INFLUENCE OF CLIMATE VARIABILITY AND LAND DEGRADATION ON ADAPTIVE LIVELIHOOD STRATEGIES OF COMMUNITIES IN THE SOUTHERN ULUGURU MOUNTAINS

BY

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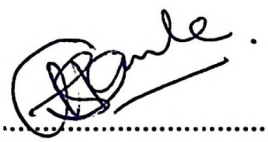
ABSTRACT

This study was conducted to investigate the emerging adaptive livelihood strategies in response to climate variability and land degradation in South Uluguru Mountains' communities. Specifically, the study sought to gauge perception of farmers on climate variability and land degradation, identify farmers' adaptive livelihood strategies and assess the environmental sustainability of the identified adaptive livelihood strategies. Study villages were stratified into highland, midland and lowland zones with respect to their elevations before randomly selecting three sample villages, one from each zone. Quantitative data were collected from 90 smallholder farmers, 30 from each of the three villages. Qualitative data were collected from three Focus Group Discussions, one from each sample village. Field observation and key informant interviews supplemented survey and data from the Focus Group Discussions. The study found that farmers of the South Uluguru Mountains area are aware of the climate and land degradation issues and attribute to over 50% of the problems hindering agricultural production in the area. The communities are impacted more seriously with frequent occurring droughts, landslides, strong winds, soil erosion, decreased soil fertility, wildfires and to a lesser extent, floods on the lowland fields due to riverbank erosion. The communities have been found to own and/or have access to various resources, more important the natural resources such as springs and rivers/streams that flow all the year round. These resources are important in implementing necessary adaptive strategies. While highland and midland farmers grow and store cassava in the field to use at prolonged droughts, lowland communities grow millet which resists droughts. Maintaining farms in both midland and lowland areas have been found to

be an important strategy for ensuring food security. It has been recommended in this study that traditional values of natural resource protection be backed by community empowerment to improve sustainability of livelihoods in terms of natural resource use. The study also recommends improving the traditional water conveying technology and its use on small scale irrigation to reduce communities' dependency on the disrupted short rains.

DECLARATION

I, **Sylvester Charles Haule,** do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.



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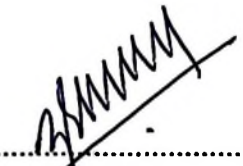

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DEDICATION

This work is dedicated to my parents, Mzee Charles Masisala and Theresia Aloys who laid a better foundation for my education; to my wife, Teofora, who made effort to ensure the wellbeing of the family during my entire study time; to my children, Charles and Esther who withstood my absence and long working hours; and to the South Uluguru Mountain Communities.

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LIST OF ABREVIATIONS

CARE	Cooperative for Assistance and Relief Everywhere
CETRAD	Centre for Training and Integrated Research in Arid and Semi Arid Land Development
CRiSTAL	Community-based Risk Screening Tool – Adaptation and Livelihoods
DFID	Department for International Development (United Kingdom)
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
HICAP	Hillside Conservation Agriculture Project
IFPRI	International Food Policy Research Institute
IPCC	Inter-governmental Panel on Climate Change
NGO	Non-Governmental Organization
SARD	Sustainable Agriculture and Rural Development
SUA	Sokoine University of Agriculture
UMADEP	Uluguru Mountain Agricultural Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VSL	Village Savings and Loan Schemes
WCST	Wildlife Conservation Society of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Climate variability and land degradation are the current global concerns and have influence on adaptive livelihood strategies. The global climate change is impacting more severely on poor African countries which according to Collier *et al.* (2008) and McCarthy (2001) cited by Senbeta (2009) have contributed almost nothing to anthropogenic climate change. Senbeta (2009) argues that severe impacts to poor African countries are attributed, among others, to the continent's low adaptive capacity and over-dependence on the agricultural sector.

Looking at the serious nature of the climate change related impacts, FAO (2008), citing various research, reported that in the period between 2000 and 2007, of the more than 230 million people affected annually by disasters, about 98 percent were affected by climate-related hazards, predominantly floods, windstorms and droughts. FAO (2008) further elaborates that during the period 1987-2006; the number of reported disasters related to hydro-meteorological hazards (droughts, floods, tropical storms, wild fires) showed a significant increase from an average of 195 per year in 1987-1998 to 365 per year in 2000-2006.

Land degradation in the form of soil erosion, landslides and loss of soil fertility accelerates the severity of climate variability impacts. In Ulugurù Mountains where the predominant inhabitants are the Waluguru who depend on subsistence

agriculture, agricultural productivity is continuously being reduced due to the greater disturbance of the climate (Nkombe 2003), land degradation in the form of loss of soil and soil fertility (Chamshama *et al.*, 2009) and massive deforestation and over exploitation of soil resources (Lyamuya *et al.*, 1994; Kilasara *et al.*, 1995). Land degradation is accelerated by the fact that farming is carried out on steep slopes, without proper or rather sustainable land management practices, making the soil liable to erosion and landslides.

Adaptive theorists purport that humans have adaptive behaviour, struggling to survive in a changing environment (Magayane, 1995). Farmers adjust to the changing environment by developing, modifying and utilizing different livelihood strategies. A livelihood comprises the capabilities, assets and activities required for a means of living (Chambers and Conway, 1992). Stressors including drought and land degradation trigger changes in farmer's livelihood strategies. In response, farmers develop adaptive mechanisms that, among others, employ the use of indigenous knowledge.

Although Uluguru Mountains are currently influenced by climate change, drought and land degradation little is known on how these factors affect livelihood strategies, and on the emerging adaptive strategies. This study examines the influence of climate variability and land degradation on adaptive livelihood strategies.

1.2 Problem Statement

Graves (1974) views man as a more active agent in shaping his destiny. Confronted by the many physical and social impediments, he seeks to overcome the problems he faces by choosing among perceived available options, and through aggregation of such choices. Thus, man modifies and is modified by the world around him in a mutually evolving system (Graves, 1974). Smallholder farmers in the Uluguru Mountains are not an exception. Living in a delicate environment where agriculture production is carried in an increasingly stressed climate, and on sloping mountains where soil erosion and landslides are common, smallholder farmers of the Uluguru Mountains shape and are shaped by their environment. However, their perceptions on climate variability and the effectiveness and sustainability of adapted livelihood strategies are not well known. Therefore, this study, using sustainable livelihood approach, aimed at finding out how farmers in South Uluguru Mountains have been able to sustain their livelihoods in an increasingly varying and changing climate and degraded land; and the most appropriate ways in which their livelihood strategies have been adapted, how effective those strategies have been and whether they are sustainable in the light of limiting factors.

1.3 Justification of the Study

The Uluguru Mountains have high rural population relying on agriculture and the environment for their livelihoods (Hymas, 2001). Agricultural productivity is continuously being reduced (Senkondo, 1994), because of climate change (prolonged droughts) and land degradation. This is a reason why various

organizations and programmes such as Uluguru Mountains Agricultural Development Programme (UMADEP), Wildlife Conservation Society of Tanzania (WCST), CARE International in Tanzania and several other actors are implementing soil and water conservation programmes in the Uluguru Mountains in order to reduce the impacts. The findings of this study will provide information on adaptive livelihood strategies used by smallholder farmers in South Uluguru Mountains, and on effectiveness and sustainability of the identified livelihood strategies to climate variability and land degradation. The study will also provide information on how climate variability is perceived by the inhabitants of the South Uluguru Mountains so much that the conservation and protection interventions of the Uluguru Mountains are designed to address people's perception and understanding of the problem of climate variability and land degradation. Rural development planners and development organizations working with the rural poor will find this information useful in designing projects and programmes in light of the influence likely to be posited.

1.4 Study Objectives

1.4.1 Overall objective

The overall objective of this study is to determine the influence of climate variability and land degradation on adaptive livelihood strategies of smallholder farmers of South Uluguru Mountains.

1.4.2 Specific objectives

i. To gauge perception of farmers on climate variability and land degradation.
ii. To identify farmers adaptive livelihood strategies to climate variability and land degradation.
iii. To assess the environmental sustainability of the identified adaptive livelihood strategies.

1.5 Research Questions

The research questions for this study were based on CARE's Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL). Module one (of the two modules), "*Synthesizing information on climate and livelihoods*", is meant to enhance acquisition of good knowledge on the community's climate context and livelihood strategies local communities employ in copying with climate related hazards through participatory methods. The questions this study embarks to answer are:

i. What is the awareness of smallholder farmers of South Uluguru on the impacts of climate variability and land degradation?"
ii. What are the current and anticipated climate variability and land degradation hazards in the South Uluguru Mountain communities?
iii. What are the impacts of these hazards?
iv. What strategies are used by communities in the study area to deal with the impacts?
v. What resources are important to livelihoods in the study area?

vi. How are the resources affected by current climate hazards?

vii. How important are these resources to adaptive strategies?

viii. How can smallholder farmers' livelihood strategies to climate change and land degradation be improved and sustained in an environmentally friendly manner?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Uluguru Mountains

Uluguru Mountains is among the Eastern Arc Mountains of Tanzania and Kenya which are known for their biodiversity and water catchment importance. In recent years Uluguru Mountains have been assessed as the third most important mountain block in the Eastern Arc for their fauna and plants (Burgess *et al.*, 1998c). Uluguru Mountains also serve as water catchments for urban areas of Dar es Salaam, Morogoro and Kibaha (Chamshana, *et al.*, 2009).

Despite its biodiversity and water catchment value, Uluguru mountains vegetative cover has been seriously reduced. Burgess *et al.* (2002) reported that a study carried out in the years between 1999 and 2001 revealed that forest area has declined from 300 km^2 in 1955 to 230 km^2 in 2001. It further estimated that by the year 2010 the forest area would be around 200 km^2 (Burgess *et al.*, 2002). This calls for consorted efforts not only to stop reduction of forest cover, but also resuming forest cover on non-reserve areas. This is the reason why several organization are putting efforts in introducing and promoting appropriate land use management practices including agroforestry and tree planting. Sustainable adaptive livelihoods are therefore imperative to sustain forests as well as the high population in the Mountain.

2.2 Climate Variability and Change

The United States Agency for International Development (USAID) defines climate variability as variations in the mean state of climate on all its temporal and spatial scales beyond that of individual weather events (USAID, 2007). Climate variability relates to much shorter and over relatively small area compared to climate change. The United Nations Framework Convention on Climate Change (UNFCCC) describes climate change as change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is additional to natural climate variability observed over comparable time periods (UNFCCC, 2007). UNFCCC further elaborates that global warming, which highly influences climate variability, is mostly due to man-made emissions of greenhouse gases (mostly carbon dioxide).

The present climate of the Uluguru Mountains is not as favorable as it was in 1950s when forest cover was greater. Over 60% of the vegetation cover is said to have been lost (Nkombe, 2003), partly because of deforestation and partly may be due to climate variability. Similarly, as population increases, more land for cultivation is required and hence forest lands are turned into agricultural land in which case forests are cleared and in turn this accelerates climatic disturbances. According to the Intergovernmental Panel on Climate Change (IPCC) (1995) cited by Chingonikaya *et al.* (2009) human activities including change in land use patterns are increasing the atmospheric concentration of greenhouse gases, mainly carbon dioxide, nitrous oxide and methane, which tend to warm the atmosphere and hence change the climate. IFPRI (2009) contends that the greatest opportunity for

agriculture to mitigate climate conditions is through reduced pressure on forest resources. Forests are said to be capable of storing up to 100 times more carbon than agricultural fields of the same area. When trees are felled, as it is done when forest land is converted into agricultural land, carbon absorption ceases and when the wood is burnt or even if it is left to rot, the carbon stored in the trees is released into the atmosphere as carbon monoxide (CO_2) (IFPRI, 2009). While converting forestry land to agricultural land could be a strategy to increase food production for the growing population, the strategy could be said as being less sustainable since in the long run it affects the climate. It is important, therefore, to consider adaptive livelihood strategies that are sustainable.

2.3 Land Degradation and Appropriate Land Development Practices in Uluguru Mountains

Uluguru Mountains, as other parts of Africa have been affected by land degradation caused by human activities and climatic stresses. Senkondo (1994) described such land degradation to include, among others, landslides, declining soil fertility, increased downstream sedimentation as visible in the Uluguru Mountains. Climate variability and land degradation are inseparable. UNEP estimated 65% of Africa's agricultural land being degraded as a result of both human and climatic variability (UNEP, 2008). Arguing on human activity contribution to land degradation, Snel and Bot (2003) blame inappropriate land use as the immediate cause of land degradation. Although human activities account for direct and indirect land degradation, climatic conditions have higher influence. Sivakumar (2007) basing on

report by USDA (2006) concluded that climatic stresses account for 62.5% of all the stresses on land degradation in Africa.

Several authors are in favour of agroforestry as one of the ways of controlling land degradation in mountainous areas. Senkondo (1994) recommends agroforestry in highly populated and degraded areas of Uluguru Mountains to control existing landslides, declining soil fertility, increased downstream sedimentation and to ease the pressure on natural forest as source of fuel wood and building poles. Bench terracing and "fanya juu" and fanya "chini" terraces are other options of managing land sustainably (Chamshana *et al.*, 2009). However, bench terracing is argued by some authors as unsatisfactory measure in steep slopes of Uluguru Mountains because they hold water on slopes making soils liable to landslides (Temple, 1972 cited by Chamshana *et al.*, 2009).

2.4 Vulnerability and Impacts of Climate Variability

Vulnerability, in regard to climate variability and change, is the question of exposure to and ability to cope with, the impacts or effects of climate variability and change. IPCC defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC, 2001, in Brooks, 2003). Davies *et al.* (2008) contends that poorer developing countries are especially vulnerable to climate related stress because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors. Smallholder farmers of South Uluguru Mountains are especially

vulnerable because their livelihood depends on their environment, which is threatened by the climate related stress and land degradation. According to Chamshama *et al.* (2009), there is growing evidence that climate change is impacting on livelihoods of forest dependent communities because in the first place changing climate impacts on forests and forest ecosystems. However the adaptive capacity of South Uluguru Mountains' communities and sustainability of their adaptive strategies are little known.

2.5 Adaptation and Adaptive Capacity

Farmers in South Uluguru Mountains are affected by drought, landslides, riverbank erosion and wildfires which in turn impact their livelihoods. In response to the impacts, the communities have to make adaptations to cope with the effects. Brooks (2003) defines adaptation as "adjustments in a system's behaviour and characteristics that enhance its ability to cope with external stresses". However, we are cautioned by Parry, (2002); Mendelsohn *et al.* (2000); Fankhauser, (1998) in Smit and Wendel (2006) that one common purpose of adaptation analyses in the climate change field is to estimate the degree to which modelled impacts of climate change scenarios could be moderated or offset (or "mitigated") by "adaptation to the impacts".

Farmers in the South Uluguru Mountains have experienced hazards related to climatic stress much like other communities. This study was designed to measure their adaptive capacity in terms of resources accessible to them, the extent to which the resources are influenced by the hazards and importance of these in implementing

livelihood strategies. It also goes in line with Brooks and Adger (2004)'s argument that the adaptive capacity inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation.

The study thus analyzed communities' resources important in pursuit of adaptation measures. Traditional knowledge and technologies used by the farmer to implement adaptive strategies were also explored as human resources. According to UNFCCC, communities must build their resilience, including adopting appropriate technologies while making use of the most traditional knowledge, and diversifying their livelihoods to cope with current and future climate stress (UNFCCC, 2007).

2.6 Sustainable Agriculture and Rural Development (SARD)

The majority of Tanzanian lives in rural areas and is mainly engaged in agricultural activities. That is why the Tanzanian Government has made efforts to make sure that there is a sustainable agricultural and rural development. FAO (1989) defines sustainable agriculture and rural development as "...the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for the present and future generations. Sustainable development in the agriculture, forestry and fisheries sectors conserve land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable". Generally it is about

sustainability, ensuring that the resources we use today will continue to be available for the coming generations.

2.7 Chapter Summary

This chapter has highlighted the biodiversity and water catchment importance of the Uluguru Mountains. It has been noted that despite its biodiversity and water catchment importance, the Mountains are threatened by climate variability and land degradation, putting the community at a more vulnerable state of climate risks. The vulnerabilities, thus, prompt the rural poor to respond to, sometimes at the expense of the natural resources. Thus, sustainability of the Uluguru Mountains environment in light of climate variability and environmental degradation requires, as a pre-requisite, a good knowledge on the adaptive livelihood strategies of inhabitants of this area. Such understanding is imperative because natural and social systems are interdependent and inseparable. Because such knowledge does not exist as yet, the aim of the present study was to find out whether the livelihood strategies of South Uluguru Mountains' community, in response to variations in climate and degrading land were ecologically sound.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Location of Study Site

Located some 120km south east of Morogoro town, South Uluguru Mountains comprise of Kolero, Kasanga and Bungu wards of Mvuha Division in Morogoro Rural District. Uluguru Mountains have 50 villages, 14 of which are in Kolero, Kasanga and Bungu wards. South Uluguru Mountains lie at an altitude of slightly less that 200 to over 2500 m.a.s.l.(Mvena and Kilima, 2009) making a remarkable variation in terms of slope, ranging from 10% to over 90%. The communities in South Uluguru Mountains unlike in other parts of Uluguru Mountains have been identified by several stakeholders as the most underserved in the district in terms of access to services including agricultural extension, roads and development projects. The adaptive livelihood strategies evolved by the communities are thought to be less influenced by the outsiders. Being minimally influenced by outsiders, the area was selected in order to identify the indigenously evolved adaptive livelihood strategies. Fig. 1 shows the map of Uluguru Mountains indicating the study site.

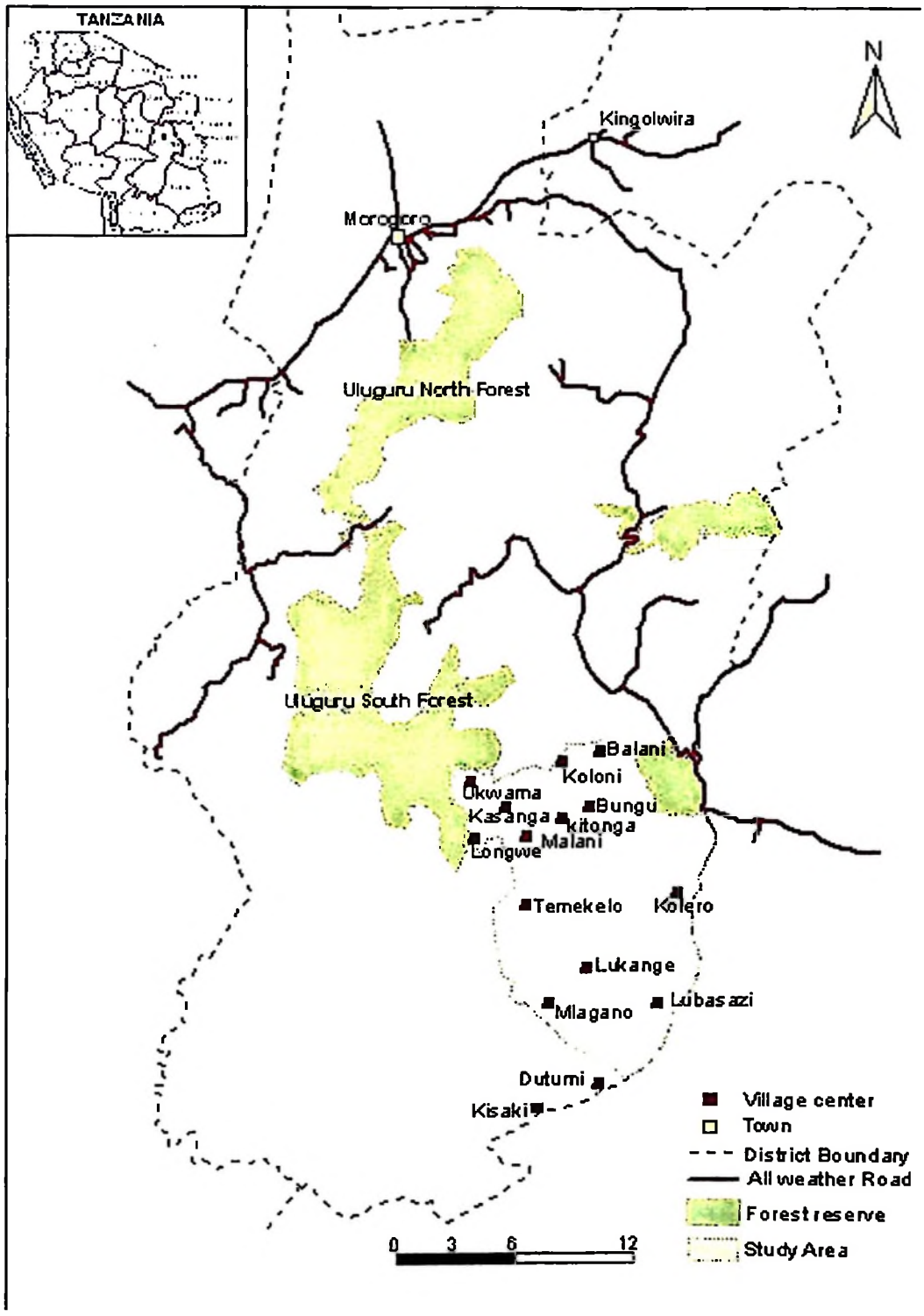

Figure 1: Map of Morogoro District showing study area

Source: Adapted from Chamshama *et al.* (2009)

3.2 Research Design

The study employed an extended cross-sectional research design as suggested by Saunders *et al.* (2007) where data were collected at one point in time. This was an appropriate design because it is cost and time effective, and enables easy collection of the data.

3.3 Sampling Procedures and Sample Size

The study population comprised of smallholder farmers operating within Kolero, Kasanga and Bungu wards. To obtain the desired sample from the population of smallholder farmers in 14 villages of South Uluguru Mountains (the sampling frame), a combination of stratified and simple random sampling methods were employed. Since the adaptive livelihood strategies were thought to vary with the variation in altitude between lower (less than 600m.a.s.l.) and higher (up to 2500m.a.s.l.) altitude areas, villages were stratified into highland, midland and lowland zones before randomly selecting three villages, one from each zone. Stratification was thought to ensure representation of all ecological features and farming systems found in the study area.

In each selected village, a random sample of 30 smallholder farmers with the age of 35 and above was selected making the minimum required sample for data analysis (Bailey, 1978). In total a sample of 90 respondents was drawn for formal interviewing. It was hypothesized that, those with ages 35 and above, have at least observed the variations in weather situation for at least 15 years. A person with 35

years was 20 years in the past 15 years, the age one is capable of recalling the climatic variations in that period.

Table 1: List of villages and total number sampled

Ward	Village	Sample size
Kasanga	Kasanga	30
Kasanga	Longwe	30
Kolero	Lubasazi	30
Total sample		**90**

3.4 Data Collection

Primary and secondary data were collected. Quantitative data were collected using an interview schedule with closed and open-ended questions designed to provide information that will lead to gauging of perception of farmers on climate variability and land degradation, identification of farmers' adaptive strategies to climate variability and land degradation. Qualitative data on the other hand, was gathered through Focus Group Discussions (FGD), direct observations and interviews with key informants.

Three FGDs were conducted, one at every sampled village. They constituted elderly men and women (50 years and above) who have actually stayed in the villages for more than 20 years. These participants were thought to have good understanding of the trends of climatic conditions for the past 20 years. Primarily, information sought included climatic disasters they have experienced in all that time, type of resources that their communities have or have access to, how resources are influenced by the

hazards, strategies farmers use to cope with the current and anticipated hazards and importance of resources in implementing livelihood strategies. FGD were also designed to verify household survey results.

Direct observations and key-informant interviews were designed to verify and source more information issues emerging from household survey and FGD. Since the study aimed at finding strategies communities have adapted in response to climate variability and land degradation, it was thought that some of these would be observed. Similarly, detailed clarification was needed from community members who actually practice certain outstanding strategies.

Secondary data on population and newly established conservation agriculture project were sourced from villages where the study was conducted and CARE Tanzania Morogoro. In addition, other secondary data such as climatic trends of Morogoro were obtained from the SUA based Tanzania Meteorological Agency Station and the Sokoine National Agricultural Library.

3.5 Data Analysis

For the quantitative data, percentages were primarily used to describe respondents' perception on climate variability. Percentages and means, standard deviation and range were used to explain the respondents' distribution on various aspects such as main livelihoods, limitations of agricultural production in the area, farmers' climate variability indicators crops and farmers' specific observation on climatic trends over

the past 10 to 15 years. Additionally, standard deviations, means and variances were used in summarising variations between variables of interest.

For the qualitative data, Module one of the CARE's Community-based Risk Screening Tool - Adaptation and Livelihood (CRiSTAL tool) was used to synthesize and analyze qualitative data on climate and livelihoods from focus groups and key informant interviews in order ascertain climate and livelihood contexts of the community. The CRiSTAL tool also enhanced determination of the sustainability of the community's livelihoods.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Respondents' Social Characteristics

Examination of demographic characteristics will provide the general picture of how these characteristics influence respondents' perceptions, attitudes, vulnerability and coping strategies to climate change of the people of South Uluguru Mountains. The demographic characteristics of respondents examined in this study were sex; age; marital status; and level of education of head of household as shown in Table 2.

Table 2: Percentage distribution of respondents by demographic characteristics

HHs personal characteristics	Number	Percent
Sex (n=90)		
Male	65	72.2
Female	25	27.8
Age (yrs) (n=85)		
Less than 40	11	12.9
40 to 59	53	62.4
60 and above	21	24.7
Marital status (n=90)		
Never married	4	4.4
Living with a spouse	62	68.9
Widow/widower	10	11.1
Divorced/Separated	14	15.6
Level of education		
No formal Education	16	17.8
Completed primary education	63	70.0
Completed secondary	0	0.0
Post secondary education	2	2.2
Functional literacy	9	10.0

4.1.1 The sex of respondents

Regarding sex of respondents, of the 90 heads of households interviewed, majority (72.2%) were males. These results do not conform to the original thinking that, because the study is carried out in a matrilineal society, majority of heads of households would be females. Similarly the results do not conform to the argument by Commonwealth Secretariat (2001) that more women are becoming functional heads of both households and farming activities due to a substantial numbers of males migrating to cities. It may imply, therefore, that in this area only fewe males migrate to towns and cities. However, women remain the main caretaker of the clan land and have fairly easy of access to it compared to men.

4.1.2 The age of respondents

Selection of study population was based on age of respondents being close to 40 years and above. These were thought to have observed the changes in weather patterns and their corresponding strategies evolved for at least 15. Experience in traditional livelihood strategies is also thought to be more prominent with old age. Age in this study thus was presented in three age groups, those with years below 40, the group of respondents with years ranging from 40 to 59, and those of 60 years and above. About two thirds (62.4.0 %) were between 40 and 59 years while those who were 60 years and above were close to a quarter (24.7%) of the sample. Those who were less than 40 years constituted 12.9% of the sample. With 87% of respondents having age of 40 years and above, the results generally suggest that the sample had a rich source of information on climate variability and land degradation.

4.1.3 Marital status of respondents

Marital status was another social characteristic that respondents were asked to provide. The categories used to classify marital status of respondents were; never married, for respondents who have never stayed with a spouse; living with a spouse, for respondents who live with a spouse as a husband/wife, be formally or informally married; widow/widower, for respondents who happened to live with a spouse but a spouse has passed away; and divorced/separated for respondents who lived with a spouse but for some reasons they are no longer living together at the time of survey.

The significance of marital status derives from the fact that spouses living together as wife and husband are more likely to adapt strategies that are labour intensive than those who are single. It was observed that over two thirds (68.9%) of respondents lived with a spouse. The proportion of respondents who either divorced or separated stood at 15.6% of total respondents. The results further reveal that respondents who were widow/widower accounted for 11.1% of the respondents. The remaining respondents were categorized as never married.

4.1.4 Education of the respondents

Education is expected to broaden individual's understanding and physical abilities or skills in pursuit of life. Education, thus, equips people to face the existing challenges (Bartle, 2002). Education level of respondents was studied in order to attribute livelihood strategies evolved by the local community to their highest level of education. In general, the results indicate that almost all (97.78%) had either received minimum education (primary education or functional literacy education) or

had not received any formal education. Detailed educational level results are presented and discussed in section 4.3.1.3 on Human capital of the study population.

4.1.5 Household size

Household size was determined in terms of number of persons in the household. Survey results show an average number of household sizes in the study area being 4.81, (Std. Dev. 2.3.) with the minimum household number being 1 and the maximum of 12 members. Details of household size and labour size are discussed in sub-subsection 4.4.1.3 (Human capital).

4.2 General Community Perceptions, Awareness and Observations on Climate Variability and Land Degradation

This section presents farmers awareness of climate variability and land degradation phenomena. For farmers to adapt livelihood strategies they first need to be aware of the problem before proceeding to trying out various options, or even, trying to evolve.

4.2.1 Farmers' opinion on the main problems affecting agriculture production

To find out general perceptions of farmers on climate variability and land degradation, farmers were asked to give their opinion on what constitutes the main problems limiting agriculture production in their villages. Farmers pointed about 15 issues as the limiting factors in their agriculture production. It was observed that 61 (24.3%) of farmers perceived incidences of dry spell as the main problem. Other

significant problems mentioned were unpredictability of weather and poor access to agricultural inputs (31 is equivalent to 12.4% each), poor access to extension services (28 counts equivalent to 11.2%) and decreasing soil fertility (25 counts equivalent to 10%). Detailed results are presented in Table 3.

Table 3: Farmers perception on the main problem facing agriculture production (n=251)

Agricultural problem	Frequency	Percent
Incidences of dry spell	61	24.3
Access to agric inputs	31	12.4
Unpredictability of weather	31	12.4
Access to extension services	28	11.2
Decreasing soil fertility	25	10.0
Access to enough agric land	23	9.2
Insufficient farm labour	13	5.2
Increased crop pests/diseases	9	3.6
Landslides	7	2.8
Soil erosion	6	2.4
Wild animals	5	2.0
Access to markets	5	2.0
Excessive rains	4	1.6
Strong winds	2	0.8
Increased temperatures	1	0.4
Total	**251**	**100**

Note: 'n' implies multiple response

When the cited factors were grouped in categories, it was observed that weather related problems (unpredictability of weather, frequently occurring dry spells, increased temperatures, strong wind and excessive rains) accounted for 39.4%, services such as input supply, agricultural extension and access to markets accounted for 25.5% while problems related to land degradation (decreasing soil fertility, soil erosion and landslides) accounted to 15.1% as indicated in Fig. 2.

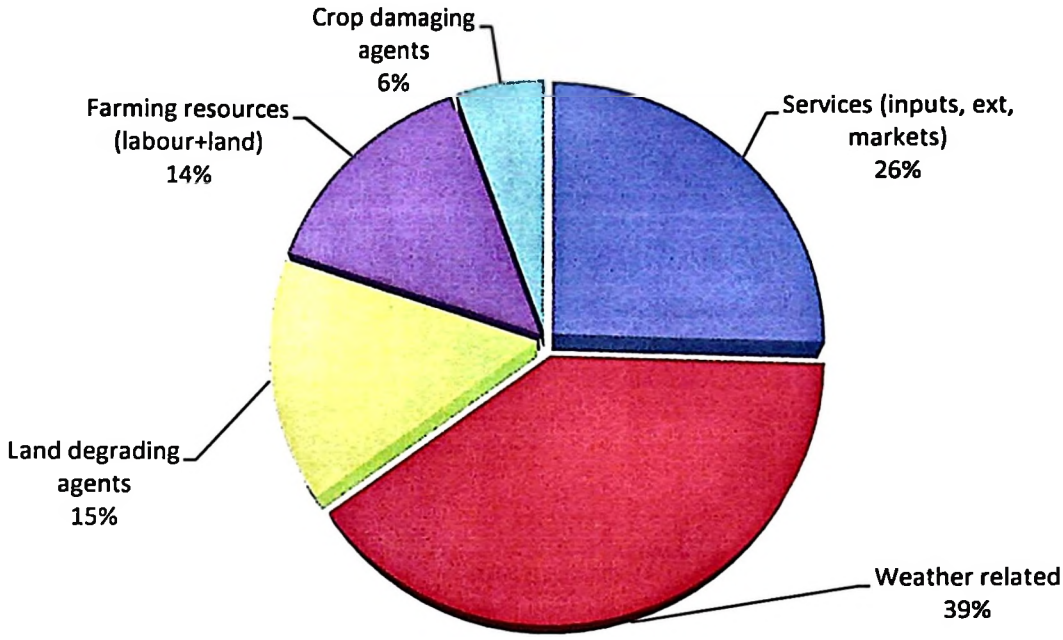

Figure 2: Percentage distribution of farmers' perception of agric problems in categories

4.2.2 Farmers' indicators of climate variability

Respondents were asked to point out what they perceive to be indicators of climate variability and what they have actually observed in the past 15 years. As presented in Table 4, reduced amounts of rains, late coming of rains and increased incidences of dry spell in some seasons were reported by almost all farmers (94.4%) as main indicators, increased agriculture production (93.3%) and increased temperatures (92.1%) were also among the most recognized indicators by respondents. Other indicators mentioned by respondents were increased prevalence of food shortages (87.6%), early coming of rains in some seasons (80.9%), occurrence of new crop pests (79.8%) and increased amounts of rains in some seasons.

Table 4: Farmers' indicators of climate variability

Climate variability indicator	Frequency	Percent
Reduced amounts of rains in some seasons (n=89)	84	94.4
Late coming of rains in some seasons (n=89)	84	94.4
Increased incidences of dry spell (n=89)	84	94.4
Increased agriculture production is some seasons (n=89)	83	93.3
Increased temperatures in some seasons (n=89)	82	92.1
Increased prevalence of food shortages (n=89)	78	87.6
Early coming of rains in some seasons (n=89)	72	80.9
Occurrence of new crop pests (n=89)	71	79.8
Increased amounts of rains in some seasons (n=89)	60	67.4

4.2.3 Farmers' observation on the general climatic trend over the past 15 years

Respondents were asked to give their assessment on amount and timing of long rains, timing of short rains and whether wind speed and temperatures has increased based on their own observation for the past 15 years. Results in Table 5a indicate that there is a general agreement on the perception that amounts of long rains to have decreased (96.1%), on the onset of long rains delaying 53.3%) and a disruption of short rain season (75.6%) in the past 15 years. There is also an agreement among respondents that wind speeds have increased (81.1%).

When cross-tabulation was carried out to find which zone area has observed more or less of a certain change over the other (Table 5b), lowlanders reported by 70% that long rains comes late than it used to be while midland reported by 46.7% and highland by 43%. This implies that, lowland area is affected most by late coming of the rains thus being more noticeable. It was reported in all three zones by 66.6% and above that there has been a disruption of short rains. These findings, however, differ

with the focus group discussion carried out in all zone areas. While it was agreed by lowland community that short rains are no longer dependable, their upland counterparts said little has changed as they continue to use the short rains the same way they used to do in the past 15 years. Further analysis shows that there was also a disagreement between the household survey results and those from focus group discussions on the question of situation of wind speed. While the survey results indicated wind speed has increased more on lowland area as reported by 80% compared to that of highland which was reported by 47%, focus group discussion disclosed that, wind damage has been observed more on midland and highland areas. Community members at Kasanga reported increase of strong winds to the extent of damaging roofs of grass thatched houses.

Table 5a: Farmers' opinions on the generally observed climatic situation in the past 15 years

Element of Weather	Frequency	Percent
Amount of Long rains (n=90)		
Increased	1	1.1
No change	2	2.2
Decreased	87	96.7
Timing of Long rains (n=90)		
Earlier than used to be	19	21.1
No change	23	25.6
Later than used to be	48	53.3
Situation of short rains (n=90)		
Normal	7	7.8
Can't tell	15	16.7
Disrupted	68	75.6
Average temperature (n=90)		
Increased	53	58.9
No change	15	16.7
Decreased	22	24.4
Wind speed (n=90)		
Increased	73	81.1
No change	9	10.0
Decreased	8	8.9

Table 5b: Specific observation of climate variability by village categories

Observed change	LOWLAND (n=30)		MIDLAND (n=30)		HIGHLAND (n=30)	
	Count	Percent	Count	Percent	Count	Percent
Long rains comes late	21	70	14	46.7	13	43
Short rains disrupted	20	66.7	27	90	21	70
Amount of LR decreased	30	100	29	96.7	28	93
Average temp. increased	30	100	22	73.3	21	70
Wind speed increased	24	80	15	50	14	47

4.2.4 Sources of climate related information

Respondents were asked to tell whether they have ever sought and used weather forecast information prior to the onset of seasons, and whether the information they got was reliable. Of the 90 respondents who responded to the question, half (50%) indicated that they do not seek weather information from any source, giving reason that weather forecast information is not always reliable. Of the 45 respondents who said they have been seeking weather information, approximately 78% cited media (mainly radio) as their main source of weather forecast and related information. On the other hand, of the 45 respondents who said they source weather information, 13 (14.4%) respondents, however, claimed that weather forecast information is not reliable and they do not depend on it much. Those who sought weather forecast information from neighbours and elders with traditional knowledge accounted for just over 15% of the respondents who source weather information.

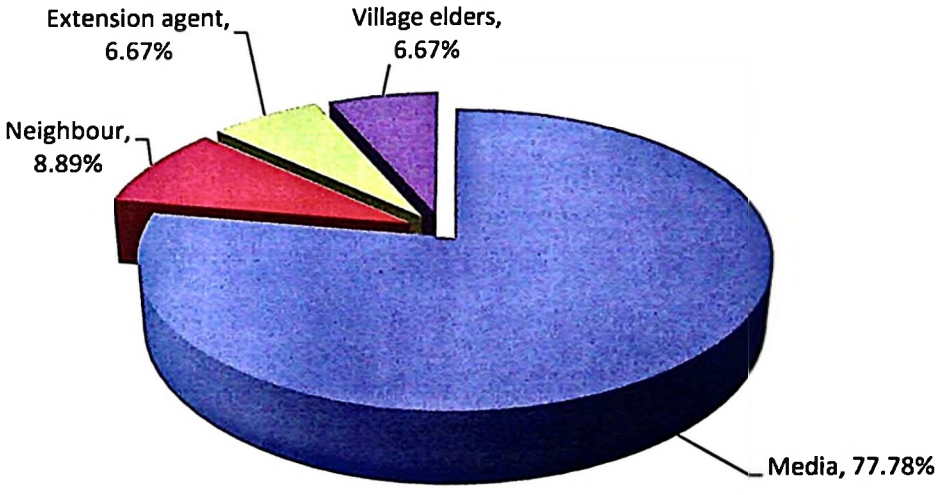

Figure 3: Main source of climate related information

Interviews with key informants on climate related information revealed that local community members rely on traditional knowledge of weather foretelling, specifically predicting timing and amount of rains for the coming season. Some uncovered traditional ways used by the community to predict timing and amounts of rains include occurrence of certain type of moths and birds. According to a key informant at Lubasazi, there are two types of small moths that migrate just before the onset of main rains. The light coloured and much bigger in size signal the coming of a blessed season. On the centrally, the dark coloured moths signals the onset of the long having little rains.

4.2.5 Farmers' perception on the land degradation problem

Farmers were asked to identify one of the four land degradation problems they consider to be a main land degradation problem in their area. Soil erosion and declining soil fertility were mentioned by farmers as the most visible signs by 29% and 28% respectively as indicated in Fig. 4. During focus group discussion, however, it was revealed that farmer could make little distinction between soil erosion and loss of soil fertility as the later seem to accompany by the other.

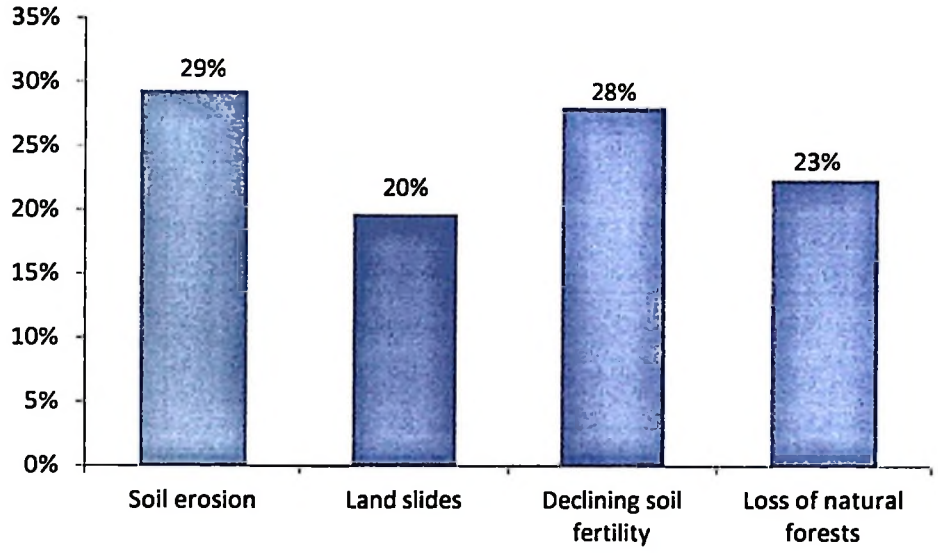

Figure 4: Farmers' perception of the land degradation problem

4.3 Livelihood context of the South Uluguru Mountains' Community

Livelihoods can generally be thought of as the things people do to make a living. Ellis (2000) defines a livelihood as the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household. Rural livelihood analysis involves identifying and understanding the resource base and options available to rural people, interactions between and among the resources, and the vulnerability context within which poor people operate (Pasteur, 2001). In line with this, Ellis (2000) contends that livelihood analysis does not only focus on livelihood activities, but also on livelihood perspective and social relations, which consist of institutions that influence capital. This section will present the observed available and/or accessible resource by community members, influence of current and future climate hazards to resources, main livelihood

activities of the community and importance of resources in undertaking adaptive strategies.

4.3.1 Livelihood resources of the South Uluguru Mountains' community

Communities in South Uluguru Mountains are endowed with numerous resources that their livelihoods depend on. As presented in Table 6, crop land, forests and water (surface and underground) are the main resources for the south Uluguru mountain community. However, there are variations across the lowland, midland and high land, the details of which are described in sub-sections 4.3.1.1 through 4.3.1.5 and summary in sub sub-section 4.4.1.6

Table 6: Livelihood resources of South Uluguru Communities

Village	Natural	Physical	Financial	Human	Social
Lubasazi	Springs/rivers Natural forests Crop land	Primary school Boreholes Road Granaries	Village Savings and lending scheme Sales of Livestock and products Selling sesame	Art craft and weaving skills Agricultural production skills Livestock production skills	VSL groups Traditional ngoma groups Clanship connectedness
Kasanga	Spring/rivers Land Bananas and other crop plants Natural and man-made forests	Church/Dispensary Road Primary school	Sales of livestock and products Savings and Lending Schemes Sales of bananas	Crop production skills Art craft and weaving skills Traditional water conveying skills	Self help groups VSL groups Clanship connectedness
Longwe	Springs/rivers Land Forests	Primary school	Financial resources Sales of livestock and products Savings and Lending Schemes	Crop production skills Art craft and weaving skills Traditional water conveying skills	Clanship connectedness Self help groups VSL groups

4.3.1.1 Natural capital

Natural capital as an indispensable source of livelihoods in rural communities is defined by DFID (1999) as the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived. Household survey, personal observation and discussion with community members found land, surface water in form of rivers, streams and springs, and natural forests to be the main natural endowment which the communities have access to.

All interviewed households had access to land in some ways. Just over a third (34.4%) of respondents reported that they were using privately owned land while another 34.4% reported to have access and using communally owned clan land. The remaining 31.1% reported using borrowed or rented land. The average land size accessed was 3.7 acres (Std. Dev. 2.19). The minimum size of land was 1 acre and the maximum was 14 acres. It was observed that land ownership was mainly private based rather than communal based. Even for the clan communally owned land, individual households were allocated a piece of land to farm as individual household rather than communally.

Since access to land for rural people determines household livelihood, households accessing reasonable amount of land may easily expand their agriculture (agriculture extensification). Land shortage was reported as one of the limiting factors of livelihood (agriculture production) by 9.2% of respondents. Of the accessible land for agriculture, average land cultivated by each household was 2.77

acres (Std. Dev. 1.37) with the minimum being 1 acre and maximum 7 acres. The remaining household accessible land area was not cultivated for various reasons including insufficient household labour (46.2%), fallowing to improve soil fertility (23.1%) and unpredictability of weather making it too risky to cultivate all accessible land (13.5%).

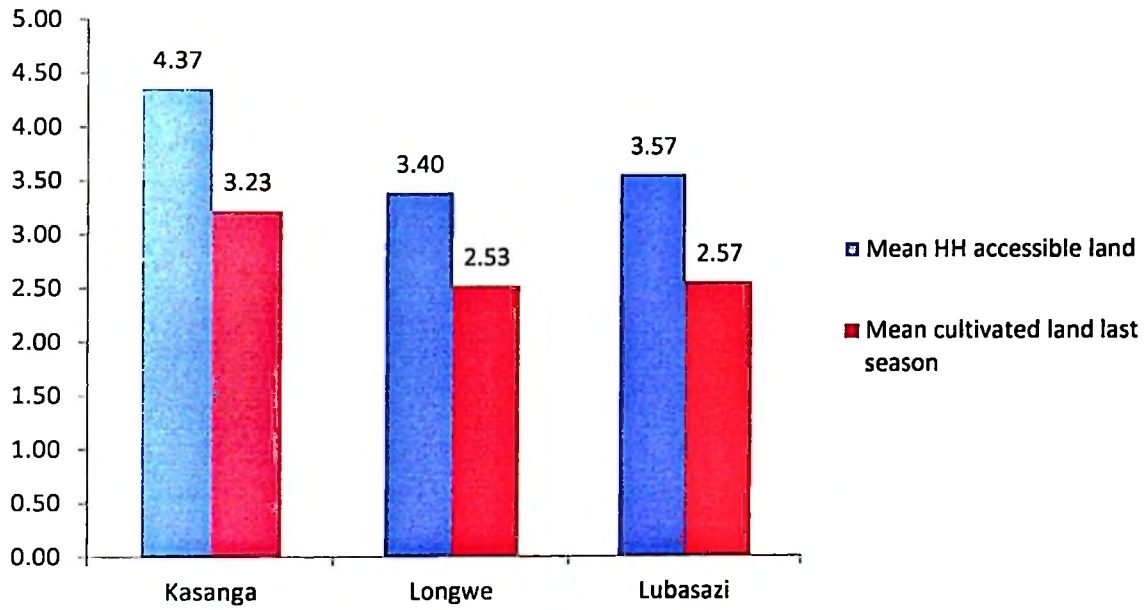

Figure 5: Mean accessible land and cultivated land by households in the three villages

As for water resources, important rivers mentioned were Msuluzi and Mkamazi at Kasanga village and Lubasazi and Mlogozi at Lubasazi village. Although these rivers flow all the year round, their use in agriculture (irrigation) is minimal. However, the community relies on them for domestic water supply. About 73.3% of the respondents reported using rivers/streams for domestic water. Those who use water from boreholes accounted for 17.8% and the rest obtain their domestic water from springs. While river/stream water may be considered as less safe for drinking, Kasanga and Longwe communities use indigenous technology to convey water from

the most safe place of the river/stream (usually close to the source/spring or the highest point with minimum contamination). It is common to find bamboo pipes crossing footpaths conveying water to the household. Fig. 6 shows non-stoppable water flowing from a bamboo pipe at a homestead in Longwe village.

Figure 6: Indigenous technology of conveying water for domestic use

Protected natural forests have been observed in all three villages, with Lubasazi having more forest land than others. The observed forests and their importance to the community were Bomani at Kasanga village and Kisuguso at Longwe village which are protected for improving microclimate. During discussion with Lubasazi community, it was discovered that Mandeni forest has been subject to minimum human alteration as it is associated with rituals and traditional forest and no one is allowed to harvest any forest product. Forests at Lubasazi that are open for firewood, building materials and art craft and weaving materials are Pango and Uwamvi. These forests also harbour a good number of wild animal species, some of them hunted by the community for use as food supplement.

4.3.1.2 Physical capital

Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods (DFID 1999). Infrastructure consists of changes to the physical environment (such as affordable transport, secure shelter and buildings, adequate water supply) that help people to meet their basic needs and to be more productive. Producer goods, on the other hand, are the tools and equipment that people use to function more productively.

Physical resources identified to support the communities of South Uluguru Mountains include road, primary schools, dispensaries at Kasanga and Lubasazi, and churches at Kasanga village and Lubasazi village, low cost rat proof granaries at all villages.

Seasonal earth road that link Kolero and Kasanga wards to the rest of the district is probably the most valued physical resource the communities have. Though the road is poorly managed, and become almost impassable during rainy season, it remains the main access by vehicles to the area. During rainy season, the community ferry agricultural produce on their heads to the nearby Mvuha or Matombo markets. Recently built grain storage structures at each village by the support of the CARE Hillside Conservation Agriculture Project (or HICAP) ranked the second important physical resource accessed by the community. Fig. 7 is a typical grain structure in Lubasazi village.

Figure 7: Low cost granary at Lubasazi village

4.3.1.3 Human capital

According to DIFD (1999), human capital represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives. DFID further explains that, at a household level human capital is a factor of the amount and quality of labour available and varies according to household size, level of skills, leadership potential and health status among others. This study sought to find size and quality (in terms of education levels) of household labour in South Uluguru Mountains.

It was hypothesized that since agricultural activities in the mountainous areas are labour intensive, the larger the households labour size the better for the household's

livelihoods. Controlling soil erosion by terracing, or digging trenches to direct excessive water, for example, requires reasonable amount of labour. The household survey results show an average number of household sizes in the study area being 4.81, (Std. Dev. 2.3.) with the minimum household number being 1 and the maximum of 12 members. On the other hand, results revealed that average household labour size was 2.46 with the Std Dev. of 1.20, ranging from 0 to 6. This means that some household had no labour and probably relied on hired labour for agricultural activities.

Looking at the education level of respondents, which describes quality of labour, almost all (97.78%) had received minimum education (primary education, functional literacy or none). Just over 2% had received secondary and post secondary education. Further analysis of the data revealed that these 2% respondents who had received secondary education and above were above 60 years old. This means their labour supply to the households' livelihood is limited due to old age. It can generally be concluded that the community has low quality labour of age between 40 and 60 years. Age-wise respondents' highest education is presented in Table 7.

Table 7: Highest education levels of respondents by age groups

Age in years	No formal		Completed primary		Completed secondary		Post secondary		Functional literacy	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
< 40	3	3.5	8	9.4	0	0.0	0	0.0	0	0.0
40 to 59	4	4.7	43	50.6	0	0.0	0	0.0	6	7.1
≥ 60	8	9.4	9	10.6	0	0.0	2	2.4		2.3
Total	15	17.7	60	70.59	0	0.0	2	2.4	8	9.4

4.3.1.4 Social capital

Networks and connectedness that increase people's trust and ability to work together and expand their access to wider institutions; membership of more formalised groups which necessitate devotion to mutually-agreed/commonly accepted rules, norms and sanctions; and relationships of trust, reciprocity and exchanges that facilitate co-operation, reduce transaction costs and may provide the basis for informal safety nets is what DFID (1999) describes to be social capital. Pretty (2003), identified three types of social capital, bonding, bridging, and linking as important for the networks within, between, and beyond communities. Bonding social capital describes the links between people with similar objectives and is manifested in local groups, such as clans, ethnic group and other reciprocal groups. Bridging describes the capacity of such groups to make links with others that may have different views, and linking describes the ability of groups to engage with external agencies, either to influence their policies or to draw on useful resources.

South Uluguru Mountain community is endowed with social groups in form of clans that have high influence on individuals and households. "Wahimba", "Wambiki",

"Wachilo" and "Wamlali" were reported by a key informant at Kasanga village as the most powerful and respected clans in the area. The informer mentioned size of land owned by the clan, number of clan members, influence of the clan leader to the general society and ability to contain conflicts within the clan being the characteristics that describes power of the clan. Clan members enjoy share of land from the clan land and moral and material support at times of difficulties such as hunger and death of a family member.

4.3.1.5 Financial capital

Although sufficient and affordable credit loan facilities are essential for smallholder agriculture development, the study revealed that the community has minimum access to these. Some farmers in the study area have access to economic capital through Village Savings and Lending (VSL) schemes. Organized and engineered by CARE International in Tanzania through the Hillside Conservation Agriculture Project in the study site, VSLs enable members access financial resources at ease. Access to loan enables community to resolve liquidity constraints. Apart from supporting agricultural activities through timely purchase of inputs and timely mobilization of farm labour, loans also facilitate the undertaking of other livelihood activities like petty trading and art crafting. Data from CARE revealed that there are about 33 VSL groups in all fourteen villages, with total of 684 members. At the time of data collection, all 33 VSL groups had a total savings of TZS 23 840 445 which is equivalent to USD 15 895.

Livestock was another important form of financial resource to several households. Over 85% of the interviewed households keep livestock of some sort. The most common type is chicken which averages 8.3 birds per household as indicated in Table 8. It was observed during informal interview at Lubasazi village that keeping livestock especially chicken is not only a way of keeping money in a form of assets; it is also a source of hope and prestige among farmers. A household respondent in Kasanga pointed out that, prior to the promotion and establishment of VSL, community main savings were in form of livestock mainly chicken and pigs to a lesser extent. He said:

> *"The easiest ways to have money say for paying school fees or taking a household member to health services was to sell livestock or livestock products, especially eggs. In fact, it is money kept in form of livestock because it is relatively easy to sell them. You can see almost every household here has some chicken. If you don't have chicken, what can you offer to a special guest?"*

Chickens are thus more liquid savings that communities of Uluguru Mountains rely on. DFID (1999) however has the opinion that the more liquid one's savings are, the more difficult they tend to be defended from claims from family members or others. Even then, communities are happier to keep their savings in form of chicken.

Table 8: Average number of animals kept per household

Village	Goat/sheep	Chicken	Pig	Duck	Rabbit	G-pig
Kasanga	1.40	9.97	0.27	0.00	0.00	0.00
Longwe	1.30	4.10	0.23	0.17	0.27	0.13
Lubasazi	1.53	12.33	1.20	0.00	0.00	0.00
Study area	1.14	8.80	0.57	0.05	0.09	0.04

4.3.1.6 Summary on the South Uluguru Community Resources

Summary on the south Uluguru Mountain community livelihood resource is presented on a pentagon illustration (Fig. 8) as suggested by Carney (1998). It entails plotting the resource access level of the community on a pentagon, with a centre representing zero and towards each corner high level access of the major categories of resources. In this case, small inside pentagon represent a South Uluguru community being highly endowed with social and natural capital, low in financial and physical capital and moderately endowed in human capital.

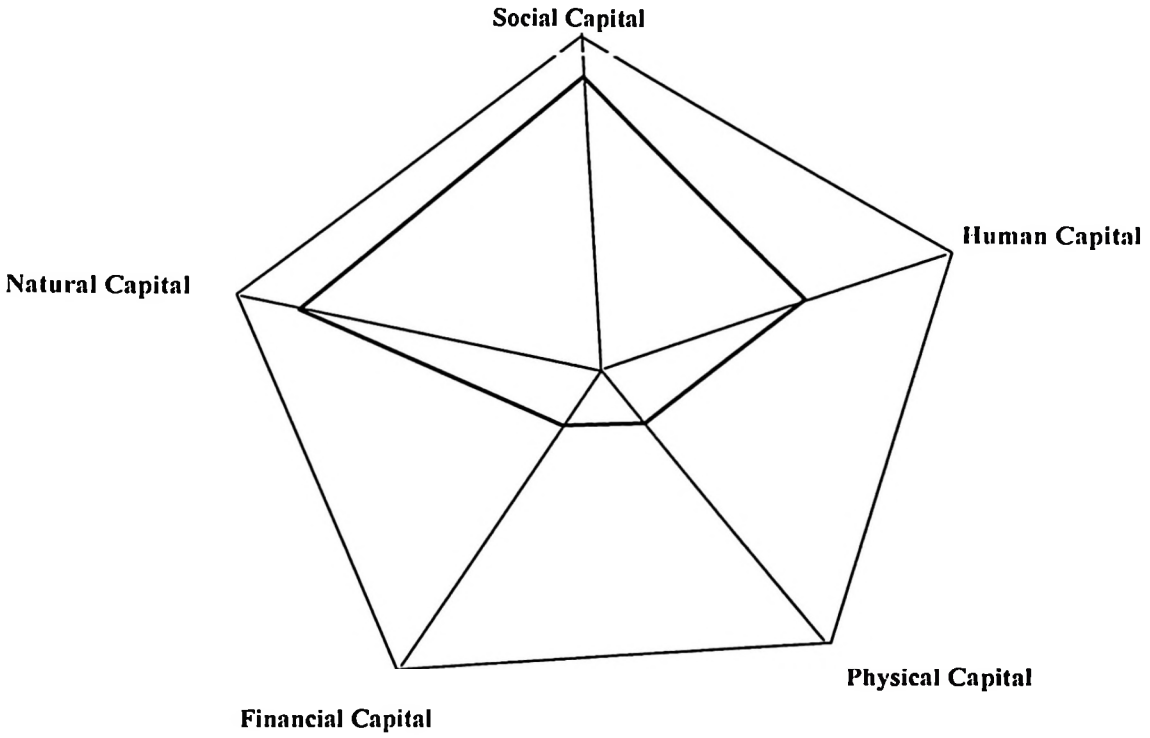

Figure 8: Resource pentagon of South Uluguru Mountain Communities

4.3.2 Influence of current and future hazards on livelihood resources of the communities

In this section, important hazards that stress livelihood resources of the South Uluguru community are presented in categories of lowland, midland and highland represented by Lubasazi, Kasanga and Longwe consecutively. The degree of influence, as describe by community members during FGD is presented in level 0 through 5, with 0 no influence and 5 very high influence.

Lubasazi

Discussions with Lubasazi community members uncovered droughts, floods and wildfires to be the prominent climate related hazards. During drought periods, when most of the vegetation is dry, fire catches easily. On the other hand, floods occur when there are excessive rains in highland and midland zone areas.

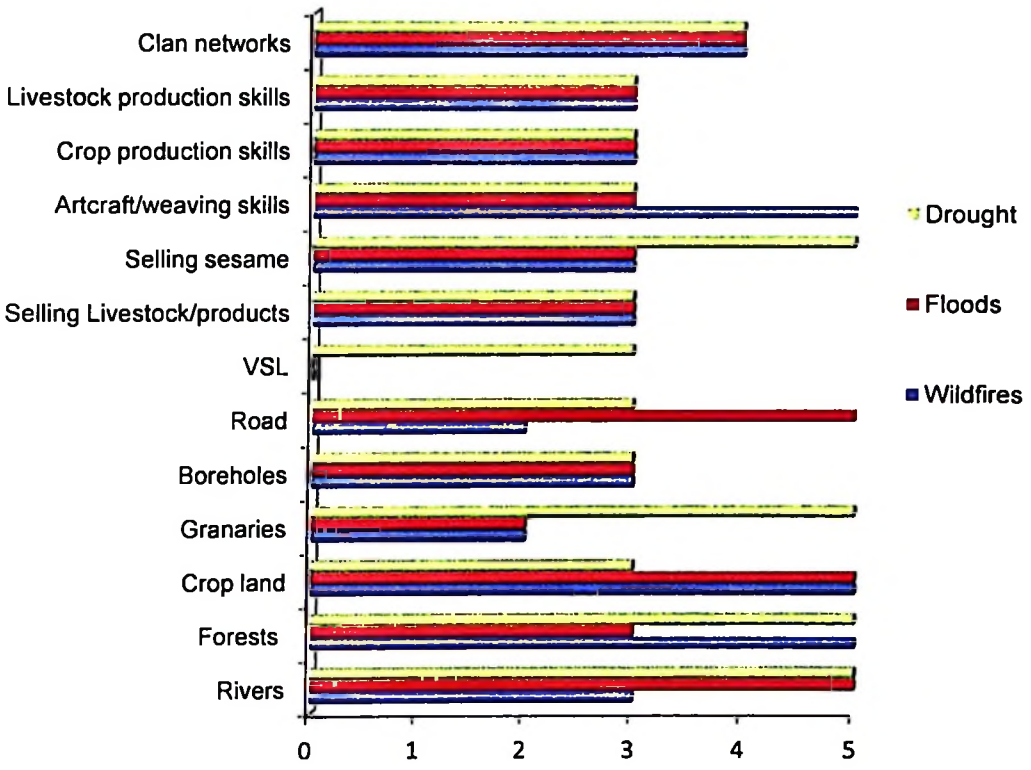

Figure 9: Influence of drought, floods and wildfires on Lubasazi community resources

All livelihood resources were reported to be influenced by the hazards in some ways, direct or indirect and positively or negatively. Fig. 9 shows that wildfires have high degree direct effect on village forests. The negative effects include damage to forests biodiversity and destruction of water sources hence reducing water quality and quantity, and reduce crop land fertility. Mandeni forest is mainly used for traditional warship; wildfires thus impact the community spiritually. There is a

negative effect on the artcraft as well. Some raw materials for weaving which are found in forest areas are destroyed by wildfires, leading to scarcity of raw materials. Riverbanks break off and flood water destroys food crops planted on land adjacent to rivers. Since many dwellings are situated in higher grounds, floods seldom damage community houses. Road is especially vulnerable to floods. Drought in this area results into household food insecurity. Unlike their midland and upland community counterparts, lowland environment was reported to support cassava in the field for less than one year hence making this community more vulnerable to droughts.

Kasanga

Kasanga village is affected more seriously with strong winds, landslides and soil erosion and loss of soil fertility. Drought is also reported to affect the community, although the effects here are less severe than in the lowland Lubasazi.

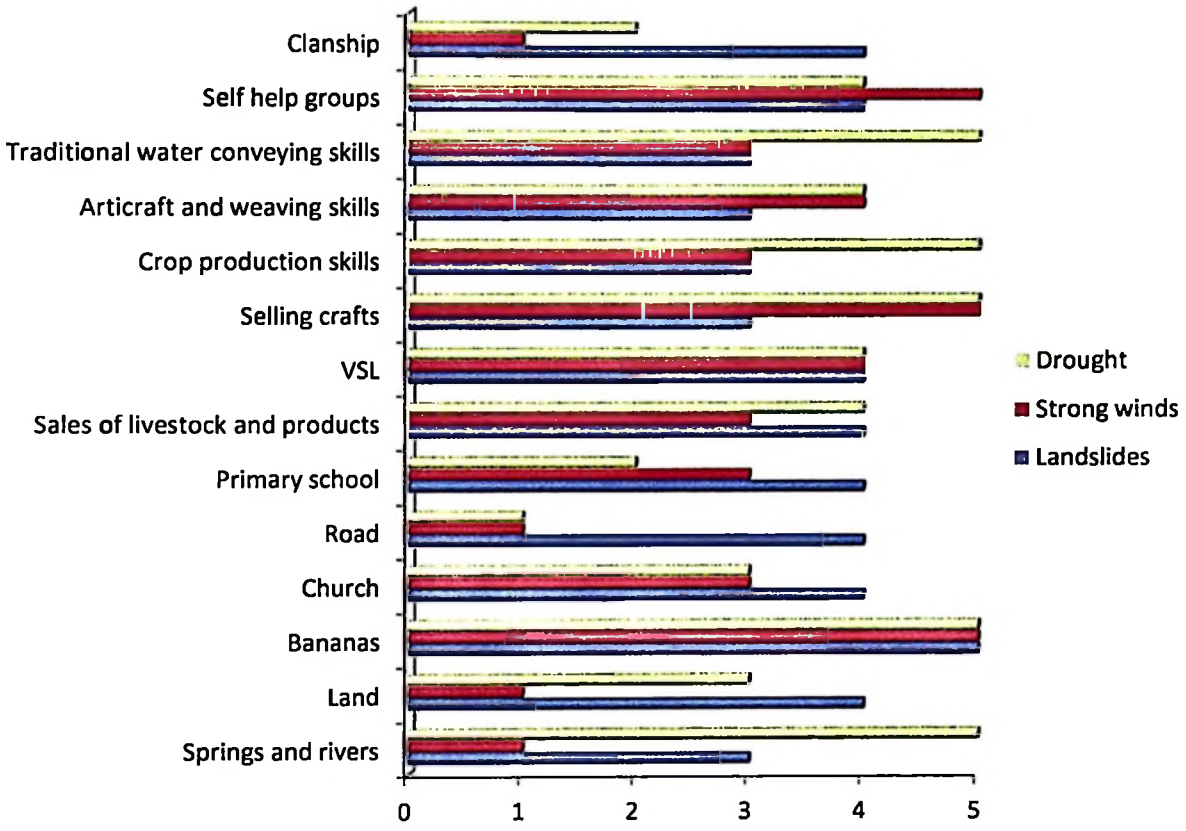

Figure 10: Influence of drought, floods and wildfires on Kasanga community resources

Landslides affect cropland both negatively and positively. When landslides occur, enormous amounts of good soils are taken away living that particular portion of land unproductive. On the other hand, where silt is deposited, the land is accumulated with rich soils and often planted with bananas which grow well. This is therefore the positive influence.

Strong winds have been reported by community members to destroy house roofs (thatch grass) and crop plants especially bananas. In this way, youth groups like

"Kubebeana Nyasi" group is motivated to help its members build a house that is strong and more comfortable.

Drought affects rivers and spring and thus reducing amount of water flowing. Drought also affects weaving skills as growth of weaving raw materials is affected. As a result, financial resources of the community are affected. Soil erosion and loss of soil fertility primarily affects crop land resources. Crop production skills are also indirectly affected as farmers seeks new ways of dealing with the problem considering the fact that, their dependence on fallowing for natural fertility regeneration requires extra land.

Longwe

Unlike their counterparts in lowland and midland, highland Longwe community was reported to be less affected by droughts impacts. Although amounts of rains have currently been observed to be lower than in the past (about 15 years ago), they are still enough to grow crops they have been growing over the years. The main climatic impacts, however, are associated with increased strong winds and landslides.

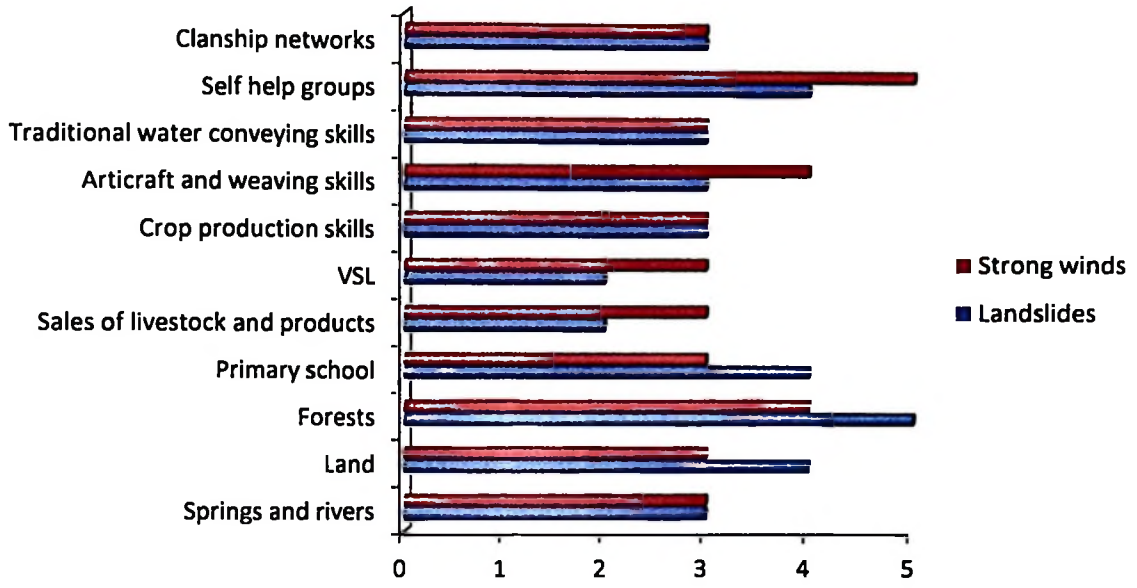

Figure 11: Influence of strong winds and landslides on Longwe community resources

Landslides affect land cropland both negatively and positively. When landslides occur, enormous amounts of good soils are taken away, living the land unproductive. On the other hand, where the silt is deposited, the land accumulates rich soils and often planted with bananas which grow well. This is therefore the positive influence. Strong winds have been reported by community members to destroy house roofs (thatch grass) and crop plants especially bananas.

4.3.3 Main livelihood activities of South Uluguru Mountains' communities

According to DFID (1999), Livelihood strategies refer to the range and combination of activities and choices that people make in order to achieve their livelihood goals. The activities may be on farm, non-farm or off-farm. Using multiple responses with the total count of 224, Table 9 of household survey shows percentage distribution of main livelihood activities of the South Uluguru Mountains communities. Food crop

production had a total count of 87 (38.8%) indicating it as the main livelihood activity. Livestock keeping (chicken and pigs mostly) had a 44 count (19.6%) indicating communities reliance on poultry and pig keeping for their savings. It was surprising to find that the community members who rely on selling labour to earn extra income to support their households accounted for only 7 counts (3.1%).

Table 6: Distribution of respondents according to their main livelihood activities

Source of livelihood	Count of HH	Percent of HH
Food crop production	87	38.8%
Cash crop production	14	6.3%
Livestock keeping	44	19.6%
Handcrafting	11	4.9%
Buying and selling crop produce	21	9.4%
Petty trading	21	9.4%
Remittance	2	0.9%
Porterage	4	1.8%
Brewing/selling local bear	9	4.0%
Assistance from relatives/friends	1	0.4%
Selling labour	7	3.1%
Skilled labour	2	0.9%
Formal employment	1	0.4%
Total	**224**	**100%**

Hunting, lumbering and charcoal making and other forms of forest products harvesting activities were not mentioned as livelihood sources, probably because they have a legal implication. Selling of dried wild meat was observed to be a common practice and this suggests some illegal hunting is a common livelihood activity. People carrying timber from the distant forest has also been observed. While timber fetches a high price on selling, licensing procedures seem to be

discouraging and thus needy individuals decide to harvest timber trees without following legal procedures. The results however indicate that the community maintains a diverse portfolio of activities for survival and in order to improve their standard of living as observed by Ellis (1999).

4.3.4 Importance of communities' livelihood resources in undertaking adaptive strategies

This section presents focus group findings of strategies farmers of the South Uluguru Mountains use to contain the current and anticipated impacts of climate variability and land degradation. It further elaborates the importance of resources used in each strategy under each of the important hazards. The hazards discussed here are drought, strong winds, floods, wildfires, landslides and soil erosion and reduced soil fertility.

4.3.4.1 Strategies and resources against the impacts of floods

Floods were found to affect mostly the lowland Lubasazi community, because of the sometimes heavy rains at midland and highland areas. Flood water inundates crops on the fields adjacent to the river. On some occasions, when floods are heavy, downstream sedimentation occurs in downstream fields, subjecting them to degradation of some sort. Farmers attributed floods to breaking of riverbanks, and thus their strategies are geared towards stabilizing riverbanks. Farmers do plant bananas and sugarcane along riverbanks as a way of stabilizing riverbank soils (see Fig. 12). De Beats (2007) found that, fine branched; long lateral roots play an important role in increasing soil resistance against erosion by concentrated flow. Belalcázar *et al* (2003) found that plantain banana roots in light soils may reach and

exceed 3.0 m, while those in heavy soils may reach 2.0 m. These characteristics give banana plants credit for use as river banks stabilizing agents.

Figure 12: Use of bananas and sugarcane to stabilize riverbanks at Lubasazi

Figure 13 shows the importance of resources in carrying out stabilization of riverbank strategy. The most important categories of resources were identified to be social and natural resources.

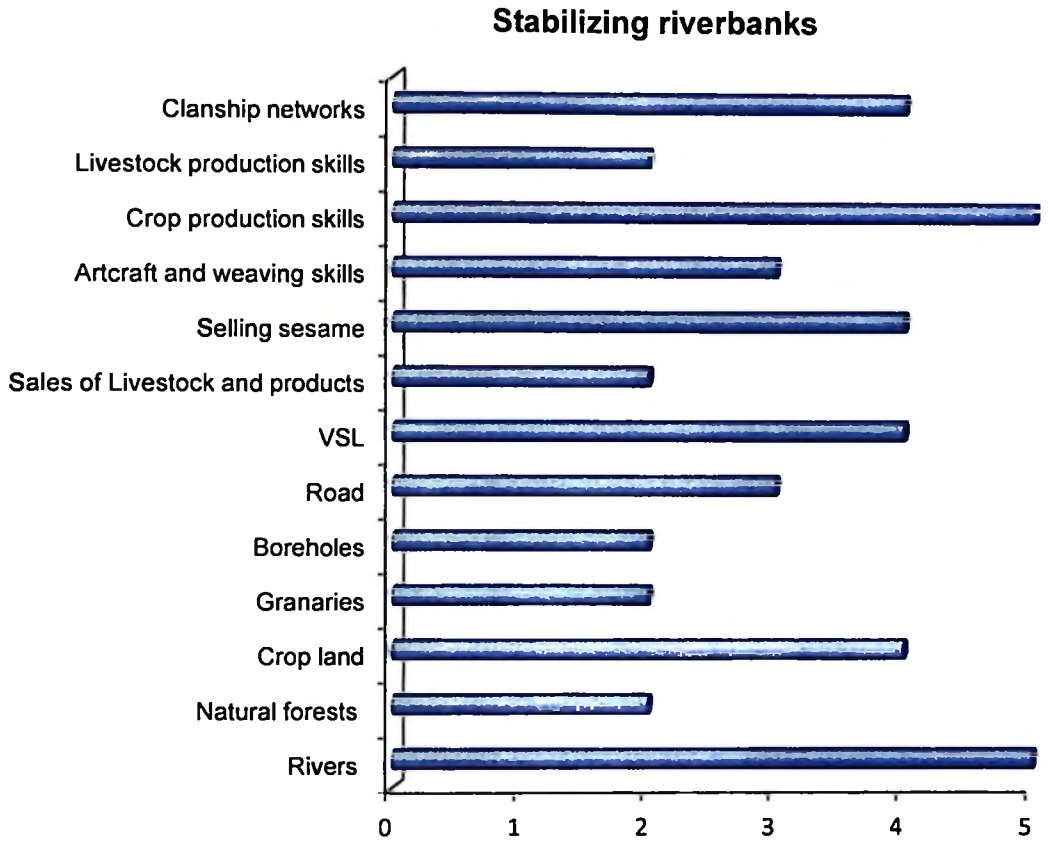

Figure 13: Importance of livelihood resources on implementing stabilization of riverbanks

River, as a resource to be worked on, is primarily important. Since banana planting is both labour intensive, financial resources are important in paying for hired labour. Financial resources are obtained from sales of sesame, and in recent years, from Village Savings and Loans schemes. Land is as important as clan membership, since the latter gives an individual an opportunity to access the other. Crop production skills are equally important.

4.3.4.2 Strategies and resources against the impacts of landslides

Landslides impacts livelihoods of midland and highland communities by damaging dwellings and crop plants in the field. They have been reported to claim lives of people at Kasanga. Some households have planted bananas and fruit tree crops around homesteads primarily to provide food and also as a means to reduce impact of mudslides, should the landslides occur. The plants reduce amount and speed of mudslides thus preventing dwellings from being inundated. Other strategies include selecting a site for dwellings which is less likely to be hit by slides. This is passive measures of landslides effects control which is mainly a land-use planning, keeping the endangered areas free of settlements to prevent life and economic damages (Fiebiger, 2006).

However, choice of site is limited to the land available and/or accessible to the household. To protect crops from damage by slides, farmers reported to have adapted two strategies. One, digging trenches across the slopping fields in order to diverge water and hence controlling the amount of water that would otherwise be held in the soil and hence weaken the land. Farmers also reported planting trees surrounding their fields. Afforestation and construction of drainage structures are considered by Fiebiger (2006) as active countermeasures of landslides control. It was observed during transect walks in the village, however, that farmers plant more vertiver grass rather than trees on the border of their field plots. The reason for this is probably due to the fact that tree occupies much bigger area and hence reduce land for other field crops.

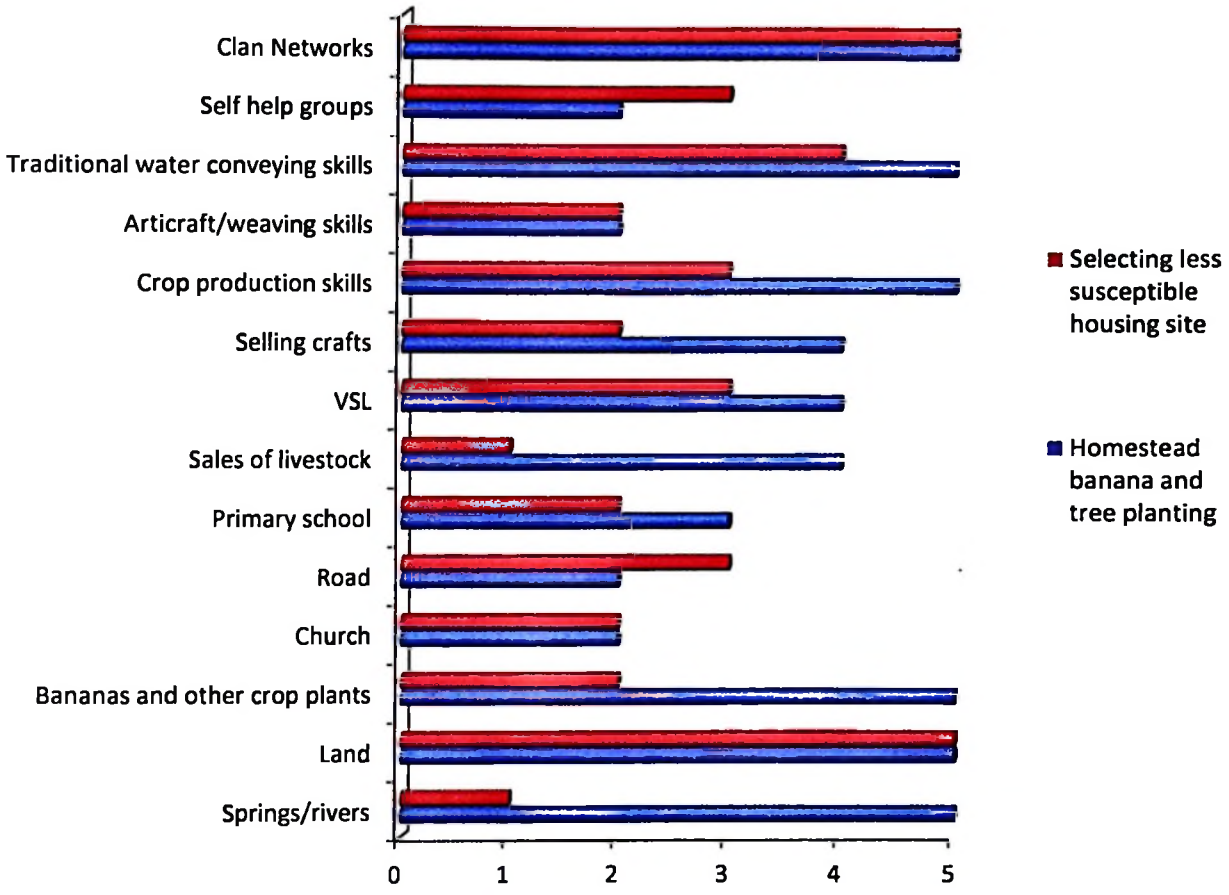

Figure 14: Importance of livelihood resources on strategies against landslides

Water resources (streams and rivers) and traditional water conveying skills are of the utmost importance in implementing bananas and tree crops planting as a strategy towards mudslide control. Crop production skills are equally important in managing and mixing these tree crops in a way that make them complement rather than compete each other.

Selection of site that is less susceptible to mudslide was found to be a less effective strategy as individuals have limited access to land. The most important resource for

this strategy was thus found to be land and membership to a clan that has enough land.

4.3.4.3 Strategies and important resources towards strong winds

Kasanga and Longwe communities reported increased strong winds in recent years as a noticeable indicator of climate stress in South Uluguru Mountains. The winds damage banana plants and remove roofs of grass thatched houses. Discussion with Kasanga community members revealed that, planting trees to act as wind breaks and roofing houses with iron sheets are the main strategies used by the Kasanga community to manage the impacts. Fig. 15 shows the level of importance of each livelihood resource Kasanga community is endowed with in adapting to strong winds.

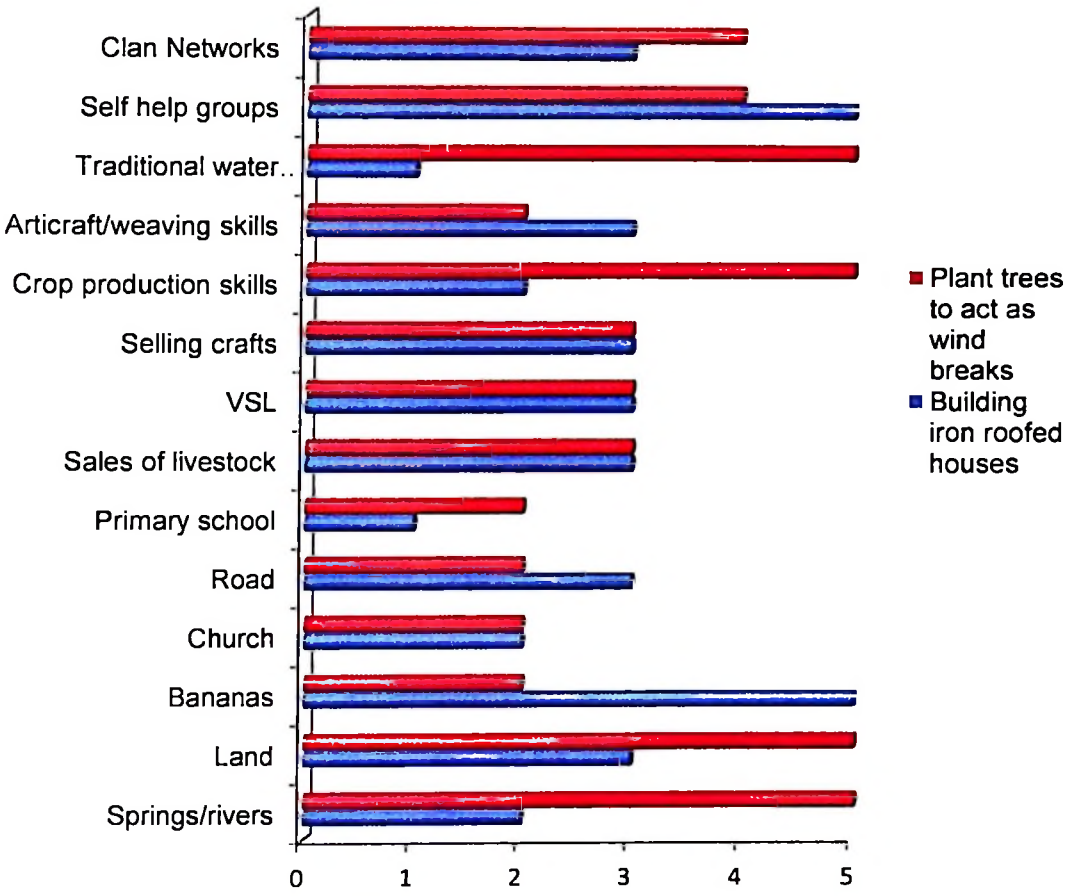

Figure 15: Importance of livelihood resources on strategies against strong winds

Water resources (springs and rivers), land, crop production skills and traditional water conveyance technology were mentioned to be the most important resources in implementing planting of trees as wind breaks. Clan networks showed to be important, probably because most land within which trees could be planted belongs to clans. Using corrugated iron sheets to roof house was mentioned to be a difficult endeavour. This is the reason why youths have formed special type of reciprocal groups which assist them in building stronger, iron roofed houses. An in-depth interview was carried out with a chairperson of one group and this was his story.

"Our group has 15 members, and works on the mutual trust philosophy. We operate by contributing cash enough to buy 200 pieces of bananas for each member, process banana by initiating the ripening process, pack in crates called 'tenga' and ferry them to Mtombozi Market where they fetch a fairly good price than we would if we had ferried bananas in bunches. The money obtained is used to buy iron sheets enough to roof one house and the sheets so bought are given to one member. Each week one member is given 30 corrugated iron sheets of 3metres long. When the cycle is complete, the group supports one member after the other in erecting a brick house by offering labour and any other necessity. So far, we have finished the first round where every one of us has 30 iron sheets, and four houses have been completed. We find this strategy as an effective way to acquire a strong house, less susceptible to strong winds. The challenge is, however, to come together as a group with individuals whom we can really trust each other. So far, in our group no one has defaulted".

Initially, youths worked as porters, ferrying banana bunches bought by banana traders to Mvuha and Matombo weekly markets (four to eight hours walking distance). This observation is in line with DFID (1999) argument that social capital is a 'resource of last resort' for the poor and the vulnerable for it provides a buffer that helps individuals to cope with shocks, such as death in the family; act as an informal safety net to ensure survival during periods of intense insecurity; and compensate for a lack of other types of capital (e.g. shared labour groups).

4.3.4.4 Strategies and resources against impacts of drought

Dry spells have implications on household food security and water shortages for domestic use. In order to ensure food availability during the drought periods (if they are to occur), midland and highland communities grow special varieties of cassava that is capable of staying in the field for up to four years. In case the drought occurs in the next one to two years, the cassava crop in the field will act as 'granary'. Kasanga Farmers pointed out that, if they have to use the crop in the field, arrangements are made to plant the reserve before starting harvesting the previously kept field.

The lower land zone is the most that is affected by climate variability. The area has experienced several dry spells. Discussions with Lubasazi community members revealed that, unlike their midland and upland counterparts, lowlanders do grow cassava for use in the same year. This is what one discussant had to say:

> "*...regardless of the variety, cassava in the field last for one year at most. To ensure food availability, we grow sorghum. Sorghum is capable of growing very well even with little rains.*"

It was also observed that some clans are spread though out the three land zone areas, owning land in all three zones. Members of such clans engage in farming in both low land and highland/midland, utilizing both environmental opportunities. In the same discussion at Lubasazi, another discussant had this to share:

> "... *for some of us who belong to clans that do not have land in midland and highland do not have the opportunity to have cassava field storage. We therefore buy cassava from highland and midland friends at times of severe food shortages. For those whose clans have land in highland areas, grow*

cassava and use them as food stores, while growing maize and millet in lowland fields."

Drought also impacts water availability for domestic use. While this was found to be a lesser problem in Kasanga, it was a bigger one in Kolero. Midland and highland communities uses bamboo pipes technology to convey water from distant area when water shortages. Their lowland counterparts rely on boreholes thus required to walk long distance to fetch water. Fig. 16 indicates the importance of livelihood resources in implementing strategies towards drought.

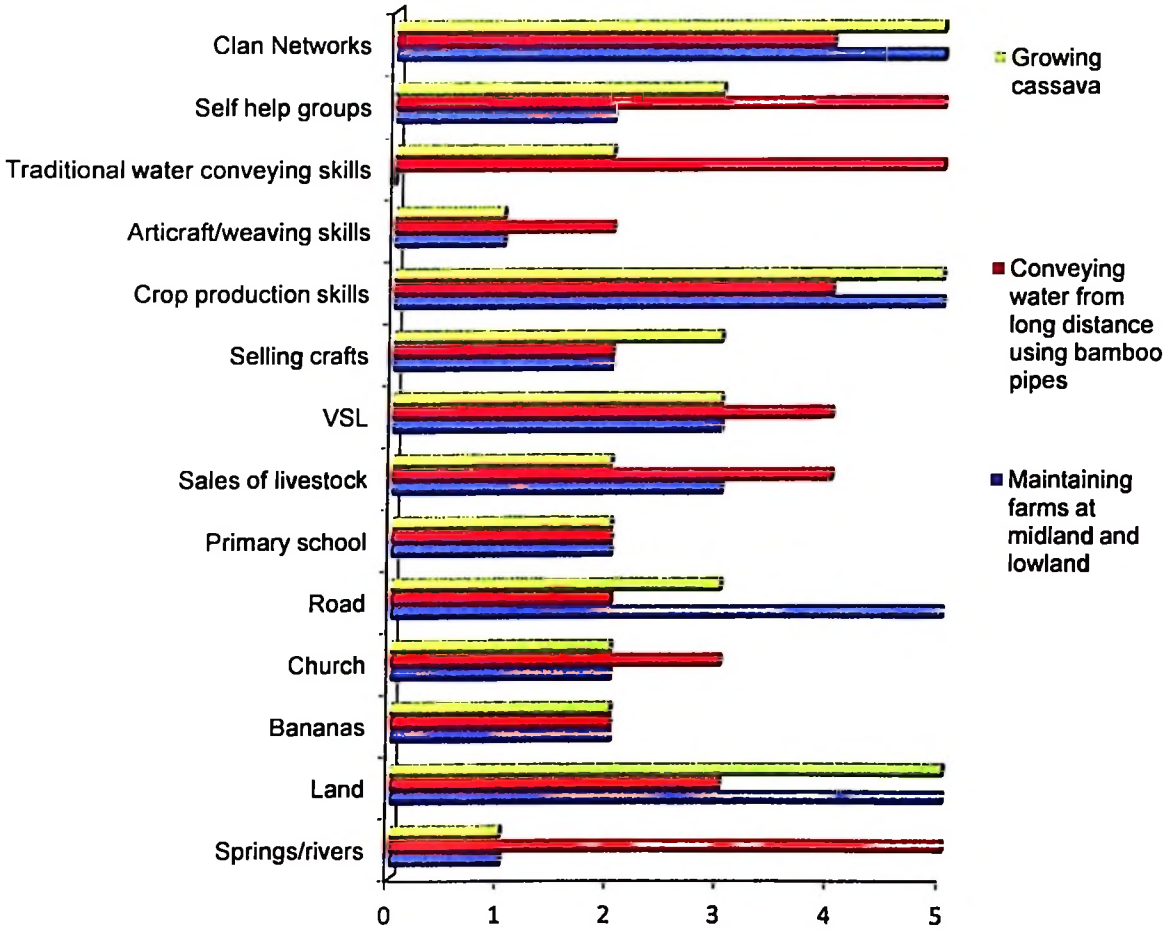

Figure 16: Importance of livelihood resources on strategies against drought

To grow cassava as a strategy toward food security, land, crop production skills and clan networks were reported to be the most important resources. Households need land in midland and highland areas where cassava grows and can be stored in the field for several years and ensures food availability drought periods. Most of the land belongs to clans, and thus membership to a clan that has land on the two zones was observed to be important. It was also observed that, knowledge of local varieties that are capable of being store in the field for up to four years was important in growing cassava.

Food security is also addressed by maintaining farms in the two zones, lowland and highland/midland. Lowland was reported to be good in production of cereals while upland was reported to be good for production of bananas and cassava. Cassava and sorghum are drought tolerant crops. To implement this strategy, communities indicated land, clanship, crop production skills and road as the most important community resources. Road was reported to be important for shipping crop produce between the two zones. However, the road that was referred to, was in poor condition and very limited number of vehicles actually use it.

The community has the traditional technology of conveying water in bamboo pipes. Most of the households in Longwe, and some in Kasanga have bamboo piped water within their household compounds. To convey water, the community mentioned springs and rivers as the utmost important resources as they are the source of clean water that they convey to their homesteads. Water conveyance skills were associated with first selection of site for homestead which must be in lower

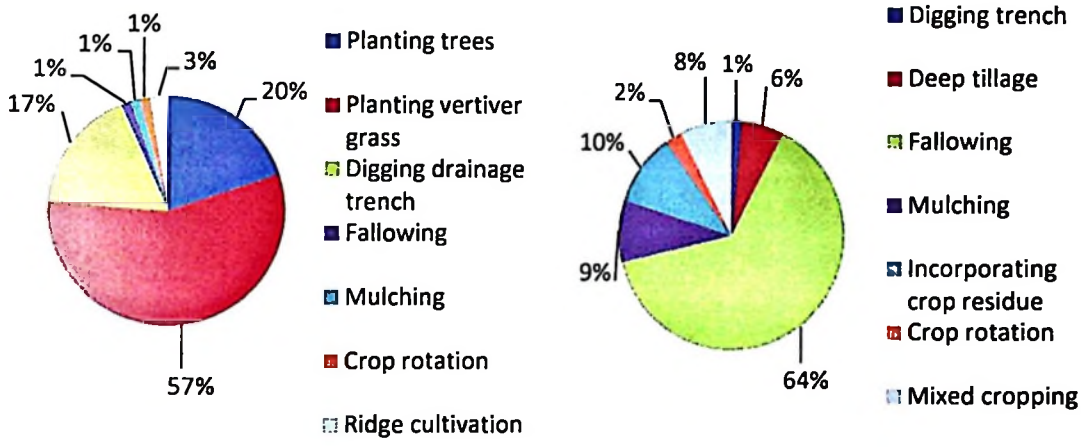

Fig. 17a: Soil Erosion management strategies *Fig. 17b: Soil fertility management strategies*

Figure 17: Soil erosion and fertility management strategies of South Uluguru farmers

4.4 Chapter Summary

The results show that South Uluguru Mountain community attribute low agriculture productivity to weather related problems (unpredictability of weather, frequently occurring dry spells, increased temperatures, strong wind and excessive rains) more than other factors such as input supply, agricultural extensions services and access to markets. Although they seem to be aware on the land degradation as a problem (soil erosion, soil fertility loss and landslides), they attribute it to weather changes, in particular too much and absence of rains in certain seasons. On the other hand, reduced amounts of rains, late coming of rains and increased incidences of dry spell in some seasons have reported to be the main indicators of climate variability.

The highland zone community settles at an altitude ranging from 1100m.a.s.l. to above 2000m.a.s.l. All the villages in the zone were not accessible by vehicle or even bicycle, and it is quite a struggle to reach on foot. There are good reasons as to why the community has chosen to continue living in this area despite of difficulties in access. Compared to the lowland and somehow the midland, the highland zone, as observed from the FGD, continues to receive reasonable amounts of rains. The area is endowed with soils that hold moisture for longer periods (probably because of low evapo-transpiration as temperatures are generally lower than the neighbouring midland and lowland areas). The main crop season is between July and December, utilizing the "Mvua nyembamba za baada ya Masika" (shallow rains succeeding Main rains) and "Mvua za Mlalo" (short rains). As the soils retains moisture for longer periods, light showers are enough to grow Maize, beans, upland rice and other food crops thus having an abundance of food during otherwise dry periods of their lowland counterparts. As a strategy to ensure food security in case prolonged dry spell occur, highland communities grow special varieties of cassava that is capable of staying in the field for up to four years. Harvesting is arranged in way that, they will always try to maintain cassava field to act as food store.

The midland zone communities seem to have higher effects of strong winds, landslides, soil erosion and loss of soil fertility. Consequently community resources such as cropland, rivers and springs and shelters are affected, thus leading to food insecurity and loss of or damage of shelters. To ensure availability of food, midland communities have been observed to maintain farms at both midland and lowland zone. If rains are good at lowland, good harvest of maize and millet is expected thus ensuring food security. On the other hand, when dry spell is prolonged, cassava

fields in the midland become their resort. Recently, the youths have adapted a strategy to build much stronger houses by reciprocal arrangements in response to damaging winds.

A lowland community which settles in altitude ranging from 200m.a.s.l to 250m.a.s.l. (as defined by this study) is impacted by droughts, wildfires and floods. While floods are attributed by heavy rains in highland and midland zone, wildfires are accelerated by prolonged dry-spells. On the other hand, warmer weather and comparable flat land in Lubasazi offer a good environment for cereals (Maize and sorghum) to grow well even with relatively short rain duration. Maize is harvested within 3-4 moths as opposed to highland and midland area where maize take up to six months to be harvested. This condition has been cited by Kasanga community (Midlanders) to attract farmers at midland and to maintain farms in both midland land and lowland area. The strategy appears to help both lowlanders and midlanders. While cassava crop which is stored in field for up to four years offers food security at bad years at midland, bump harvest of maize and sorghum are expected from lowland when rains have been moderately good. If a farmer is maintaining farms in both areas, he/she stands a good chance of food security.

Communities slash and burn method of land preparation is probably important in triggering wildfires. Wildfires have been reported by the community to affect natural forests, which are important for traditional beliefs of the South Uluguru Mountain community. The study did not identify strategies in response to or those that are geared to containing wildfires. It was alluded, however, that, forests (especially the sacred Mandeni forest) are protected by instilling to community

members, sacred values of the forest for it houses ancestral spirits. For this, community members respect the forest and avoid purposeful actions that would destroy forest, including setting fire.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

i. The study found that, South Uluguru Mountains' communities are aware of climate variability and land degradation as a problem in pursuit of their livelihoods. For instance, they attribute over 50% of the main agricultural problems to the weather stresses (39%) and land degradation problems (15%). Farmers indicators of climate variability includes unpredictability of the onset and duration of long rains, disruption of short rain seasons (not experiencing short rains in many years) and increased incidences of dry spells in some years while some years while in some years rains come in excessive amounts. On the other hand, soil erosion and loss of soil fertility are perceived to be the main land degradation problems across the threes zone area. However, soil erosion is more serious in midland and upland zones probably because of the fact that many of the fields are on steep terrain. Lowland communities perceive loss of forests as their main problem related to land degradation.

ii. (ii) The study found out that drought, strong winds, floods, wildfires, landslides, soil erosion and reduced soil fertility as the main climate related hazards impacting on the South Uluguru communities. Stabilization of riverbanks by planting bananas and sugarcane has been identified as an important strategy towards the impacts of floods in lowland areas. Lowlanders have also adopted cultivation of drought resistant sorghum as a strategy toward the effects of prolonged dry-spell and drought. Planting trees in form of

agroforestry and home garden was found to be strategy toward strong winds that affect crops and dwellings. Interestingly, the study found that, youths are mobilizing in what they call "Kubebeana nyasi" groups for combining efforts in erecting strong houses that could resist the impacts of strong winds. Another important strategy the communities in the area use is planting vertiver grass in field boundaries. Although the primary purpose of these was to mark field boundaries, the communities have found that the grasses are also helping to control soil erosion and provide thatch grass.

iii. Sustainability of the adaptive strategies was gauged in terms of influence of resources in carrying out various strategies on the one hand, and the extent to which the resources are influenced by hazards. The communities are highly endowed with natural and social resources. Although natural resources such as surface and ground water, agricultural land and forests are threatened by such hazards as droughts, floods, landslides and wildfires, human and social capital resources such as traditional crop production skills, water conveying skills, traditional values of protecting forest and social networks seem to help out the natural resources and thus make the strategies sustainable to some extent.

5.2 Recommendations

i. To improve sustainability of livelihoods in terms of natural resource use, this study recommends backing the traditional values of natural resource protection with empowerment efforts to better resource protection practices. Based on the argument by Brosius *et al.* (1998) that local people have knowledge and practices and a greater interest in sustainable resource management than the

outsiders, a further study is recommended to understand local conceptions, values and practices on the traditionally valued forests and other natural resources. This understanding will help in empowering communities in managing community-based resources in a more sustainable fashion. In this way sustainability of the livelihood will be enhanced.

ii. Utilization of surface water for irrigation has been observed to be at the minimum. Small scale irrigation, using traditional bamboo water conveying technology at midland and highland communities could reduce communities' dependency on the disrupted short rains. This study recommends a study on how to improve the technology so much that it is used for small scale irrigation and thus increase communities' food security. Currently the technology is used mainly for conveying water for domestic use. On the other hand the technology is considered to be less efficient as large amount of conveyed water does not reach required points.

iii. This study also recommends a two-fold agronomic study on cassava, the most dependable food crop at times of prolonged dry spells. First; to verify farmers' claims that certain local varieties are capable of withstanding harsh field conditions for up to four years. If confirmed, these varieties could be up-scaled in other areas with similar ecology. Second, to verify lowland farmers' claim that cassava varieties that are capable of staying in the field for up to four years in highland and midland zones does not last for more than a year in lowland. Consequently, the reasons for this could be established by the same study so much that alternatives could be recommended.

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APPENDICES

APPENDIX 1: HOUSEHOLD INTERVIEW SCHEDULE

INTERVIEW SCHEDULE FOR THE STUDY ON INFLUENCE OF CLIMATE CHANGE AND LAND DEGREDATION ON LIVELIHOOD ADAPTIVE STRATEGIES IN SOUTHERN ULUGURU MOUNTAINS

Ref. No:_____

Interview Date: ..... **Interviewer Name:** .....

GENERAL INSTRUCTIONS TO THE INTERVIEWER

For questions with predetermined answers, read all alternatives and circle the number corresponding to the answer chosen by respondent.

Please ensure that all questions are read to the respondent and answers recorded.

A. HOUSEHOLD IDENTIFICATION

A1.Ward Name..... A2. Village Name.....

A3. Village category ..... A4. Hamlet Name.....

B. HOUSEHOLD PROFILE

1. Name of head of household .....
2. Sex of respondent 1=Male 2=Female
3. Marital status of head of household (*Circle the number corresponding the status*)
   1. Married
   2. Separated/divorced
   3. Widowed
   4. Never married
4. Highest education level reached by head of the household.
   0. No formal education 1. Completed primary education 2. Completed secondary education
   3. Post secondary education 3. Adult education
5. 01. Size of the household.....
   02. Number of persons who provide labour for the household.....
6. Which of the following statements corresponds to place of birth of the head of household? (*Circle the number corresponding to the correct response*) (*If the answer in this question is (born in this village) go to question B6*)
   1. In this village 2. Not in this village but in this district
   3. Not in this district but in this region 4. Outside this region
7. What was the main reason for you moving to this village? (*Circle the roman number corresponding to the correct response*)
   I. Looking for arable land 2. Employment 3. Uncertain weather where I came from
   4. Join a relative 5. Marriage 6. Others (specify) .....
8. How many years have you actually stayed in this village? .....

C. HOUSEHOLD LIVELIHOODS

1. What land size (in acres) does your household own for agricultural purposes? (*Probe to have an estimation of the total land area used for agriculture*) .....

2. Please describe to me type of land ownership for land that your household has access to for agricultural purposes

   1. Owned by and used by hh member 2. Borrowed rented to the hh 3. The hh uses clan's land
   4. Others (Specify) .....

3. Please tell me about land that you cultivate out of your total land area.
   a. Did you cultivate all of your plots in the last season? (*If yes go to question C4*) 1. Yes 2. No

   b. What is the total size of land cultivated in the last crop season .....

   c. What three reasons for not cultivating the non-cultivated area

      i .....

      ii .....

      iii ....

4. How many of following livestock does the household currently keep? *(if does not keep write 0)*

Item No	Type of livestock	Number
C4.1	Cattle	
C4.2	Sheep and/or goats	
C4.3	Chicken	
C4.4	Pigs	
C4.5	Ducks/Turkey/Guinea fowls	
C4.6	Rabbits	
C4.7	Guinea pigs	
C4.8	Others (Specify)	

5. What would you consider to be the most important household's livelihood activity? Mention three main/primary livelihood activities.

   1. .....

   2. .....

   3. .....

6. What is the main source of water for your agricultural activities?

   1. Rain 2. River/stream 3. Pond 4. Borehole 5. Tap 6. Spring

7. Of all the plots your hh cultivate, is there any that is under irrigation farming?
   Yes 2. No

8. If yes in question C7 above, what is the source of water for irrigation?

   1. Rain 2. River/stream 3. Pond 4. Borehole 5. Tap 6. Spring

9. What is the source of water for domestic use?
   1. Harvesting rain water 2. Rivers/stream 3. Pond 4. Borehole 5. Tap 6. Spring

10. What is your agricultural productivity status over a period of 10 years? Is it:
    1. Increasing 2. Decreasing 3. remained constant 4. don't know

11. Please tell me three causes for (increased/decreased) agricultural productivity over a period of 10 years? (*Respondent should only indicate reasons for either increasing or decreasing*)

    C11.1. What do you think are the causes for an increased agricultural productivity over a 10 years period?
    i. .....
    ii. .....
    iii. .....

    C11.2 What do you think are the causes for a decreased agricultural productivity over a 10 years period?
    i. .....
    ii. .....
    iii. .....

12. Does your household experience times of food shortages? *(If No go to question C16)*
    1. Yes 2. No

13. Looking in the past 5 years, in how many years would you say your hh had actually had food shortage?
    0. We did not experience food shortage at all 1. In one year 2. In two year
    3. In three years 4. In four years 5. In all five years

14. Please mention three main causes of food shortages for your household?
    1. .....
    2. .....
    3. .....

15. Do you think land ownership in this area has any effect on livelihood activities of households?
    1. Yes 2. No

16. If the answer in C15 is yes, in what was doe system of land ownership affects household livelihood activities?
    .....
    .....

17. Do you think the way land is owned in this area has influence on household livelihood resources and activities? 1. Yes 2. No

18. If yes, explain how .....
    .....

D. FARMERS PERCEPTION AND KNOWLEDGE ON CLIMATE VARIABILITY AND LAND DEGRADATION

1. What does climate mean to you?

1.	Rain	1. Yes	2. No
2.	Temperatures	1. Yes	2. No
3.	Clouds	1. Yes	2. No
4.	Winds	1. Yes	2. No

2. Have you ever heard of climate change/variability?

1. Yes 2. No

3. From which source you first heard about climate change/variability?
   1. Relative/friend, 2. Extension agent, 3. Village leaders,
   4. Environmental group 5. Media

4. Please indicate 'yes' if you think an item represents indication of climate variability and 'no' for an item you view does not indicate climate variability?

1. Long rains coming later than usual	1. Yes	2. No
2. Long rains coming earlier than usual	1. Yes	2. No
3. Long rains becoming too little	1. Yes	2. No
4. Long rains becoming too much	1. Yes	2. No
5. Frequently occurring dry-spells/droughts	1. Yes	2. No
6. Increased average temperatures	1. Yes	2. No
7. Reduced crop production	1. Yes	2. No
8. Increased crop production	1. Yes	2. No
9. Increased incidences of food shortages	1. Yes	2. No
10. Occurrence of new pests	1. Yes	2. No

5. Do you think you as a household or as a village community have been affected by climate variability/change?

1. Yes 2. No

6. If yes in D5, in what ways have your household/village been affected by climate variability/change?
   1. Shortage of food
   2. Increased insect pests
   3. Reduced production of cash crops

7. In recent years, large portion of Uluguru Mountains has been affected by frequently occurring dry-spells. How does your household respond to prolonged dry-spells?

1.	Planting drought resistant crops	1. Yes	2. No
2.	Planting early maturing crops/crop varieties	1. Yes	2. No
3.	Buying food incase harvests are low	1. Yes	2. No
4.	Practice mixed cropping	1. Yes	2. No
5.	Practice irrigation farming	1. Yes	2. No
6.	Using mulching materials on cropland	1. Yes	2. No

8. Whom do you think has the biggest responsibility in arresting the climate variability problem?
   1. Central Government
   2. Non-Government Organizations
   3. Village government
   4. Business persons
   5. Villagers, both as individuals and as a whole.

9. In the following items, I would like you to tell whether there has been a change (in a general perspective) on not referring to the past 15 years.

1.	Amount of rains	1. Increased	2. No change	2. Decreased
2.	Short rains	1. Comes earlier	2. No change	3. Comes later
3.	Long rains	1. Comes earlier	2. No change	3. Comes later
4.	Wind speed	1. Increased	2. No change	2. Decreased
5.	Temperatures	1. Increased	2. No change	2. Decreased

10. Do you usually feel a need for information about amount, distribution and/or timeliness of rains for the coming cropping season?

1. Yes 2. No

11. If the answer in D10 is "Yes", where do you normally acquire weather forecast information for the coming cropping season? (*Respondent should choose or mention two sources*)

1. Village government leaders ( )
2. Agricultural extension service ( )
3. Neighbours/friends/relatives ( )
4. Village Elders ( )
5. Fortune tellers/rainmakers ( )
6. The media ( )
7. Others (specify) .....( )

12. a. Have the information provided to you been useful? 1. Yes 2. No

b. i. How *if yes*.....

ii. Why *if no*.....

13. Which two among the following would you say are the main land degradation problems in this village?

0. None 1. Soil erosion 2. Land slides

3. Loss of soil fertility 4. Deforestation

14. Please tell the causes of the named land degradation problem you mentioned in D13.

1. Soil erosion .....
2. Landslides.....
3. Loss of soil fertility.....
4. Deforestation .....

15. In the following questions I would like to know about the status and information on land degradation of household fields. Here land degradation will mean one or all of the following: washing away of top soil by wind or water, presence of gullies on the field, loss of soil fertility, landslides and downstream sedimentation.

    a. Would you say land in one or more of your farms ever degraded? 1.Yes 2. No

    b. If yes, what indicator among the following did you observe?

    1. Soil erosion 2. Gullies on the field 3. Loss of fertility

    4. Landslides 5. Downstream sedimentation

    c. Have you ever stopped growing crops from any of your plots due land degradation?

    1.Yes 2. No

16. Have you ever tried to seek information on how to correct the land degradation problem on your farm?

    1.Yes 2. No

17. Would you tell me source and usefulness of information on how to prevent/control land related problems?

    .i. Source of information.

0. None	1. Relative/friend/neighbour	2. Extension agent
3. Village leaders	4. Environmental group	5. Media

    ii. Did you use that information? 0. N/A 1.Yes 2. No

    iii. Was that information useful? 0. N/A 1.Yes 2. No

D18. Please indicate whether you agree or disagree with the following statements about **climate change and variability** by **ticking one box on each row.**

	View on climate variability	Agree	Neutral	Disagree
1	Every person in his capacity has a responsibility to mitigate the effects of climate variability	☐	☐	☐
2	There is no way individual persons can contribute to the reduction of climate variability effects	☐	☐	☐
3	The central government is required to motivate people to protect their environment	☐	☐	☐
4	Although there is climate change and variability, I cannot personally be affected.	☐	☐	☐
5	I don't believe that there is the problem of climate change and variability problem	☐	☐	☐
6	Irrigation farming is the best way to cope with effects of climate variability in terms of food security	☐	☐	☐

D19. Please indicate whether you agree or disagree with the following statements about **land degradation** by **ticking one box on each row**

	View on land degradation	Agree	Neutral	Disagree
1	I am on the opinion that land degradation is a serious problem in this village	☐	☐	☐
2	Slash and burn as a land preparation method does not contribute to land degradation	☐	☐	☐
3	Farmers are using burning method because there is no other easy way to prepare land for cultivation	☐	☐	☐
4	I would prefer cultivating farms on sloping land than in flat land, if I have to choose between the two	☐	☐	☐
5	Planting trees and vertiver grass on the field crops helps to protect land degradation on steep slope fields	☐	☐	☐
6	Even if I use borrowed land, I can plant trees and vertiver grass as a way of controlling soil erosion	☐	☐	☐
7	Planting trees and vertiver grass in a crop field reduces space for field crops	☐	☐	☐
8	Trees and vertiver grass should only be planted on field boundaries not inside the field across the slope	☐	☐	☐

E. LAND MANAGEMENT STRATEGIES

1. How does your household respond to the decreasing amount of rains?

   1. Using early maturing varities 2. Growing drought resistant crops

   3. Irrigation farming 4. Others (Specify) .....

2. Some people use one or more of the following strategies to cope with impacts of food shortages at bad times. I want you to tell me whether you have never, sometimes or always used them.

No	Item	Yes	No
1.	Sell labour		
2.	Take children and other family members to capable relatives		
3.	Claim food aid from neighbours, relatives, or government		
4.	Turn to wild foods (fruits, vegetables, animals)		
5.	Reduce current consumption		
6.	Shifting to lower quality foods		
7.	Collecting and storing large amounts of foods at good times for future use		
8.	Sell some household assets		

3. What traditional practices that you consider appropriate to manage specific land degradation problems?

   E3.1 Controlling/managing soil erosion.....

   E3.2 Controlling/managing landslides.....

   E3.3 Managing soil fertility.....

4. What would you say are the main three hindrance to agricultural productivity in this village?

   E4.1 .....

   E4.2 .....

   E4.3 .....

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION

APPENDIX 2: FOCUS GROUP DISCUSSION FORM 1

Guiding questions: What are the climate change hazards? What are the impacts of hazards to the communities?; What are communities' strategies towards the impacts?

IMPACTS	STRATEGIES TOWARDS THE IMPACT	EFFECTIVE?	SUSTAINABLE?	ALTERNATIVE STRATEGIES	NOTES

APPENDIX 2: FOCUS GROUP DISCUSSION FORM 1

Guiding questions: What are the climate change hazards? What are the impacts of hazards to the communities?; What are communities' strategies towards the impacts?

IMPACTS	STRATEGIES TOWARDS THE IMPACT	EFFECTIVE?	SUSTAINABLE?	ALTERNATIVE STRATEGIES	NOTES

APPENDIX 3: FOCUS GROUP DISCUSSION FORM 2

Guiding questions: What are the communities' most important resources; how are they affected by the climatic hazards; how important are the resources to livelihood strategies?

RESOURCE CATEGORY	COMMUNTIRY RESOURCES	DEGREE TO WHICH RESOURCES ARE AFFECTED BY HAZARD	WHAT STRATEGIES THE RESOURCES ARE IMPORTANT	DEGREE OF IMPORTNANCE OF RESOURCE TO THE STRATEGIES	NOTES
Natural					
Physical					
Human					
Social					
Financial					

(Degree of importance is provided in a 0 to 5 scale, 0 = not important, 5 = very important)

APPENDIX 3: FOCUS GROUP DISCUSSION FORM 2

Guiding questions: What are the communities' most important resources; how are they affected by the climatic hazards; how important are the resources to livelihood strategies?

RESOURCE CATEGORY	COMMUNTIRY RESOURCES	DEGREE TO WHICH RESOURCES ARE AFFECTED BY HAZARD	WHAT STRATEGIES THE RESOURCES ARE IMPORTANT	DEGREE OF IMPORTNANCE OF RESOURCE TO THE STRATEGIES	NOTES
Natural					
Physical					
Human					
Social					
Financial					

(Degree of importance is provided in a 0 to 5 scale, 0 = not important, 5 = very important)