMA	Wildlife Management Area

## **ABSTRACT**

Wildlife Management Areas (WMA's) in Tanzania are portions of village lands set aside for wildlife management. Despite the socioeconomic benefits of WMAs, rural households surrounding them have experienced a number of problems, ones which pose a threat to food security. However, there has been little accompanying exploration of strategies adopted by rural households in response to food insecurity. Accordingly, the purpose of this study was to compare strategies adopted by rural households in response to food insecurity in areas surrounding Burunge WMA in Babati District, Tanzania. The study methods used included in-depth interviews, focus group discussion, direct observation and informal conversation. A sample of 12 heads of household was selected for interview based on three social strata (very poor, other (neither very poor nor leader) and leader) and four categories of problems experienced by rural households: crop damage, land or crop loss, and crop damage and livestock losses. One household was selected per social stratum for each problem. Household data was analysed through content analysis. Findings from the study indicate that households in all social strata have adopted multiple strategies, comprising both natural and non-natural resource-based activities. Furthermore, it was observed that wildlife related factors (wildlife crop raiding & livestock predation) and non-wildlife related factors (drought, lack of agricultural education/extension services, crop and livestock diseases, poor use of improved inputs and market price fluctuations) have aggravated household food insecurity. However, there is little evidence to show that the Burunge WMA implementation itself has increased household food insecurity. The study argued that Burunge WMA implementation has exacerbated the intensity of human-wildlife conflicts. In particular, this study recommends the introduction of compensation schemes, the promotion of climate sensitive agricultural forms and increasing crop protection patrols. All of which will ameliorate problems for rural households, enhancing food security and fostering sustainable wildlife conservation.



## **1.0 INTRODUCTION**

### **1.1 Background Information**

The previous decade has witnessed an increasing demand for the participation of rural households in natural resource management, particularly in relation to wildlife conservation on village lands (Maganga *et al.* 2008; Kaswamila, 2009; Wilfred, 2010; Lynn, 2010; Sulle *et al.* 2011; Mfunda and Røskaft, 2011; WWF, 2014).

The idea behind rural households' participation in natural resource management is that they will gain rewards in return for their management efforts (Songorwa, 1999; Kaswamila, 2012). This has been believed to improve their standard of living, providing local people incentives to support natural resources conservation in a sustainable way (Johannessen, 2005; Kideghesho, 2006; Kideghesho and Mtoni, 2008; Mkumbukwa, 2008; Lynn, 2010; Sulle *et al.* 2011; Kaswamila, 2012).

As is the case with so many other governments in the developing world, the Tanzania Government has adopted a participatory approach with regard to wildlife conservation (Igoe and Croucher, 2007; Nelson, 2007; Blomley and Iddi, 2009). The approach emphasises the need for collaboration with other stakeholders, including rural households living adjacent to the protected areas, to manage wildlife resources (URT, 1998; WWF, 2014). In regard to wildlife management the approach has been referred to as Wildlife Management Areas (WMAs), with the same concept of conserving wildlife resources in village lands (Igoe and Croucher, 2007; Wilfred, 2010; Sulle *et al.* 2011; Mfunda and Røskaft, 2011).

At present, there are more than 17 WMAs in Tanzania (Benjaminsen and Bryceson, 2012). Since the year 2004 WMAs in Tanzania have covered an area of 2.5 million hectares and more than 410,000 rural households - who were predominantly dependent on natural resources for crop farming, livestock keeping and other natural resource-based income generation activities. These have now been affected, either through eviction or loss of access to natural resources (Agrawal and Redford, 2009; Lynn, 2010; Benjaminsen and Bryceson, 2012; Neves and Igoe, 2012; Bitanyi, 2012; WWF, 2014).

The implementation of WMAs on village lands in Tanzania has, however, been of benefit to rural households (Kaswamila *et al.* 2007; Mkumbukwa, 2008; Kideghesho and Mtoni, 2008;

Mfunda and Røskaft, 2011). Such benefits include the provision of revenues to participating villages used for improving basic social services such as construction of classrooms, teachers' houses and village government offices, water supply, health services provision, creation of employment opportunities and the payment of tuition fees to students from poor families (Wilfred, 2010; Sulle *et al.* 2011; Kaswamila, 2012).

Although WMAs have therefore contributed to rural households in some ways, these have also experienced negative consequences, which have outweighed by their perceived benefits (Sachedina and Nelson, 2010; Wilfred, 2010; Sulle *et al.* 2011). These include loss of agricultural lands to WMAs, livestock grazing restrictions in WMA, resource use and access restrictions in WMAs and exacerbation of human-wildlife conflicts (crop raiding/damage by wildlife, livestock and human predation) (Kideghesho and Mtoni, 2008; Kaswamila, 2009; Kaswamila and Songorwa, 2009; Lynn, 2010; Wilfred, 2010; Kaswamila, 2012; Benjaminsen *et al.* 2013).

The combination of these negative consequences has reduced the livelihood options available to rural households deprived of both crop production and income generation (Kaswamila *et al.* 2007; McCabe, 2010; Mfunda and Røskaft, 2011; Kaswamila, 2012; Benjaminsen and Bryceson, 2012; Nyahongo and Røskaft, 2012). In addition to these issues there are contextual factors which continually make rural households vulnerable. These factors include natural hazards such as agro-climatic shocks (drought), floods and the occurrence of crop and livestock diseases (Gifford-Gonzalez, 2000; Neumann, 2001; Ribot, 2010; Coppolilo, 2009; O'Keeffe, 2013; Ribot, 2014). These factors reduce both crop production and livestock productivity and render rural households vulnerable (Arnold *et al.* 2011; McCabe, 2010; O'Keeffe, 2013).

Furthermore, contextual factors such as poor social relations, an inconsistent policy towards land tenure, a lack of planning, market fluctuations, poor infrastructure and poverty are considered to cause livelihood vulnerability of rural households (Sauerborn *et al.* 1996; Ribot, 1998; Lynn, 2010; Ribot, 2010; Ribot, 2014).

In response to both negative consequences and the influence of contextual factors, rural households adopt strategies to improve their livelihood and food security (Barrett *et al.* 2001; McCabe, 2003; Paavola, 2008; McCabe, 2010; Ngailo, 2011; Nyahongo and Røskaft, 2012). The

strategies are composed of both natural and non-resource based activities (Salafsky and Wollenberg, 2000; Orr and Mwale, 2001; Barrett *et al.* 2001; McCabe, 2003; Thornton *et al.* 2007; Orindi *et al.* 2007; Paavola, 2008). Several studies have documented that wildlife and non-wildlife related factors have affected food security of rural households surrounding WMAs. Among these detrimental factors are: wildlife crop damage, livestock predation, floods, poor rainfall patterns, lack of agricultural extension services and poor use of improved agricultural input (Haule *et al.* 2002; Morton, 2007; Maganga *et al.* 2008; Mfunda and Røskaft, 2011; Nyahongo and Røskaft, 2011; Benjaminsen *et al.* 2011; Mwakatobe *et al.* 2014; Lyamuya *et al.* 2014).

Although much work has been conducted regarding factors affecting food security of rural households living adjacent to WMAs, there has been little accompanying exploration of the strategies adopted by rural households in response to food insecurity. This appears to be the case even though household food insecurity is an acknowledged and real phenomenon in the majority of rural households surrounding WMAs, Burunge WMA is one of them (Kaswamila *et al.* 2007).

It is therefore essential to understand strategies employed by rural households in response to food insecurity in the study area. Through doing so, researchers, conservation authorities and other wildlife conservation stakeholders can better design their programmes and thereby enhance household food security.

In accordance with this, the study has the intention of comparing strategies by different wealth groups in response to food insecurity in villages bordering the Burunge Wildlife Management Area (WMA) located in northern Tanzania range lands. Specifically, the study aims to explore how Burunge WMA implementation has impacted upon rural household food security, identifying strategies by rural households in response to food insecurity and how they changed due to WMA induced impact, and, finally, to assess how the WMA affect rural household attitudes towards wildlife and conservation.

### **1.1.1 Household Food Security**

Household food security is universally defined as access by all households to adequate food at all times (FAO, 2003; WFP, 1996). Adequacy, in this instance means sufficient, both in quality and quantity, to support a healthy life. This requires that the diet supplies enough energy (calories),

protein, minerals, and vitamins. While plant foods are capable of supporting a healthy life, efficient utilisation of nutrients requires a balance between foods of plant and animal origin. In some cases they act synergistically. For example, while plant protein may be deficient in some essential amino acids, addition of small quantities of animal protein may balance out the deficit (Whyte, 1974).

## **1.2 Conceptual Framework**

It is recognised that rural household livelihoods are constructed within a diverse range of activities, which involve dependency upon both natural resources and non-natural resources, through which rural households meet their necessities including food (Ellis 1998; Hussein and Nelson, 1998; Ellis, 2000; Barrett *et al.* 2001; Smith *et al.* 2001; McCabe, 2003; Ellis and Allison, 2004; O’Keefe, 2013). These livelihood activities, which rural households depend on, can be constrained by factors either within the system where the livelihood activity is carried out or contextual conditions. These would include such factors as environmental, political, social, economic, historic, demographic and policy conditions, determining the ability of rural households to overcome the livelihood activity constraints (Ellis, 1999; Ellis, 2000; Block and Webb, 2001; Barrett *et al.* 2001; McCabe, 2003; Ellis, 2005; Paavola, 2008).

This study asserts that rural household livelihood activities are constrained by conservation measures imposed in village lands set aside for wildlife management (WMA). The measures include grazing livestock restrictions, use of natural resources and access restrictions, and crop farming being forbidden in WMA (both cash and food crops). These conservation measures are in accordance to the wildlife conservation measures reported by several studies (e.g. Johannessen (2005), Nelson and Makko (2005), Kaswamila *et al.* (2007), Barirega *et al.* (2010), Kideghesho (2006), Kideghesho *et al.* (2007), Nelson *et al.* (2007), Brockington (2007), Sachedina and Nelson (2010), Sulle *et al.* (2011)).

Conversely, external shocks/disturbances such as human health shocks, natural shocks (e.g. droughts and floods), conflicts, crop and livestock diseases, policy changes, and loss of family members, coupled with existing contextual conditions, are, in the context of this study, also believed to constrain rural household livelihood activities. This relates to findings of Nelson and Makko (2005), Kideghesho (2006), Sallu *et al.* (2010), Barrett *et al.* (2001), Tschakert and Dietrich (2010) and Osbahr *et al.* (2008) who assert that there are external factors contributing in

limiting livelihood activities ranging from social, political, economic as well as natural events. The combination of WMA measures, contextual conditions and external shocks/disturbances are factors expected to cause vulnerability of rural households in relation to the household food security under study. Similar findings in comparable settings are noted by Kaswamila (2012) and O’Keefe (2013). Kaswamila (2012) observes that WMA rules and other regulations have led to loss of access to agricultural land and/or grazing land, which caused the decline in both cash income and crop production while O’Keefe (2013) notes the significant negative effects of climatic invariability on household livelihood.

Furthermore, this study recognises that external disturbances/shocks influence vulnerability by destroying the households’ asset base and limiting the available options for securing rural household food security. This argument accords with Ellis (1999), Eriksen and Lind (2009), Miller *et al.* (2010), Eriksen *et al.* (2005), Adger (2006), Mongare and Chege (2011), Orindi *et al.* (2007), Barrett *et al.* (2011) and Ellis (1998) who assert that the occurrence of an array of external factors reduces livelihood strategies. Many studies have indicated that, to ensure food security, households have to adopt strategies such as livestock and crop farming intensification, diversification of livelihood activities (complementing crop farming with livestock production, employment in other farms or in the non-farming sector, self-employment and gathering) and migration (Ellis, 1998; Ellis, 2000; Paavola, 2008; Below *et al.* 2012; Sallu *et al.* 2010; Wren and Speranza, 2010; Barrett *et al.* 2001; Davies and Bennett, 2007; Vermeulen *et al.* 2012). These strategies are also assumed to be adopted by rural households in the study area in response to WMA conservation measures, contextual conditions and external shocks/disturbances which pose threats to household food security.

In the study area diversification of livelihood strategies is believed to depend on the household objectives, access to natural resources and the general level of asset holdings within households. This is in accordance with Paavola (2008), Eriksen *et al.* (2005), Barrett *et al.* (2001) and Ellis (1998) who reported that the level of a household’s assets determine its strategies. For households in the study area to ensure food security a combination of household assets are required, whereby it can be assumed that possession of a variety of assets will reduce both vulnerability and shocks of households to food insecurity. This relates to reports of Smit and Wandel (2006), Eriksen *et al.* (2005), Orindi *et al.* (2007) and Miller *et al.* (2010), who found

that ownership of assets, would increase capacity for the household or individual to cope with hazards and stresses including food insecurity.

Furthermore, for rural households to be capable of providing a response to the aforementioned external changes, it would depend on the adaptive capacity that enables it to access and put into use available assets. In the study area the diversification of livelihood is assumed to function as a safety net to vulnerable households. This is also the case when households are severely confronted with factors that constrain the attainment of their preferred livelihood options, such as those precipitated by WMA conservation measures, contextual conditions and external shocks/disturbances.

The significance of adaptation strategies in this study is to empower rural households' resilience to withstand changes from external shocks, WMA conservation measures and the contextual conditions in relation to households' food security. In this study household resilience to changes such as WMA conservation measures (which alter the resource use pattern and livelihoods), contextual conditions and external shocks/disturbances are assumed, as indicated by studies performed by Pasteur (2011), Eriksen *et al.* (2005), Orindi *et al.* (2007), Miller *et al.* (2010) and Davoudi *et al.* (2012), to comprise two distinct types. The two forms of resilience are applied in this study (i.e. specified resilience and general resilience). Specified resilience involves resilience on an occurred event such as restriction on grazing pastures (political event), and general resilience, the resilience of household to unpredicted events such as agro-climatic shocks. These two forms of resilience are very important: rural households may be more resilient in a particular change, for example in sustaining food security against agro-climatic invariability, but may be less resilient in another.

Strategies adopted by rural households under study are believed, through the reduction of threats and leveraging potential outcomes of shocks to food security, to enable rural households to be resilient to WMA conservation measures, contextual conditions and external shocks/disturbances relating to food security. They facilitate rural households' exploitation of available livelihood options and aid their coping with the adverse consequences. This implies that the rural households that adopt strategies with more resilience to adverse changes would, accordingly, improve household food security, increase their income and reduce vulnerability. Conversely, rural households that adopt strategies which prove to be less resilient will result in the reduction

of household food security and increased household susceptibility to, and inability to cope with, various shocks and stresses.

The framework begins with external shocks/disturbances, contextual conditions (such as social relations, political influence, economical, market fluctuations, demographic, poor infrastructure, poverty, poor farming technology) and WMA conservation measures, which are recognised as the causative agent for rural household vulnerability to food insecurity and income generation. It is believed that political economy is among the contexts that influence the asset base in rural households. However, the framework shows that contextual conditions, external shocks and WMA conservation measures cause vulnerability by destroying the asset base of rural households. These include natural, physical, human, social and financial assets and limiting available options towards enhancing food security. In response to changes brought out by contextual conditions, external shocks and WMA conservation measures, rural households have to adopt strategies in order to address these changes.

In contrast, however, the framework illustrates that rural households have to use bribes (corruption), and breaking, ignoring, resisting and changing WMA rules and other regulations in order to overcome constraints imposed on resource access in WMA.

The framework was used as a guide in comparing strategies for sustaining food security adopted by rural households in Burunge WMA.

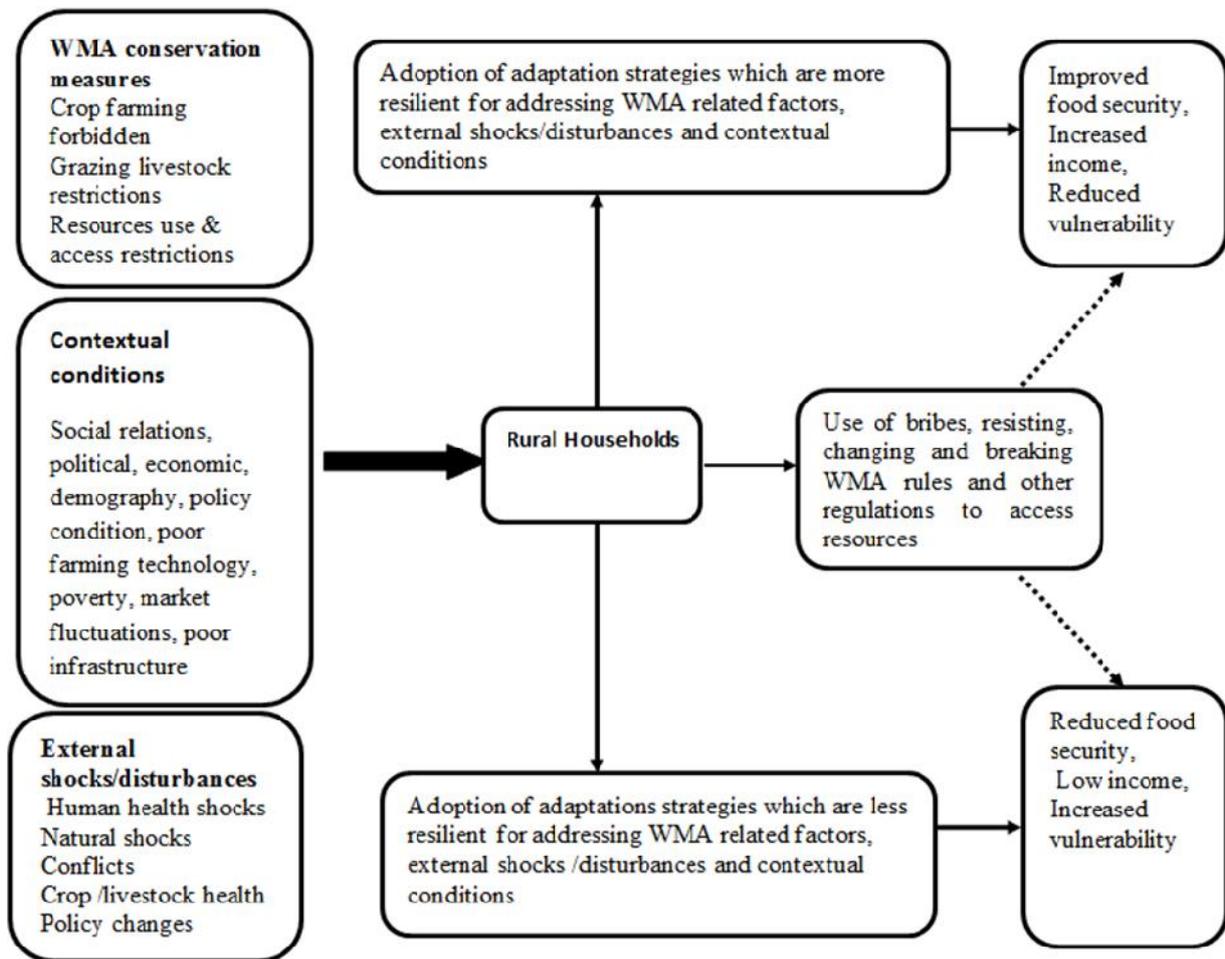


Figure 1: Conceptual framework for comparing rural household strategies in response to food insecurity in Burunge WMA

### 1.3 Research Objectives

The main objective of this study was to make comparison between strategies for sustaining food security adopted by rural households of different wealth groups (social status) in Burunge WMA.

The study was guided by the following objectives:

- i. Describe how WMA implementation has impacted on rural households' food security in the study area.
- ii. Identify adaptation strategies to sustain food security adopted by rural households in the study area and how these strategies have changed because of WMA induced impacts.

- iii. Assess how WMA's effects on food security affects local communities attitude towards wildlife and Wildlife Management Area initiatives.

#### **1.4 Research Hypotheses**

The study was guided by the following hypotheses about the link between Burunge WMA implementation and rural household strategies in response to food insecurity:

- i. WMA and other regulations restrict local people from using their preferred livelihood activities, thereby affecting their food security.
- ii. Implementation of the WMA has forced rural communities to develop new adaptation strategies in response to the effects of WMA on their livelihoods.
- iii. Household adaptation strategies differ depending on a range of social-economic aspects.
- iv. WMA effects on food security have produced negative attitudes of rural households towards wildlife conservation on village lands.

#### **2.0 THE STUDY AREA DESCRIPTIONS**

This study was conducted in Burunge WMA, located in Mbugwe division-Babati district-Manyara region. The study area lies in the semi-arid lowlands, with an altitude ranging between 950 to 1200 meters above sea level (URT, 2003). Burunge WMA commenced in the year 2000 and was certified in 2004. The area underwent a trial period for 3 years, until March 2006 when it was gazetted (BWMAS interview, 2015). In 2007 it received its user rights. A Resource Management Zone Plan (RMZP) was carried out and the village lands were divided into areas for residents, farming, livestock pasture, conservation, hunting blocks and open spaces (BWMAS Interview, 2015). The WMA began with five villages; Mwada, Sangaiwe, Vilima vitatu, Minjingu and Magara. Later on three villages, Mwada, Minjingu and Magara, were divided, Mwada village was separated into Ngolei village, and Minjingu village into Kakoi and Olasiti villages, and Magara village into Maweni and Manyara villages. This division currently forms the ten villages constituting Burunge WMA (BWMAS interview 2015). These villages originated from three wards (Mwada, Nkaiti and Magara). Burunge WMA has land area of 24, 319 ha (280km<sup>2</sup>) (WWF 2014; BWMAS interview, 2015).

Characteristically, Burunge WMA is adjacent to Tarangire NP, near to Ngorongoro Conservation Area (NCA), Kilimanjaro National Park and Amboseli National Park in Kenya. The study area is

an important pathway of wildlife connecting Tarangire NP, Lake Manyara National Park (LMNP) and the NCA (WWF, 2014). The major ethnic groups in the study area include: Maasai and Mbugwe (WWF, 2014). There are also a few minority ethnic groups such as the Nyaturu, Nyiramba, Wairaqwi and Barbaig (WWF, 2014).

The main economic activities of the area include food crop farming (i.e. maize, rice, sorghum, beans, cowpeas, pigeon peas), cash crop farming (i.e. sesame, sunflower, cotton), livestock keeping (i.e. cattle, goats, sheep and chickens), small businesses (i.e. traditional souvenirs, basket making, beads, and carving), and vegetable farming. Among the main activities performed by rural households during the rainy season are food crop production, cash crop production and livestock keeping (URT, 2003). These activities vary during dry season and make livestock keeping and small businesses more prominent.

The rainfall pattern is bimodal, with short periods of rain between October and December and long ones in the months of February and May (URT, 2003; URT, 2013). The average annual rainfall in the study area is estimated as being between 500 mm and 750 mm (URT, 2003; Kaswamila, 2006). The months of June and October are considered the driest. The soils are alkaline sandy and alluvial clay loam (URT, 2003).

Five out of ten agro-pastoral villages, Mwada, Sangaiwe, Ngolei, Kakoi and Olasiti, forming Burunge WMA were selected for study. Criteria for study villages selection were the presence of severe human-wildlife conflicts (i.e. wildlife crop raiding and livestock predation), household land loss due to WMA, proximity to protected areas, richness of wildlife resources and diversity range of social economic profiles ( i.e. ethnic diversity).

Mwada village is located within Mwada Ward. The population is estimated at 3,763 (Babati District Council PHC, 2012). The village is bordered by Lake Burunge and Tarangire NP (figure 2). The livestock census shows there are: 5,907 cattle, 2679 goats and 1,510 sheep (Babati District livestock Census, 2013).

Sangaiwe village is situated in Mwada Ward. The village shares its border with Tarangire NP in the east and the Dodoma-Arusha highway in the west (figure 2). In the north it borders Lake Burunge. Its population is estimated at 3,065 (Babati District Council PHC, 2012). The livestock

population includes 2,684 cattle, 2,801 goats and 860 sheep (Babati District livestock Census, 2013).

Ngolei village is also found in Mwada Ward. It shares its border with Tarangire NP and Lake Burunge. The population is estimated at 2,284 (Babati District Council PHC, 2012). Reports on livestock shows there are: 6,984 cattle, 4,480 goats and 1,860 sheep (Babati District livestock Census, 2013).

Olasiti village is located in Nkaiti Ward, with an estimated population of 4,036 (Babati District Council PHC, 2012). The village shares its border with Lake Manyara National Park, Tarangire NP as well as the Dodoma-Arusha highway. The number of livestock is estimated to be 7200 cattle, 5,695 goats and 3,218 sheep (Babati District livestock Census, 2013).

Kakoi village is also found in Nkaiti Ward. The village is adjacent to Tarangire NP. Its population is estimated at 3,691 (Babati District Council PHC, 2012). Livestock census shows there are 6,530 cattle, 5,219 goats and 2,180 sheep (Babati District livestock Census, 2013).

Currently, Burunge WMA is faced with a number of challenges, notably population pressure. In 2002 Burunge's human population was 21,943, yet had risen to 33,767 in 2012 (HDIC, 2010; Babati District Council PHC, 2012). This was caused by high rates of immigration to the study area. Other challenges include the increase in the number of livestock, increase in conflicts over land use between farmers, livestock keepers, natural resource collectors and the continuous monitoring of the collected revenues by government - which makes the timely receipt of revenue to Burunge WMA difficult (BWMAS interview, 2015).

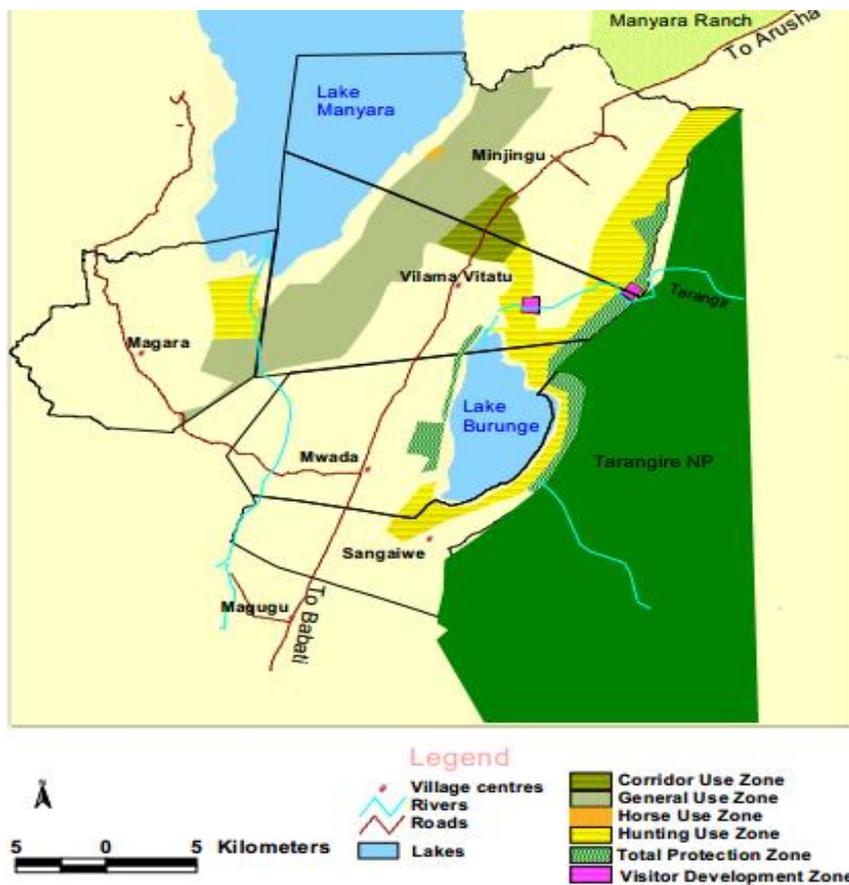


Figure 2: Burunge WMA map (HDIC, 2010)

### 3.0 RESEARCH METHODS AND LIMITATIONS

#### 3.1 Data Collection

In-depth interviews with rural households, formal interviews with BMWAS, direct observations and informal conversations were the primary methods used to collect information. The in-depth household interviews were triangulated with a focus group discussion, as outlined in Morgan (1996) and Uddin and Anjuman (2014). A literature review was also conducted in order to obtain insight on problems experienced by rural households living adjacent to protected areas. Principally, the study aimed to investigate issues relating to rural households. The following are descriptions of the methods used and why these were chosen.

### **3.1.1 In-Depth Household Interview**

In-depth interviews were implemented to obtain detailed information regarding the research objectives. These were conducted in 12 rural households located in five selected villages of Burunge WMA. The interview guide (Appendix 1) was prepared before entering the field, but was adjusted after obtaining preliminary information from initial discoveries. The interview guide design was based on Casley *et al.* (1988) which emphasises the provision of opportunities to give information about the prevailing situation.

This method was used for the reason noted by Legard *et al.* (2003), Boyce and Neale (2006), Coombes *et al.* (2009), that: “it helps in exploring issues in depth and detail, it facilitates in understanding complex issues such as impacts and outcomes, it is useful in gathering opinions, facts and stories that will reflect on the research questions from the respondent’s point of view.”

The advantage of this method is that, if there are noticeable gaps in data collected, they can be filled while the interview remains fairly conversational (Cavestro, 2003). This is due to the fact that it uses an open set of questions, allowing the interviewees to express their opinions through discussions.

In this study in-depth interviews were based on detailed discussions that included questions related to problems they experienced by rural households surrounding Burunge WMA, strategies adopted in response to food insecurity and attitudes towards wildlife and wildlife conservation, livestock watering and grazing strategies during droughts, and firewood collection strategies. Probes such who, what, why, where and how are used while asking questions so as to encourage respondents to answer more effectively and accurately. Moreover, in-depth interviews were also used to verify some of the information obtained from relevant literature.

### **3.1.2 Focus Group Discussion**

As argued by Morgan (1996), Powell and Single (1996) and Legard *et al.* (2003), a focus group discussion is a dialogue between people in small groups participating together with the aim of describing their perceptions, opinions and advocating ideas or recommending courses of actions regarding certain issues.

This study used focus group discussion to gain insight into rural households surrounding Burunge WMA, regarding problems experienced and their root cause. This method was used for

the following reason highlighted by Legard *et al.* (2003) that it offers opportunities to validate responses gathered through the in-depth interviews. Moreover, according to Morgan (1996), Powell and Single (1996) and Uddin and Anjuman (2014) the use of focus group discussion helps in eliciting information on a range of norms and opinions in a short time, stimulating conversation and reactions in group dynamics, discovering social motives on how people think about an issue.

Among the risks of this method is the possibility of fallacious information by the interviewees. In this study this was checked by using value-neutral ways as described by ETR Associates (2015), information seeking words were used (e.g. “tell me more about that’ ...), clarifying (e.g. “can you explain what you mean?”). And acknowledging (“I hear what you are saying...”).

Prior to going into the field the focus group discussion guide (appendix 2) was prepared and was modified after conducting in-depth household interviews. One focus group discussion was conducted in the study area, with the help of the field assistant. The group comprised of 5 heads of households, and its composition consisted of the same individuals who participated in the in-depth interview.

The group members characteristics were diverse, it consisted a mixed group of age, gender (two female heads of households), ethnicity, livelihood activity (crop farming & livestock keeping), problems experienced (livestock loss, crop damage and land loss), income (very poor, other (neither very poor nor leader) and leader/richer). The maximum duration for the focus group discussion was three hours.

Information that was gained included perceptions and opinions towards WMA, impacts experienced by being closer to protected areas, rules and regulations that form obstacles to their livelihood options, factors affecting crop production and livestock productivity and factors contributing to livestock losses. Other topics of conversation included resource access (cropping land, livestock pasture, firewood, thatch grasses, wildlife, poles, water for both livestock and human consumption and wild foods), where the interviewees graze and water livestock during droughts, patterns and trends currently (after WMA establishment), and for the last 10 years (before WMA establishment). These trends and patterns included the months in which they suffer wildlife crop raiding, harvest variations, food availability and livestock health problems).

### **3.1.3 Direct Observations and Informal Conversation**

Throughout the data collection process there was the potential for direct observation and informal conversation. This method was chosen because it helps in obtaining information about interactions between rural households and identification of the day-to-day life bases, their activities, their problems, and, possibly, the identification of the social structures in the rural settings that constrain/favour resources access (Cavestro, 2003). This method was also used in the field to verify the collected information and to generate questions. For example, if cow dung was used for cooking purposes in the study area, which meant that there was a scarcity of firewood in the area.

Moreover, direct observations have the advantage of occurring daily since I was part and parcel of the rural household for the period of study in Burunge WMA, where the field work was conducted. *“Observations of the physical structures, social differences, behaviors, actions and symbols in solitude or with others with whom observations are discussed, provide important information for posing central questions”* (Mikkelsen, 2005).

### **3.2 Sample Selection Strategy**

Respondents for the study were picked out without randomisation. This involved the use of PIMA data set for 23 households (Burunge PIMA surveys 23 households) which is based on the PIMA questionnaires. PIMA (Poverty and Ecosystem Impact of Tanzania’s Wildlife Management Areas) “is a three year interdisciplinary research project which aims to discover how Tanzania’s Wildlife Management Areas have changed people’s lives and their effects on wildlife and the environment” (<http://www.ucl.ac.uk/pima/people.htm>). This was used to prepare the sampling matrix. The Burunge PIMA surveys 23 households, and contains information on household assets such as land and livestock. It also offers information on what problems were experienced by rural households surrounding Burunge WMA, such as crop damage, livestock losses and land loss.

The sampling matrix was formulated based on four problems encountered by rural households, as shown in appendix 3. The 23 households in PIMA data set are divided into four social statuses (wealth groups) based on participatory wealth ranking by a focus group that ranked all households into rich, poor, normal and very poor. The social statuses/wealth groups in the matrix include, leader (rich), other (neither leader nor very poor) and very poor. Leader, for the

purposes of this data set, includes the Authorised Association (AA) member/chairman/board of trustees, Village Game Scouts (VGS), Village Chairman (VC), Village Executive officer (VEO), Ward Executive Officer (WEO), Sub-village Chair, or Natural Resource/Environment Committee Chair/Secretary/Treasurer. For each problem a total of three households were selected, one from each social status. Therefore, a total of 12 households were selected for in-depth study. Furthermore, 11 households were used as backup to be selected in case the chosen households declined to participate.

Prioritisation and replaceable order for household is shown in Appendix 3. The order, Kak 294, San 350, San 37... conveys that the first priority is to interview household number 294 in Kakoi village, but if they are not available or not interested, another household, number 350 in Sangaiwe village or household number 37, was considered for study. This pattern was applied for other orders, as shown in appendix 3.

Prior to the commencement of the in-depth interview, validation of the information provided by household for PIMA data set was performed. The purpose of this was to cross-check if information truly matches. Information such as livestock losses was verified to prove their veracity by observation and informal conversation with nearby neighbours.

### **3.3 Data Analysis**

Most of the data collected was entirely qualitative in nature and this necessitated the use of qualitative data analysis technique. Accordingly, a content analysis technique was used whereby data were interpreted and organised into different themes based on the conceptual descriptions of ideas expressed by the respondents.

### **3.4 Research Limitations**

The study was problematized by the use of a small sample size (12 households). This may not be truly representative of the situation in the study area due to the fact that households were referring to their own situation and experiences and not their perceptions of the general community. The sample size used also hindered statistical analyses of information collected. It was noted that members of the rural households perceived the study as an investigation of people and opinions against the establishment of WMA in their villages. This caused some heads of

household to be unavailable on the date agreed for interview. Overall, however, the study received good cooperation from most rural households visited.

## **4.0 RESULTS**

This chapter covers the analysis of data gathered from the field which is presented according to the objectives of the study and in conjunction with its underlying hypotheses.

### **4.1 Social-economic characteristics of the heads of household**

Table 1 presents socio-economic characteristics of 12 heads of household in Burunge WMA. The respondents' age ranged from 35 to 72 years, with an average of 49 years. Ages were categorised into two groups: middle (35-55) and older (> 55). The majority (10 respondents) were married couples and two were widowed. The study further shows that 8 respondents had household members below 18 years and 4 respondents had household members above this. With respect to the educational level, the study showed that all 12 respondents had attended primary school education. As regards ethnicity, the majority (5 respondents) were Maasai. Other respondents, with the order of 3, 2 and 1, were from the Mbugwe, Nyiramba, Rangi and Nyakyusa ethnicities respectively (Table 1). The study also revealed that the economic activities of rural households included agriculture, agriculture & livestock keeping (agro-pastoralists), fishing, petty businesses and masonry (Table 1). The majority (8 respondents) were involved in both agriculture and livestock keeping, 4 respondents were involved in agriculture, 1 respondent was involved in fishing at Lake Burunge and petty businesses, such as the selling of woven baskets and beads, and the selling of local chicken were prominent in very poor households (Table 1). The results also show that two rural households were involved in masonry activities and this was prominent in both very poor and other (neither leader, nor very poor category) (Table 1).

**Table 1: Socio-economic characteristics of the heads of household in the study area n=12**

Number of people	Leader	Other (Neither leader, nor very poor)	Very poor	Total
Age in years				
26-55	3	3	2	8
56-85	1	1	2	4
Marital Status				
Married	4	4	2	10
Widow	0	0	2	2
Education				
Primary education	4	4	4	12
More than primary	0	0	0	0
Sex				
Male	4	4	2	10
Female	0	0	2	2
Total members in a household				
Below 18	4	2	2	8
Above 18	2	1	1	4
Economic activities				
Agriculture	1	0	3	4
Agriculture & Livestock keeping	3	4	1	8
Fishing	0	0	1	1
Petty business	0	1	1	2
Masonry	0	1	1	1
Ethnicity				
Maasai	2	1	2	5
Mbugwe	1	2	0	3
Nyiramba	1	1	0	2
Nyakyusa	0	0	1	1
Rangi	0	0	1	1

**Source:** Household interview (2015)



*Plate 1: Overview of Lake Burunge (Picture by Author, 2015)*



*Plate 2: A fisherman at Lake Burunge with his fishing equipment (Picture by Author, 2015)*

The picture in plate 1 shows Lake Burunge which is within Burunge WMA, but fully controlled by Babati district Council as a source of revenues. The lake is used by rural households who obtain their livelihood through fishing activities. These fishing activities are normally done from 1<sup>st</sup> July up to 31<sup>st</sup> December each year. From January up to 30<sup>th</sup> June of each year, fishing activities in Lake Burunge are prohibited as per Babati district conservation measures. The picture in plate 2 shows the head of household, who believes his household livelihood has been affected by both Lake Burunge and Burunge WMA conservation measures.

#### **4.1.1 Land ownership**

In the study area, the majority the household land was privately owned. Table 2 shows that in all three social statuses the majority (10 households) owned land between 2-10 acres while 2 households owned land of more than 10 acres. The results revealed that the majority of

households in the study area owned a small portion of land. Some households owned more than 10 acres of land, for multiple uses but primarily for crop farming.

**Table 2: Land ownership in the study area n=12**

Land owned (acres)	Leader No	Other No	Very poor No
Below 2	0	0	0
2 -10	3	3	4
More than 10	1	1	0
Total	4	4	4

**Source:** Household interview (2015)

#### 4.1.2 Distribution of livestock kept by household in the study area

Table 3 shows the distribution of livestock kept by households in the area. The study revealed that some of the livestock to be found in rural households across the Burunge WMA were cows, goats, sheep, donkeys and chickens, and that cows were the dominant type, followed by goats and sheep, as shown in table 3. The results in Table 3 show that there was little livestock kept in the very poor social status category in comparison to the leader and neither leader or poor category. Furthermore, Table 3 revealed that chickens were the main kind of livestock kept on a very small scale.

**Table 3: Distribution of livestock kept by household in the study area n=12**

Social status	Livestock owned	Mean	Min No.	Max No.
Leader	Cows	24	0	60
	Goats	17	0	36
	Sheep	19	0	32
	Donkeys	1	0	2
	Chickens	3	0	10
Other (neither leader, nor very poor)	Cows	16	8	24
	Goats	19	12	25
	Sheep	12	5	20
	Donkeys	0	0	0
	Chickens	25	10	10
Very poor	Cows	5	0	18
	Goats	5	0	19
	Sheep and donkeys	0	0	0
	Chicken	1	0	4

**Source:** Household interview (2015)

### 4.1.3 Distribution of crops grown by rural household

Table 4 presents crops grown by households in the study area. The results show that both food and cash crops were grown among the three social statuses of household (leader, others and very poor). The main food crops grown were maize and rice, while sesame, cotton and sunflowers were the main cash crops. It also revealed that the food crops grown by households can also be traded and act as a cash crop: maize can be sold in the nearby market for the purpose of obtaining other household necessities. Based on the social status of household, it was observed that other households were not involved in growing other crops. For, example, under the leaders' category, one head of household was involved only in growing rice. He mentioned his reason for not growing other crops such as maize was that his village lands are highly susceptible to frequent floods, which makes growing crops such as maize difficult. Conversely, households under neither leader nor poor category were also involved in growing both cash and food crops, as shown in the Table 4. Moreover, household interviews showed that households under the category of very poor were involved in both cash and food crops cultivation.

**Table 4: Distribution of crops grown by rural household in the study area**

Social status	Crops grown by household
Leader	Rice, maize, cotton, sesame, cowpeas, beans, pigeon peas, sunflower
Other(Neither leaders, nor poor)	Maize, cowpeas, beans, sesame, sunflower, rice, green grams, pigeon peas.
Very poor	Maize, horticultural crops, rice, beans, cowpeas, pigeon peas, green grams sesame.

**Source:** Household interview (2015)

### 4.2 Burunge WMA implementation and rural household livelihood

The household interviews revealed that the implementation of Burunge WMA in village lands has subjected rural households to problems such as loss of access to agricultural lands, grazing of livestock being forbidden, and resource use and access restrictions. It was observed that Burunge WMA has increased conservation efforts, which has improved habitats and consequently increased wildlife populations. This has exacerbated human/wildlife conflicts through crop raiding/damage by wildlife, livestock predation, lack of compensation schemes, harassment by Village Game Scouts, and lack of economic benefits. The presence of these problems has negatively affected rural household food security, income generation and general welfare (Focus

group and Household interview, 2015). One head of household stipulated that, before the establishment of Burunge WMA in their village lands, he used to grow maize, sesame, cowpeas, and pigeon peas, yet later, in the mid-2000s, he abandoned cultivation of these crops due to the loss of his 4 acres of land and wildlife crop raiding. Furthermore, he also abandoned cotton farming due to the poor market price. Another head of household under the category of very poor stated that due to the increased wildlife crop raiding in her farm, predominately by elephants, she abandoned growing maize and alternatively she cultivated sesame and green grams.

#### **4.2.1 Rural household perceptions on Burunge WMA benefits**

Box 1 represents rural household perceptions on the benefits of Burunge WMA in their village lands. It can be noted that, 5 households reported that they did not know the benefits of Burunge WMA, and three households did not know the benefits of Burunge WMA because they did not even understand if there had been an establishment of community wildlife management in their village lands. These households were one from Mwada village-Makirinya sub-village and two from Sangaiwe village-Neneto sub-village. One household from Mwada village-Mbuyuni sub-village mentioned that he did not know the benefits of Burunge WMA in their village lands. Despite the stated fact that he did indeed understand that there was wildlife community management in village lands, he considered the WMA as strategies for the village government to secure village lands for the purpose of wildlife conservation. The field results also showed that 7 respondents mentioned that they understood the benefits of Burunge WMA in their village lands (Box 1). It is worth noting that rural households regretted their village's participation in WMA for the reason that WMA impacts were considered beyond what was expected and appeared to be a source for depriving household livelihoods. The Household interviews revealed that there were other investors within WMA who provided social services, such as water supply to nearby rural households. The results also showed that the ten villages joined Burunge WMA differed in both Impacts and results of WMA implementation and wildlife conservation opportunities. The pictures in plates 3, 4, 5 and 6 show some of the benefits of Burunge WMA in the study area.

**Box 1:** Burunge WMA benefits as perceived by rural households

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Provision of revenues to participating villages which were used in providing social services (Construction of classrooms at primary and secondary schools, construction of teacher and clinical officers houses, construction of dispensaries and village government offices).  
Provision of employment (some members from participating villages were employed as Village Game Scouts and office attendants)  
Environmental conservation in village lands  
Facilitation in construction of secondary school laboratories  
Payment of school bursaries for students from poor families

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**Source:** Household interview (2015)



**Plate 3:** Classrooms constructed by Burunge WMA in the study area (Picture by Burunge WMA, 2015)



*Plate 4: Mbugwe secondary school laboratory under construction by Burunge WMA (Picture by Burunge WMA, 2015)*



*Plate 5: Health centres under construction by Burunge WMA in the study area (Picture by Burunge WMA, 2015)*



*Plate 6: Village government offices constructed by Burunge WMA in the study area (Picture by Burunge WMA, 2015)*

#### **4.2.2 Burunge WMA rules, village by-laws and other regulations**

Rural households were asked to discuss Burunge WMA rules and other regulations in their village lands. The results are shown in Boxes 2-7.

Boxes 2-7 represent the Burunge WMA rules and regulations imposed in the study area. The study revealed that 3 households (one from Mwada village and two from Sangaiwe village) did not understand if there was Burunge WMA in their village lands, even though they understood the various rules and regulations enacted in their villages. The household interviews indicated that restrictions to harvest resources such as forest and non-forest products from WMA were perceived as detrimental by rural households. The village by-laws prohibit rural households entering into the conserved areas without permission from the village government. This has made rural households unable to freely access forest products (poles, timber, charcoal, and medicinal plants) and non-forest products (grazing pastures, thatch grasses, honey, wildlife) as they used to do before Burunge WMA's establishment. Moreover, restriction on the collection of firewood has exacerbated environmental degradation in areas outside WMA, as firewood is the only source of energy for cooking for the rural households. Crop farming prohibition within WMA has caused rural households to lose crop farming land, which has aggravated the decline of both food production and cash income.

Additionally, the household interviews revealed that village by-laws differed between villages. In some villages firewood collection was allowed, as was livestock grazing in a designated area within WMA. Even though firewood collection and livestock grazing were allowed, they were strictly prohibited in WMA zones reserved as hunting blocks, photo tourism areas and lodges (VGS interview, 2015).

The household interviews and focus group (2015) also revealed that rural households which violated the enacted WMA rules and other regulations were caught by VGS (Village Game Scouts), beaten, sent to court and fined. In other villages rural households stipulated that they were caught collecting firewood in the area designated for WMA and given fines.

### **Box 2: Burunge WMA rules**

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Restrictions on resources access in the WMA (firewood, poles, timber, grasses, honey, wildlife, and wildlife)

Crop farming forbidden in the WMA

Restrictions on entering and grazing livestock in the WMA

Restrictions on fishing at lake Burunge without a license

Restrictions on environmental degradation in WMA i.e. bush fires

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**Source:** BWMAS interview and Household interview (2015)

### **Box 3: Mwada village by-laws**

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Periodic opening and closing of lake Burunge

Prohibition on entering the conserved area without permission from the village government

Restrictions on cutting fresh trees without permission from the village government

Fishing with small sized nets is restricted

Collection of dried fallen firewood in the WMA

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**Source:** Village leader and Household interview (2015)

### **Box 4: Sangaiwe village by-laws**

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Collection of dried and fallen firewood in the WMA

Periodic opening and closing of lake Burunge

Fishing with small sized nets is restricted

Prohibition on entering in the conserved areas without permission from village government

No cutting of fresh trees allowed without permission

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**Source:** Village leader and Household interview (2015)

### **Box 5: Ngolei village by-laws**

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Livestock grazing in WMA during severe drought under VGS supervision  
Restrictions on cutting down fresh trees  
Restrictions on entering conserved areas without permission  
Restrictions on fishing by using small sized nets  
Request for permission for harvesting poles from nearby forest required  
Do not enter conserved area with weapons  
Permission is required for removing livestock entering WMA accidentally

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**Source:** Village leader and Household interview (2015)

### **Box 6: Olasiti village by-laws**

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Restrictions on killing wildlife in village lands  
Restrictions on cutting down fresh trees  
Collection of dried & fallen firewood allowed in village lands  
Restrictions on entering conserved areas without permission

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**Source:** Village leader and Household interview (2015)

### **Box 7: Kakoi village by-laws**

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No collecting of firewood in WMA, restrictions on cutting fresh trees  
Restrictions on killing wildlife in village lands  
Restrictions on entering WMA without permission  
Livestock grazing in WMA during severe drought under VGS supervision  
Restrictions on cutting/collecting firewood in Tarangire NP.  
Restrictions on grazing livestock in Tarangire NP  
Restrictions on collecting firewood across Tarangire river  
Collection of only dried & fallen firewood in village lands  
Restrictions on cutting trees in own farm without VEO permission

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**Source:** Village leader and Household interview and focus group (2015)

VGS: Village Game Scouts

NP: National Park

## **4.3 Negative consequences experienced by rural households**

Table 5 presents the consequences for rural households surrounding Burunge WMA. The consequences are in order of the problems experienced by rural households, and differ among households. The household interview results stipulated that, for the past decade, rural households in the study area used village lands for multiple purposes (crop cultivation and livestock grazing), under villages' land use plans. Moreover, villages gave out lands to WMA and currently, due to land shortages, it is not possible for rural household to expand their portions of land they own. Among other challenges causing land scarcity in the study area were high

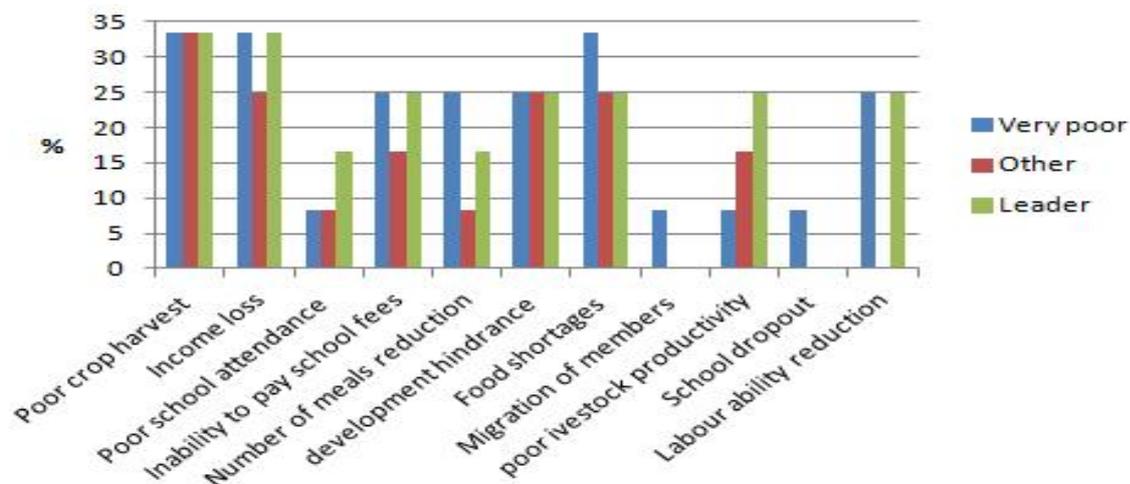
population growth as an outcome of local immigration (BWMAS interview, 2015). This has caused high land demand for various livelihood activities including livestock keeping and crop farming, leading to a continuation of land use conflicts between WMA and rural households (BWMAS interview, 2015). It was also observed that under the current WMA conservation measures, it is not possible for rural households to expand their land sizes. The majority of rural households under study owned 2-10 acres of land, which, according to them, was not enough for the expansion and intensification of farming operations. For the majority of rural households land scarcity was seen as the contributing factor for the decline of both income and crop output.

**Table 5: Negative consequences in relation to food security and general welfare experienced by rural household surrounding Burunge WMA**

Land loss or Crop loss	Poor/no harvest of food and cash crops, income loss, poor school attendance, inability to pay school fees in time, inaccessible to health services, reduction in the number of meals, labour ability reduction, household development hindrance, food shortages, hunger,
Livestock losses	Food shortages, poor school attendance, reduction in livestock productivity i.e. milk production), inability to pay school fees, hindrance in household development, reduced livestock milk production, loss of income
Crop damage	Reduction in number of meals, poor school attendance, food shortages, school dropout, poor/no harvest of food and cash crops, migration of household members, not paying school fees on time, failure to pay school fees at all, loss of income, hunger, household development hindrance

**Source:** Household interview (2015)

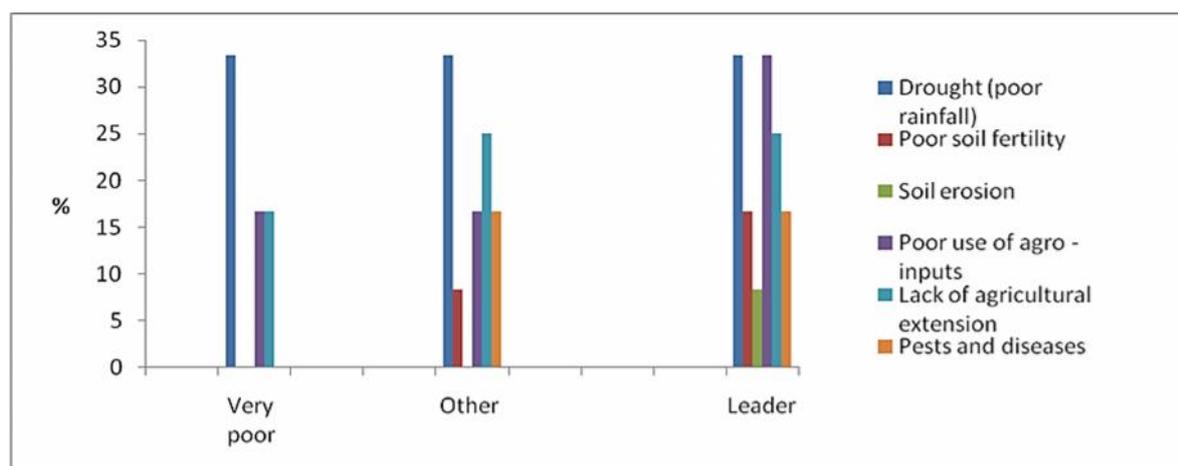
Figure 3 shows proportions of the negative consequences in relation to food security and general welfare of the rural households surrounding Burunge WMA experienced. Among the most significant consequences to rural households were poor crop harvests for food and cash crops, loss of income and food shortages (figure 3).



**Figure 3: Rural household responses regarding negative consequences in relation to food insecurity and general welfare**

**Source:** Household interview (2015)

Heads of households reported that the food insecurity in their households is not a result of wildlife related factors (crop raiding and livestock predation) only. They indicated on other non-wildlife related factors such as adverse rainfall patterns, poor use of improved agricultural inputs (i.e. seeds), and the lack of agricultural education/extension services and pests and diseases in their villages were the most significant factors posing a threat to their households' food security (figure 4).



**Figure 4: Rural household responses on non-wildlife related factors influencing crop production**

**Source:** Household interview (2015)

Heads of household who had lived in the study area for a long period revealed that wildlife crop raiding had been present since the 1970s but its intensity was very low. They now considered, however, that wildlife crop raiding is a serious problem in their villages.

The results also indicated that the rural households who conducted their farming activities far from lands set aside for wildlife management areas had not experienced this. It was observed that some village lands affected were close to other protected areas. For example, Kakoi village was in very close proximity to Tarangire NP, this resulted in a greater overlap between wildlife habitat and agriculture, and therefore increased human-wildlife conflicts such as wildlife crop raiding. Moreover, household interview results revealed that, even though households have suffered considerably from wildlife crop raiding, which has resulted poor/no harvest of their crops, there were also non-wildlife related factors causing food insecurity and deprivation of livelihood in their households. These factors included small farm sizes, high costs of agro-inputs (chemicals and fertilisers), and pest and disease outbreaks.

The household interviews also showed that rural households have lost their livestock due to both livestock predation and diseases. Livestock predation was observed to occur even before the establishment of Burunge WMA. It was, however, noted that livestock predation intensity before the year 2000 was minimal in comparison to recently, where there is a high frequency of livestock predation by wildlife. Livestock predation either occurred at their compound “Boma” or during grazing. The results revealed that both livestock predation and livestock diseases have resulted in the reduction of rural households’ herd sizes. Moreover, rural households in the study area owned non-improved local breeds, which are characterised by low reproduction potential.

The household interviews showed that Burunge WMA has enacted rules and regulations restricting villagers from grazing their livestock in the WMA, thereby limiting the availability of livestock pastures, especially in periods of severe drought where pastures in non-WMA are scarce, yet plentiful in Burunge WMA. The lack of pastures during dry spells caused livestock mortality and many livestock lost weight, and consequently fetched the lowest market prices. It was indicated that households which depend on livestock for its livelihood and source of food suffered by loss of livestock due to predation as well as a reduction in livestock productivity i.e. reduction in milk production. The interview results show that presence of rules and regulations restricting livestock grazing in WMA has affected livestock productivity, and that livestock lost

bodyweight and were infested by diseases, causing mortality and negatively affecting market prices.

In addition to Burunge WMA's implementation in village lands of livestock grazing restrictions, drought (poor rainfall pattern) which affected pasture availability, livestock disease outbreaks such as East Coast Fever (ECF) Foot and Mouth Diseases (FMD) have resulted in livestock losses/deaths and decelerated livestock productivity in terms of milk production. Heads of household also revealed that migration of livestock keepers has hampered pasture availability for livestock, in addition to the Burunge WMA restriction on livestock grazing in the WMA.

However, the magnitude of the consequences of food insecurity to rural households surrounding Burunge WMA is different - two households reported that despite wildlife crop raiding in their farms still they harvested enough to feed their household throughout the year. One head of household reported that he made considerable efforts in guarding crops against wildlife, while another stipulated that he has 60 acres of land, and even if crop raiding occurred, he can harvest enough for his household. One female headed household reported that food insecurity has resulted in the fragmentation of her family members and school dropouts; that her two children have migrated due to household hardship and it is normal for the household to suffer a reduction in the number of meals. In contrast, three heads of household reported that school dropouts and labour ability reduction did not occur in their households.

#### **4.3.1 Crop harvests of rural households surrounding Burunge WMA**

Box 8 shows the harvests of rural households surrounding Burunge WMA before and after Burunge WMA establishment. Maize and rice were the major crops grown by rural households in the study area. The harvests of all crops were recorded in bags of 100 kilograms (kgs) per acre as shown in Box 8. The results show that the harvests of major crops after implementation of Burunge WMA have declined. The harvest of sunflowers as a cash crop has remained relatively low before and after WMA establishment (Box 8). However, sesame as a cash crop showed an upward trend compared to before the establishment of WMA. According to rural households this was due to its lucrative market price and it being less susceptible to wildlife crop damage.

Figure 5 illustrates crop harvests per individual household before and after Burunge WMA establishment. Figure 5 indicates that, before WMA, 2 households were harvesting more than 20 bags of maize per acre, while rice harvests ranged between 20-30 bags per acre for three

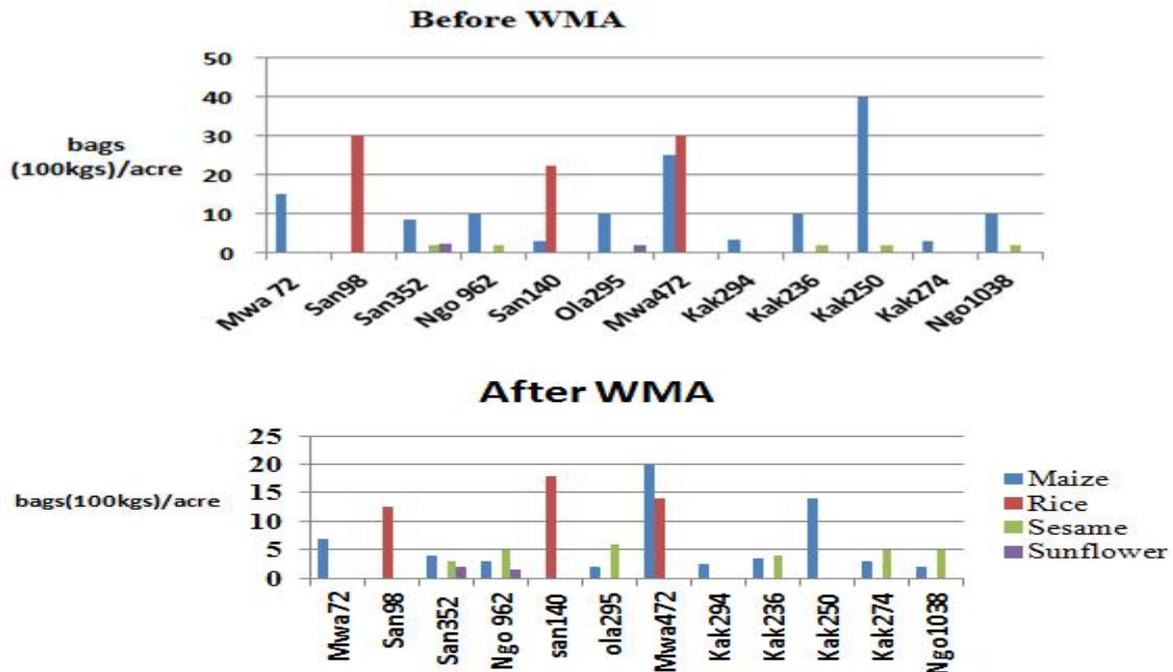
households only. Sesame and sunflower harvests were relatively low. Results in figure 5 reveal that maize harvests before WMA were relatively higher for some households.

Results in figure 5 after WMA establishment depict maize harvests for two households as ranging between 10-20 bags per acre, while rice for three households was between 12-18 bags per acre. Moreover, the harvests of sesame increased at an increasing rate compared to sunflower. It also shows that there has been a significant reduction in maize harvests.

**Box 8: Means of Rural household harvests (bags (100kg)/acre) before Burunge WMA establishment n=12**

	Before WMA			
	Maize	Rice	Sesame	Sunflower
Mean	11.5	6.875	0.833333	0.375
St deviation	11.14164995	12.5736467	1.029857301	0.882274952
Upper CI	18.22076433	20.56261451	1.684201824	1.442849492
Lower CI	4.062535576	4.58467886	0.3751278	0.32170041
t value	2.201			
	After WMA			
	Maize	Rice	Sesame	Sunflower
Mean	5.5	14.83	4.67	1.75
St deviation	6.0599	2.8431	1.0328	0.3536
Std error	1.7494	0.8207	0.2981	0.1021
Upper CI	9.3958	16.6398	5.3229	1.9746
Lower CI	1.6951	13.0269	4.0105	1.5254
t value	2.201			

**Source:** Household interview (2015)



**Figure 5: Rural household harvests before and after Burunge WMA establishment**

Source: Household interview (2015)

Mwa = Mwada village San = Sangaiwe village Ngo = Ngolei village Ola = Olasiti village Kak = Kakoi village

#### 4.3.1.1 Wildlife and non-wildlife related factors leading to poor/no harvests

Results from Table 6 reveal that not only have wildlife related factors (wildlife crop raiding) caused poor harvests of rural household food and cash crops; there are other contributing non-wildlife related factors (Table 6). Responses from rural households showed that 10 respondents reported that wildlife crop raiding caused poor or no harvest of their field crops, 11 respondents claimed that drought has played a significant role in reducing the field crop harvests. Additionally, non-wildlife related factors such as lack of agricultural education (7 respondents), poor use of agricultural inputs (6 respondents), pest and disease outbreaks (4 respondents) contributed to poor harvests of household field crops (Table 6).

**Table 6: Wildlife and non-wildlife related factors leading to poor/no harvests of both food and cash crops in villages surrounding Burunge WMA n=12 (Total number exceeds 12 as respondents were allowed to give multiple answers)**

Factor	Response
Wildlife crop raiding	10
Small farm size	2
Poor soil fertility	3
Poor rainfall (drought)	11
Lack of agricultural education/extension	7
Soil erosion	1
Poor use of improved agricultural input	6
Pests and diseases outbreaks	4
Highest cost of agricultural inputs	2
Bird outbreaks	2
Floods	1

**Source:** Household interview (2015)



**Plate 7:** *The effect of drought /poor rain fall in maize fields in the study area (Picture by Author, 2015)*

The picture in plate 7 shows maize field in the study area, which has been significantly affected by drought. The incidence of drought has caused poor maize growth, and consequently yield, which are not satisfactorily for household food demand and other necessities.

#### **4.3.2 Factors leading to poor livestock productivity in the study area**

Table 7 presents factors that have contributed to poor livestock productivity (reduction in milk production). The household interviews revealed that households are dependent on their livestock for their livelihood. It was observed that households can use milk for both income generation and

household consumption. The results also showed that households sell livestock during times when they do not have food, enabling them to purchase foodstuffs for their households. Table 7 depicts factors that hinder livestock productivity and, therefore, increase food insecurity. The results from Table 7 reveal that livestock grazing restrictions imposed by Burunge WMA, as reported by 8 respondents, were among other factors contributing to poor livestock productivity. Households indicated that, during dry periods, livestock productivity in terms of milk production declined and this created food insecurity and income poverty. Nonetheless, there are other factors contributing to poor livestock productivity and, therefore, household food insecurity (shown, in Table 7), and the most significant of these are droughts and lack of pasture in village lands (7 responses) and livestock predation (6 responses).

**Table 7: Factors leading to poor livestock productivity in villages surrounding Burunge WMA n=12 (Total number exceeds 12 because respondents were allowed to give multiple answers)**

Factor	Response
Livestock predation	6
Drought/Un reliable rainfall	7
Livestock grazing restrictions in WMA	8
Livestock diseases outbreak	5
Lack of pasture in village lands	7
Overstocking	1

**Source:** Household interview (2015)

#### **4.3.3 The exacerbation of human wildlife conflicts in villages surrounding Burunge WMA**

Rural households surrounding Burunge WMA have experienced a number of human/wildlife conflicts, which negatively impact upon the households' general welfare and pose risks to household food security. Table 8 presents the type of human/wildlife conflicts experienced by households surrounding Burunge WMA. Results in Table 8 show that the main conflict experienced by rural household surrounding Burunge WMA was wildlife crop raiding, followed by livestock predation (Table 8). It was observed that presence of these human/wildlife conflicts have caused rural households to have negative attitudes towards wildlife and wildlife conservation.

**Table 8: Human wildlife conflicts experienced by rural households surrounding Burunge WMA n=12 (Total number exceeds 12 because respondents were allowed to give multiple answers)**

Type of conflict	Response
Wildlife crop raiding	11
Livestock predation	6
Threats to lives	1

**Source:** Household interview (2015)

#### **4.3.3.1 Destructive wild-animal species to crops and livestock**

Table 9 shows that elephants were the most destructive wild animals in the study area, followed by wild pigs, hyenas and zebras. The results also indicated that destructive wild animals were highly distributed in areas surrounding Wildlife management areas and protected areas such as the Tarangire NP. It was observed that Kakoi village, which is adjacent to Tarangire NP, and rural household farms which are close to Lake Burunge, have been much affected by wildlife crop raiding.

**Table 9: Destructive animal species in Burunge WMA to rural household crops and livestock n=12 (Total number exceeds 12 because respondents were allowed to give multiple answers)**

Destructive animal species	Response
Elephant	9
Monkey	1
Wild pig	4
Birds	2
Lion	2
Hyena	4
Gazelle	2
Zebra	4

**Source:** Household interview (2015)

## **4.4 Rural household strategies for accessing livestock pasture and water**

### **4.4.1 Strategies rural household uses to access pasture.**

Results from Table 10 represent strategies rural households used in response to drought and WMA livestock grazing restrictions, to ensure grazing pasture availability for their livestock. The majority of households stated that they obeyed the rules and regulations imposed by Burunge WMA and village government and that they never grazed their livestock in WMA. One

head of household mentioned that he used to graze his livestock in WMA without fear of being caught or punished because he believed that the area set aside for WMA was their land and they used it before WMA establishment. He stated that he could not tolerate the poor pasture availability for his livestock while there was plenty of pasture in the WMA. Another head of household stated that he bribed VGS who allowed him to graze his livestock in WMA throughout the dry season.

**Table 10: Rural household strategies to access pastures**

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Renting portion of land in wetlands
Purchasing of hays
Purchasing of maize straws from neighbours
Stocking of maize straws after harvest and used as livestock feeds during drought
Grazing livestock in WMA after bribing Village Game Scout (VGS)
Stocking of rice straws after harvesting and used as livestock feed during drought
Grazing livestock in wet valleys throughout the dry season
Grazing livestock in WMA despite the rules and regulations imposed
Using of maize bran as livestock feeds
Grazing livestock in nearby village lands
Requesting permission to graze livestock in other wards

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**Source:** Household interview (2015)



**Plate 8:** *Livestock grazing outside WMA (picture by Author, 2015)*

Picture in plate 8 shows livestock grazing outside WMA by rural household members in the study area.

#### **4.4.2 Strategies used by rural household for watering livestock during drought**

Box 9 represents household strategies for watering livestock during drought, especially in the months of late May up to December. It was noted that, before the WMA establishment, rural households used the wet valleys now within the lands set aside for wildlife management - which have water throughout the year. The use of dams along the Arusha-Dodoma highway was not sustainable because dam water availability was dependent on rainfall pattern in the study area. The heavy dependence of livestock on dam water has caused some to dry up either in the onset or mid period of drought seasons. Moreover, some households were living far away from the Arusha-Dodoma highway where the dams are located. This involved livestock travelling long distances, which ultimately decreased livestock health and productivity. Water valleys in non-WMAs were into two categories: some had water throughout the year (Oltukai valley and wet valleys in Kakoi village), and others were seasonal. This caused rural households to construct traditional wells in wet valleys for watering livestock in cases where water was not available. It was also noted that one household watered livestock in WMA wet valleys after bribing VGS to allow livestock watering in WMA. It was revealed that the majority of the rural households didn't water their livestock in WMA, which has affected their livelihood activities.

#### **Box 9: Household strategies for watering livestock during drought**

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Watering livestock in rough dams constructed during Arusha-Dodoma highway construction

Watering livestock in wet valleys which are not in WMA

Watering livestock in wet valleys inside WMA

Construction of traditional wells in wet lands

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**Source:** Household interview (2015)



*Plate 9: Livestock being watered in dams along Arusha-Dodoma highway (Picture by Author, 2015)*



*Plate 10: Wet valley used by rural households for watering livestock (Picture by Author, 2015)*

Pictures in plates 9 and 10 show areas used by rural households for watering their livestock during the drought period, and complying with WMA rules and regulations which restrict entering livestock in WMA.

#### **4.5 Rural Household accesses to firewood and water in the study area**

##### **4.5.1 Strategies used by rural household to access firewood in the study area**

Box 10 represents household strategies for accessing firewood in the study area. It was revealed that before the 2000s rural households used to collect firewood from the area now set aside for wildlife management and other surrounding areas in their villages. Burunge WMA rules and other village by-laws have made it difficult for rural households to access firewood, both in the

WMA and non-WMA. The WMA rules and other regulations restrict harvesting resources in the WMA, including firewood as well as cutting trees in village lands without permission. The study revealed that there were other reasons for difficulties in obtaining firewood in the study area. These included the environmental degradation/deforestation which has occurred over the past decade for the purpose of clearing land for crop farming. The results indicate that the majority of rural households obeyed the WMA rules which restrict firewood collection, but some did not abide by these rules and, without fear of punishment, entered and collected firewood in WMA, which amounted to theft.

#### **Box 10: Rural household strategies for firewood access**

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Purchasing of dried pigeon pea trees from neighbours  
Collection of fallen dead wood in non-WMA  
Pruning/cutting trees around homestead  
Stealing firewood in WMA  
Use of cow dung as substitute for firewood  
Requesting permission from VEO to cut trees in own farms

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**Source:** Household interviews and focus group (2015)

**VEO** (Village Executive Officer)

#### **4.5.2 How do rural households access water for human consumption**

Box 11 defines ways used by rural households to access water for human consumption during both dry and wet seasons. The results indicate that rural households did not access water for human consumption from the areas set aside for wildlife management. The household interviews showed that rural households' access to water was not a problem in either the dry or wet seasons, while in other villages water access was a serious problem, particularly in the drought season. Moreover, the interviews revealed that, in villages with water availability throughout the year, a few villages suffered poor water quality (high levels of salt content). The use of flooded water by households was seen as a causative agent for human disease infestation such as cholera, typhoid fever and stomach-related diseases. The construction of traditional water wells was seen as a difficult activity for a single village (Olasiti village Oltukai sub village-plate 13) because of the rock phosphate landscape which hindered well construction, and forced rural households to share one source of water with livestock for their day-to-day consumption. It was observed that village governments did not carry out any substantial efforts in delivering water services to rural

households. The presence of investment companies and Tanzania National Parks Authority (TANAPA) were significant in providing water services to rural households.

**Box 11: Ways which rural household used to access water for human consumption.**

- 
- Fetching water from water streams outside WMA
  - Use of flooded water
  - Homestead constructed water wells
  - Fetching water from nearby villages
  - Fetching water from community constructed water wells
  - Use of wet valleys in non WMA
  - Use water pumps constructed by village government
  - Use of water pumps constructed by TANAPA or investor company
- 

**Source:** Household interview (2015)



**Plate 11:** Rural household members fetching water from water pump (picture by Author, 2015)



**Plate 12:** Rural household members fetching water in wet valley outside WMA (picture by Author, 2015)



*Plate 13: Phosphate rocks landscape of Olasiti village-Oltukai sub village (Picture by Author, 2015)*

#### **4.6 Strategies adopted by rural households in response to food insecurity**

The rural household strategies in response to food insecurity in the study area were divided into problems (i.e. land loss, livestock losses and crop damage) which rural households have experienced, and the head of households' social statuses as shown in Table 11, 12 and 13.

##### **4.6.1 Rural household adaptation strategies to food insecurity based on land loss**

Results from Table 11 indicate strategies adopted by rural households surrounding Burunge WMA in their response to food insecurity based on land loss. The results revealed that some households were forced to devise adaptation strategies to food security that were not related to the impacts of Burunge WMA establishment. For example, one household from the leader category mentioned that the main contributing factor for his crop loss was not loss of land or wildlife crop raiding, but due to agro-climatic changes, such as poor rainfall patterns in his village. The results also show that purchasing food at local markets and petty business were adaptation strategies adopted by all three rural household social statuses (Table 11). The petty businesses adopted included the selling of water, selling of local chickens, eggs and selling of firewood. One head of household from neither leader nor poor category mentioned that he collected dried and fallen wood from the nearby forest and sell them to his neighbours. Moreover, sometimes if he is in need of poles for house construction he requests permission from the village Executive officer (VEO) who issued him a license indicating how many poles to cut and within how many days, usually a two week period. Another head of household from the very poor category mentioned that, before the Burunge WMA establishment, he owned 6 acres

of land close to Lake Burunge, but following this he lost 4 acres, which were surveyed and earmarked as land for wildlife management. He remained with 2 acres, which he used to grow maize. Due to the increased wildlife crop raiding in his maize farm he then started fishing at Lake Burunge, and has been harassed by VGS as he is doing so in the area set aside for conservation. Even though there are restrictions he continued as it enabled him to provide food for his household. The results also indicated that, due to the increased wildlife crop raiding, some rural households have changed their strategies: increasing maize production in non-WMAs, and developing petty businesses. The study revealed that one household in the very poor status category listed its main occupations as both fishing and farming activities, under the leader category one household was involved in rice farming as its main activity, and, in the neither leader nor very poor category, the household was involved in both farming and livestock keeping.

Moreover, results in Table 11 revealed that the adopted strategies comprised of both natural and non-natural resource based activities. The activities consisted of farm activities (growing of sesame, maize, rice, sunflower and horticultural gardening), off-farm activities but within agriculture (casual labour at other farms and petty business involving agriculture) and non-farm activities (Fishing at Lake Burunge and petty businesses not involving agriculture). Results show that households in all social statuses adopted equal numbers of strategies. It was also observed that households in this category were not involved in livestock selling.

**Table 11: Rural household strategies in response to food insecurity based on land loss**

Strategies in response to food insecurity	Social statuses (wealth groups)		
	Leader	Other	Very poor
Petty businesses (eggs, chickens, water, firewood)			
Causal labour at other farms			
Purchasing food at local markets			
Fishing at lake Burunge			
Horticultural gardening			
Growing maize			
Growing sesame			
Growing sunflowers			
Growing rice			
Livestock selling			

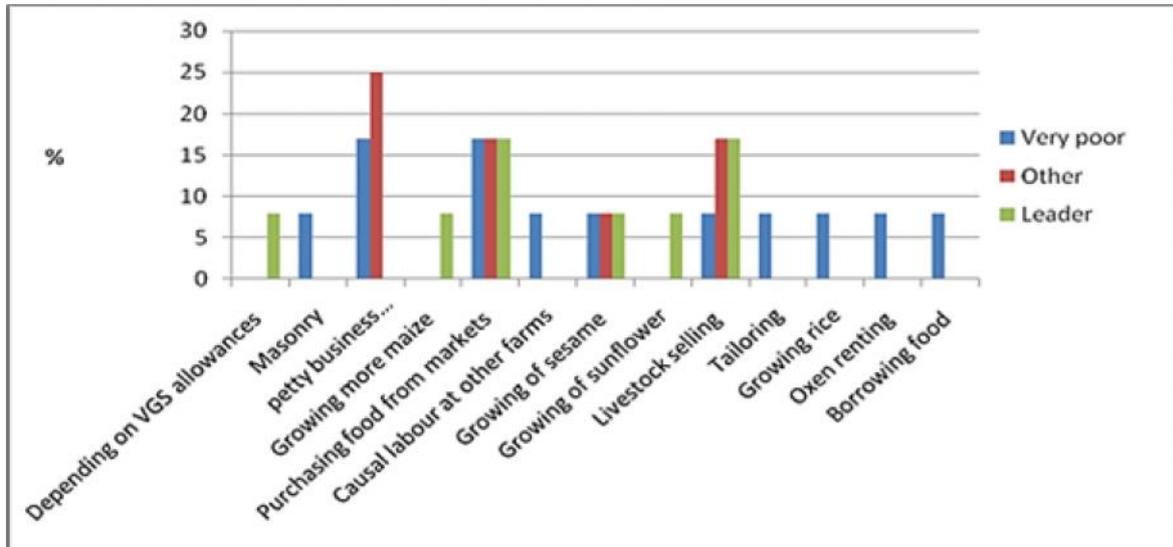
Source: Household interview (2015)

#### **4.6.2 Rural household adaptation strategies to food insecurity based on livestock losses**

Results from figure 6 show that food purchasing from local markets was used by all wealth groups, and the selling of livestock was highly used by the other and leader social groups. The results also indicate that petty businesses were prominent in very poor and other (neither very poor nor leader) wealth groups. Results in the livestock losses category showed that small family size plays an important role in ensuring the food security adaptation strategy is sustainable. One household under the leader category mentioned that he has a small family size (composed of four people only, two adults and two children), and the adaptation strategies he adopted were satisfactory to meet food demands of his household and its general welfare. The results also revealed that assets possession in terms of livestock is important for the rural household to have a range of adaptation strategies. This is revealed in the very poor category, where the household diversified activities to oxen renting (figure 6) enabling an increase in income, which was used for food purchases and other livelihood necessities. The responses from the head of households showed that there is a problem of higher prices of food commodities in local markets which necessitated the selling of livestock, which reduces herd sizes.

Two households mentioned that their adopted strategies to food security are satisfactorily in meeting their household food demand and general welfare, though one household in the leader category mentioned that his adopted strategies were somehow satisfactory. The field study showed that all households in the livestock losses category were both farmers and livestock keepers.

The field results also indicated that the price of food commodities at local markets was high, which prohibited rural households purchasing enough food for their consumption. Livestock selling was prominent in both leader and other (neither leader, nor very poor) wealth groups. It was also noted that the prices for livestock changed seasonally.



**Figure 6: Rural household responses to strategies in response to food insecurity based on livestock losses**

**Source:** Household interview (2015)

Table 12 illustrates rural household strategies in response to food insecurity based on livestock losses in the study area. Results from Table 12 reveal that the adopted strategies comprised both natural and non-natural resource-based activities. The activities consisted of farm activities (growing (of sesame, rice, maize and sunflower) and livestock selling), off-farm activities but within agriculture (causal labour at other farms and petty business involving agriculture) and non-farm activities (VGS allowance, masonry, oxen renting, petty businesses not involving agriculture and borrowing food from other). Results show that households under very poor social status adopted a considerable number of strategies in comparison to households under other (neither leader nor very poor) and leader social statuses. It was also observed that households in very poor social status were not involved in livestock selling.

**Table 12: Rural household strategies in response to food insecurity based on livestock losses**

Strategies in response to food insecurity	Social status ( wealth group)		
	Leader	Other	Very poor
VGS allowance			
Purchasing food at local markets			
Livestock selling			
Masonry			
Tailoring			
Oxen renting			
Petty businesses (chickens, beads, carvings )			
Borrowing food from others			
Causal labour at other farms			
Growing sesame			
Growing sunflower			
Growing more maize			
Growing rice			

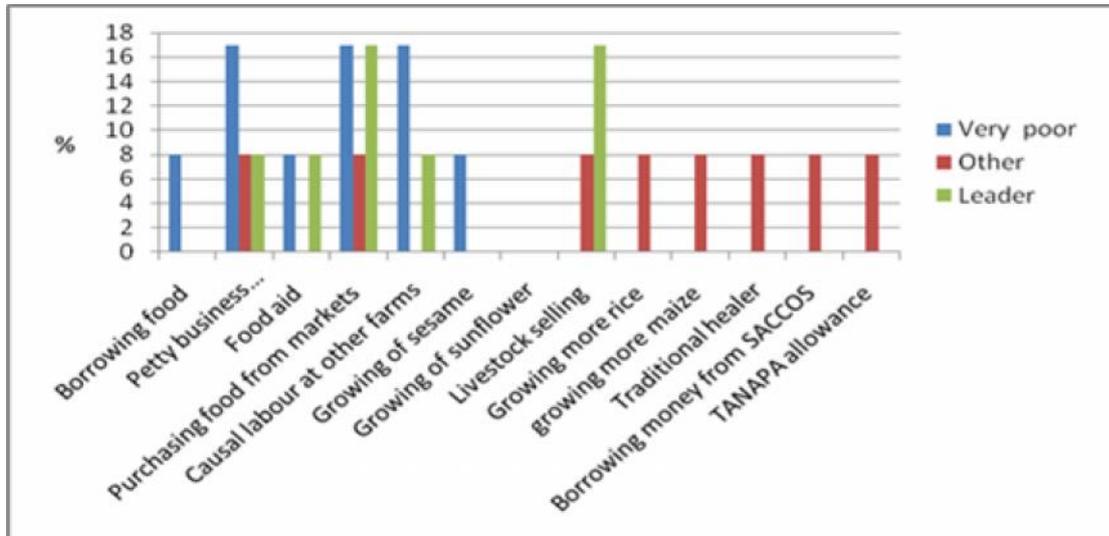
**Source:** Household interview (2015)

#### **4.6.3 Rural household adaptation strategies to food insecurity based on crop damage**

The results from figure 7 show strategies adopted by rural households in response to food insecurity from the impact of crop damage. Petty businesses and causal labour were prominent in very poor category (figure 7). Petty businesses were mainly conducted by households bordering Tarangire NP, which is a tourist destination. Livestock selling was used by leader and other (neither poor nor leader) category, but was prominent in the leader category (figure 7). The results from figure 7 also revealed that purchasing food from local markets was used by all categories in the study area, but highly prominent in very poor category (figure 7). The households under the leader category mentioned that the adopted adaptation strategies were not satisfactorily for meeting food demand and other necessities because of the low market prices received from livestock selling. Additionally, customers for stone piles were not available and, if available, low prices were received, which were not satisfactory to meet household food requirements and other necessities. Two households under the very poor category were female headed and their main occupation was farming, but they received poor harvests due to wildlife crop raiding, poor rainfall pattern and lack of agricultural education. The poor prices rural households received from petty businesses such as beads and woven basket selling rendered

them unable to meet household food requirements and other necessities due to the income received being outweighed by the high prices of food commodities in local markets. The field study showed that the household under leader category was both a farmer and livestock keeper. One household leader under the other social group (neither leader nor very poor) mentioned that the adaptation strategies in response to food insecurity he adopted were satisfactorily to meet food demand and other livelihood necessities for his household. The field study also revealed that the household under neither leader nor very poor category was both a farmer and livestock keeper, and even though the household possessed livestock, never sold his livestock in response to food insecurity. Instead, he primarily depended on that harvested from his farms being enough for his household despite wildlife crop raiding and poor rainfall pattern. The head of household mentioned that he has enough land (12 acres), and he used it to grow food crops and consequently harvested enough food for his household throughout the year.

Moreover, household interviews showed that another female headed household under very poor category abandoned maize farming due to increased wildlife crop raiding. She adopted growing sesame on her crop land, but she stipulated other reasons for the low harvest of sesame as being poor rainfall pattern, lack of agricultural education, poor use of improved agricultural inputs i.e. seeds. She also mentioned that the lowest market price of sesame in the local markets caused her failure to meet food demand for her household throughout the year. The household under very poor social status stipulated that all strategies adopted for food insecurity were unsustainable and satisfactory to meet household food requirements and other livelihood necessities.



**Figure 7: Rural household responses to strategies in response to food insecurity based on crop damage**

**Source:** Household interview (2015)

Results from Table 13 illustrate strategies adopted by rural households in the study area in response to food insecurity based on crop damage. The results revealed that the adopted strategies comprised of both natural and non-natural resource-based activities. The activities consisted of farm activities (growing sesame and maize, livestock selling), off-farm activities but within agriculture (causal labour at other farms and petty businesses involving agriculture), and non-farm activities (traditional healing, borrowing money from SACCOS, TANAPA allowance, food aid and petty businesses not involving agriculture). The results indicate that households under other (neither leader nor very poor) adopted a greater number of strategies in comparison to households under very poor and leader social statuses. It was also observed that households in very poor social status were not involved in livestock selling.

**Table 13: Rural household strategies in response to food insecurity based on crop damage**

Strategies in response to food insecurity	Social status		
	Leader	Other	Very poor
Food aid			
Borrowing food from other			
Petty businesses (beads, carvings, chicken)			
Causal labour at other farms			
Livestock selling			
Purchasing food at local markets			
Growing maize			
TANAPA allowance			
Borrowing money from SACCOS			
Traditional healer income			
Growing sesame			
Growing more rice			

**Source:** Household interview (2015)



**Plate 14:** Sesame field in Kakoi village (Picture by Author 2015)

The picture in plate 14 shows sesame fields in Kakoi village, specifically, a new cropping pattern which has been adopted by rural households due to the increased wildlife crop raiding in maize fields and poor rainfall pattern in the village lands.

#### **4.6.4 Methods used by rural households to prevent wildlife crop raiding and livestock predation**

Box 12 represents methods used by rural households to prevent both wildlife crop raiding and livestock predation. Crop raiding was performed by wildlife such as zebras, elephants, gazelles and wild pigs and livestock predation principally by lions, hyenas and leopards. The interview

results showed that the methods used by rural households to guard their crops and livestock varied among household social statuses, few leader and neither leader nor poor households managed to obtain well-constructed and wire fenced cowsheds (as shown in picture plate 16), with the majority of households having poorly constructed and unfenced cowsheds, offering easy targets for predators (as shown in picture plate 15).

The rural household interviews and focus group discussion revealed that female headed households suffered a higher number of livestock predation incidences compared to male headed households. This is because in female headed households there were no males who can occasionally guard livestock against predators during the night. The results showed that, in households without dogs, there was a high incidence of livestock predation. However, employing people for field crop guarding was costly to rural households and poor households could not afford to, resulting in a higher level of crop destruction. Furthermore, crop protection performed by Village Game Scouts (VGS) was not conducted across all villages in Burunge WMA. Both wildlife crop raiding and livestock predation has forced rural communities to change their cropping pattern, some abandoned maize production and opted for horticultural crops, sesame farming and others completely abandoned livestock keeping.

**Box 12: Methods used by rural household to prevent wildlife crop raiding and livestock predation**

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The use of traditional wildlife scares in farms  
Personal crop guarding  
Employing people to guard crops  
Construction of cowsheds “Boma”  
Fencing of cow sheds “ Boma”  
Use of dogs to scare predators  
Depending on VGS crop protection initiative

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**Source:** Household interview and focus group (2015)

**VGS:** Village Game Scouts



**Plate 15:** Rural household members standing in front of their poorly constructed cowsheds “Boma” (Picture by Author, 2015)



**Plate 16:** Head of household standing in front of his wire fenced cowshed “Boma” (Picture by Author, 2015)

#### **4.6.5 Sustainability of adaptation strategies in securing household food security**

Table 14 represents sustainability of strategies adopted by households in response to food insecurity.

Rural heads of household were asked whether the adopted strategies in response to food insecurity were satisfactorily in meeting household food demands and other livelihood necessities. The responses were categorised into three sets of strategy outcome: strategies which yielded sustainable responses to food insecurity; strategies which somehow provided sustainable responses to food insecurity; and strategies which resulted in unsustainable responses to food insecurity, as shown in Table 14.

For the purposes of this study 'sustainable' refers the state whereby the adopted strategies against food insecurity provide the household adequate food (in both quantity and quality) at all times. In this regard, the household is termed as food self-sufficient. 'Somehow sustainable' is when the adopted strategies yielded food to the household for some periods of the year while failing to provide adequate food for subsequent periods of the year. In contrast, 'unsustainable' means that the adopted strategies in response to food insecurity did not provide access to adequate food to the household at all times. Under this category the household is said to be food self-insufficient.

Results from Table 14 show that strategies in response to food insecurity adopted by rural households based on land loss were not sustainable for households of every social status. However, the strategies for food insecurity based on livestock losses were sustainable for one household in very poor and other (neither leader nor very poor) social status while somehow sustainable to leader households. Furthermore, strategies in response to food insecurity based on crop damage were sustainable to households under other (neither leader nor very poor) and one leader social status. These strategies were also unsustainable to households under both very poor and leader.

**Table 14: Sustainability of household strategies in response to food insecurity**

	Very poor			Other (neither leader nor very poor)			Leader		
	Sus	Shs	Ns	Sus	Shs	Ns	Sus	Shs	Ns
Land loss									
Livestock losses									
Crop damage									

Source: Household interview (2015)

Sus= Sustainable    Shs= Somehow sustainable    Ns= Not Sustainable

Source: Household interview (2015)

#### **4.7 Rural household attitudes towards Burunge WMA and wildlife conservation**

Despite the benefits of Burunge WMA to participating villages, rural household perceptions on Burunge WMA establishment and wildlife conservation were negative. Rural households perceive the WMA establishment in their village lands as government strategy to secure their lands in favour of wildlife conservation. During the focus group discussion majority of discussants seen implementation of Burunge WMA to be contrary to what was agreed before WMA operation. They stated that “since Burunge WMA establishment areas for livestock grazing and firewood collection are not yet allocated”. One head of household stipulated that, “what Burunge WMA is doing is cruel to villagers, if there are rules imposed on accessing resources there must also be procedures for households to access them”.

In fact, participants in the focus group discussion stated that “we don’t get the benefits of Burunge WMA other than crop destruction, livestock losses, human injuries and deaths”. Furthermore, that, “we will no longer tolerate wildlife on our village lands because we don’t obtain any compensation from wildlife crop raiding and livestock predation”. These responses showed that rural households were not in favour of wildlife conservation initiatives on their village lands, due to the negative consequences they suffered. All focus group participants agreed with the argument that the village lands which had been converted to areas for wildlife conservation should be returned to their original land uses.

## **5.0 Discussion**

This discussion firstly relates the findings to the hypotheses. Secondly, it examines the implications of problems experienced by rural households in relation to food security. Finally, it draws comparisons between strategies adopted by rural households in the study area in response to food insecurity.

### **5.1 Hypotheses**

#### **5.1.1 Hypothesis 1: WMA and other regulations restrict local people from using their preferred livelihood activities and thereby affect their food security.**

The first hypothesis suggests that WMA and other regulations restrict local people from undertaking their preferred livelihood activities, thereby affecting their food security. Results from the study area show the presence of WMA rules and other regulations enacted by respective village governments have affected livelihood strategies preferred by rural households in the study area (see sections 4.2.2 and 4.3). This is supported by Kaswamila (2012) in an analysis of the contribution of WMA on livelihood in Tanzania northern range lands. The study found that village by-laws prevent rural households from entering into conserved areas without written permission from governing authorities. This has caused rural household to lose access to resources ranging from forest to non-forest products, which they used as a source of their livelihood before WMA implementation. As argued by Kaswamila (2012) restrictions on harvesting forest and non-forest products in WMA limited livelihood options for households depending on the collection and gathering of natural resources, which reduces dietary diversity and income. This is similar to what was experienced by rural households in the study.

In the study area crop farming restrictions in WMA have caused rural households to lose access to land they used for crop production before the WMA establishment. The consequences of this are a decline of both crop (food and cash) production and household income, as argued by Mfunda and Røskaft (2011) and Kaswamila (2012). However, in Burunge WMA the human population has increased at an ever-growing rate as a result of local migration, which has caused competition over resources, thus impacting upon availability. Therefore, the establishment of Burunge WMA in the early 2000s can be explained as a primary factor in rural households losing access to resources. Moreover, this report observed the loss of resources in the form of land to be

variable between households. However, this study did not quantify the loss of land, though Kaswamila (2012) quantified the land lost to WMA as ranging between 19-65%, which represents a huge impact upon livelihood.

Grazing livestock restrictions in WMA have also affected livestock productivity negatively (in terms of reducing milk production) during periods of drought where pastures are not easily available outside WMA. The decline in livestock productivity in the study area has caused financial losses to rural households who were predominantly dependent on livestock for their survival. Information from the study area showed that, when pastures were not available in village lands, livestock lost weight, and when sold at auction, the lowest market prices were fetched. Compounding this, livestock productivity in terms of milk production was very low due to insufficient grazing pastures, and this has forced rural household to both reduce their available dietary diversity and to lose income.

According to Nyahongo and Røskaft (2012) when grazing pastures are not sufficient, livestock are highly susceptible to diseases. Livestock diseases significantly reduce both livestock productivity and household income, thereby exacerbating food insecurity and vulnerability (Nyahongo *et al.* 2008; Nyahongo and Røskaft, 2012). This situation is similar to that observed in the study area regarding drought incidences, livestock disease infestations and livestock productivity.

Therefore, based on the above information, the study confirms the hypothesis that WMA and other regulations restrict local people from using their preferred livelihood activities, thereby affecting their food security.

### **5.1.2 Hypothesis 2: Implementation of the WMA has forced rural communities to develop strategies in response to the effects of WMA on their village lands.**

The second hypothesis suggests that the implementation of WMA has forced rural communities to develop strategies in response to the effects of WMA on their livelihoods. The results indicated that rural households adjacent to Burunge WMA adopted a number of strategies in response to the effects experienced (see sections 4.4, 4.5 and 4.6). Results also show that rural households have diversified their range of livelihood activities in order to improve their livelihoods. It should be noted that, not only has the impact of WMAs forced rural households to

develop strategies in response to food insecurity, but also there were non-WMA related factors such as agro-climatic shocks, unstable markets, crop and livestock diseases that have influenced rural households to adopt livelihood strategies. It is believed that households have developed strategies to combat the experienced consequences (crop damage, livestock losses and drought) since before the introduction of participatory wildlife conservation to the study area. Despite this, it is not clearly known to what magnitude WMA related and non-WMA related factors have impacted upon rural households.

In order for the study to confirm this hypothesis, a comparison between WMA villages and control sites (villages outside WMA) is required. This will enable the validation of whether WMA implementation has impacted upon strategies adopted by rural households.

### **5.1.3 Hypothesis 3: Household adaptation strategies differ depending on a range of social-economic aspects.**

The third hypothesis suggests household adaptation strategies differ depending on a range of social-economical aspects.

#### **5.1.3.1 Age**

In the study area, age was seen to influence on the ability of households to adapt to the preferred livelihood option. Eight heads of households ranged between 26-55 years, with four households at 56-85 years (Table 1). It was observed that, rural households in 56-85 years, only two households had a high ability to adapt to food insecurity incidences compared to households in the age range of 26-55 years. This information is in accordance with various reports including Amsallu and De Graaff (2007), Teshome and de Graaff (2012) and Gebrehiwot and Van der veen (2013), which assert that age has a significant influence on the ability of a rural household to adapt various strategies in response to food insecurity.

However, in rural households age can both increase and decrease the ability to adopt various strategies in response to food insecurity. Adesina and Zinnah (1993) found that individuals are more likely to have the ability to adapt because they more education than the older generation or perhaps have been exposed to new strategies as migrant labourers. Moreover, young people are energetic and have proven to be more active, flexible and ready to try various strategies without fear of the associated risks (Adesina and Zinnah, 1993). This implies that the younger the head of household the higher the ability for adapting strategies and vice versa.

According to Marenya and Barrett (2006), the incentives for rural households to invest in productive futures for their farming activities (crop and livestock) usually diminish with age. In respect to this, age might be a reason for rural households having the ability to adapt.

### **5.1.3.2 Agricultural extension services**

Agricultural extension services could be seen to greatly influence rural households' ability to adapt, as they could assist rural households in identifying and analysing their production constraints, and becoming aware of opportunities for improvement by changing their outlook regarding difficulties arising from both crop farming and livestock production. This argument is supported by Bonabana-Wabbi (2002), who reported that rural households who are more exposed to formal extension information have a higher propensity towards increasing their ability to adapt than those with less exposure. Furthermore, Bonabana-Wabbi (2002) observes that the influence of extension visits can counterbalance the negative effect of lack of years of formal education in the overall decision to adapt.

In the course of the study it was observed that there was inadequate provision of agricultural extension services to rural households. This caused rural households to continue using non-improved crop and livestock husbandry practices in their day-to-day farm operations. This has contributed to poor crop and livestock productivity, thereby affecting household food security and income. However, the use of non-improved farming practices was also attributed to the high costs and poor availability of inputs (fertilizers, seeds, agro-chemicals and veterinary medicines).

Equally, it was revealed that owning farm implements impacts on the ability for a rural household to adapt e.g. crop cultivation as a strategy in response to food insecurity. This is due to the fact that major cultural practices like land preparation, planting, threshing as well as weeding are more easily practised using improved farm implements such as a drawn plough. Limbu (1999) observes that rural households who own drawn ploughs can be more flexible in changing and adapting tillage practices than rural households, who must rent or borrow. Unfortunately however, the study revealed that the most common farm implement owned by rural households is the hand hoe. This finding is consistency with reports by Amani (2004) and URT (1996) which assert that majority of rural households in Tanzania use this implement. Moreover, URT (1996) explained that, of ten rural households, only one owned a plough. This suggests that the

majority of rural households in the study area may not be in a position to adapt to strategies that need adequate and timely preparation, such as planting and weeding.

#### **5.1.3.3 Wealth**

In the study area wealth is equated with possession of land and livestock. Livestock were observed as economic as well as social capital and a sign of wealth. It was observed that the majority of very poor households were not holding livestock as an asset in their households in comparison to households under leader and other (neither leader nor very poor) social statuses. The study revealed that those households which possessed livestock had a higher ability to adapt to negative impacts emanating from both wildlife and non-wildlife factors than those without livestock. This is in agreement with Knox and Meinzen-Dick (1998), who argue that wealth is linked to power and property rights over natural resources, affecting households' options for adopting livelihood strategies. Equally, Caveness and Kutz (1993) found that a rural household with substantial land has a higher ability to adapt to livelihood strategies of their choice. This is analogous to the findings in the study area, whereby the majority of rural households held small land sizes, which hindered their ability to better adopt their preferred options. It was noted that only two households in the leader social group owned more than 10 acres of land and were capable of producing enough for their households, the rest was composed of very poor and other (neither leader nor very poor) who possessed 2-10 acres of land (see Table 2).

#### **5.1.3.4 Gender**

The gender of household heads was observed to influence rural households' ability to adapt. In the study area it was found that women were more prone to livelihood vulnerability in comparison to men. This observation is in alignment with the study conducted by Pattanayak *et al.* (2003) who assert that ability to adapt tend to differ due to the unequal access of men and women to complementary inputs, whereby usually women have lesser access to critical resources such as land, cash, and labour. A similar situation was revealed in the study area.

Results show that rural households were adopting different adaptation strategies (see sections 4.6.1, 4.6.2, 4.6.3 and 4.6.4). Social-economic aspects such as land ownership and livestock holding vary across rural households. It can be noted that households with high range of social-economical aspects had sufficient adaptive capacity to accomplish various changes influencing their livelihood. This was due to possession of adequate resources, thus reducing livelihood

vulnerability. This is similar to the findings of Ericksen *et al.* (2005), who argue that entitlement or access to resources is associated with the reduction of individual or household vulnerability by increasing its capacity to cope with adverse events.

It was observed that rural households in the study area frequently lacked the means of improving their ability to adapt. Below *et al.* (2012) and Paavola (2008) suggest that, in order to improve adaptation ability of rural households, public investment in infrastructure, in the availability and technically efficient use of inputs, in strengthening social capital, agricultural extension and micro credit are all significant. These also are recommended to be implemented in the study area so as to increase households' ability to adapt to various changes influencing food security and general welfare.

Therefore, basing on the information above, the study confirms the hypothesis that household adaptation strategies differ, depending on a range of social-economic aspects, in their ability to adapt.

#### **5.1.4 Hypothesis 4: WMA effects on food security has resulted negative attitudes to rural household towards wildlife conservation on their village lands.**

The fourth hypothesis suggests that WMA's effects on food security has resulted in negative attitudes of rural households towards wildlife and wildlife conservation. Based on the results from both household interviews and the focus group, rural households perceived the WMA initiative as a government strategy to secure their village lands in favour of wildlife conservation (see section 4.7). Reactions from group discussion revealed that there was a demand by households concerning land apportioned to WMA to be returned to its original uses.

Results also showed that despite the benefits WMA has brought in village lands, rural households had negative perceptions on wildlife and wildlife conservation measures. Rural households perceived wildlife and wildlife conservation as a source of livelihood vulnerability to rural households due to increased problems such as crop damage by wildlife, livestock predation and human injuries, livestock grazing restrictions in WMA, crop farming prohibition and resource (forest and non-forest products) harvesting restrictions in WMA. These problems ultimately resulted into household food insecurity and income poverty, as reported by Kideghesho (2010), Kaswamila (2009) and Kaswamila (2012).

It is worth noting that the households under study have reported livestock predation and crop damage incidences to their respective village governments but no compensation has been given. They ended up filling forms without receiving any feedback. This was observed to have increased negative attitudes towards wildlife and wildlife conservation on village lands. This statement is supported by Holmern *et al.* (2007) who postulated that lack of compensation schemes for livestock losses in Tanzania causes negative attitudes towards wildlife and wildlife management on village lands, resulting in the killing of carnivores. Negative attitudes towards wildlife and its conservation has been reported to hinder wildlife resource management in many parts of Tanzania (Nelson and Makko, 2005; Kideghesho *et al.* 2007; Kideghesho, 2010). This has also been reported elsewhere in Africa (Hazzah *et al.* 2009; Tessema *et al.* 2010).

Based on the above information, the study confirms the hypothesis that WMA effects on food security has resulted in negative attitudes of rural households towards wildlife and wildlife conservation in village lands.

## **5.2 Problems Experienced by Rural Households**

Crop damage and livestock losses by wildlife were more frequently cited problems by rural households in Kakoi village and at farms located near Lake Burunge in comparison to other areas. Kakoi village shares its borders with Tarangire NP. Studies performed in Tanzania by Sillero-Zubiri and Switzer (2001), Mtoni and Kideghesho (2008), Foley and Faust (2010), Hariohay (2013) and Mwakatobe *et al.* (2014) argue that the proximity of farms and human settlements to Protected Areas (PA) increases the chances of crop raiding and livestock predation. This is the case in Burunge WMA, as those farms and human settlements situated close to Tarangire NP and Lake Burunge are the ones most frequently invaded.

However, these studies did not outline the influence of non-wildlife factors and other confounding and uncontrollable elements that contribute both crop damage and livestock losses. These include drought and diseases, which were observed in the study area to cause significant economic loss to households. This relates to findings of Gifford-Gonzalez (2000), Haule *et al.* (2002), Røskaft *et al.* (2013), and Dickman *et al.* (2014), Mwakatobe *et al.* (2014) and Lyamuya *et al.* (2014) who assert that disease outbreaks played a significant role in crop damage and livestock losses. The pattern of disease infestations affected all wealthier groups in the study

area, thus aggravating their household food security statuses. However, very poor households were most affected due to the lack of effective strategies against these consequences.

However, this report did not quantify the rate of wildlife damage in the study area. Sillero- Zubiri and Switzer (2001) observe that this is difficult to quantify in both actual yield and economic terms. In contrast, a study carried out in Tanzania by Dickman *et al.* (2014) quantified the rate of damage by wildlife, suggesting the rate of livestock losses are at 9.1% to diseases, 1.2% on predation and 2.8% due to theft. The results of Dickman *et al.* (2014) demonstrate how strongly diseases can impact on livestock losses. Observations of Dickman *et al.* (2014) could be exaggerated by the study being conducted in areas adjacent to PA, where there is a higher probability for livestock and wildlife interactions posing a risk for significant disease transmission such as trypanosomiasis from wildlife to livestock.

Moreover, Nyahongo and Røskaft (2012), Nyahongo *et al.* (2008) highlight that livestock diseases may increase with drought. This situation is similar to the findings of this research. Drought has affected pasture and water availability for livestock. Persistent levels of drought have created a poor harvest of food and cash crops, forcing household livestock sales for purchasing livelihood necessities, including food.

Agricultural extension and veterinary support services are not well organised in Burunge WMA. Availability of these services could help in preventing and controlling serious crop and livestock diseases.

The analysis of information suggests that crop damage and livestock losses by wildlife occurred before WMA implementation, but its intensity was very low in comparison to that which occurred following the transition (see section 4.3). This increase it may be exacerbated by the establishment of Burunge WMA. It is believed that WMA have increased conservation efforts, improved habitats and consequently increased wildlife populations. These wild animals scavenge freely in nearby village lands and potentially cause losses. This argument is supported by Lyamuya *et al.* (2014) and Dickman *et al.* (2014) who performed their investigations elsewhere in Tanzania, arguing that increased conservation with regards to wildlife resources led to an increase of wildlife, which posed consequences to rural households.

Crop damage by wildlife in the study area was seen to negatively affect all wealthier groups in Burunge WMA. This relates to Kaswamila *et al.* (2007), who worked in a similar location. They found crop damage to be at an average of 0.008 tons per year, equivalent to two month's household food loss. However, Kaswamila *et al.* (2007) do not account for the contribution of other factors to crop damage, and are consequently not in a position to validate whether wildlife factors are the main agents for crop damage. It was uncovered however, that the very poor were more prone to food insecurity through this problem compared to leaders and other (neither leader nor very poor) due to the reduction of coping capacities to subsequent incidences.

Other studies performed elsewhere in Africa by Naughton-Treves (1998), Barirega *et al.* (2010) and O'Connell and Rodwell (2000), demonstrated these problems to be the major factors for decreases in the amount of food produced. However, these studies did not substantiate the influence of contextual elements to food insecurity.

Local communities have to spend valuable time and resources in protecting their crops and livestock. This is consistent with Gupta (2013), who argues that individuals living close to PA have experienced both direct and indirect economic costs from wildlife. The hiring of guards to protect against wildlife was very expensive to the very poor compared to leader and other (neither leader nor very poor). This resulted in the continuation of crop losses in their farms.

### **5.3 Household Strategies in response to food insecurity**

The results of this study suggest that strategies in response to food insecurity are composed of elements of both natural and non-natural resources (see Table 11, 12, and 13). This is in accordance with studies performed by Barrett *et al.* (2001), Block and Webb (2001), Smith *et al.* (2001), Ellis and Allison, (2004), Paavola, (2008) and Homewood *et al.* (2012), who found that individuals in rural areas perform multiple activities to earn their livelihood. Furthermore, they categorised activities into on-farm (involving both crops production and livestock keeping), off-farm (activities in other farms but within agriculture e.g. casual labour) and non-farm (activities not involving agriculture i.e. business income). These are identical to those activities performed by households in Burunge WMA.

The analyses of data suggests that all wealthier groups adopted diversified ranges of livelihood strategies in response to food insecurity (see sections 4.6.1, 4.6.2, 4.6.3 and 4.6.4). These

activities were constrained in providing adequate food to households because of factors such as market price fluctuations and low harvests of both food and cash crops. The selling of livestock was not often conducted by very poor households in comparison to leader and other (neither leader nor very poor). This is because the majority of them did not, anyway, own livestock. Leader and very poor households were heavily involved in food crop production even though these were used for commercial purposes as well. Some households, due to their dependence on other livelihood strategies, did not sell their livestock as a response to food insecurity. This observation relates to findings of Mwakatobe *et al.* (2014) who highlight that the selling of livestock is perceived as a cost by households due to the significant role it plays in herd size reduction. Conversely, Røskoft *et al.* (2013) and Sauerborn *et al.* (1996) argue that livestock holding in rural settings is considered as social capital and a sign of wealth.

Moreover, frequently livestock and crop losses were seen to reduce asset holdings of the households under study, leaving them vulnerable to subsequent uncertainties. This is due to the reduction of households' ability to cope with further shocks or external disturbances such as agro-climatic stresses. This relates to similar findings of Davies and Bennet (2007), Thornton *et al.* (2007) and Mackenzie and Ahabyona (2012) who assert that the decrease in asset levels lowers the coping capacity of individuals or households. For households strongly dependent on crop and livestock selling in the long-term, this limited available options in response to food insecurity. From the study, it appears that majority of very poor households compared to leader and other (neither leader nor very poor) adopted less resilient strategies in addressing food insecurity to consequences encountered in relation to food security (see section 4.6.5). The outcome for this is a reduction in food security, income poverty and increased vulnerability. This finding is supported by Eriksen *et al.* (2005), Cooper *et al.* (2008) and Scheffran *et al.* (2012), who consider that the ultimate end for households which have lost their adaptive capacity to external factors is that of being more susceptible to and unable to cope with changes in regards to food security. However, this study did not measure how resilient these strategies were, as argued by Constan and Barret (2013), and it can be considered that there is limited work done that can give empirical examples in measuring resilience to food insecurity. On other hand, the small sample size under this study hindered statistical analysis to determine the significant of strategies in response to food insecurity.

Very poor households were more prone to livelihood vulnerability, due to the lack of enough land for agricultural expansion and livestock ownership. This has reduced their livelihood options in comparison to leader and other (neither leader nor very poor). This is consistent with Alinovi *et al.* (2010) who assert that lack of assets in terms of land and livestock drastically reduce rural households' capacity to avert changes in relation to food security. However, Caveness and Kurtz (1993) note that households with substantial land would adapt better to adverse conditions.

The assertion that very poor households have multiple activities and be more prone to livelihood vulnerability is in agreement with the findings of Eriksen *et al.* (2005), who argue that households with several activities will have lower engagement intensity in comparison to households with specialised activities. This observation is different when compared with other (neither very poor nor leader) households. These households engaged in multiple activities, which yielded food security, greater income and reduction in vulnerability.

## **6.0 Conclusion**

From the findings presented in the previous sections of this thesis it can be observed that the rural households living adjacent to Burunge Wildlife Management Area (WMA) have experienced a number of problems before the establishment of Burunge WMA in 2003. These include crop damage, land or crop loss, livestock losses, livestock and human injuries by wildlife, poor livestock and crop productivity. The intensity of problems such as crop damage by wildlife and livestock predation was low before WMA establishment, but there is now a high intensity of these problems for rural households.

The implementation of Burunge WMA has exacerbated already-experienced problems. Due to increased conservation efforts of Burunge WMA wildlife habitats have been improved, which has consequently increased wildlife populations. This has led to increased competition for resources with rural households in the area. The wildlife populations scavenge freely on village lands and cause crop damage, livestock predation and threats to human life. These problems were particularly prominent for rural households living and conducting their farming activities adjacent to Protected Areas such as Tarangire National Park (NP) and Lake Burunge.

The findings indicated that these problems were caused by both wildlife (livestock predation, human injuries and wildlife crop raiding) and non-wildlife related factors (agro-climatic shocks (drought), poor use of agricultural inputs, land scarcity, lack of agricultural education/ extension services, livestock and crop diseases, market price fluctuations and high population growth in the study area). The research findings revealed that both wildlife and non-wildlife related factors have contributed to aggravating household food insecurity by lowering crop and livestock productivity, ultimately leading to the decline of crop production and household income.

It is not possible for the study to confirm that only wildlife related factors have caused food security problems to rural households, as the study did not measure the magnitude of each factor in household food insecurity. It was found that both categories of factors contributed to rural household food insecurity. Similarly, the study is not in a position to shed light on the level of influence that Burunge WMA implementation has had on household food insecurity. Doing so would mean including in the research a full food security assessment between WMA villages and villages outside WMA before and after WMA establishment; something that is beyond the scope of this research.

Research findings show that rural households adopted a number of strategies in response to food insecurity in the study area. These strategies consist of both natural and non-natural resource based activities. Despite the fact that rural households adopted multiple strategies, this study established that the strategies of very poor households under study were less resilient in addressing food insecurity incidences in comparison to leaders and others (neither leader nor very poor). This implies that very poor households will continue be more prone to vulnerability, food insecurity and low incomes compared to other wealthier groups.

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## APPENDICES

### Appendix 1: In-Depth Interview Guide

The purpose of the interview in this study is to understand problems experienced by rural households surrounding Burunge WMA and how these problems have impacted on rural households' food security and general welfare. Additionally, it is to understand strategies in response to food insecurity that have been adopted by rural households in the study area, and how these strategies changed because of WMA establishment. Lastly, the study has the intention of revealing the experienced problems affect rural households' attitude towards wildlife and wildlife conservation.

<b>Interview Number</b>	
<b>Occupation of the Interviewee</b>	
<b>Date of the interview</b>	
<b>Name of the village</b>	
<b>Interviewee sex</b>	<b>Male:</b> <b>Female:</b>

#### 1. General information

What challenges regarding food security have you faced in 2000 and now? Why are you facing these challenges? How are these challenges affecting your household food security?

What are the consequences of food insecurity in your households? (probe children's school dropout, Diseases and malnutrition, reduced number of meals per day) How have these affected your household's livelihood?

What are your strategies for overcoming the problem of food security in your household in 2000 and now? Why are you currently using these strategies? Why have you changed your strategies to food security from those you used in 2000 and the one you're currently using?

How has the lack of food in your household hindered your household development?

What are sources of energy for cooking in 2007 and now? Where have you obtained these sources in 2007? How are you getting these sources of cooking currently? Why are there changes in accessing the cooking sources? What are you doing to ensure you have enough sources of cooking? What are the reasons for your answer?

2. What do you understand regarding WMA in your village lands? What do you think are the benefits of WMA in your village? (Probe why) Which rules on resource access have been imposed on your village? Are these rules restricting your livelihood? (If yes why, and if not why?), Which WMA rules are threats to your household food security? Are you obeying these rules and regulations? (If not why), How these rules are enforced?) How are these rules and regulations affecting your livelihood? (Probe, have you been forced to change your livelihood?)

Which livelihood activities have you opted after implementation of these rules and regulations?

### **3. Land ownership and crop harvests**

How many acres of land have you owned in 2007 and 2000 (before WMAs)? Currently, how many acres of land do you own?

How much land is used for farming? (including land that you don't own but rent from others)  
Before WMA how many bags (1 bag = kg?) of the crop you harvested? Food crops (2007, 2000) Cash crops (2007, 2000)?

After WMAs how many bags (1 bag =kg?) of the crop have you harvested? Food crop for the (2012, 2013, 2014) seasons? And cash crops for the (2012, 2013, 2014) seasons? What factors do you think cause your harvest reduction? Why?

What are the consequences to your household livelihood? (Probe if are you able to send your children to school) How has food availability in your households been affected? Have you been forced to reduce food consumption in your household? (Probe how this affects labour availability in your household?) How this has affected your household health and well-being? What are your strategies towards sustaining food security? Are these strategies sustainable for your household food security? (If not why?)

### **4. For crop farming activities**

How often does crop damage by wildlife occur in your fields? How was it developed? (Probe before WMA and after WMA) Which animals cause crop damage and how? Have you received compensation for wildlife crop damage? Was the compensation enough to cover the crop loss? (If not why?) How has this affected your household food availability? What are the consequences for your household livelihood? What are your strategies towards sustaining food security? Are these strategies sustainable for your household food security?

### **5. For livestock keepers**

Could you explain how drought affects your livestock husbandry? How have droughts affected your household food security? How was the access to grazing land in 2000 (before WMAs, why?) and in 2007 (after WMAs, why?) What do you do to ensure your livestock have enough grazing pastures? (Probe why).

How does pasture availability affect your livestock? What are the effects to your livestock's health and productivity? How do these affect your household food security? Explain why? What are the consequences for your household livelihood? ( Probe school dropout and reduction in number of meals) What are you doing to ensure food security in your households? (Probe why)

### **6. Resource Access**

How was the access to water for human consumption in 2000 and 2007? How was access to firewood in 2000 and 2007? How was the access to wild food in 2000 and 2007? How was access to grazing pasture in 2000 and 2007? How was access to medicinal plants in 2000 and 2007? How was access to livestock watering in 2000 and 2007? Why there are changes in accessing resources between 2000 and 2007? What you do to ensure you can access the

resources you need? How do changes in resource access affect your household livelihoods? (probe food availability to your household) What are the consequences to your households? (Probes: are you able to pay school fees for your children, are you experiencing children dropping out of school? Why? ).What other factors affecting your household access to resources? (Probe WMA rules and social relations)

### 7. Opinions and Suggestions

In your opinion what do you think should be done to reduce both the negative effects of WMA's to rural households and food security, and to ensure rural households' positive attitudes to WMA's and wildlife? Do you think the introduction of compensation schemes for crop damage by wildlife and livestock predation will be good for you (if yes why and if not why),

Could migration, the fencing of WMAs, provision of social services, and soft loans for rural enterprises improve your livelihood and food security to your household (if yes why and if not why).

## Appendix 2: Focus Group Discussion Guide

The aim of the discussion is to understand the problems experienced by rural households surrounding Burunge WMA and how these problems have impacted upon rural households' food security and general welfare. The study aims to capture and understand strategies used to cope with these problems, and to understand rural household knowledge regarding Wildlife Management Areas (WMA) and how their livelihood has been affected by (WMA) implementation. Moreover, to understand households' access to natural resources before and after Burunge WMA establishment. Finally, the study seeks to document rural household attitudes towards community based wildlife conservation.

<b>Date of the FGD</b>	
<b>Duration of the FGD</b>	
<b>Number of participants</b>	
<b>Sex</b>	<b>Male:</b> <b>Female:</b>

### 1. Understanding of Wildlife Management Area (WMA)

- Do you know about WMAs? How are you involved into this? Why has your village joined WMA?
- What are the benefits and disadvantages for your village of being a member of WMA?
- Do you think your livelihood has changed since WMA was implemented in your village lands? Are there problems/effects to your village? How do you solve these problems?
- What should be done in order to improve benefits of WMAs to your village? Provide reasons for your answers.

## **2. Understanding livelihood activities in the last 10 years**

- What were your livelihood activities 10 years ago (before the implementation of WMA)?
- Did these activities provide food security in your household? Provide reasons for your answers
- Which food crops have you grown in the past ten years?
- Which cash crops have you grown in the past ten years?
- What quantities of food and cash crops have you harvested in the past ten years?
- What type of livestock have you kept in the past ten years?
- Which wild resources were you able to collect freely in the past ten years?
- How intense/serious was the issue of wildlife crop raids in the last 10 years?

## **3. Effects of the WMA's implementation to villagers livelihoods**

- Describe the effects (positive and negative) of WMA in your village?
- How much land + rented did you own before WMAs (2007) and now? What wildlife are the causes of field crop raiding? Where do you graze your livestock? Are the pastures enough for your livestock? Where do you get wild foods, watering for livestock, medicinal plants, firewood, bush meat and water for human consumption? (Including which rules and regulations are respected, ignored, and which are enforced)
- Have you experienced livestock predation by wildlife?
- What changes/effects have affected your livelihood?
- How have these changes affected your household food security? Provide reasons
- Explain how your livelihood activities have changed after the implementation of WMAs in your village lands?
- What determines who can use which resources for how long and under what conditions in your village?
- What are your strategies to secure food for your household? Are they sustainable for providing food security for your household?

## **4. Villagers suggestions and opinions on how to reduce WMA's negative impacts in their village lands and improve their livelihoods**

- What are you doing to reduce WMA and other negative impacts on your village lands? Are you able to reduce the negative impacts of WMA? Provide reasons for your answer.
- What should be done in the future to reduce WMAs' negative effects to livelihoods and food security? Do you think the introduction of compensation schemes to livestock and human predation, migration, fencing of WMA, provision of social services, provision of soft loans for rural enterprises and imposing land tenure security will reduce WMAs' negative impact and ensure households' positive attitude towards WMA and Wildlife?

### Appendix 3: Sampling Matrix

Social status	Land loss or Crop loss	Livestock losses	Crop damage	Livestock losses and crop damage
Leader	San98	Ngo962, Ola609, Ngo970	Ola295, San392	Kak250, Kak70, San315
Other(neither leader nor very poor)	San352	Ngo1038, Ngo727	Mwa472, San89	Kak274, Kak530, Kak351
Very poor	Mwa72	San140	Kak294, San350, San37	Ola300, Kak236
Village	Sub village	HH number	Social Status	HH head is female
Kakoi (Kak)	Kiserian	70	Leader	
Kakoi	Ole Volos	236	Very poor	1
Kakoi	Ole Volos	250	Leader	
Kakoi	Ole Volos	274	Leader	
Kakoi	Ole Volos	294	Very poor	1
Olasiti (Ola)	Oltukai	295	Leader	
Olasiti	Oltukai	300	Very poor	
Olasiti	Oltukai	351	Other (neither leader nor very poor)	
Olasiti	Kibaoni	530	Other (neither leader nor very poor)	
Olasiti	Eluay	609	Leader	
Mwada (Mwa)	Mbuyuni	72	Very poor	
Mwada	Makirinya	472	Other (neither leader nor very poor)	
Ngolei (Ngo)	Vituwey	727	Other (neither leader nor very poor)	
Ngolei	Ngolei	962	Leader	
Ngolei	Ngolei	1038	Other (neither leader nor very poor)	
Sangaiwe (San)	Gembo	37	Very poor	1
Sangaiwe	Gembo	89	Other (neither leader nor very poor)	
Sangaiwe	Neneto	98	Leader	
Sangaiwe	Neneto	140	Very poor	
Sangaiwe	Sangaiwe	315	Leader	
Sangaiwe	Osoley	350	Leader	
Sangaiwe	Osoley	352	Other (neither leader nor very poor)	
Sangaiwe	Osoley	392	Leader	

Leader in this data set implies the Authorised Association (AA) member/chairman/board of trustees, Village Game Scouts (VGS), Village Chairman (VC), Village Executive officer (VEO), Ward Executive Officer (WEO), Sub-village Chair, Natural Resource/Environment Committee Chair/Secretary/Treasurer