

**ROLE OF COMMUNITY-BASED INSTITUTIONS, PARTNERSHIPS AND
PRACTICES IN ENHANCING CLIMATE CHANGE ADAPTATION IN
MWANGA DISTRICT, KILIMANJARO, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
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ABSTRACT

Local communities in Tanzania have been struggling to adapt to climate change and variability and have already adopted use of different local knowledge and practices under various adaptation mechanisms to respond to climate change impacts in different ecological zones and livelihoods. The role of local knowledge and practices in enhancing adaptation are not well studied and documented. This study aimed to assess roles of community-based institutions, partnerships, networks and practices as measures to enhance climate change adaptation (CCA) in Mwanga District. Primary and secondary data were collected using Participatory Rural Appraisal techniques and Household surveys. Qualitative data were analysed using content analysis while quantitative data were analysed using descriptive and inferential statistical analyses. Social Network Analysis analyzed interactions of family networks, community-based institutions and partnership networks. The study identified community-based formal and informal institutions and partnerships that enhanced CCA. Informal institutions included households, sacred forests (*Mphungi*), village communal work conferences (*Misalagambo*), and traditional water sources (*Ndiva*). Formal institutions included Village Government (VG), Faith Based Organizations, and smallholder irrigation farmers groups. Institutions enhanced community climate change adaptive capacity through common pool resources conservation, ownership, access and use. The VG regulated community adaptations and resolved resource use conflicts. Informal partnerships included finance saving groups. Formal partnerships included finance saving and credit groups, cooperative banks and societies. Partnerships formed sources of knowledge, financial capital and communal access to resources. Networks included food, cash and work relationships within and outside study areas. Internal and external networks increased households' adaptive capacity. Households adopted multiple adaptation

practices. The study concludes that community-based institutions, partnerships, organizations and networks enhance adaptive capacities at an individual, household, and community level. The study recommends these be well facilitated to effectively enhance CCA at micro scale.

DECLARATION

I, Jonathan Lucas Kwiyege 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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DEDICATION

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LIST OF ABBREVIATIONS AND SYMBOLS

CBI	Community-Based Institutions
CBO	Community-Based Organization
CBP	Community-Based Partnership
CE	Council of Elders
DG	District Government
FBO	Faith Based Organization
HH	House Hold
IPCC	Intergovernmental Panel on Climate Change
NGO	Non Governmental Organization
PADEP	Programme Action for Development Projects
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Sciences
TASAF	Tanzania Social Action Fund
TZS	Tanzania Shillings
UFCCC	United Nations Framework Conventions on Climate Change
UNDP	United Nations Development Foundation
URT	United Republic of Tanzania
VEO	Village Executive Officer
VG	Village Government
VLEC	Village Local Environmental Council
WFP	World Food Programme
WV	World Vision
WWF	World Wildlife Fund
CCA	Climate Change Adaptation

CHAPTER ONE

1.0 INTRODUCTION

1.1. Background Information

Livelihood systems in most developing countries, and certainly livelihoods in Africa, are intermittently impacted by climate change, and the burden on them is cumulative (Virtanen *et al.*, 2011). Reversing the impacts is hard mainly due to poverty and environmental dependence for survival (UNDP, 2007; Schmidhuber and Tubiello, 2007; UNFCCC, 2007). Most of climate change adaptations studies (Haddad, 2005,; Pelling and High, 2005,; Vincent, 2006; Smit and Wandel, 2006,; OECD, 2006; Tol and Yohe, 2006; Paavola, 2008,; Nelson *et al.*, 2008,; Agrawal and Perrin, 2008; Reid *et al.*, 2009;) have shown little efforts on the contributions of local institutions and partnerships to the adaptive capacity of societies (Agrawal, 2009,; Reid *et al.*, 2010).

Tanzania highland areas, arid and semiarid areas are facing increased temperature, droughts and increased erratic rainfalls (Mwandosya *et al.*, 1998) which have resulted into continuous reduced agricultural productivity (IPCC, 2001; Thornton *et al.*, 2006; URT, 2006). Like in other countries, local communities in Tanzania have been struggling to adapt to climate change. However, the micro scale climate change issues like loss of arable lands, eruption and spread of diseases and pests affecting both animals and plants are moderately well thought out. The climate change impacts such as aridity, coping strategies, and adaptation and mitigation strategies have also been little considered despite their great contribution to local communities' adaptive capacity. The concern of this research was therefore to explore the roles played by community based institutions, partnerships, networks and practices as a measure in enhancing climate change adaptations for livelihoods in Mwanza district. According to Chambers and Conway 1992 cited in

Agrawal and Perrin, 2008 page 4) livelihoods constitutes the capabilities and social assets necessary for a means of living.

Local communities in the highlands (North Pare Mountains) and lowlands in Mwanza District in Tanzania have been experiencing climate change and variability following the climate change global experiences the impacts of which are obvious. Following the impacts of climate change and variability, Mwanza local households are inevitably exposed to vulnerabilities such as droughts, arable land shortage, floods, climate change and variability induced diseases. These impacts have in anyhow possibly prompted the local residents and local community stakeholders at large at different elevations to either similarly or differently act to overcome the impacts to reduce vulnerabilities. Local communities at these highlands and lowlands of Mwanza District may possibly be not only adapting globally against climate change but also locally according to their local indigenous knowledge to access available resources for survival. Following such possibilities, this study intended to explore community based institutions, partnerships and practices as measures to enhance climate change adaptation (CCA) in Mwanza District, Kilimanjaro region, in Tanzania.

1.2 Problem Statement and Justification of the Study

1.2.1 Problem statement

The importance of local community partnerships, institutions and practices in CCA is not that much well thought-out. Although many new adaptation-oriented initiatives are being launched by governments and non-state actors at different levels to deal with climate risks (Agrawal, 2008,; Bastakoti, 2010), they have been modestly effective in assisting local communities to adapt to climate change, despite their great material, technical and financial supports. Different local knowledge and practice systems may have already

acclimatized and adopted climate change and adaptation mechanisms to address the impacts in different conditions and livelihoods. However, much of this ‘local’ adaptation takes place in the context of social relations, not purely as individualistic ‘innovation’. On the other hand, most of climate change adaptations studies (Haddad, 2005,; Pelling and High, 2005,; Vincent, 2006; Smit and Wandel, 2006,; OECD, 2006; Tol and Yohe, 2006; Paavola, 2008,; Nelson *et al.*, 2008,; Agrawal and Perrin, 2008; Reid *et al.*, 2009;) have shown little efforts on the contributions of local institutions and partnerships to the adaptive capacity of societies (Agrawal, 2009,; Reid *et al.*, 2010).

Whereas some of developing countries have already formulated climate change policies and others lagging behind, the consideration of the roles of community based organizations (CBOs) as stakeholders in CCA and mitigation strategies is little proposed and almost unnoticed. Most governments tend to bypass local institutions, social organizations, local finance groups, and local governments in climate change policy process and implementations. However, they are inevitable mediators of local livelihood systems’ adaptive capacity. Despite their abundance in most parts of Tanzania they are contribution to CCA is underrepresented.

This research was therefore envisaged to examine the roles of community based institutions, partnerships and practices as measures in enhancing CCA in North Pare Mountains (highlands) and lowlands in Mwanga District. The impacts of climate change and variability mainly drought and erratic rains are experienced and possibly well known as the result of climate change in Mwanga (Wangui *et al.*, 2012). Having observed such results, local communities may have also adopted various local mechanisms to observe and act individually, institutionally, organizationally and through linkages in order to strategically access resources to earn living and ensure survival. In that case, this study

was designed to address the existing gap about the magnitude of local institutions, organizations, partnerships and practices as measures to enhance CCA in the highlands and lowlands in Mwanga district.

1.2.2 Justification of the study

The findings of this research unfold and document the roles of local institutions, community based partnerships and practices for communities' CCAs at micro scale such that they will be incorporated in the future for CCAs and mitigation plans, contribute to baseline information for further studies and academic references, provide valuable information for policy processes and analysis, and for sustainable development planning under climate change scenarios.

1.3 Objectives

1.3.1 Main objective

To assess the roles of community local institutions (formal and informal), partnerships and practices in enhancing CCA in Mwanga District

1.3.2 Specific objectives

- i. To examine the roles of community-based formal and informal institutions that enhances CCA in the study area.
- ii. To assess roles of community-based partnerships in enhancing CCA for livelihoods.
- iii. To assess roles of community-based practices in enhancing CCA in the study area.
- iv. To assess roles of social networks in enhancing CCA for livelihoods in the study area.

1.3.3 Research Questions

- i. What are local institutions, partnerships and practices that enhance CCA in the study area?

- ii. What roles do Community-based formal and informal institutions play to enhance CCA in the study area?
- iii. What roles do community-based partnerships and practices play to enhance CCA for livelihoods in the study area?
- iv. What roles do social networks play to enhance CCA in study area?

1.4 Conceptual Framework

The conceptual framework of this study (Fig.1) assumes that community-based institutions, partnerships, networks, and practices enhance CCAs for livelihoods. As measures of adaptive capacity of the society at local scale, community-based institutions here refers to formal and informal mechanisms that shape social and individual expectations, interactions, and behaviours (Agrawal and Perrin, 2008; Mbeyale, 2009; North, 1990 cited in Bastakoti, 2010 page 6).

Community -based organizations (CBOs) are formal and informal concrete/structures manifestation of institutions with an identifiable location, personnel, and rule structures (Agrawal, 2008). In this study CBOs are considered and grouped as local stakeholders. They are groups of individuals bound by common purposes (North 1995), formed by members with common location, interest and purpose (Messer & Townsley, 2003). Community partnerships are considered as two or more persons who co-work in an enterprise or corporation, carrying out business together where as networks are interconnected systems of entities or people. (Bodin & Crona, 2009), as they maximize availability of resources to local livelihood systems (individuals, households and village communities).

Community practices are directly and indirectly responses or actions that local communities practice in order to adapt to climate change impacts. A community refers to a

group of individuals united by commonality of purpose, characteristics, beliefs, and/or actions (Agrawal, 2008).

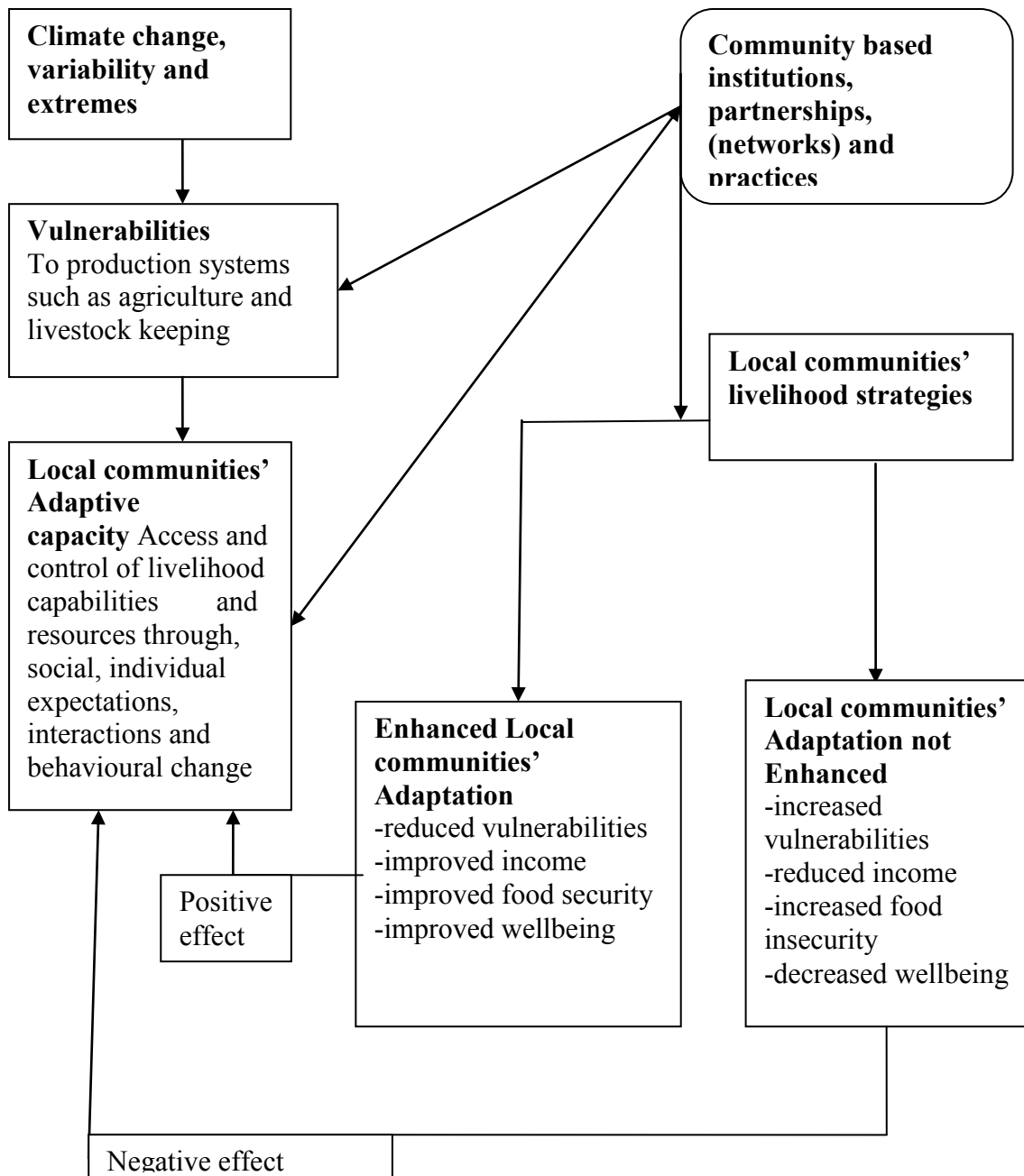


Figure 1: Conceptual framework of the study

In this study, the word community is used to refer to village (local) community. To adapt implies to reduce sensitivity or exposure, to reduce vulnerability to climate change through building adaptive capacity which is the ability of a system to manage or adjust to climate changes to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001; IPCC, 2007; Daze *et al.*, 2009).

The principal assumption underlying the framework is that climate change, variability and extremes exposes production systems (such as agricultural and livestock keeping) into impacts such as high temperature, drought and erratic precipitation which influence local communities' adaptive capacities to access and control of resources. The study assumes that community-based institutions, partnerships, networks and practices observes climate change impacts and enhance local communities' adaptive capacities and their livelihood strategies to enhance local communities' CCA which result into reduced vulnerabilities, improved income, food security and well being using the available resources. On the other hand, local communities livelihood strategies alone with their local CCA not enhanced would result into increased vulnerabilities, reduced income, increased food insecurity, and decreased wellbeing due to weak access of livelihood capabilities and resources.

1.5 Study Limitations

1. Reluctance in disclosing information.

Most of informants and some leaders of several community groups and individuals showed reluctance in disclosing information about their organizations. They were giving appointments to meet researchers but when it came time to meet them for interview they could say either being overwhelmed with other activities with other duties and apologize requesting to postpone until next time. More time was spent and more different methods were applied to capture reliable information from respondents since some of them had

memberships in such organizations. However, tolerance and patient were also adhered to access information.

2. Data recalling problem

Most families lack household data records related to income. This posed a study limitation at both the high lands and the lowlands communities. Most of respondents were hesitating to provide the truth about their families however they were curious to ask why they were asked questions related to their income. According to Manyika (2000) information based on memory cannot be reliable but if no records exist, it may be the only way to get at least an idea of change. To overcome this limitation the same questions were noted through researcher's field observation and asked during focus group discussions in order to triangulate information given by respondents.

3. Inaccessibility.

Accessibility of most of lowland hamlets was difficult due to remoteness. Unavailability of respondents at their households was also one the limitations, since most of the residents spent most of their time at their farms working to avoid walking long distances due to sunny weather. To overcome this, few households were visited per day; early appointments were made with respondents to ensure successful early morning household visitations. Direct farm visitations were also done to meet respondents at their right time and places. Researcher observation of the farm size and village surveys revealed the household status.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Concepts Climate Change

2.1.1 Climate change

The Intergovernmental Panel on Climate Change (IPCC), (2001) defines climate change as any change in climate over a period of 30 years or more due to natural variability or as a result of human activity. The global climate change is evidenced by increase in average global temperature, and associated impacts such as increase in extreme weather events; retreating snow and declining glacier; sea level rise; and erratic rainfall (Daze *et al.*, 2009).

It is agreed among the scientific community that human induced greenhouse gas emission has contributed significantly to the climate change. Anthropogenic activities such as the large-scale burning of fossil fuels to operate power plants and automobiles are releasing greenhouse gases like CO₂ into the atmosphere at an extraordinary rate. Over the past 100 years, the earth's surface has warmed by approximately 0.6°C. The global climate change efforts are finding adaptation and mitigation measures while reducing emissions of Green House Gases (IPCC, 2001; OECD, 2008).

2.1.2 Climate change vulnerability

Climate variability due to global warming has made most of livelihood systems vulnerable, due to increased vulnerability of production systems such as the agriculture and livestock systems in Africa. Climate Change Vulnerability is referred to 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,

extent and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (IPCC, 2001). Different communities, households and or individuals have different degrees of vulnerability due to their differences in climate variations exposures. For instance, the Maziwe Island communities in Tanga region are expected to have higher exposure to sea level rise and cyclones, while in semiarid North-Pare areas in Tanzania will be highly exposed to drought (Daze *et al.*, 2009).

2.1.3 Adaptive capacity

Adaptive capacity of a system (individuals, households and communities) is concerned with its ability to manage or adjust to climate changes to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001). The extent of adaptive capacity depends mainly on the access and control over natural, human, social, physical, and financial resources, and may be influenced by external factors of which includes policies and institutions (Daze *et al.*, 2009). The exposure of human livelihoods to changing weather patterns is accompanied by an increasing rate of impacts on water, air, food quality and quantity, ecosystems, agriculture, and economy (IPCC, 2007).

2.1.4 Climate change adaptation

Adaptation to climate change is ‘an adjustment in or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’ (IPCC, 2007). The process of adaptation of human systems involves the engagement of a number of stakeholders at different levels and in multiple sectors. It needs understanding of existing vulnerability of individuals, households, and communities for designing adaptation strategies and implementations, and then monitoring and evaluation of the effectiveness of activities and sharing knowledge

learned. Therefore to adapt is to reduce sensitivity or exposure, to reduce vulnerability to climate change through building adaptive capacity (CIDA, 2001).

2.2 The Status of Climate Change in Tanzania

The climate change has made Tanzania increasingly vulnerable through its impacts on agriculture, energy, livestock, health, transport, and other key economic sectors for national development. The impacts of global warming have threatened the agrarian population who depend on subsistence agriculture for their daily livelihoods. Prevailing trends of droughts and floods have impacted most Tanzanians with hunger leaving them increasingly food insecure in most places. Disappearance of ice cape at Mount Kilimanjaro has implications on the life of the majority around it and the tourism sector (Meena and O'Keefe, 2007). Mwanga district population is among the districts experiencing the climate change impacts in the western part of mountain Kilimanjaro. The droughts have impacted the energy sector to the extent of reduced power supply thus lowering national industrial productivity. The unpredictable climatic extremes such as the El Nino floods in 1997/98 and drought left deadly effects in Tanzania (URT, 2007a). The impacts of temperature and rainfall pattern changes have repercussions to the crop production of different agro ecological zones in Tanzania (TMA, 2005)

To address climate change impacts, the government has assessed the vulnerability of key economic sectors: agriculture, energy, forestry and wetlands, health, human settlements, coastal and marine resources and decided to establish adaptation strategies. The United Republic of Tanzania initiated through Vice President's Office Division of Environment the National Adaptation Programme of Action (NAPA) in 2007 and the URT parliament ratified international conventions to ensure effective adaptive capacity. The United Nations Framework Convention on Climate Change of 1992; Convention to combat

Desertification, particular Africa, Paris of 1994; The Kyoto Protocol, and Convention on Biological Diversity of 1992 are some of conventions ratified in the United Republic of Tanzania (URT, 2006). Since 2004/05 severe drought and subsequent poor crop yield have resulted. The country efforts to initiate climate change adaptation strategies has increased at macro scale and stakeholders such as international and national NGOs (like CARE international, World wildlife Fund (WWF), World Vision, Red Cross have been allowed to help the communities to adapt to climate variability through their social, economic and environmental projects at both local and national levels (URT, 2007a).

2.3 Community-based Institutions and CCA

Different scholars have defined local institutions differently. It's therefore, widely accepted that institutions mean different things to different people and under different situations (Mbwilo, 2002). For instance, North (1990) defined institutions as rules that shape human interactions, and they structure incentives in human exchange, whether political, social or economic. They are at times regarded as stable, valued, recurring patterns of behaviours and include rules and procedures that shape how people act, their status and legitimacy (Brinkerhoff and Goldsmith, 1992). According to Agrawal and Perrin, (2008) institutions are formal and informal mechanisms that shape social and individual expectations, interactions, and behaviours. Institutional setups shape interactions and behaviours of public (local agencies and local governments; including departments responsible for agriculture, education, environment, forestry, livestock, and water), private (service organizations and private businesses) or civic (membership organizations such as religious organizations (traditional rite groups, churches and mosques) and cooperatives). Kayambazintu *et al.* (2003) broadly defines local institutions as norms, rules and regulations that govern behaviours.

In cases of common property resources management, institutions are regarded as regulatory systems of formal laws, informal conventions, and norms of behaviour, mainly designed to coordinate individual and collective actions for controlling and managing natural resources (North, 1990; Ostrom, 1992,; Kauzeni, 1994; Cleaver, 1999; Mbwilo, 2002). The probable reason being, their roles in conflicts resolution, management and encouraging people to take long-term view by creating expectations and bias for co-operation that go beyond individual interest (Cousins, 1996). The definitions of local institutions are based on location (Mayeta, 2004), and tend to comprise both formal and informal institutions. Examples of informal institutions are the customary controls over the resources, which have been reported to have greatest potential for being effective (Deme, 1998; Hilhorst and Caulibaly, 1998).

In the other way, institutions are grouped as internally and externally institutions (Mayeta, 2004). The internally sponsored institutions are essentially traditional norms, rituals, and custom used in regulating access to and utilization of various natural resources a given society. Internally sponsored institutions represent the established local systems of authority and other phenomena derived from the social-cultural and historical process of a given society (Appia-Opoku and Hyma, 1999). They usually originate from local culture and have firm roots in the past and reflect knowledge and experience of local people. Other local institutions includes traditional chiefs and councillors, clan heads and Kraal heads (Kayambazimthu *et al.*, 2003), sacred groves, 'Ngitiri' and 'Lyabujije' in Shinyanga (Kajembe and Kessy, 1999; Kajembe *et al.*, 2000).

Otherwise the externally sponsored institutions represent the formally established institutions governed by the state. The state in this sense can be either local or central government (Mayeta, 2004). Under this case, the Village natural resources committee,

(Kayambazinthu *et al.*, 2003), village governments, village development committees, and other civil society organizations are established to coordinate community development in a given area (Messer & Townsley, 2003). The government administrative structures are included in externally sponsored institutions, as they are not rooted in the local base they are just set and established by the government for the administrative purposes. Other institutions considered here are the established policies and regulations that govern access to utilization of the natural resources by different resource users. Such policies include the natural resources policies, forestry policies, land policies, and Wildlife policies.

Being important instruments of managing resources, local institutions for regulating natural resources had existed since pre-colonial era in Sub-Saharan Africa. According to Kajembe *et al.* (2000) sponsored natural resource policies failed in Tanzania due to lack of local legitimacy, institutional overlap with persisting traditional structures and different interpretation by individuals and groups to suit their own ends. But, most of them lost their authority and legitimacy during the colonial era. The subordination of customary authorities such chiefs and headmen to repressive state apparatuses has undermined the legitimacy of these institutions. However, the existence, present processes and roles of these local institutions may have recently needed for enhancing livelihood adaptive capacity against climate change. The institution changes are important in resolving existing resource use conflicts which seem to be a common phenomenon in most climate variability and change impacted areas like in the North Pare Mountains and lowlands in Mwanza district where land and water resources have been reduced as a result of prolonged drought (Wangui, *et al.*, 2012).

Local institutions as stable, valued, recurring patterns of behaviour that regulate resources utilization (Kajembe *et al.*, 2003) may have undoubtedly influenced CCA to local

communities within localities which they are undertaken (Pelling, 1998; Adger, 2003). In some cases institutions and processes tend to operate even beyond normal localities, although their effect may change depending on the nature of actors and location. Processes determine the ways in which individuals behave within or as they interact between themselves or with local institution and local organizations.

Local institutions have shown great importance due to increased disruptiveness of climate change, presence of many adaptation projects being supported by lots of funds without clear understanding of roles of local institutions (Agrawal, 2008), unequal effects of climate change to the rural poor and continual relevancy of local institutions for all adaptation interventions. Their existence in rural areas have influenced livelihoods and adaptation of rural households to climate change mainly in three ways: i) structuring environmental risks and variability, thereby nature of climate impacts and vulnerability; ii) constituting and organizing incentive structures for household and community level adaptation responses affecting choice of specific adaptation practices; iii) and mediating external interventions into local contexts, and articulating between local and extra-local social and political processes through which adaptation efforts unfold (Agrawal, 2008, Perrin *et al.*, 2009 and Walubengo, 2007).

Studies in Ethiopia, Mali and Yemen, show local institutions connecting rural households to local resources and collective action, link local populations to national populations, channelling flows of external support to different social groups by enhancing awareness, participation, accountability and ownership essential for resilience and adaptation to climate variability and change (Perrin *et al.*, 2009).

Local institutions objectives, history and activities assessment through household surveys, focus group discussions, key informant interviews and observations techniques have been in most cases employed to obtain valuable data on roles of local institutions on climate change adaptations to livelihoods (Bermann, 2008; Agrawal and Perrin, 2009 and Bastakoti, 2010). Local institutions ideally poised to promote structures and practices that facilitate adaptive capacity and system resilience and they are well placed to collect and coordinate information from communities about their needs and experience of climate change and adaptation that could benefit stakeholders at across scales by guiding research and policy (Biermann, 2008).

2.4 Community-based Organizations and CCAs

Agrawal², (2008) defined organization as a concrete manifestation of institutions with an identifiable location, personnel, and rule structure. Uphoff, (1986) defined organizations as "structures of recognised and accepted roles, formal or informal" That "[They] are the players: groups of individuals bound by a common purpose" (North 1995 cited in Messer and Townsley, 2003 page 10). Local organizations are formed by members with common location, interest and purpose.

Some common CBOs that have been observed to enhance CCAs among local communities in Tanzania include, local governments, religious, clubs, schemes, youth associations, insurance farmers' schemes, local banks (Mbeyale, 2009; Walubengo, 2007; Biermann, 2008). Box 1 gives the broad difference between institutions and organizations according to Messer and Townsley, (2003). Unlike institutions which are normative, organizations have purposes, are more structured and can sometimes act as institutions. These two sometimes form collective purpose and can thus include some people and exclude others.

Box 1 – Differences Between Institutions And Organizations

- *The terms 'institution' and 'organization' are often used interchangeably but distinctions can be made between the two.*
- *Institutions generally establish what sort of behaviour is "normal" in society - they are "normative". Organizations establish a common purpose for the people that make them up and their roles in achieving that purpose – they are more "structured".*
- *Organizations and institutions may overlap - a given organization may or may not be an institution, and a given institution may or may not be an organization. For example, a local bank branch is an organization but not an institution; a central bank is an organization that is also an institution, while money is an institution, but not an organization (Uphoff, 1997).*
- *Both institutions and organizations often, but not always, express "collective goals" that are broadly accepted by all their members.*
- *Institutions and organizations often include some people and exclude others. This may be an important part of how they are defined, the role they play and the effect they have on rural poverty and the livelihoods of poor households. Understanding why and how this happens is important when looking at rural poverty.*
- *Organizations can acquire special status and legitimacy if they satisfy people's needs and meet their expectations over time. In these cases, we can say that an organization has become 'institutionalized'*

Source: Messer and Townsley, (2003).

In most of African countries, local organizations are stated to play certain roles in influencing adaptive capacity. In Ethiopia there has been a long history of religious and civil society organizations including local savings groups, mutual self-help groups and ethnic-based or regional development associations which provide support during times of stress and social events such as death or marriage (Berhanu, 2002, and Virtanen *et al.*, 2011).

According to Biermann (2010) local organizations can create an environment that enables actors to flexibly adjust to changing climatic stressors or one that leaves actors with few adaptations options. They may be particularly well-situated to mediate between stakeholders at different scales and to channel external information and resources for adaptation (Cash *et al.*, 2006) Organizations can also promote collective learning that can lead to innovative ways of dealing with change (Agrwal, 2008; Armitage *et al.*, 2008; Pelling *et al.*, 2008) as they tend to link external and internal actors.

2.5 Community-based Practices and CCAs

Community adaptation practices include directly and indirectly responses or action that local people practices in order to minimize cost of or adapt climate change impacts. Most studies have identified and classified adaptation practices as mobility, storage, diversification, and communal pooling, and exchange (Agrwal, 2008; Agrawal and Perrin, 2009; Perrin *et al.*, 2009; Walubengo, 2007). These adaptation practices have mostly been enhanced by the presence of community institutions ranging from single private individuals, households level involving neighbourhoods, extended families, clans, several households and the formal and informal community organizations.

Communities adapt to climate variability and extremes by properly choosing crops or trees to plant on their land, whether to keep cattle or sheep and whether to zero graze or take out live stocks to graze. The migration, planting drought resistant crops such as aloe farming, fuel woods for cooking purposes, reducing number of live stocks to small manageable herds, settling around water points, have been observed in Kenya (Macharia, 2009).

The study in Arusha by Biermann, (2008) showed that communities migrate from their home places to other areas. Male migration and return have been observed among pastoral communities like Maasai and least parts of families are sedentary despite the observation that most sedentary households have notified to have been associated with overgrazing and degradation, encroachment by farmers and high experience of land privatization leading into resource conflicts prevalence due to decaying coexistence.

In Mwanga district a study by Wangui *et al.* (2012) describes the social-geographic adaptation as the core of livelihood diversification and differential vulnerability to climate change and environmental change more broadly. This is observed to have high

degree of interdependence among groups of people of different language/cultural groups and socio-economic status interacting along environmental gradients from high to low altitude. The interdependence may be expressed as social network made by various ties such as kin, neighborhoods, friendships, rules and regulations enforcements to ensure positive responses against climate risks.

2.6 Community-based Partnerships (CBPs) and CCAs

Community-based partnerships involve two or more persons who co-work in an enterprise or corporation, carrying out business together. In operation of partnerships, owners combine resources such as finance, skills and talents to conduct business for the purpose of generating and sharing profits. Partnerships tend to increase, access to resources use and management, tax advantages and incentives (Bibby, 2006). According to Bibby (2006), partnerships in form of Savings and Credits cooperatives and banks have been very useful in environmental protection and provision of various community based networks which are useful in promoting awareness about the risks HIV and other pandemic disease. They therefore might be good means of responding to costs of climate change vulnerabilities and poverty reduction mechanisms among local livelihoods. Partnerships increase possibilities of members to acquire capital, better management abilities, and less personal stress hence maximizing livelihood stability or resilience in response to climate change impacts.

2.7 Role of Social Network in Adaptation to Climate Change Impacts

A network is explained as a large and distributed group of individuals or organizations that exchange information and work toward a common goal (Bodin and Crona, 2009). Networking catalyses coalitions and partnerships, acts and values formulation resulting to increased number of stakeholder individuals, organizations, groups, business,

partnerships, and coalitions taking collaborative, sustainable CCA for livelihood within livelihood systems (individuals, family(household) and communities) (Bodin and Crona, 2008 and Bodin and Crona, 2009). According to Bodin and Crona (2009) there are potentially positive effects of networking such as information disseminating with regard to adoption of new sustainable farming techniques, more agricultural output at the village level, and the communication channels, once established between the core and peripheral actors. Networks are driven by similarities and trust such as same location, memberships (same club, event and gender) kinship (mother of sibling of), cognitive (knows, knows about), interactions (talk to, advice to, helped to), and flows (information, beliefs, personnel, resources) (Borgatti *et al.*, 2009).

Social Networks are comprised of individuals or organizations known as actors (also known as nodes) who are tied to one another through socially meaningful relations which can be analyzed for structural patterns that emerge among these actors. The analysis of Social networks looks beyond attributes of individuals to also examine the relations among actors, how actors are positioned within the network and how relations are structured into overall network pattern (Wellman and Gulia, 1999; Wellman and Frank, 2001).

Social networks play a role in local communities' ability to adapt to climate change as they improve capacity, efficiency, and effectiveness in problem-solving. They share common goal of maximizing the ability of individuals or organizations to improve their ability to prepare for and respond to threats to agricultural productivity and food security (Miller *et al.*, 2011) posed by climate change impacts as well as to assist local peoples rationally decide right way to adapt climate change. Social networks call attention that poor people generate substantial resilience themselves through friends, families, and local institutions such as religious bodies and community groups. They visualize the way poor

people all over the world withstand the storm of climate change impacts through connecting one another to share food, money and information to recover from lost jobs or reduced remittances (King *et al.*, 2010).

Networks influence individual actors (Marin and Wellman, 2009) or groups; For-instance, a study on the strength of nodes/ties between actors shows how strong ties and weak ties relate to different kinds of outcomes. Strong ties make actors share emotionally intense relationship with one another as they communicate more frequently to one another. In that case strongly socially networked individuals tend to influence one another than the weakly tied ones, share similar opinions, offer one another emotional support and help in times of emergency to shortly adapt or cope with climate change threats, communicate effectively regarding complex information and tasks, more likely trust one another (Amanzi, 2011).

Advantages of strong ties in climate change impacts responses are observed to strongly influence stakeholders to enhance mutual learning and sharing resource use advice (Bodin and Crona, 2006; Newman and Dale, 2007), they act as channels for information and knowledge flow through ties, in that case share information and knowledge. To ascertain the roles of social networks in CCA one needs to assess the patterns of relationships depending on which network is in focus (type of relations), the characteristics of networks, social processes and knowledge transfer (Amanzi, 2011; King, 2000).

2.8 Livelihoods and Climate Change

Livelihoods comprise of the capabilities, material and social assets necessary for a means of living (Chambers and Conway, 1992). Livelihood capabilities are generally defined as ‘the range of things people can do leading in life (Moser and Norton, 2001). According to SWELL (2005) livelihood capabilities include knowledge, skills and abilities that the

household draws on to secure its livelihood. Household members' capabilities combine knowledge, skills, state of health and ability to labour or command labour that enables them to make best use of their assets and engage in different livelihood activities. Capabilities such as risk taking, innovation, enterprise initiative, critical thinking, and dynamic problem solving (James-Wilson, 2006) ensure livelihood sustainability of any household. Sustainable livelihood tackles climate change and variability related impacts such as drought, rainfall and temperature extremes like floods, high temperature, cyclones and erratic rains (Carney, 2002). The ability of the local people in villages to sustain their livelihoods comprises the idea of coping with and recovery from external climate change related stresses so as to maintain or enhance existing capabilities and assets within an individual, household and community (village community) level.

Messer and Townsley, (2003) described livelihood to not only mean 'activities that people carry out to earn a living' but rather 'the different elements that affect peoples' ability to ensure their living and their household which include livelihood assets (human capital (People's health and ability to work, knowledge and skills), natural capital (such as land, water, forest and livestock, for people in rural areas), social capital (both tangible relationships such as formal membership and informal groups (for instances local leadership community groups, and links to local government or NGOs, and intangible relationships such as kinship, trust and mutual support, and reciprocity networks all of which can play a critical role, particularly in times of crisis), financial capital (may come from conversion of production into cash in order to cover periods when production is less or to invest in other activities. They may make use of formal and informal credit to supplement their own financial resources and physical capital (may include tools and equipment, as well as infrastructure such as roads, ports and landing places, telephone networks, and market facilities. Access to these, as well as other forms of infrastructure,

such as water supply or health care facilities, tend to influence people's ability to earn an adequate livelihood)) (Carney, 2003); activities that allow households to use the assets to satisfy basic needs; different factors outside household's direct control ability (seasons, natural disasters, economic trends that affect its vulnerability and possibly institutions that may help influence them in achieving adequate livelihood). To ensure livelihoods, local people and their households' strategies to adapt climate change depend much on the way they use their assets, the named elements focusing on roles of local institutions (Chambers and Conway, 1991; Messer and Townsley, 2003).

However, different households tend to have different levels of access to livelihood assets due to differences in elements of livelihoods (Messer & Townsley, 2003). Whereas the household assets base need to be strong and relatively well-balanced; physical capital (providing new technology and infrastructure), the financial capital (having savings, supplies of credit, regular remittances and pensions, social security payments or insurance) and the human capital (providing education), natural capital (ways in which people access resources ownership, rental, common pool, considering conditions resources (their productivity, and changes over time) and the key role of the social capital of households (that create new assets and opportunities) (Messer and Townsley, 2003; Carney, 1998; Carney, 2003).

Most of village local communities tend to have abundant natural capital such as forest resources, arable lands, and water, with their human ability to labour available, but in most cases observations gathered through interviews with households, key informants, committee members and other community leaders show that financial capital and physical capital inadequacy tend to make village sustainable development at individual level, household level and community level (More and Treue, 2009) at large sluggish. Since,

when people work hard and produce much of farm products, market to exchange their product tend to be unavailable leading to poorly exchange which in return make them continuously get poorer with their resources degraded. However, the present climate change vulnerabilities hasten the extent of food and financial insecurity triggered by reduced arable land and high costs of living and managing the available resources. In order to enhance further adaptation of the increasing climate related threats social capital may have been one of the important resources enabling peoples' survival (Eguavoen and Tesfai, 2011) and village livelihoods. In the context where climate change and variability poses drought, extremes, and seasonality variability, the local households may have already adapted the impacts through local institutions, organizations, partnerships and practices in various means to enhance their livelihood development sustainable (Eguavoen and Tesfai, 2011)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Overview

This chapter presents the methodology used in this study. It covers the study area description, research design, sampling procedure, methods for data collection, and data analysis techniques.

3.2 Justification of the Study Area

Numbers of local institutions, partnerships and practices present in the area pull interest to study their roles in CCA for livelihoods following the increased climate risks and uncertainties. Production systems practiced in the elevation extremes (highlands and lowlands) increasingly vulnerable because of the climate change risks and uncertainties. Mwanga district qualified as a study area because of presence of North Pare Mountains that form portion of Eastern Arc Mountains and lowland elevations occupied by notable distribution of diverse land uses and biodiversity. Mwanga District is also one of the districts around Kilimanjaro Mountain.

3.3 Study Area Description

3.3.1 Study area location and size

The study was done in two villages namely Mwanga and Kirya in the lowlands and highlands respectively. The villages are located in Mwanga district (Fig. 2), in the highlands that form North Pare Mountains and lowlands elevation gradients in Mwanga district, in Kilimanjaro region, Tanzania. Mwanga district forms one of six districts in Kilimanjaro Region. The district lies between 3° latitude 25'' and latitude 3° 55'' South of Equator and between longitudes 37° 25'' and 37 58'' East of Greenwich. The district is bordered to the Northeast by Kenya, to the Northwest by Moshi Rural district, to the West

by Moshi Urban district, to Southwest by Manyara Region, and to the South by Same District. The District covers an area of 2,641 Square kilometres, which is divided into five divisions, 16 Wards and 60 Villages.

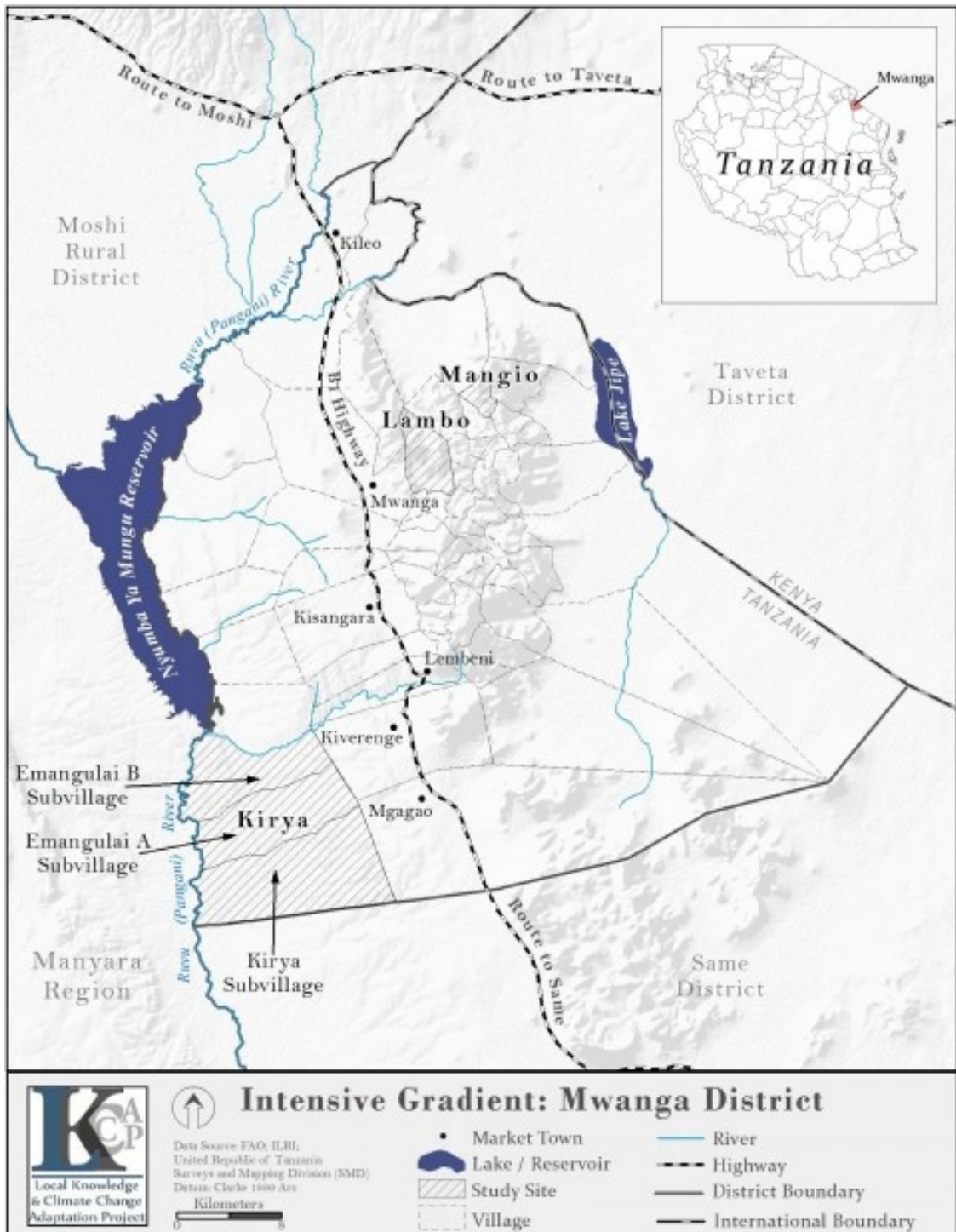


Figure 2: Map of Mwanga District showing study areas

Source (Wangui *et al.*, 2012)

3.3.2 Topography

The Area is characterized by Eastern and Western Lowlands that lie between 550-700 meters above sea level and in the middle are Usangi and Ugweno highlands that form one of Eastern Arc Mountains. These highlands form table Mountains with altitude that ranges from 900- 2500 meters above sea level.

3.3.3 Climate

The District is semi-arid and experiences 400 – 600 mm of rains per annum in the low lands and between 800 – 1,250mm in the highlands. There are two distinct rainy seasons, short rainfall (“Vuli”) from October to December and long rains (“Masika”) from March to June. The District experiences some strong and dry winds blowing normally from the East to the West. The temperatures range between an average of 14 °C during June – July and 32 °C during other months.

3.3.4 Hydrology

In the Eastern low lands lies Lake Jipe which is one of the sources of River Pangani which meanders down to the west to Nyumba ya Mungu dam. The water bodies of Mwanga District are 82.4 km² of which 56 km² is covered with Nyumba ya Mungu Dam and 26.4 km² is covered with Lake Jipe. Pangani River passes through Nyumba ya Mungu Dam in Mwanga District; the stretch of the Pangani River which passes in the Mwanga District is 32 km² long.

3.3.5 Vegetation

The land area is covered by shrubs of Acacia type in both Eastern and Western Lowlands which occupies an area of 1,233 square kilometres. Short grass exists in the highlands and forests around the mountains and some of these forests were preserved by the people long-time ago for ritual ceremonies. The highland occupies an area of 808 square kilometres.

3.3.6 Population and ethnography

According to 2002 Census, there were 115, 620 people living in the District. Total households were 24,326 (NBS, 2004). The highland areas are more densely populated compared to lowlands. At the highlands Pare and some Chagga people whereas at lowlands are mixed non-indigenous people who come to live in the lowlands named as “Swahili” and Maasai communities.

3.3.7 Economic activities

The key economic activities performed are agriculture, livestock keeping and fishing. Food crops production include: Maize (*Zea mays*), leguminous crops, Paddy (*Oryza sativa*), Bananas (*Musa spp*), fruits, vegetables whose productivity is subsistence with no surplus and cash crops include: Coffee (*Coffea sp*) and Sisal (*Agaves sp*) with also low production. Livestock keeping in the highlands is mainly intensive and pastoral in the lowlands. Animals kept include Cattle, goats, sheep, and poultry.

3.4 Data Collection Methods

3.4.1 Research design

Cross-sectional research design was used for this study. Data was collected from the field at a single point in time from a selected sample of respondents using standard survey techniques and the minimum sample size used was 30 respondents. This design is used in descriptive studies for determination of relationships of variables (Bailey, 1994; Kajembe, 1994). According to Bailey (1994), if study is conducted from within a sample frame of 500 or less households then a minimum sample size of 30 representatives is allowed. The design was adapted due to its being timely and financially economical.

3.4.2 Sampling procedures

A multiple sampling procedure was used where by two villages were purposively selected one from the North Pare Mountains and the other from the Lowlands in Mwanika District: The highlands which form North Pare Mountains and lowlands. Thus therefore, Mangio and Kirya villages of Mwanika and Kirya wards respectively, were selected as study sites.

The unit of analysis of this research was the household. According to World Bank (1995) a household is defined as a unit that consists of one or more persons related or unrelated who live together in one part or of more than housing and have common catering arrangements. The sampling frame was all the names of household heads in the village registers which were obtained from the VG offices. Random sampling was used to select respondent households that were included in the study. Table 1 depicts the distribution of households in the study sites where 30 households were randomly selected from each village. Random selection was made easier by the assistance of village leaders from each study village and hamlet. Key informants were purposively selected at village level.

Table 1: Sampled Households

Site/Village	Location	No. of Households	No. of Sampled Households
Mangio	Highlands	324	30
Kirya	Lowlands	475	30
Total		799	60

3.4.3 Reconnaissance Survey

Pre-visiting was done in order to familiarize the study area as well as to get hold of general picture of the study sites, village officials and making the data collection arrangements. During reconnaissance survey both highlands and lowlands were pre-visited. Weather characteristics, economic activities, infrastructure, traditional and cultural ways of living were noted to ensure actual field data collection success. Reconnaissance

survey enabled sampling confidence of study sites. Pre-testing of questionnaires was done to check the clarity, comprehensiveness, redundancy and meaningfulness of household questionnaires and group discussions checklist. Familiarization of study sites socially networked the researcher with Mwanga district officials, village local officials, key issues and stakeholders ensuring connectedness. Pre-visiting made keen adjustments necessary to outfit the field conditions.

3.4.5 Primary data collection

Multiple data collection methods were used to collect data from the field. Participatory Rural Appraisal (PRA) techniques, focus groups discussions (FGDs), semi-structured interviews and key informants, Household questionnaire surveys and researcher personal observations were employed to address specific objectives.

3.4.5.1 Key informants interviews

Key informants interviews (Appendix 2) were used to identify present community-based institutions, organizations and partnership, and to capture local institutions' elements of adaptive capacity, i.e. data related to history, objectives, programmed activities, responses to climate change impacts and vulnerabilities within the particular communities, problems and challenges faced, the evolution, articulations with local communities and impacts. A total of 10 key informants were selected in each sample village and identified using snow ball sampling technique (Bastakoti, 2010). District officers (social development, agricultural, irrigation, and environment and land planning officers), Village chairpersons, village executive officers (VEO), heads of clans, cooperative, associations, groups and club chairpersons and secretaries, health, water, livestock and environmental village committees or boards members are some of the key informants that were interviewed.

3.4.5.2 Focus Group Discussions (FGD)

FGDs (Appendix 2) were done with members of business or financial groups, sacred groves leaders at local levels. FGD was also conducted with representatives of CBOs and groups whose members could not be easily assembled for discussion. FGDs with respective groups' members were held at their own project areas, offices and meeting venues for detailed observation of what they do. The FGDs aimed at addressing the roles or contributions and problems of local stakeholders and partnerships in groups in enhancing CCA for livelihoods improvement.

3.4.5.3 Household surveys

Household surveys (Appendix 3) were employed to provide a range of critical livelihood activities that answers the questions related to variability in adaptive capacities at household levels among the residents within the study areas. The survey was administered to capture elements of networking to address the roles of community based organizational and family networks in enhancing climate adaptation for livelihood. The questionnaires were also designed such that they addressed perceptions or awareness and responses of local people such as farmers, herders, women, youths, and small traders to local regional and global environmental change. Surveys were done using structured questionnaires that were administered to randomly selected household from the sample village lists of households. A total of 30 households were randomly selected from each sample village (Bailey, 1994,; Angelsen *et al.*, 2011).

3.4.5.4 Researcher's observations

Researcher observation was employed to capture data on the way CBOs, Partnerships and Practices enhance local communities' adaptive capacities. Observation involved field visitations, where residents such as farmers and livestock keepers were directly visited at

their work places. Notes and pictures of various features were taken during field surveys to make responsible fulfilments of necessary data.

3.4.6 Secondary data

Secondary data were collected from various literature sources such as books, journals, periodicals, reports, proceedings of conferences and symposia, thesis and dissertations at Sokoine National Agricultural Library (SNAL) at Sokoine University of Agriculture, Mwanza district planning, land planning and environment, agricultural, community development departments, cooperatives and natural resources departments.

3.5 Data Analysis

Both qualitative and quantitative analysis techniques were used to analyze data obtained to address the objectives of this study.

3.5.1 Qualitative data analysis

Analysis of qualitative data obtained from FGDs, Key informants and direct observation were analyzed by using content analysis method for the purpose of having quality and precise results. Emerging issues were communicated through discussion with informants to get detailed facilitated interpretation. In this analysis the components of the verbal discussion that were held with respondents were analyzed in detail whereby recorded dialogue with respondents was broken down into smallest meaningful units of information to ascertain values of respondents (Biermann, 2008 and Bastakoti, 2010). Content analysis was made easy by conceptual and relational analysis. Conceptual analysis involved noting the frequency of ideas and issues of occurrence and importance during field surveys. Relational analysis involved examining relations among noted concepts and situations

regarding climate change impacts and responses made by local communities. Qualitative analysis addressed CBOs, practices and partnerships and their roles and setbacks encountered in enhancing CCA to local communities as they operate to achieve their set plans and objectives.

3.5.1 Quantitative data analysis

The quantitative data collected through structured questionnaires were summarized and coded. The Statistical Package for Social Sciences (SPSS) software was employed for data analysis. Descriptive statistics analysis (mean, frequencies, and percentages) was used to produce figures, charts and graphs that presented the frequencies of occurrences of cases between Mangio village and Kirya village in terms of number and percentages.

3.5.2 Social Network Analysis

The local community organizational and family network data from household questionnaire surveys and semi-structured interviews were summarized, coded and entered into the Microsoft office excel sheet, from where they were imported into Ucinet spreadsheet of Ucinet six (6) for windows (version 6.380) (Borgatti, Everett, and Freeman..., 2002) computer software for analysis. UCINET 6 were used as social network data analysis, data were coded within Excel sheet and exported to UCINET software sheet ready for analysis. SPSS was not used to analyse network data because network analysis do not use individuals as their unit of analysis (Borgatti *et al.*, 2002). The analysis focused at assessing the roles played by family relatives, organizational, and social linkages. Family relative linkages were examined in the context of family farm work, food and cash aids from relatives in the village of residence, relatives outside the village of residence but within Mwanga district, relatives residing outside Mwanga district and outside Tanzania.

The analysis included: Strength and type of linkages (family local organizational membership, and CBOs organizational, family relative, farm work aid, food aid, cash aid and aid status) Degree of centrality was analyzed to address the networks with large number of connections to households in the respective villages. Betweenness centrality aimed at examination of families and organizations that are located or set in between of other families, local institutions or CBOs such that they act as bridges to connect or link other families, local institutions or CBOs (inside or outside the village). And the way each link or connection benefits the other in the network. Social networks analysis was aimed for the purpose of addressing the roles of networking in adapting climate change risks within the communities.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents research findings and discussion based on study objectives. These include: community-based formal and informal institutions that enhance CCA in the highlands and lowlands; community-based partnerships that enhance CCA in the highlands and lowlands; local CCA practices in the highlands and lowlands, and networks that enhance CCA for livelihoods under climate change scenarios in the highlands and lowlands.

4.2 Community-based Institutions (CBIs) and Their Roles in Enhancing CCA

The Community Based Institutions (CBIs) found to enhance climate change adaptation (CCA) in the study area include both formal and informal institutions. Formal and informal institutions were well recognized in the highlands where as in the lowlands formal institutions were well recognized than the informal institutions. The reason for this may be less ethnic diversity in the highlands compared to the lowlands.

4.2.1 Roles of informal institutions in enhancing CCAs

There are seven types of informal institutions whose roles enhanced CCA in study areas (Table 2). These informal institutions were grouped as norms and cultural practices. As reported by most respondents, these institutions are passed from one generation to another. Similar findings from Usambara Mountains reported that institutions have their own setting, target and guidelines for implementation, enforcement and role(s) to play in enhancing CCA (Sicheeba, 2011).

Table 2: Informal institutions, nature, roles, enforcement mechanisms and location

Institutions	Nature	Roles	Enforcement	Location
Every household must attend communal activities (<i>Msalagambo</i>).	Norm	Control access to common pool resources and social services among Households and resolve resource use conflicts.	Household, village elders	Highland and Lowlands
It is not allowed to enter or cut any tree from sacred forest. Entrance in sacred forests is specifically for traditional rituals (<i>Mphungi</i>)	Norms	Sacred forest conservation and protection, Maintain natural ecosystem services	Clan leaders and Village elders	Highlands
Perennial crops are usually mixed with annual crops (Household)	Cultural practices	Enhance social linkages, food and cash mutual aids	Household leaders	Highlands
Traditional water sources (<i>Ndiva</i>)	Norm	Ensure supply of water for irrigation and household use.	Clan leaders, Heads of Households	Highlands
Keeping a diverse number of live stocks (Household).	Cultural practices	Enhance diversification of live stocks thus live banking to ensure food and income security.	Heads of Pastoral Masai families (<i>Orpayan</i>) and traditional leaders <i>Laibon</i>	Lowlands
Share information about rich grazing lands with other pastoralists from other areas (Household).	Cultural practices	Ensure live stocks survival	<i>Orpayan</i>	Lowlands
Young men (<i>Morani</i> <i>Armurani</i>) migrate with cattle (Household).	Cultural practices	Ensure live stocks survival	<i>Orpayan</i>	Lowlands

Norms were well established and cultural based institutions acknowledged by the respondents in study areas. They were termed as *Msalagambo*, *Mphungi* and *Ndiva* as Gweno vernaculars to mean ‘communal work conferences’, ‘sacred forests’ and ‘traditional water sources’ respectively. According to Mbwilo (2002) norms were traditionally recognized to pursue communal interests. *Msalagambo* (*Misalagambo* in

plural) was coordinated by village elders and leaders where as *Mphungis* and *Ndivas* were protected and conserved by clan leaders, village elders and leaders, and household heads. Studies on local institutions in Southern Africa, Dodoma urban and Lushoto districts in Tanzania reported that informal institutions are headed by clan heads, traditional chiefs, elders, village chairperson and VEO (Kayambazimthu *et al.*, 2003; Kajembe *et al.*, 2000; Mayeta, 2004).

In the North Pare Mountains, *Msalagambo* (or 'Tamasha' in Swahili) demanded the village work force in households to participate in communal activities (such as road and water sources construction and maintenance, and burial ceremonies). Every man and woman in a household had to take with his/her livestock fodder, fuel woods and money to funerals. This kept all households well linked to one another and promoted mutual aiding behaviour (a practice of assisting one another) in everyday household interactions and during emergencies such as floods and wind storms. Every household showed effective participation in assisting victims of floods, wind, and storms to maintain social capital (Berhanun, 2002). This makes a very important social capital as a livelihood asset.

The impacts of climate change mainly drought and floods were experienced since early 1950s (Wangui *et al.*, 2012) in the lowlands. *Msalagambo* formed the communal strategy to adapt the situation using available human and natural assets to access community pool resources and an important social capital. Through *Msalagambo* the abandoned agricultural lands due to extreme drought were being restored by digging and channelling water through irrigation water canals in these lands.

Our findings revealed that irrigation farming of cereals (maize and rice), legumes and vegetable crops enabled people to respond to drought and temperature extremes in the

lowlands and water in this case forms an important natural capital as a livelihood asset for climate change adaptation. In the past, *Misalagambo* were overseen by elders and household heads but afterwards the VG considered it a tool to accomplish communal interests (Amanzi, 2011; Mayeta, 2004). The Village Government (VG) through VEO coordinated *Misalagambo* and ensured effective participation of every resident participates in communal activities. VG use food aids brought in the village as incentives by distributing it to people who attend communal activities. The VG has also set up a fine of TSH 5000 which is instituted as a penalty to a person who fails to participate in communal activities without critical reasons. Incentives and fines encourage effective participation in various communal activities including construction of public infrastructures such as dispensaries, schools, roads and water canals. Incentives and fines encourage people to participate in protection, control and manage natural resources (North, 1990,; Mbwilo, 2002,; Agrawal, 2008, and Perrin *et al.*, 2009).

Msalagambo enabled individuals to adapt to climate change related challenges such as droughts, floods, and storms as a community, minimizing costs that would be incurred by a single individual or household. Access to land and water creates opportunities for irrigation farmers to expand farm sizes, manage well crops to increase production which in return increases household food availability and income. *Msalagambo* encouraged people to take long term view by creating expectations and cooperation beyond individual expectations (Cousins, 1996 and Mayeta, 2004). Several studies have reported that community level adaptation responses affect choice of specific adaptation practices by mediating external interventions into local contexts, articulating them between local and extra-local social and political processes through which adaptation efforts unfold (Agrawal, 2008, Perrin *et al.*, 2009 and Walubengo, 2007).

Sacred forests, *Mphungi* is a mixed natural and social capital asset, formed by remnants of indigenous forest patches in the highlands. These existed just because of their historical and social reasons that they were sacred places where clan leaders conducted circumcisions and traditional rituals. And that no one is allowed to go within the forest except traditional leaders and some other people during special events for special purposes. According to Kajembe *et al.* (2000) sacred forests are protected for traditional purposes such as worshipping and sacrifice offering. Sacred forests institutions ensure conservation and survival of indigenous forests which regulate the microclimates by encouraging suitable weather and sequester carbon thus contributing climate change mitigation. Traditional, medicinal and weather prediction (some trees such as *Albizia schimperiana* flowering used to indicate that the rain season was beginning) are other cultural values obtained from sacred forests considered important by village residents and clan leaders to the extent of protecting forests. The observations are in line with Kajembe *et al.* (2000) who reported that protection of sacred forests preserved indigenous tree species with medicinal values.

Traditional water sources commonly known as *Ndiva* form another kind of institution and natural capital assets culturally recognized to ensure supply of water for irrigation and household uses. *Ndivas* are named based on the clan head of the area where they are located. Management and protection of *Ndivas* was inevitable following increased water shortage currently experienced in highlands. In most cases *Ndivas* courses originate from catchments which could be sacred forest or catchments of village forest reserve. Both sacred forests and traditional water sources are clan owned, protected and conserved resources that benefit the community enhancing communal adaptation to water shortage resulted by climate change and variability. Each household member was responsible to protect and conserve these resources under the leadership of responsible clan heads. In his

study at Kipengere Game Reserve in Iringa, Mayeta, (2004) reported that elders and traditional leaders were responsible for ensuring that natural resources are well managed and properly utilized using traditional rules and regulations for sustainable use.

Households' heads ensured existence of complex distinctive spiritual, material, intellectual and emotional practices that were inherited from one generation to another. According to the interviewed respondents, households culturally implemented practices which were acceptable to the society and were enforced by community or clan leaders and heads of households. The identified cultural practices were the typical characteristics of the society and social group values (Amanzi, 2011 and Perrin *et al.*, 2009). Households traditionally intensified agricultural practice by mixing wood perennials, shrubs and annual crops in highland farms to ensure maximum land use and productivity to overcome food and income insecurity as a response to climate change and variability.

Households noticed arable land limitations and uncertain productivity in agriculture system. To overcome this, farm crop diversifications and land use intensification were already adopted by households in the highlands. In that case one would observe banana, coffee, trees (such as *Eucalyptus sp*, *Grevillia robusta*), horticultural crops, legumes and grain crops, tuber crops (such as cassava (*Manihot esculenta*), sweet potatoes (*Ipomoea batatas*) and yams (*Discorea species*) livestock units and live stocks (poultry, sheep and dairy cattle) sedentary kept in the same piece of land around homes. Such agriculture system conserved land, nutrients circulation in the soil and improved farm productivity. The system offered an opportunity to keep live stocks in units to ensure availability of protein, manure and income to cater for other important household requirements. A study by Wangui *et al.* (2011) in North Pare Mountains noted that community-based institutions roles form an incentive to promote natural resources availability, protection,

management and conservation at the same time ensure sustainable livelihood systems including 'zero-grazing milk production, banana (*Musa spp*), maize (*Zea mays*), taro (*Colocasia esculenta*) root, cardamom (*Elettaria cardamomum*) and coffee (*Coffea spp*) production in the highlands which optimise and modify households' adaptive capacity to overcome negative impacts of climate change.

In Pastoral Maasai households there were notable institutions among the lowland communities. Households had to keep a large number and variety of live stocks as live banks. These could be exchanged for money for purchasing food and or farm inputs. Live banks were targeted address food sustainability by direct purchase and investing in farms where most of pastoral farmers sold their farm harvests opting to buy animals with an expectation that animals will reproduce and multiply. Other animals were sold to gain capabilities, to prepare and manage farms to address food shortage. Share of information about rich grazing lands with other pastoralists from other areas formed another kind of Maasai cultural practices that facilitated *Morani* migration with cattle to other pastures. Migration among the Maasai is a common practice adopted to ensure survival of livestock mainly cattle and enhance diversification.

Household heads, *Orpayan* and Maasai traditional leaders, *laibons* disseminated information related with grazing pastures. *Laibon* is the most respected Maasai traditional leader who foretells, inform and advise the community about future events including start and longevity of rain seasons, drought, hot seasons, warning people to take precautions earlier. In addition to that, *Orpayans* are linked to one another by social capital and trust with which they exchange information about rich grazing lands when dry season prolongs) while other places experience rains and suitable grazing lands mainly cattle when pastures around are no longer supporting the herds available.

Diversification of livestock types (cattle, goats, sheep, poultry and donkeys) were due to their different abilities to withstand drought and extreme temperature conditions (Oxfarm, 2003). Donkeys and goats adapted well drought conditions compared to local breeds of cattle which migrated to other rich grazing lands when drought prolonged. According to their tradition, adult men *Orpayan*, and young men (*Ormurani* (young Maasai at age ranging 15-20 years which are at warriorhood period after circumcision)) (Kosyando, 2006) migrated with cattle whereas young male children at childhood stage and women remained home taking care of goats, sheep and poultry.

Migration ensured existence of livestock although associated with a number of risks and uncertainties such as theft, death, and diseases. According to that migration was reported to increase vulnerability of both human and live stocks lowering pastoralists' adaptive capacities (Agrawal, 1999; 2008).

The roles of informal institutions in the lowlands were less observed and pronounced than in the highlands possibly due to heterogeneous tribes encouraged by immigrants as fishermen, pastoralists and irrigation farmers. The high ethnic diversity made of Pare, Gweno, Chagga, Maasai, Nyaturu, Nyiramba, Sukuma, Gogo, Sambaa, made informal institutions play little CCA enhancement roles in lowlands. A Study in the Uluguru Mountains revealed that informal institutions differ with cultural composition (Amanzi, 2011). Therefore in the lowlands informal institutions were well adhered among the Pastoral Maasai households while other tribes' households had to respect traditional rules and regulations. Norms and cultural practices enhance households to overcome the adverse consequences of climate change in the study areas although differed in terms of their manifestation and effects.

The differences in acceptability, enforcement and implementation of informal institutions in enhancing CCAs in highlands and lowlands were the result of differences in cultural composition (Amanzi, 2011), nature of land tenure in the highland and lowland, production systems and natural resources, and degree of vulnerability resulted by climate change (IPCC, 2001; Daze *et al.*, 2009).

4.2.2 Roles of community-based formal institutions in enhancing CCAs

Eight formal institutions were identified in both highlands and lowlands (Table 3). These institutions were categorised as by-laws, rules and programs. By-laws were dominantly executed by Village Government (VG), Council of Elders (CEs), Village Land and Environment Committee (VLEC), and Kirya Irrigation farmers Organization, (UWAKIMA). The VG and VLEC dominated in both highlands and lowlands and were effective in their roles to enhance CCAs. Whereas the CEs was in the highland and UWAKIMA was in lowlands. The set of by-laws were established by village authorities and were approved by the District council.

The declining land productivity is caused among other factors by climate change and variability has made land a limited resource to the growing population. According to Mwanga District (2010) socio-economic profile, the population density in 2002 was 45 per square kilometre, and in year 2011 population density had reached 55.2 per square kilometre. Elders were entitled to permit land transfer from one individual to another to overcome and avoid the emergencies of land use and ownership conflicts. This by-law existed due to the fact that land was (a common property resource) inherited by clan or family. Table 3 depicts the Council of Elders (CEs) having power to regulate and control land ownership and transfer issues in the highlands.

According to PMORALG (2012) elders' council had power over important tribal or village matters such as a threat from another tribe, the outbreak of serious disease, famine, and environmental conservation. In the lowland the VG regulate land ownership and use through the VLEC.

Through CEs the VG managed to avoid and control land resource disputes and ensure that inheritable resources are available for every community members, since most residents inherited it from their fore fathers. According to Mayeta (2004), natural resources utilization and management are regulated by the council of elders who are also responsible for resolving resource use and ownership conflicts. The VG set up by-laws and guidelines to manage and protect wetlands and forest resources for sustainable uses. The VG through Village land and Environmental committee (VLEC) together with VEO office ensured conservation and protection of village forest reserves and sacred forests (*Mphungi*). Considering the values of the available wetlands VG allowed village members to grow taros (as on-farm food reserves) as alternative food sources following uncertainty of rain fed agriculture aggravated by high temperature and erratic rains which result into reduced farm productivity.

Table 3: Formal institutions that enhance CCA and enforcement

Institutions	Nature	Role	Enforcement	Location
-Land transfer is not allowed without permission from the CEs	By-law	Promote access to common resources and social services; and resolve resource use conflicts.	CEs, VG	Highland and Lowlands
-It is not allowed to cut any tree from either sacred forest (<i>Mphungi</i>) or village reserved forest. -It is prohibited to cultivate in wetlands and catchments during wet season. -Tree planting	By-laws Program	Promote access to common resources and social services, and resolve resource use conflicts. Climate change mitigation	VG, VLEC VG:VLEC, PIs, KKKT	Highlands Highlands
-People in need and disables should be helped	Rule	Enhance food and income security and ensuring linkages	FBOs (KKKT, MPCT, TAG, SDA, MUS LIM)	Highland lands and lowlands
-People should sleep under mosquito nets. -Families should practice family planning	Programs	Improve adaptive capacity.	PIs: (MD and KD)	Highlands and lowlands
-Every child should be taken to school	Program	Improve human capital and thus adaptive capacity	PIs: (MPS, MSS, KPS, MbPS) and VG	Highlands and Lowlands
-Every farmer should pay for Irrigation water and respect water distribution schedule per farm season. -Perennial crops are not allowed to be grown in irrigation lands.	By-laws	Promote effective water and land uses. Linking farmers with internal and external stakeholders.	UWAKIM A and VG	Lowlands
-It is not allowed to graze live stocks in the irrigation area. Farmers should not cultivate along livestock corridors	By-laws	Regulate and control resource use competitions and conflicts	VG, VLEC	Lowlands

A number of studies have reported the observation that the VG controls access of community pool resource (Amanzi, 2011, Agrawal. 2008 and Mbwilo,2002) in an

innovative way to respond to climate change (Cash *et al.*, 2006). The VG, PIs and FBOs also channel in external information and knowledge to enhance CCA to the community (Biermann, 2010). In that case local community organizations contribute greatly on enhancing adaptation as they connect the community with outsiders. They are the media of change and collective community adaptation to climate change impacts.

In the lowlands, the “*Umoja wa Watumia Maji Kirya na Mangulai*” UWAKIMA practiced irrigation farming in the lowlands along Pangani Basin. As a regulator, UWAKIMA monitored, controlled and maintained water allocations to ensure subsistence food and income supply through irrigation farming of vegetables, grains and legumes for food and sale. It ensured equal access to available limited arable land, forests products and water resources. It also regulated, minimized and resolved resource use and ownership conflicts driven by drought which prevails among livestock herders and farmers. Resource use and ownership between irrigation farmers and pastoralists is regulated through land and water use plans and allocation made by VG through VLEC (Agrwal, 2008; Armitage *et al.*, 2008; Pelling *et al.*, 2008). UWAKIMA constituted of by-laws, National Acts, rules and regulations to protect and manage water uses (URT, 2010). Water uses in the area included domestic use, irrigation farming and live stocks use.

The rules were enforced by Faith Based Organizations (FBOs) which included Lutheran Church (KKKT), Mangio Pentecostal Church (MPCT), Tanzania Assemblies of God (TAG), Seventh Day Adventist Church, (SDA), and Islamic Church (ISLAM)). FBOs in both highlands and lowlands provided remittances mainly food, financial, material (shelter and clothing) to the highly vulnerable disabled, HIV patients, elders, widows and orphans. For-instance, the Lutheran church leaders had established special committees to raise fund from internal and external sources to assist orphans elders and widows. Religious leaders

encouraged members to develop entrepreneurship skills through social groups and connect them with NGOs such as World Vision and CARE-International. FBOs fulfil the rule of Love stated in their holy books, which instruct them to pray and take good care of marginalised groups in a society .FBOs leaders provide support during times of stress and social events to disabled groups (Berhanu, 2002 and Virtanen *et al.*, 2011)

Tree planting programs encouraged reforestation and conservation of trees in both highlands and lowlands and were held by Private Institutions (PIs), VG through the VLEC and FBOs. In highlands the program aimed to mitigate climate change and its impacts. The PIs mainly Mangio Secondary School (MSS) had mobilized students in an environmental club which participated in tree planting and conservation around school compounds. Students were imparted with environmental conservation theoretical and practical knowledge preparing them to become ambassadors of environmental conservation in response to climate change impacts.

Church leaders encouraged members to plant trees to restore the changing climate caused by anthropogenic activities. The VG together with District government (District land planning and natural resource management department) and NGOs like PADEP managed natural resources to ensure continuous supply of ecosystem services such as water, cropland, precipitation and temperature regulation and natural wildlife habitat. In the lowlands the tree planting was implemented by academic institutions showing least success due to high aridity, water scarcity, extreme temperature, and small cooperation in the lowland. Primary school children were getting imparted with environmental conservation education with little practical achievement due adverse drought. In response to climate change, a Mangulai B Primary School opted to set aside areas of about 50 hectares of indigenous forests to mitigate climate change and sequester carbon. PIs have

enhanced people's ability of to adapt well due to increased individual and community adaptive capacities. These institutions form the agents of behavioural change enhancing households to adapt climate change impacts.

Regulations and incentives were commonly used to encourage change of behaviour (Pretty, 2003). In the study area CBIs form the major control of peoples' behaviour and actions towards natural resources. They ensured conservation of forests, catchments and seasonal wetlands (swamps). They regulated natural capital exploitation as the solution to climate change and promote both production and livelihood systems diversification to increase production and ensure their survival. The VG through VLEC promote sustainable ecosystem management and use of ecosystem services such as water, and wetlands for root crops and horticultural crops production during drought seasons when there are no alternative food sources available. Formal institutions tend to mediate external interventions (Walumbengo, 2007) by collecting and coordinating CCA information about experiences related to CCA to facilitate adaptive capacity (Bastakoti, 2010 and Bermann, 2008).

4.2.2 Formal institutional enforcement mechanisms and setups

The village government comprises of the village council and village assembly. The Village council operates within three important organs (Village chairperson, Village Executive Officer (VEO) and village committees). The village council is considered as a trustee managing property on behalf of the villagers, it ensures adherence to by-laws by various stakeholders (URT, 1982). They formally operate under the Local Government Act No.9 of 1982 (URT, 1982), Environmental Management Act No. 20 of 2004 (URT, 2004), Village Land Act No.5 of 1999 (URT, 1999), and Forest Act No14 of 2002(URT,

2002). Policies, regulations, procedures and strategies formally operate together with norms, customary laws and by-laws to bring about community CCA. According to the Local Government Act No.9 of 1982 of the United Republic of Tanzania, the village government is the regulator and ensures adherence to by-laws (URT, 1982).

Private institutions includes academic and health institutions whose formal institutional set ups bases on the Education and Health laws and Policies (URT, 1990) of the United Republic of Tanzania. They ensure health and environmental conservation practices. FBOs have formal institutional set ups legally recognized by the constitution of the United Republic of Tanzania (URT, 1997) and whose enforcement is based on Holy scriptures enforced by religious leaders.

Irrigation farmers worked as a team of water users (UWAKIMA) in the lowlands. UWAKIMA is headed by the chairperson, general secretary and treasurers who work under the guidance of the special board and farmers committees comprising of various stakeholders to ensure continuous flow of irrigation water from water canals. UWAKIMA exists under the Water Sanitation and Supply Act No.5 of 2009 (URT, 2009), National Irrigation policy, 2010 (URT, 2010), Water Management Act, 2009, and Village Land Act No.5 of 1999, by-laws, control rules, regulations and practices. In both highlands and lowlands irrigation farming was encouraged by District Agricultural Department through District Irrigation office which works hand in hand with the central government in the ministry of Agriculture and Irrigation in collaboration with NGOs like Green bird college of Mwanga, World Vision and World Food Program (WFP).

4.3 Community-based Partnerships (CBPs) Enhancing CCA.

Both informal and formal CBPs existed in the highlands and lowlands though there were more CBPs in the highlands than lowlands. This observation was perhaps caused by less ethnic diversity in the highlands as compared to the lowlands. Lower ethnic diversity made people easily associate into partnerships due to high social capital and trust between one another.

4.3.1 Roles of Informal CBPs in enhancing CCAs

The informal CBPs roles that enhance CCAs are presented on Table 4.

Table 4: Informal CBPs roles that enhanced CCAs

Study area	Name	Members	Roles
Highlands	Mama-Msuya Group	15	-Source of household income, capital for micro businesses and for home rehabilitation
Lowlands	Emangulai A farmers	7	-Provide finances to purchase farm inputs at discounted price and reduce production costs
	Upendo food vendors	2	-Source of household income and capital for micro businesses

The informal partnerships that were identified in the highlands and lowlands are indicated in Table 4. Informal CBPs formed the non registered finance savings groups of people with common interest who formed circular savings to one another. These groups were called in Kiswahili ‘*Vibati*’ (plural) or ‘*Kibati*’ (singular) and were common among micro business individuals. Vibati members make periodic cyclic pledge of shares to each other in a group. For instance, if a group has 10 partners, with every member assigned a number with which she/he is scheduled for pledge visitation by the rest group members on the specified time interval.

Deposition of shares is done as a contribution given to a fellow member as they schedule visitations to every member visitations intervals included daily, two days, twice per week, weekly or monthly depending on the nature of partnership and the amount pledged to be contributed by each member. In most cases the amount range from 100 to 100,000 TZS which depend on the pledge schedule allocated, nature of members (micro businesspersons, employed or not employed or farmers), location, and level of trust to one another. Informal CBPs were found purposely as financial saving to create alternative sources of income and to reduce risks and uncertainties brought about by climate change impacts such as financial loss experienced when capitals were invested in farm micro projects in response to climate change and variability.

The Mama Msuya Group members in the highlands and Upendo food vendors in the lowlands carried out micro-businesses as alternative sources of income. Savings could be used to expand their micro businesses, to buy food, to enrol children to school, house rehabilitation and or invested in other income generating activities to ensure improved wellbeing. In Lowlands, Emangulai-A partners managed to buy farm inputs at discounted price saving their money for other uses. Farm inputs (seeds, fertilizers, water pumps, pesticides) use and application would increase irrigation farm productivities. Increased in productivity has implication on the increase of food availability and income to households. The research conducted in Marangu Northern Tanzania and Sierra Leone, also reported that some members of financial savings groups managed to buy agricultural inputs (seed, tools and chemicals) as well as to hire labours to prepare and or rehabilitate farms using savings (SEED Network, 2010). Households responded to climate change impacts by forming financial saving groups at different levels to address uncertainties and risks in production systems to maximize household adaptive capacity. Financial saving groups form sources of capital for micro business individuals, alternative source of fund to cover

household requirements and duties (such as enrolling children to school) and maintain social capital and trust among group and non group members.

4.3.2 Roles of Formal CBPs in enhancing CCA

The formal CBPs roles on enhancing CCAs are presented on Table 5. The primary and secondary formal CBPs identified in study areas are formal CBPs that legally exist in Tanzania based on Cooperative Act (URT, 1991) and Policy (URT, 2003) of the URT and were formally recognized by the District government through the District community development and cooperative development and markets departments. Primary partnerships were commonly pronounced as “*vikoba*” which means Village Community Banks (VICOBA). Members of VICOBA ranged from 25 to 30 to timely operate and provided them with significant economic benefits. According to SEDIT (2012) groups with more than 30 members failed to achieve significant economic growth just because they had too many members to collaborate effectively at their initial stages. The Uchumi Group VICOBA (UGV) in the highlands and Nguvu kazi VICOBA (NKV) in the lowlands were savings and credits groups initiated by villagers under the guidance of CARE-international in collaboration with the District community development office. Their roles (in Table 5) in enhancing households to adapt to climate change and variability were revealed as the result of members’ accessed loans, networks, mutual aids (remittances), and improved house hold income which reduced uncertainties and risk of climate change.

Table 5: Formal CBPs and their roles that enhance CCA

Primary Study Area	Name	Roles	No. of Members
Highlands	Uchumi Group VICOBA (UGV)	-Improve household income -Provide micro loans (business, health, education, household food loans) -Integrated knowledge related workshops -Promote individual networks and cooperation -Provide mutual aids among members	30
Lowlands	Nguvu Kazi VICOBA (NKV)	-Improve household income -Provide agricultural, health and education loans to members -Provide mutual aids among members -Access group macro soft and hard loans from banks	28
Secondary			
Highlands	Mangio Partnership (MMP)	-Provided market for livestock products by linking farmers with buyers	21/200
	Vuchama Rural Cooperative society (VNRCS)	-Provide market for agricultural products -Train farmers about good farm management practices in response to climate change -Link farmers with other stakeholders -Provide farm inputs to farmers	350
	Vuchama Savings and Credits Cooperative Societies (VNSACCOS)	-Source of household and community groups income -Provide business loans, agricultural loans, education loans, emergency loans, and home loans -Provide managerial skills and entrepreneurship education to members	348

Membership in community-based organization reduces household vulnerabilities (CIDA, 2001). Members had opportunities to access agricultural loans, business loans, health loans and education loans. Each loan was provided at its own interest rate depending on purpose and time interval for reimbursement. Agricultural loans were provided to members who invested in agriculture to buy farm inputs (seeds, chemicals and tools). The

money assisted farmers to expand their farm projects, improve soil conditions, rent lands and employ farm labour to earlier prepare farmlands. Agricultural loans improved farm productions leading to increased household food and income of the NKV irrigation farmer members in the lowlands. In the highlands agricultural loans showed unsuccessfulness due to unpredictable little rains which made most rain fed agricultural projects uncertain ending to failures. UGV members opted to start business loans with which most established micro-businesses. The micro-business involved exchange agricultural products such as banana, vegetables, cereal crops and legumes (mainly maize and beans) and household needs such as clothes, shoes, sugar and soap. Micro-business provided members with net benefits that enabled them to purchase food for their families and enrol their children to school. Enrolment of children to school assisted to intensify human capital which is an important asset in enhancing household adaptive capacity.

The health and education loans were accessed at zero interest rate from special security funds established by group members. The loans had benefited 100% members of both groups in the highlands and lowlands. Through education and health loans members managed to enrol their children to school and pay for health services and household food creating healthy and human capital.

The roles of loans in the highlands and lowlands are in line with SEED Network (2009) report from the study in Tanzania and Sierra Leone which pointed out that agricultural loans, business loans, health loans, education loans, and household food loans ensured household food security by promoting household food availability, food access, utilization and stability. And that each loan was highly demanded at different period depending on the situation (SEEDIT, 2012). Primary CBPs promoted household income obtained share-outs (savings and interests shared at the end of each circle (52 weeks)) assisted members

to expand their farm projects, buy assets like water pumps and motorcycles, start-up alternative income generating activities and pay for household requirements such as food and enrolling children to school college. The share-outs improved household capabilities and assets mainly financial and human capital ((Carney, 2002 and SEDIT, 2012). Household income and loans from the household financial capital which intensifies other capitals such as human capital in form of education(through taking children to school), labour, skills, experience, knowledge, creativity and inventiveness (Carney, 2002) all of which reflect reduction of vulnerabilities.

Primary CBPs also promoted members social capital, trust and cooperation among members. They also promoted network with other community-based groups, NGOs and Governmental institutions. Membership and group networks provided more opportunities to members such as internalization of external integrated knowledge package such as managerial skills, entrepreneurship and CCA practices and techniques which increased abilities of members to address the drought and erratic rains in production and livelihood systems (SEdit, 2009 and EAFF, 2010). As a group, NKV in the lowland managed to access both soft and hard loans from financial institutions. For instance, they had managed to get a loan of power tiller from the Mwanga Rural Cooperative Bank (MRCB) which enhanced farmers to expand their farmlands because of its being economical in terms of time and energy invested. Both hard and soft loans and grants from various sources contributed to the increased members' household adaptability. The mutual aiding behaviour between members promoted and assured members of household food and income stabilities.

The roles of cooperative groups (indicated in Table 5) that enhance CCA were provision of market for livestock products (milk and eggs) and agricultural crop produces, and to

provide bank services at local level. According to the Tanzania cooperative policy of 2002, cooperative societies and banks were expected to assist members to achieve development goals as fast as possible through joint efforts to alleviate poverty (URT, 2002) by addressing food and income insecurities hastened climate change.

The MMCS attracted market for livestock products (milk, eggs, and live animals). Milk from three types of dairy cattle kept included Fresian, Jersey and Ashian was the only livestock product produced. MMCS members and non-members collected milk in one 'pot' which was sent at Mwanga Town for sale. The strategy addressed market issues although livestock productivities were very low. According to the chairperson of this group, milk production per dairy cow ranged between 1 to 6 litres per day per cow (with average of 3litres per cow) with an average of 50 litres per day. of 200 livestock keepers in Mangio village only 21 members had registered and the rest used to sell their milk to MMCS office. Selling milk individually when the amount is reduced by impacts of climate change is costly, but through organizing groups selling of milk of one litre of milk becomes possible. Through economies of scale, inadequate livestock foddors, livestock management techniques and chemicals to well manage live stocks contribute to low milk production. Management costs were higher due to livestock shortage and heat stress resulted by drought and unpredictable little rains experienced in the highlands. The partnership reduced the transport cost and other operation costs that would be incurred to sell a little amount of milk produced by a single person by collecting all the milk in one pot and selling it at a set uniform price.

Although there are other contributing factors, climate change and variability contributed to reduced production of cereals and legumes resulting into no surplus. Subsistence production of food crops forced VNRCS to become coffee buyer in the highlands.

VNRCS linked member farmers with VN-SACCOS in order to get agricultural loans to purchase farm inputs. The society also linked farmers with agricultural experts and extension officers from government organizations and NGOs like PADEP, to train farmers about good farm management practices to bring about continuous improved productivity. According to Piprek (2007) and REDET (2008) cooperative groups linked their members with financial savings and credits groups and financial institutions like banks (Bibby, 2006). For-instance, in Mangio VNRCS assisted farmers to manage soil erosion by practicing conservation agriculture (agroforestry) with additional techniques such trenching to prevent soil and nutrient down flow during erosion, proper plant spacing, tree planting, pruning and thinning to reduce competition among farm components so as to enhance condition necessary for coffee growth and development. Proper application of herbicides, pesticides and fungicides were other additional trainings provided. The contribution made members and farmers to respond to climate change and variability in the highlands by maximizing crop productivity. Cooperatives enhance community-based collective actions which include creating market and natural resources access (Ngigi, 2009 and Agrawal, 2008). They provide knowledge, technology, policy, institutional and financial support (credit facilities for vulnerable communities (Ngigi, 2009).

VN-SACCOS members (in Table 5) included individuals, informal and formal CBOs, FBOs, and PIs. It enabled most of individuals to adapt climate change by providing them with micro business loans, agricultural subsidies loans education, emergency loans, set a small interest rate ranging from 12 to 1% percent depending on the nature of loan. Loans also helped members to pay fees for their school children, buy food; build good (rehabilitate) houses, and initiate various farm projects (especially coffee farmers). The SACCOS contributed to adaptive capacity of many individuals, social groups, and private institutions to improve income and food security by pledging shares, promoting trust,

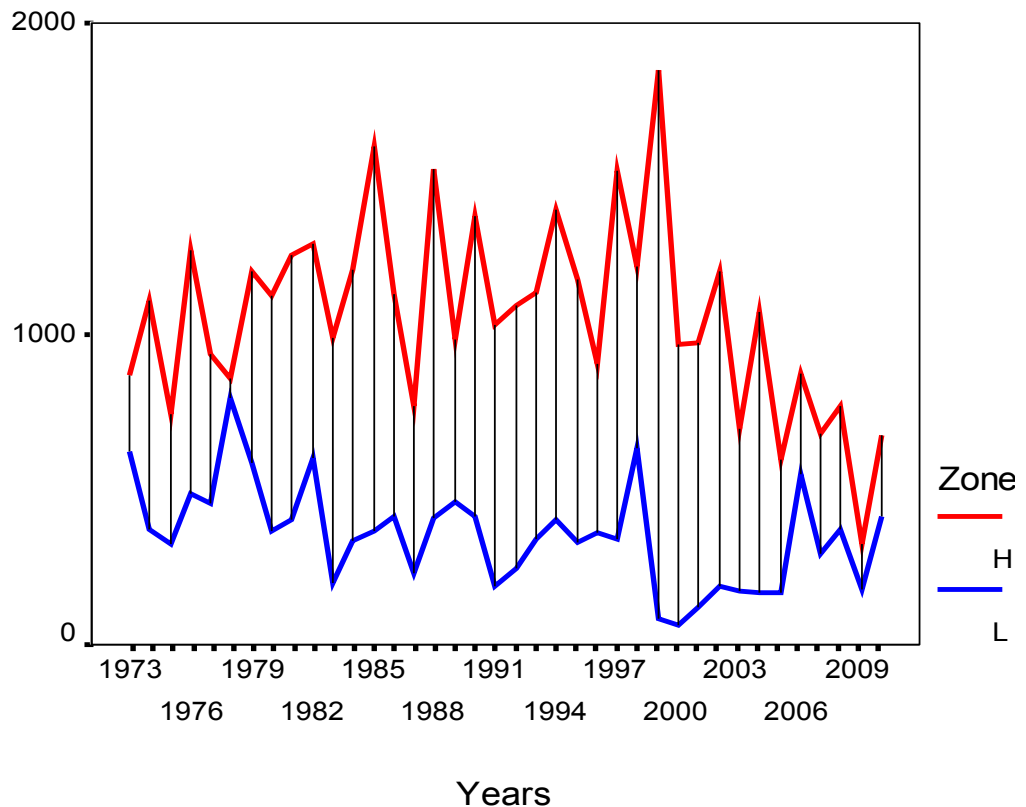
improving their network status, providing them with entrepreneurship skills, and loans under simple stipulations. In expanding financial access, cooperative societies and banks linked rural poor with formal banks such as CRDB in Tanzania to facilitate them with loans, deposit facilities and capacity building in response to enhancing their livelihood adaptations (Prek, 2007). According to Agrawal (2008) farmers responded to drought by adapting their farming, live stocks and other income generating activities to achieve some degrees of sustainability between their livelihoods.

Cooperatives enabled members at Mamesa village of Kilimanjaro, Tanzania to diversify from coffee production into brick making and store and supply of agricultural inputs (Bibby, 2006; Bodin and Crona, 2008). Cooperative societies and banks promote cooperation, communication between households, financial and social security which all together provide members with financial and social assets to adapt and recover themselves from stresses of climate change (Bibby, 2006; Agrawal, 2008 and Bodin and Crona, 2008).

4.4 Community-based Practices that Enhance CCAs

Almost 100% interviewees had experienced the changing climate and its unpredictable variability. Results from Fig. 3 showed the decline mean annual total rainfall trend at the highland zone and lowland zone. The detailed mean annual total rainfall data for Fig. 3 are indicated in appendix 4 of this thesis. Most people at the highlands had realized that the climate has changed from previously experienced normal weather conditions (wetness and heavy suitable rains prevailed in years back) to dry condition, high temperature, low and erratic rains. In the lowlands people experienced persistent drought and high temperature. The impacts had implications to household agricultural crop and livestock production. In the highlands, unpredictable rains made rain-fed agriculture uncertain and rain-fed

agricultural lands abandoned in the lowlands resulting into serious household food and income shortages. The study in Moshi rural District in Kilimanjaro reported that drought reduced crop harvests to about 67% of households and nil harvest to about 22% of households resulting into household food and water shortages (Meena and O’Keefe, 2007).



H= Highlands and L=Lowlands

Figure 3: The trend of mean annual total rainfalls from 1973 to 2010.

Source: (Pangani Basin Authority)

However, most households and communities have developed various practical mechanisms to respond to drought and unpredictable rains to address food and income shortages for survival. These practical mechanisms to enhance CCAs in highlands and lowlands included various forms of agroforestry, irrigation farming, market exchange,

mobile phone aid network, asset diversification, migration, and on-farm storage practices as indicated in Table 6. According to Agrawal and Perrin (2008) CCA practices are categorised into four adaptation responses namely mobility (helps to address risks across space) storage (time), diversification (asset classes), communal pooling (across households), and market exchange (can substitute mobility, storage, diversification and communal pooling when markets are well accessed). The CCA practices adoptions depended on the nature and status of drought posed in respective areas. Also the differences in population pressure, remoteness, historical background and the livelihood capabilities of the particular individual households (Virtanen *et al.*, 2011 and Messer & Townsley, 2003)

Table 6: Community-based practices that enhance CCA in highlands and lowlands

PRACTICES	RESPONDENT HHs					
	HIGHLANDS			LOWLANDS		
	% of occurrence			% of occurrence		
	Yes	No	Total	Yes	No	Total
Agroforestry	96.7	3.3	100	6.7	93.3	100
Irrigation farming	6.7	93.3	100	93.7	3.3	100
Market Exchange	83.3	16.7	100	86.7	13.3	100
Mobile phone aid Network	83.3	16.7	100	56.7	43.3	100
Asset diversification	26.7	73.3	100	83.3	16.7	100
Migration	23.3	76.7	100	40	60	100
On-farm storage	50	50	100	0	100	100

4.4.1 Roles of community-based practices in enhancing CCA

4.4.1.1 Agroforestry

An estimate of 96.7 % of respondents practiced agroforestry at the highland village compared to 6.7 % of respondents who practiced agro forestry in lowland village (See Table 5). Highland dwellers were culturally farmers where as lowland dwellers were mixed nomadic pastoralists, fishermen and farmers. Households in the highlands used

their limited land to grow multiple crop varieties ranging from woody perennials to annual herbaceous crops in adapting to drought and unpredictable rains. In the same land management units, trees (such as *Eucalyptus spp*, *Grevilliea robusta* and *Persea spp*), coffee (*Coffea sp*), banana (*Musa sp*), taro (*Colocasia esculenta*), sweet paper (*Capasicum annum*), cardamom (*Elettaria cardamomum*), cassava (*Manihot esculenta*), sweet potatoes (*Ipomoea batatas*), maize (*Zea mays*), legumes, yams (*Discorea spp*), and animals mainly hybrid cattle, local bred sheep and poultry combined around houses. Animals were confined in units and supplied with necessary requirements (fodders and water) to avoid grazing on crops. The study in Rural Moshi District reported that population growth increased agricultural land scarcity leading households to end up into agricultural land intensification through home gardens (Meena and O'Keefe, 2007 and Paavola, 2006). Home gardens formed an environmental conserving production system that forms a collective name for land use system and practice in which woody perennials are deliberately combined on the same land management unit with herbaceous crops and or arrangement or temporal sequence such that there are both ecological and economic interactions among different components (Lulandala, 2010).

The components of home gardens were intensified by different kinds of food and cash crops to maximize production. Increased production resulted into food availability to suit household food requirements throughout the year. To address uncertainty due to seasonal rain variability, some crops were grown earlier when short rains began and others (those which required long maturity period) were grown earlier when long rains start. Drought resistant crops such as sunflowers, sweet potatoes (*Ipomoea batatas*) and cassavas (*Manihot esculenta*) also combined within agroforestry systems to maximize produces to address erratic rains and dryness. Trees in farms provided suitable conditions for other crops like coffee, ginger (*Zingiber officinalis*), cardamom (*Elettaria cardamomum*), sweet

pepper (*Capsicum annuus*), and other climbing fruit and tuber plants like passion plant (*Persea spp*) and yams (*Dioscorea spp*). Lots of components are added in farms to minimize the impacts of crops failure, to optimize crops productivity and household income through sell of farm products such as banana (*Musa sp*), cardamom (*Elettaria cardamomum*), coffee (*Coffea sp*), sunflower (*Helianthus annuus*), sweet papers (*Capsicum annum*), trees and trees products.

The findings are in line with several studies which reported that households respond to drought and erratic rains by adapting resource management practices such as planting on easily maturing crops, adopting resilient varieties of crops, selective keeping of live stocks (Somorin,2010; More and Treue, 2009; Meena and O’Keefe,2007). Adapting multiple crop production by diversifying crops such as maize, rice, beans, cassava and other crops which could produce at even relatively low rains (Baumhard *et al.*, 2011). According to Mitchell and Tanner, (2006) farmers in Zambia practised drought adopting conservation agriculture which involved minimum tilling methods to trap moisture, improve the quality of the soil, reduce soil erosion and create growing conditions which exhibit drought tolerance. A case study in Mozambique reported of the presence of a farmers network that involved planting drought resistant species such as cassava and sweet potatoes in response to climate change (Mitchell and Tanner,2006).

4.4.1.1 Irrigation farming

The irrigation farming was carried out in the highlands by 6.7 percent of respondent households (See Table 6). The rarity of irrigation farming in the highlands was due to water shortage and limited land which led into failure of most irrigation farming micro projects established by households and by a number of community member groups in the highlands. However, 93.7 percent of respondents (in Table 6) in the lowlands practiced

irrigation farming. Being semi-arid, lowland areas received too little unpredictable rainfall to support rain-fed agriculture. To address aridity people communally established irrigation canals to ensure availability of water from Pangani River. Pangani basin formed the useful arable land where mainly annual crops such as cereals (maize and rice), legumes and vegetables were grown for food and sell. The presence of surface irrigation scheme has increased the ability of lowland farmers to address drought through farmlands expansion and use of farm inputs (seeds, fertilizers, water pumps, sprayers and chemicals) to ensure increased soil and crop productivity.

Intercropping and mono-cropping were common cropping techniques through which drought resistant crops and seeds varieties of cereal and vegetables were grown. This increased farm produces consequently increasing household food availability and income security. Such situation has attracted many people from highland areas of North Pare Mountains, inside and outside Mwanza district to the lowland. Pastoral communities have also adopted crop production becoming agro-pastoralists to ensure household food availability to attain and sustain livelihoods in response to drought. IFAD (2010) reported that Irrigation scheme contribute to a rise in productivity of land cultivated by small-scale farmers. However, irrigation farming experienced social conflicts over access to resources (water) and was constrained by salinity of water. This was also reported by EAFF (2010) that increasing salinity reduces productivity of land and income of farmers. Rice farmers addressed salinity by communally working to improve drainage systems in order to minimize the salinity, creating sustainable irrigation farming.

4.4.1.2 Market Exchange

Findings from the study has shown that, 83.3% and 86.7% of interviewed households in highland and lowland villages practiced market exchange in response to climate change

(See Table 6). Market exchange involved agricultural products including coffee, banana, sweet pepper, cardamom, cereals, legumes, livestock and livestock products (milk and eggs) and forest products from home gardens. Sell of forest products (timber, fruits and fuel wood) contributed to household income to 86% of households in the highlands. In the lowlands, farmers exchanged farm products mainly vegetables crops including (tomatoes (*Lycopersicon esculentum*), pepper (*Capsicum spp*), sweet and water melons (*Citrullis spp*), onions (*Allium sp*)) cereals, and legumes. Also it includes exchange to live stocks and livestock products.

Market exchange aimed to earn money to increase financial capital to fulfil household requirements such as food, pay for health services and pay for school children expenses, to re-invest for subsequent farming season. Many studies reported that people adopt various market exchanges to improve their household revenue flow in response to climate change (Agrawal and Perrin, 2008). However, farmers sold most of their produces at farm prices because of remoteness and poor roads, transport costs were also too high for farmers to manage to access markets price. They had no choice except to accept farm prices because there had also no specific markets for them to sell their products at market prices. Similar observation was also reported by More and Treue (2009) that efficient marketing system would benefit farmers in the study areas. They recommended that farmers should be educated through training and workshops on how to well address the market issue in order to increase net benefits obtained micro-businesses.

4.4.1.3 Mobile phone and mutual aid network

About 86.7% of all the total households interviewed in both highlands and lowlands owned mobile cell phones. It was noted that about 83.3 % and 56.7 % of respondents at

the highland and lowland villages respectively contacted relatives for food and financial aids (See table 6). Results depict differences between people at the highlands and those at the lowlands in terms of their communication networks with their relatives for remittances. Since 43.3 % had no mobile phones and little number of people had strong relationships with people outside the village. Most of respondents practiced Mobile phone SIM banking. They recommended mobile phones to have helped them in receiving money transferred from family friends and relatives, which they used to buy food, buying farm inputs, rehabilitate houses pay for health services and school fees for their children.

Households strengthened their networks with various people inside and outside home places. Farmers contacted retailers to collect farm goods that were ready for exchange. They could inform and bargain price with buyers through mobile phones. Mobile phones formed important household tools for people to achieve information and knowledge on concepts of global climate change, its impacts, and adaptation mechanisms through mobile phone text messages and radio narrations services. Handricks and Chidiac (2011) reported that mobile phone networks enhanced individuals and financial savings and credits community based groups to save money and manage to buy farm inputs which in return increased their farm productivities improving household food and income availability which means well being. A study by Meena and O'Keefe (2007) in Kilimanjaro reported that high level of remittances received by households through mobile phones formed greater source of income such that the money housed used to hire on-farm labours.

4.4.3.5 Asset portfolio diversification

About 83.3% households at the lowlands and 26.7% households in the highlands had accumulated different kinds of assets to adapt to climate change (Table 6). The common assets possessed include mobile phones, motorcycle, bicycles, renting land and houses.

Most households in the lowlands used motorcycles, and donkeys to simplify accessibility of resources such as water and farmlands which are distantly located from their homes. Motorcycles and bicycles were used to provide transport facilities commonly used by both farmers and retailers. Pastoralists used donkeys to fetch water, and carry loads such as bags of cereals to milling machines, luggage during migration and farm harvests from farm places. On the other hand farmers less preferred donkeys because of being the most pest farm crops of all live stocks in the area. The use of bicycles, motorcycles, donkeys, renting lands and mobile cell phones enhances abilities of Households to adapt climate change as they contribute to increase household adaptive capacity. Mobile phones were useful as information sources and financial service access tools. Respondents recommended to have used it to access weather information, to communicate with agriculture extension officers on farm and crop issues, to organize markets and to simplify money transactions with other people outside the villages.

Residents of lowland villages divided their own lands into renting plots as strengths to coexist the increasing costs of production induced by drought and temperature extremes. For years some households had adopted their lands to landless farmers at a rent of 50,000TZS to 100,000TZS per acre per season. Land could also be rent out in return of farm harvests in accordance with the amount that could be paid by renters. About 30% of households in the highlands and 31.7% households in the lowlands owned renting lands and houses. The rents helped the majority to purchase food, afford paying for health services and manage their farm crops. Following such benefits, most of households chose to rent portions of their land pieces and some are constructing renting houses to maximize their monthly and daily earnings. This alternative source of food and income is growing as a result of influx of people (seasonal immigrant farmers) from Northern and Southern Pare Mountains and other places of Tanzania for the purpose of carrying out irrigation farming.

Farmers used water pumps to irrigate farm crops to address serious drought and high temperature. To owners, water pumps formed the other source of income as they hired to other farmers for money.

Individuals diversified skills and occupations to merge and suit various local occupation diversifications such livestock keeping, farm crops management, brick making, driving motorcycles (offering transport services for men) and micro business of farm produces for the majority of women as alternative livelihood system to earn income under climate change scenarios. These human intangible assets enabled people to diversify income generating activities to maximize household income and improve well being. Shares and social capital as assets formed capital stocks of an individual in a CBP or CBOs. Capital stocks formed the agents of households' livelihood capabilities and climate change adaptive capacity improvement. They offered individual abilities to expand agricultural projects, improve their houses, purchase CCA assets and offer an alternative source of livelihood systems.

To pastoralists, animals (poultry, goats, sheep and cattle) formed important assets as their bank accounts. Most pastoral households formed no partnerships to save their finances, however they saved money in form of live stocks (live banks) which is their cultural practice. Live banks were the solution to food and income shortages posed by drought and other climate change impacts. Pastoral HHs chose to increase herd sizes by diversifying live stocks due to their differences in abilities to adapt to drought, its associated impacts to live stocks such as loss of preferred livestock fodders. According to one of the informants, 'goats are adapted well to drought conditions compared to donkeys, cattle and sheep. According to respondents, sheep and cattle do not withstand high heat stress associated with prolonged drought and water shortages. These factors were stated to have led into

their high mortality commonly experienced during dry seasons compared to poultry, goats and donkeys which are heavy feeder grazers and browsers. Sheep and cattle are mainly grazers.

Pastoral communities considered live stocks (live banks) as their local financial reserves. With animals HHs were sure of food security; however some households adopted land assets and engaged in irrigation farming to produce food and generate income from agriculture. To maintain their cultural practice, their harvests were exchanged for money and later save it in form of live stocks. Live stocks in turn were exchanged to manage farm costs and pay for enrolling children to school. Live banks assured pastoral households of food availability throughout the year.

4.4.1.4 Migration

About 23.3 % and 40% of respondents at the highlands and lowlands respectively opted to migrate as an adaptation to climate change (See Table 6). A small number of people prefer to migrate in response to drought. Migration in the highlands was mainly agro-migration. Farmers temporarily moved to the lowlands in response to drought which had exposed them into household food and economic insecurity. Pastoral communities allowed adult men to migrate with live stocks to other parts of a country looking for pastures to enhance survival of live stocks. migration of both human and live stocks were due to drought, water shortages, reduced livestock pastures, reduced arable lands and high uncertainty of rain-fed agriculture which proved crop failure. In the lowlands, immigrant irrigation farmers from Pare Mountains hired arable land to grow staple food crops (cereals, legumes and vegetables) to optimize food and income using the available waters from Pangani River. On the other hand, seasonal pastoral out-migration from lowlands to other northern

parts of Mwanga along Lake Jipe was made in response to high prolonged drought seasons.

Locally managed migration has enabled local people in both lowlands and highlands to withstand drought and erratic rains associated livelihoods impacts. Nomadic pastoralism is very sensitive to climate change (Paavola, 2006). In his study on livelihoods, vulnerability, and adaptation to climate change in Morogoro region, Paavola (2006) reported that in attempt to reduce dependence from agriculture production Northern Tanzania pastoralists such as Maasai, Nyaturu and Barabaig transhumance and sale cattle were the traditional responses to drought, seasonal and climatic variations. According to Agrawal (2008) the poor are more likely to migrate in response to crop failure where as rich one were likely to be institutionally secure in access resources that make migration unnecessary. Migration is more likely to be an effective long-term strategy for pastoralists and agro pastoralists confronting lower rainfall or range productivity in contrast to settled agriculturists. Migration of human and live stocks indicated weak social and institutional networks. It reduces the adaptive capacity of migrants as it reduces the effectiveness of improving human capital through health and education services provision to people (Agrawal, 2008 and Davies and Bennett, 2007).

4.4.1.5 On-farm food reserves

On-farm food reserves were designed to respond to food shortages. Results indicate that 50% of households practiced on-farm food storages (See Table 6). People addressed prolonged drought seasons and rainfall variability by adopting cultivation of taro at the wetlands to ensure household food availability. Wetlands were the village community lands set aside as conserved areas and protected by by-laws by VG and VLEC. They

formed boundaries of seasonal rivers, dams and swamps at the village lowland areas. On-farm food reserves were potential household food assuring resources during food scarcity.

Since wetlands and swamps were community pool resources, every household had equal chance to access a plot to grow taros (*Colocasia esculenta*). Allowing individuals to have on-farm food reserves created an incentive that strengthened social network between the individual households the village government officials that end up into strong norms in natural resource management which are recommended to be very useful in CCAs (Bodin and Crona, 2008). Conservation of wetlands and catchments forests and swamps is critical for the livelihoods of the rural poor and ecotourism which in any case contribute to their wellbeing (Bodin and Crona, 2009).

4.4.1.6 Communal Pooling

There are communal adaptation practices employed by highland and lowland communities that enhance household capabilities and individual practices against climate change. According to Agrawal and Perrin, (2008) communal pooling is defined as ‘adaptation responses that involve joint ownership of assets and resources; sharing of wealth, labour, or incomes from particular activities across households, or mobilization and use of resources that are held collectively during times of scarcity. Communal pooling enabled people to build Mangio secondary school and other education and health institutions (MD, and MPS) which are important in raising human capital. Communal pooling enhanced conservation of natural water sources, sacred forests, communal and state forests like Kwataigo forest reserve and wetlands (like ‘*Tingingi*’; where they grow tuber crops mainly taros during dry season) present in the Mangio village.

Well organized household and institutional networks in both highlands enhanced construction of roads and access roads that simplify transportation. Through communal

work, irrigation farmers in Kirya managed to tap water from Pangani River by communally digging irrigation water canals using their own resources (human resources and natural resources). In their studies, Virtanen *et al.* (2011) and Agrawal and Perrin (2009) pointed out communal land conservation measures, re-forestation, and improvement of school and health facilities as some of the typical communal pooling activities. Communal pooling reduces risks would be experienced by different households and enlarges doors of opportunities to address and reduce vulnerabilities (Agrawal and Perrin, 2008).

4.5 Roles of Networks in Enhancing CCA for Livelihoods

Various households' acquaintances had been established in the highlands and lowlands in response to climate change. Relationships between stakeholders: households or families, community groups, local, national and international organizations and institutions, were considered locally valuable to people living in vulnerable rural areas at the highlands and lowlands (Mangio and Kirya villages). These interactions and their roles in enhancing CCA are discussed in this section.

4.5.1 Family relative mutual aid networks

Majority of local people were socially connected to one another (interacting) in response to climate change. Household interactions aimed to maximize resources use and minimize risks and setbacks that could be individually faced in adapting climate change for their livelihood. Households (HH) in both highlands and lowlands were connected either through food, farm working, and money in responding to the impacts of climate change. Family relatives' food, work and cash mutual aids networks (Figure 4 and 5) in Mangio and Kirya Villages, include those between neighbouring HHs indicated as Family Friends (FF) and family relationships with social groups such ethnic group and religious groups

which formed the Village Social Group Family Network (VSGFN). FFs and VSGNs connected HHs that mutually aided each other with food, work, money, skills and experiences related with climate adaptation that enhanced HHs to address challenges resulted by climate change.

The second category of networks was that of food, work, money, skills and experiences interactions between related families, the Family Relative Networks (FRN) which were categorized into food, farm work and cash networks and were identified at village, district, national and international levels. FRN within the village included, the Family Village Relative Network (FVRN), Village Relative Food Network (VRFN), Village Relative Work Network (VRWN), and Village Relative Cash Network (VRCN). FRNs at district level included, Mwanga District Family Relative Network (MDFRN), Mwanga District Relative Work Network (MDRWN), Mwanga District Relative Food Network (MDRFN), Mwanga and District Relative Cash Network (MDRCN). And FRNs outside Mwanga District were mutual aid relationships that between families in the village with relatives residing outside Mwanga District but within Tanzania. FRN outside Mwanga included the Mwanga District Family Network (OMDFN), Outside Mwanga District Relative Work Network (OMDRWN), Outside Mwanga District Relative Food Network (OMDRFN), and the last group was for FRNs outside Tanzania which included the Outside Mwanga District Family Relative Cash network (OMDFRCN) and the Family Relative network Outside Tanzania (FNOT).

FRNs tied together the closely related families through mutual aids of food, cash and capacity flow within households in response to climate change. Pelling and Hugh (2005) trust and interpersonal relationships make social capital useful in enhancing CCAs through exchange and collective use of available resources in response to climate change

variability. In this case resources collectively exchanged and used between relatives could be financial, land, water, human assets such as knowledge and skills and available food. Family networks are mainly socially significantly maintained due to kinship relationship between individuals. Mutual aids networks were maintained by social capital and good reputation (trust) among individuals of the same family and between family friends (Woolcock, 2001 and Bodin and Crona, 2008). Other studies reported that social relations involved kinship and friendship ties which affect the exchange of different kinds of support and companionship (Marin and Wellman, 2012).

4.5.1.1 Family networks degree of centrality and betweenness centrality in the Highlands

Fig. 4 shows 45 nodes with different sizes and locations. The location and number of connections of the node corresponds to the degree of centrality of the tie or family network whereas the size of the node presents the degree of betweenness centrality. The family social linkages (FSL), Family Relative Network (FRN), FF, VRFN, OMDRN, VRCN, MDRN and VRWN respectively, have high degree of centrality, high degree of betweenness centrality and thus centrally located in the figure. This implies that most of local people in Mangio are socially well connected in the village and very well tied to their relatives in the village, and to those inside and outside Mwanga District. Most of these family relatives maintain their relationships by assisting one another with food, finances and farm works.

The ties' betweenness degree expresses the way nodes are located between families or HHs in the diagram (Wasserman and Faust, 1994). In that case, FFs, Family Friend (FR)

and Social Linkages (SL) play a great role of bridging HHs and their relatives through continuous food, cash, work, family and social problems settling assistances.

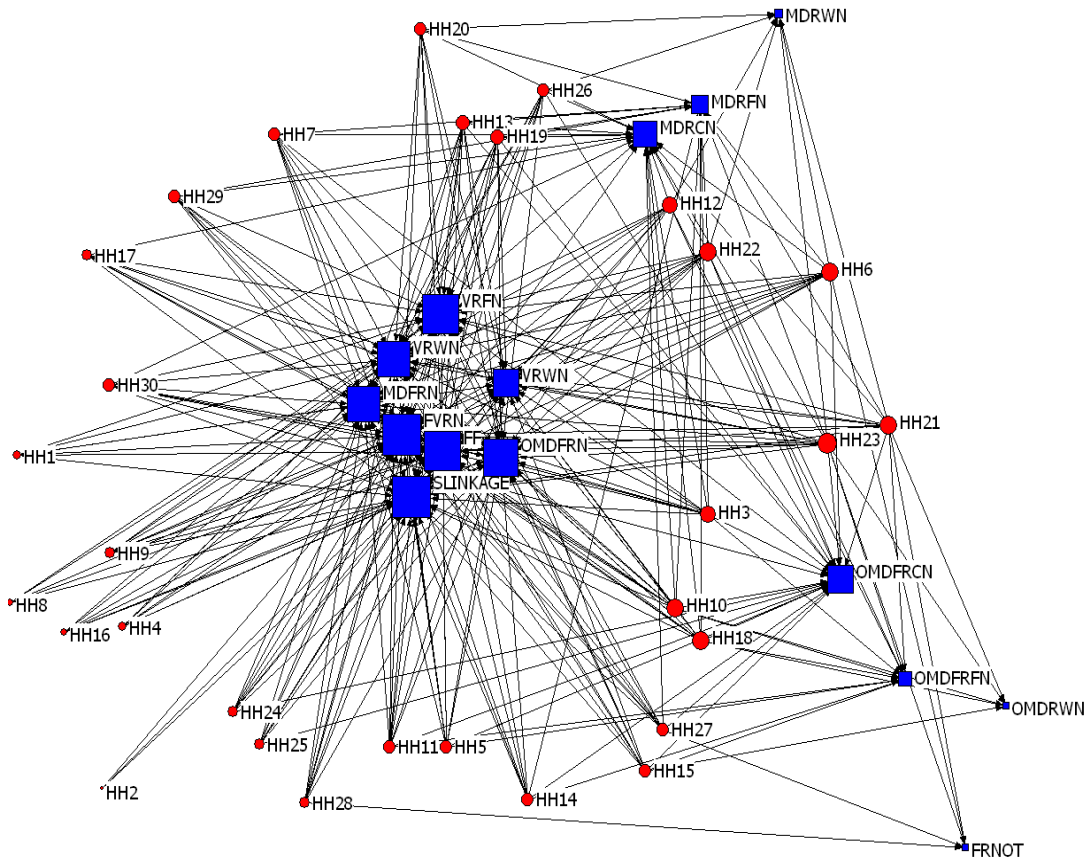


Figure 4: Position of Family relative networks degree of centrality in Highlands.

KEY: HH	=Households
FVRN	= Family Village Relative Network,
VRFN	=Village Relative Food Network
VRWN	=Village Relative Work Network
VRCN	= Village Relative Cash Network
MDFRN	= Mwanga District Family Relative Network
MDRWN	=Mwanga District Relative Work Network
MDRFN	= Mwanga District Relative Food Network
MDRCN	=Mwanga and District Relative Cash Network
OMDFN	= Mwanga District Family Network
OMDRWN	= Mwanga District Relative Work Network
OMDRFN	=Outside Mwanga District Relative Food Network
OMDFRCN	=Outside Mwanga District Family Relative Cash network
FNOT	= Family Relative network Outside Tanzania

The MDRFN and OMDFCN have lower scores (small sizes or few connections) and thus lower degree of centrality; the two are located at the periphery in the figure. Despite, lower degree of centrality, MDRFN and OMDFCN portrays family relatives outside

Mangio village living inside and outside Mwanga District (in other places of Tanzania) assist food and money to enhance survival lots many families in the village.

In most cases, food is received by means of courier persons using either private or public transport, while, cash was transferred and received through mobile phones personal accounts, bank and as the use of post from relatives outside the village and messengers. OMDFN, MDRWN, OMDRFN, OMDRWN and FRNOT show least connections and so least degree of centrality and betweenness centrality. They are located at the far marginal position of the network. Their mutual aids assistances are counted negligible, because of their remoteness. However, peripheral nodes may have a great contribution in enhancing tie strengths and to network centrality.

4.5.2.2 Degree of centrality and betweenness centrality in the Lowlands.

Fig. 5 shows 45 nodes of family networks in the lowlands of Pare Mountains in Kirya Village. The sizes of the nodes presented betweenness centrality and the node arrows or number of connections (scores) presented the degree of centrality. The study found that FSLs and FFs in Kirya had highest scores. This indicates that village members were well connected between one another. This observation elaborates the way families in Kirya are linked to one another by communally dealing with issues like digging, building, and maintaining irrigation canal; working to construct roads, school and dispensary servicing; and maintenance attending burial ceremonies. These communal activities performance called 'misalagambo' or "TAMASHA" made families most connected to one another such that VRFN, VRCN, and VRFN had high score of degree of centrality, although the MDRNs and OMDRNs had high score also. Bodin and Crona (2008) recommended that strong social network link individuals in the community and may reflect strong norms (in this case *Msalagambo*) in natural resource management and could be significant in enhancing both household and communal CCA.

The village relative relations' high strategic connectivity of mutual aids ties was because of closeness in terms of social and home distance among family relatives. However, despite high centrality, VRWN seem to play a minor role in bridging family relatives in the village, its role is similar to OMDRCN where families receive money from their relatives outside Mwanga district. The MDRCN and the MDRFN showed significance of relatives residing in Mwanga District to their families in Kirya. MDRWN, OMDRFN, OMDRWN, and FRNOT are located at far marginal side of the figure. Despite least scores of degree of centrality, some HHs form significant influences in enhancing their related families to adapt to climate change in Kirya Village.

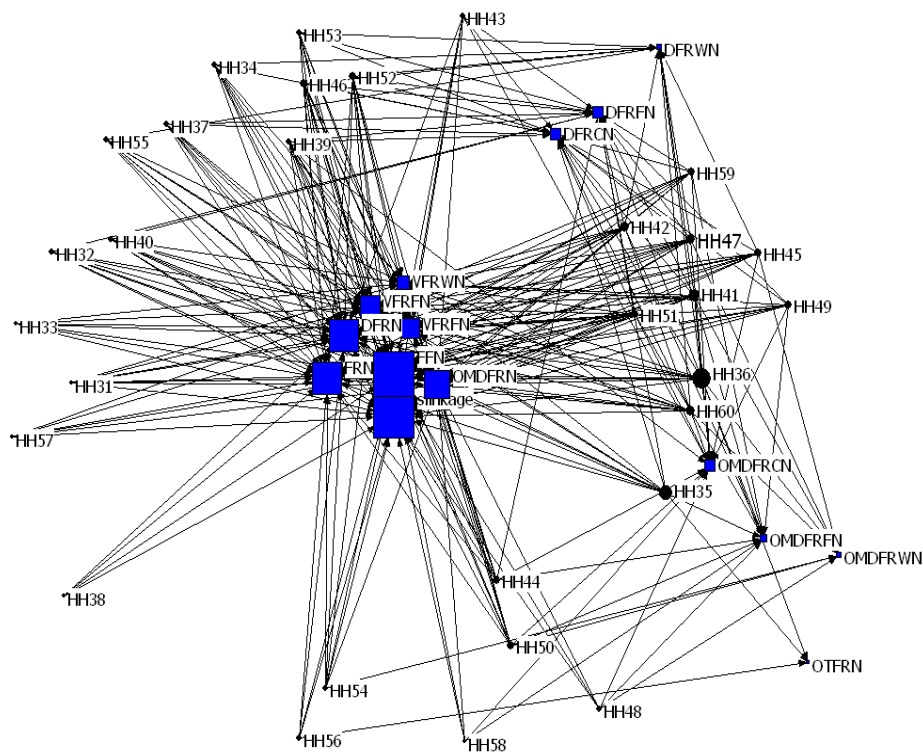


Figure 5: Position of Family relative networks degree of centrality in lowlands

4.5.2.3 The family mutual aids networks

Table 7 depicts the HHs food, cash and work mutual aids status networks variations in the Mangio and Kirya villages, in Mwanga District and outside Mwanga District. Village Relative Mutual aids Status (VRMUST), District Relative Mutual aids Status (DRMUTST), and Outside Mwanga district relative Mutual aids Status (OTMUTRST) are shown in Table 7 to indicate mutual aids scores for the family relative food, cash and farm work network statuses in the highland and lowland villages. 60% and 63% of the respondents in Mangio and Kirya villages respectively indicates that the village relative mutual aids relationships were increasingly getting stronger to most of families. The increase was mainly due to increased climate change related impacts to livelihoods and production systems whose pressures influence individual HHs to end up looking for available networks for remittances. And the closer helpful network and mutual aid normally come from even closer family relatives in the village in terms of distance and in terms of tie trust and kinship (Pelling and High,2005; Pretty, 2003 and Eguavoen *et al.*,2011).

Table 7: The status of networks strengths in study sites, inside and outside Mwanga District

STATUS	Number of cases in %			
	HIGHLAND (MANGIO)	VRMUTST	DRMUTST	OTMUTRST
Increased (3)	18(60)	13(43.3)	12 (40)	
Stayed Same (2)	2(6.7)	6(20)	16 (53.3)	
Decreased (1)	10(33.3)	11(36.7)	2(6.7)	
Total, N	30(100)	30(100)	30(100)	
LOWLANDS (KIRYA)				
Increased (3)	19(63)	14(47)	63(50)	
Stayed Same (2)	3(10)	6(20)	13(43)	
Decreased (1)	10(27)	12(33)	2(6.7)	
Total N	30(100)	30(100)	30(100)	

Footnote: Village Relative Mutual aids Status (VRMUST), District Relative Mutual aids Status (DRMUTST), and Outside Mwanga district relative Mutual aids Status (OTMUTRST) HHs interactions with local institutions, CBOs and CBPs in the highlands

While VRMUST tied together HHs with relatives in the village, in Mwanga DFRMUTST and outside Mwanga (OTMUTST) were increasing strong to most HHs who made up from 40 to 50%. Some of respondents found themselves being kept under the same situation of mutual aids assistance from their relatives irrespective of increasingly being vulnerable. The reasons for continuous constancy and declining flow of mutual aids between HHs and their relatives living in other areas away from them included reduced farm produce surplus and increased cost of living and production. Because of that, approximately 25 percent of interviewed families were increasingly experiencing weak networks which would perhaps be fragmented if climate change would increase impacting the livelihoods of these households.

4.5.3.1 Degree of Centrality

There are HHs networks with different CBOs, CBPs and local institutions present in Mangio Village as depicted in Figure 6. In the figure, degree of centrality of any node is presented by its number of connections (scores) and node size concurrently. It was found that almost all HHs formed membership to ‘TAMASHA’ giving it highest degree of centrality with 34 connections. The local communities are beneficiaries of TAMASHA whose other name in Gweno vernacular is ‘Msalagambo’ to mean the local village special work conference.

The VG managed CBOs and local institutions with which various communal duties such as roads construction, *Ndiva* construction, breaking and collecting stones, burial ceremonies attendance, brick making, fetching water for public local institutions construction like schools and hospitals and VGs important disputes settlement are made. All men and had to attend TAMASHA except only for special apology; in that case TAMASHA formed an important informal community-based institution whose

involvement sounded very potential for HHs by ensure access of common pool resources particularly water, academic and health services, and roads in the village. Monitored and managed by VG (by VEO, VLEC and VG chairperson).

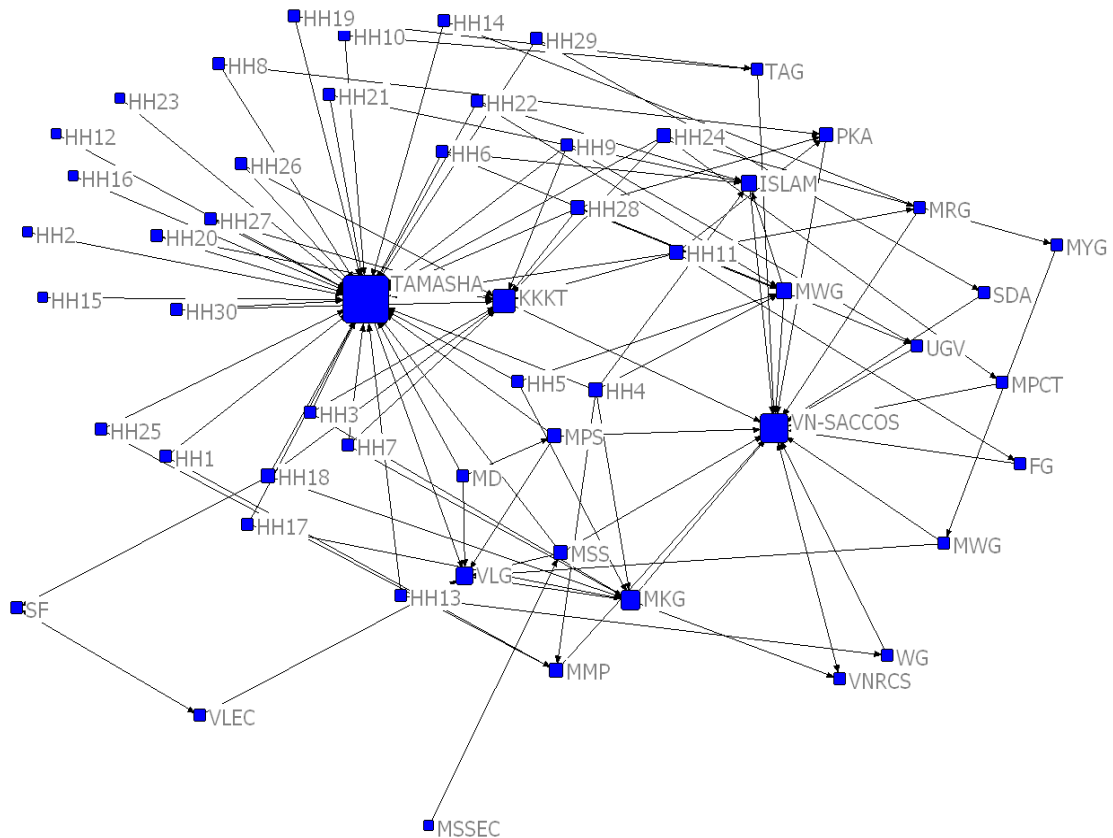


Figure 6: Degree of Centrality of Family local institutions, CBOs, and CBPs networks in the highlands

TAMASHA made HHs informed and networked to one another in the village. The network ensured connectedness of people in the highlands leading to the implementation of village public projects and succeeded building a dispensary (MD), schools (MPS and MSS), Traditional water sources ‘Ndivas’ maintenance, and roads under the assistance of various public and private assistances. TAMASHA has also been a means to balance distribution of food assistances donated to villagers by the governmental or private organizations. In Mangio, the Lutheran church (KKKT) was found to have larger number of member HHs and therefore has higher degree of centrality next to TAMASHA. KKKT

church has high influence in Mangio village; it was found to be the good medium to internalize information and knowledge related to CCA in the highland community. It had actually been encouraging its followers to join into groups and initiate projects to improve and sustain their livelihoods. Other CBOs with high scores were MKG and VG which had at least tied with individuals and other CBOs in the village. The ISLAM, Muslim Women Group (MWG), Mangio Milk Partnership (MMP), VN-SACCOS, TAMASHA, Mangio Primary School(MPS), Mangio Secondary School (MSS), Uchumi Group Vikoba (UGV), Sacred Forest (SF), Village Environmental Committee (VEC), Mangio Widows Group(MWG), PKA, Mangio Pentecoste Church of Tanzania (MPCT), Family Group (FG), Mangio Kahawa Group (MRG), Mangio Youth Group (MYG), Mangio Dispensary (MD), Upendo Group (UG), Wapendanao Group (WG), and TAG Church household organizational network have least scores and thus lower degree of centrality.

However, the Mangio HHs organizational network is much centralized due to the fact that it is dominated by only few central nodes and while the rest nodes being connected by individual HHs in between. The multiple connected nodes act as brokers who enhance information flow from one node to another, and the removal of such HHs may quickly result into network fragmentation into unconnected sub-networks and or isolates. The marginally located CBOs might form important innovative information and external knowledge informers to village members (Crona and Bodin, 2006; Pell *et al.*, 2009).

4.5.3.2 Positions and effects of local institutions, CBOs and CBPs networks in the Highlands

The study went further to find out the way local institutions are positioned themselves among other internal and external governmental and NGOs. Fig. 6 depicts the way local organizations are strategically located between others in the highlands. The VN-SACCOS

had high betweenness centrality. This partnership plays important role of providing savings and credits to local institutions in Mangio; in that case most of CBOs are customers or members of VN-SACCOS. VNSACCOS enabled most local institutions and community-based groups have access to loans and save their groups funds safely. VN-SACCOS is connected to Mwanga Rural Cooperative Bank (MRCB) which provide it with loans to assist people in Mwaniko ward, its members and personnel received trainings from CARE International and other financial institutions on issues related to money handling, savings and credits management skills, entrepreneurship skills, business, simple accounts and commerce skills, leadership and conflict management skills. VN-SACCOS offered bank services which included financial savings and credits for micro and micro-farming projects such as coffee farmers' (MKG) farm projects(Hendricks and Chirac, 20011).

The VG show high betweenness score after VN-SACCOS, it coordinates various internal and external organizations, it links and fixes external governmental and NGOs influences to village members groups, and at the end effecting village members through TAMASHA. Betweenness centrality refers to the strategic location of stakeholder between other important constituencies (Borgatti, 2005). Through VG, social groups were initiated and imparted new and good conservation agricultural practices, livestock management and market, micro livestock projects management, encouraged donors (PADEP and TASAF) to fund and provide capital for HHs micro poultry projects. Coffee farmers have been trained on good coffee farm management practices and motivated farmers to be in groups so that they can access loans and other assistances such as market, subsidies and inputs from the DG, VN-SACCOS, and VNRCS. The VNRCS forms the other node between money nodes. It connects other CBOs with coffee stakeholders who impart technical and financial assistances to coffee farmers groups. Community groups, partnerships and

institutions act as bridges between internal and external stakeholders in enhancing primary and or secondary CCA in the highlands.

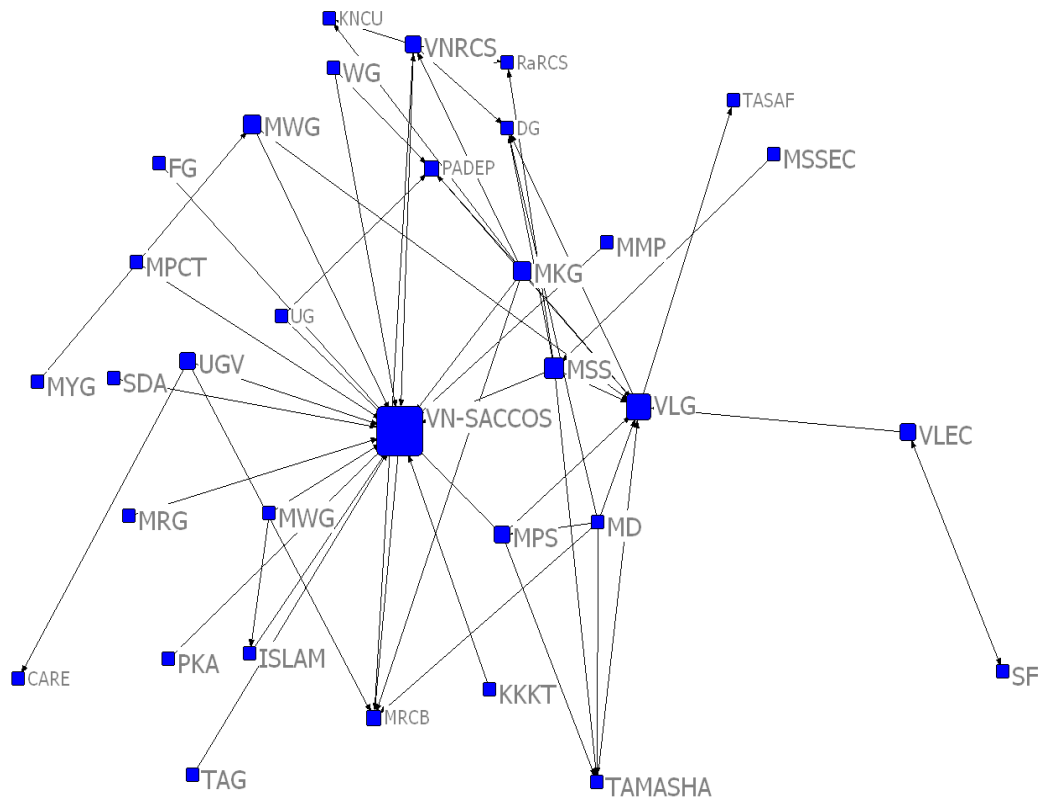


Figure 7: Betweenness centrality of local institutions, CBOs, and CBPs networks in the lowlands.

4.5.3 HHs interactions with Local institutions, CBOs and partnerships networks in the Lowlands.

4.5.4.1 Degree of Centrality

The Figure 8 shows Betweenness centrality of local institutions, CBOs and CBPs networks in the highlands. In the network TAMASHA and UWAKIMA had highest betweenness centrality with 30 and 22 connections respectively. According to Moore et al (2003) the more central and visible actors in the network are more likely potential allies for other powerful actors, thereby appearing even more powerful. VG, KKKT church, NKV and VLEC also showed centrality and, UWMKMA, Kirya Dispensary (KD), Kiryea

Primary School (KPS), TAG Church, and Kirya Workers Association (KWA) showed least centrality. This Kirya village network was dominated by only two central nodes of an informal village community network, 'TAMASHA' and UWAKMA. The network was much centralized such that the cease of membership of the House Holds: HH2, HH6, HH25, HH12, HH20, HH1, HH10, HH14, HH16 and HH25 might result into unconnected sub-networks.

Like in the highlands, TAMASHA played important networking roles in enhancing communal pooled CCAs in Kirya. Through such informal local organization, people at Kirya have managed to establish irrigation scheme, build KPS, KD and MbPS by working together under the VG. The ability to permanently adapt drought persisting in Kirya village has been successful through TAMASHA or 'Msalagambo' in their local words. In that case UWAKIMA forms a CBO that links Kirya farmers to other internal and external public and private organization. Through UWAKIMA farmers were getting opportunities to good farm practices, air out their views as well as funds to enlarge the irrigation scheme and to cooperation.

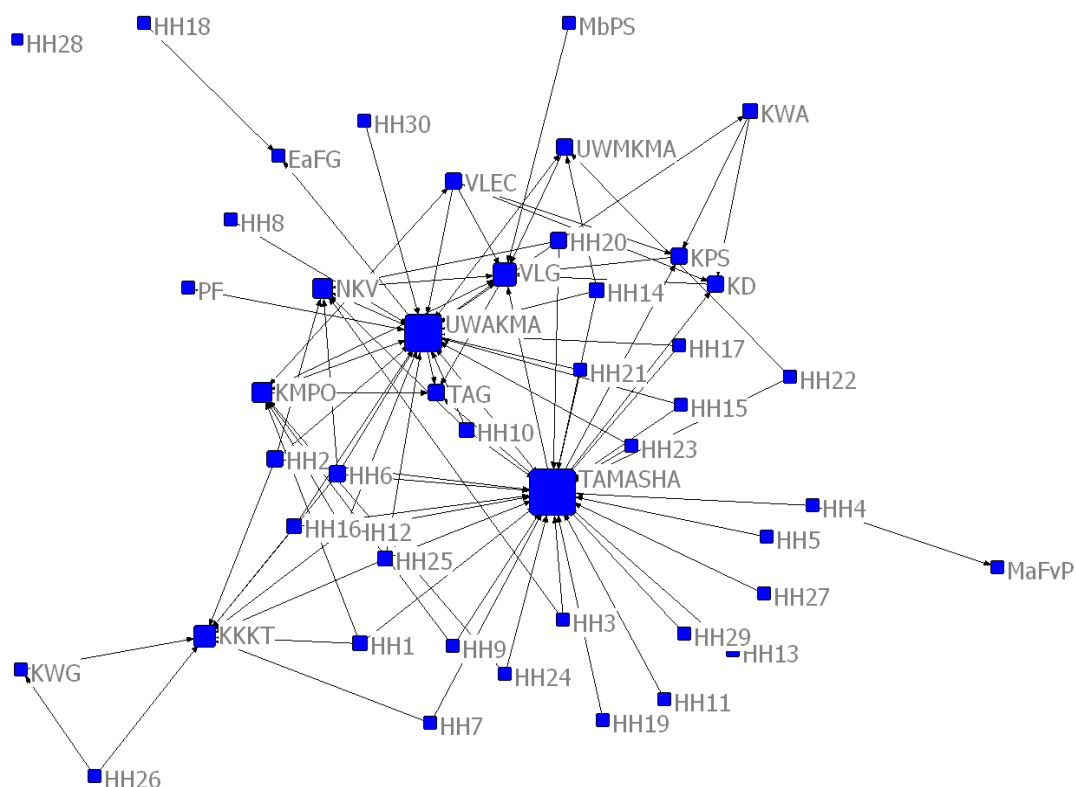


Figure 8: Position of centrality of family, local institutions, CBOs and CBPs networks in the lowlands.

The VG through VLEC form important institutions that ensure coordination between pastoralists and farmers, ensuring management of the village resource through planning, allocation and enforcing sustainable use. In most cases local people used to concentrate and make ties from which they are exactly sure of getting some benefits (Bodin and Crona,2009) and most central nodes seemed to have large impacts in terms of enhancing CCAs.

4.5.4.2 Positions and effects of local institutions, CBOs and CBPs networks in the lowlands

A total of 28 nodes of internal (village) organizations and external linkages they form centrality in the lowlands, in Kirya village (Figure 9). VG, UWAKMA, and PADEP depicted betweenness centrality of 15, 13 and 9 ties respectively.

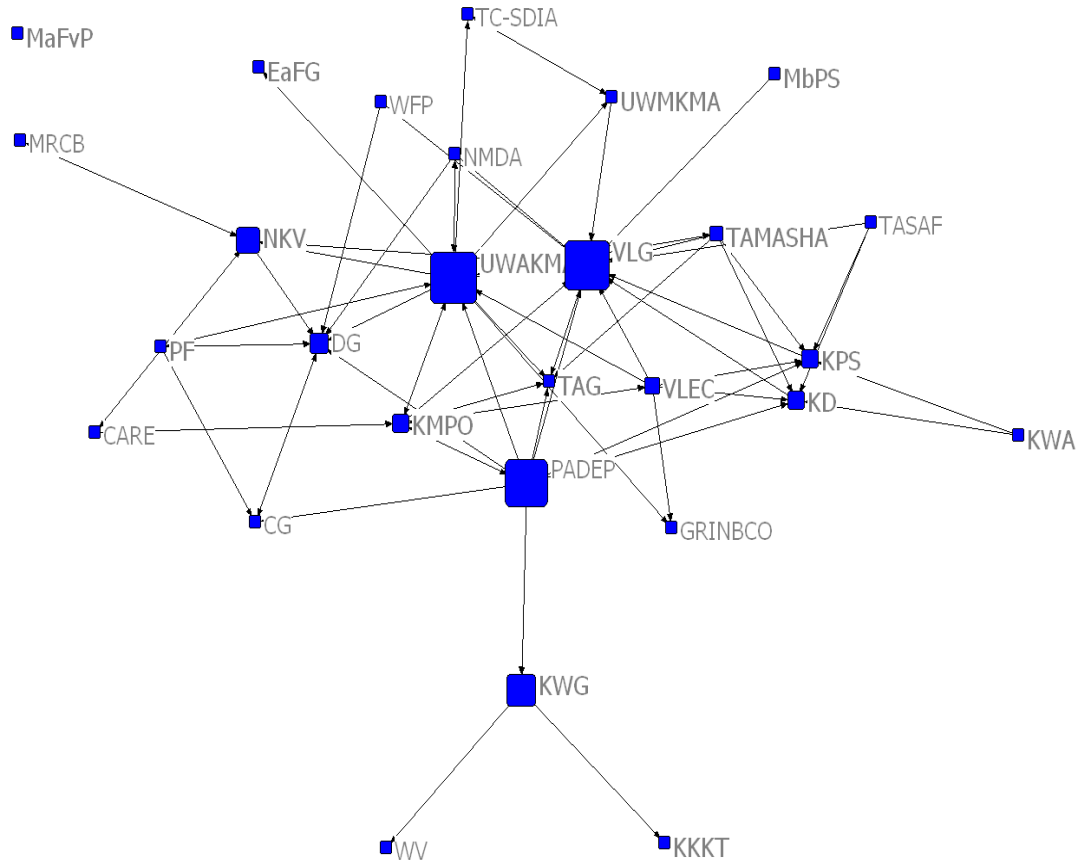


Figure 9: Betweenness centrality of CBIs, CBOs, and CBPs networks in the lowlands

NKV, KPS, VLEC, KMPO, DG,, KD and TAG were also found to be strategically located between other actor organizations. The VLG links TAMASHA, UWAKMA, Mangulai B Primary School MbPS, UWMKMA, VLEC, KPS, VLEC, Kirya and Mangulai Pastoral Organization (KMPO), TAG church, with WFP, WV, PADEP, TC-SDIA, and TASAF. In these linkages, CBOs receive trainings on irrigation farming and livestock keeping practices, funds for micro and macro village projects, leadership skills and projects management skills, and food assistances to HHs in the village. UWAKIMA links its members with VLG linked organizations and transfer benefits to its members and the community at large. The CG via DG, GRINBCO and WFP sponsored UWAKIMA's the construction of irrigation infrastructures. Nyumba ya Mungu Dam (NMDA) and Pangani Force (PF) monitored water resource used by UWAKIMA maintain and control

exploitation at sustainable level. The KWG from KKKT church was linked to WV and PADEP and KKKT church was and from organizations various material and intellectual assistances had been provided to widows. The KD and KPS workers have been tied together by KWA. Whereas Kirya pastoralists were linked to CARE international, PADEP, VLG, VLEC, UWAKIMA, TAG church by KMPO from where they shared informed of market, management practices, settle land and water use conflicts, receive extension services, trainings and expert advices. Linkages made by most of CBOs to external public and private institutions made members well informed (Main and Weelman, 2009) and confidently adapt climate change and variability.

CHAPTER FIVE

5.0. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Local Communities in Mwanga district are well informed on the climate change effects manifested by erratic rains, drought, water scarcity, increased temperature, crop failure and loss of arable land all of which forces them into food and income insecurity. However, this study assesses the roles played by community-based institutions, partnerships, social networks and practices in addressing impacts of climate change at the highlands and lowlands of Mwanga District. The findings depict the way informal and formal institutions and partnerships that enhance local people's adaptive capacities at an individual, household (family) and village community levels.

Community-based formal and informal institutions managed to mobilize local people to conserve natural resources for livelihoods sustainability. They form the key channels of the local community external knowledge related to climate change, guide and manage communal work to fulfil communal interests and easily exploit communal pulled resources or common pool resources. Local institutions manage wisely many resource use conflicts which frequently occur due to land scarcity and water sources. Local institutions enhance strong networks and cooperation among households which make them trust one another. CBOs assist households to integrate their local capabilities and external knowledge and technology because in groups people recognize, get imparted with skills, and funded by both public and private organizations to enhance CCAs. Family networks and organizational networks positively enhance most households to manage risks and uncertainties brought about by climate change at individual, household and community levels. Networks form channels of both internal and external knowledge, food, and

finances from various household sources such as relatives, family friends and among CBOs members. Partnerships as agents of financial security enhance local banking, forms sources of capital for farm and business micro projects, sources of funds to cover households' expenditures and measures of social capital to most residents in Mangio and Kirya village. Through networks, members gain psychological, economic, and social and health related capabilities to address climate change.

Households in Mwanga District highlands and lowlands have chosen to practice diversified conservation agriculture and nomadic livestock production, irrigation farming, and migration, maintain strong ties as a social net between one another and between relatives, and accumulate various assets to respond to the impacts of climate change to community livelihoods.

5.2 Recommendations

5.2.1 Local stakeholders should be well informed and involved in resource ownership and management.

As basic beneficiaries of the available resources, CBOs and CBPs members need to be well informed and involved in resource ownership and management. Resource use policies, planning and management processes should not bypass local institutions as important stakeholders to avoid priority differences between the higher and lower government level or between local and central government. They should also be well informed about various micro projects they launch to conduct and enhance household to adapt to climate change and reduce vulnerabilities at their localities.

5.2.3 Provide capital for funding micro projects.

Local partnerships especially the formal partnerships: financial savings and credits groups and cooperative societies and banks, should be highly considered and trusted to access funds in form of either hard or soft loans and grants to enhance local peoples adaptation strategies. Since local partnerships provide loans at low interest rates with simple conditions which can be fulfilled by most of local people in the villages. Enhancing local partnerships means enhancing local communities; they are formed, lead and managed by villagers themselves

5.2.4 Promote entrepreneurship, expertise and extension services to CBOs and CBPs members

The entrepreneurship knowledge forms an important pillar in enhancing effective and efficient adoption of micro projects, both farm and non- farm business based activities. Entrepreneurship, business management and good leadership skills promotion enhance informal and formal CBOs and CBPs, and networks ability to widen abilities of local communities to reduce climate change vulnerabilities.

5.2.5 Train CBIs, CBOs, CBPS leaders

NGOs, macro public and private institutions should not only use CBIs, CBOs and CBPs as mediators of climate change impacts facing the local community, but they should rather train them to become good organizers, managers, motivators and proactive to their members. Since leading requires various technical and educational qualifications, local institutions require well trained personnel to ensure effective their enforcements. For instance, in religious groups educating and training church leaders can make a great impact to most local community members, including those with no memberships in other CBOs. Religious leaders are forms influential positions in the society such that training

them on entrepreneurship, business, innovation and extension techniques, good farm and livestock management and health skills make it easier to transfer such knowledge to the large number of people at a short time. In most cases, FBOs leaders and CBOs leader forms the good mediators of external knowledge that would in any case maximize members' adaptive capacity to climate change impacts in their respective localities

5.2.6 Promote long term CCAs options.

CBOs in the study area have addressed climate change through a number of practices at the level of their adaptive capacities. However, most of these practices are likely not to enhance sustainable livelihoods without external intervention. So, to enhance medium and long term adaptation practices such as storage, planting drought resistant food and cash crops such as millet, sorghum, planting trees, coffee crops production in Mwanga, external support is necessary. The government should intervene in CBOs and partnership strategies towards local communities' CCAs.

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APPENDICES

Appendix 1: Matrix of methods for data collection

No	Specific objectives	Data to be collected	Method of data collection	Technique of data analysis
1.	To identify and examine the roles of community-based formal and informal institutions enhancing CCA in the study area.	Community-based formal and informal institutions	Interviews, FGDs, Questionnaires, and Oral History, Researcher observation.	Content analysis
2.	To identify and assess the roles played by community-based partnerships in enhancing CCA in the study area.	Different formal and informal community-based partnerships	Interviews, FGDs, Observations, and Questionnaires survey	Content analysis, conceptual relational analysis and descriptive statistical analysis
3.	To identify and assess roles of CCA community-based practices in enhancing CCA in study area	Community-based practices in highlands and Lowlands	Interviews FGDs, and Questionnaires surveys	Descriptive statistics and content analysis
4.	To identify and assess roles networks in enhancing CCA for livelihoods.	HH relations with relatives, social groups, partnerships and institutions.	Interviews, FGDs, Observation, Oral History and Questionnaires surveys	Social Network analysis and descriptive statistical analysis

Appendix 2: Checklist for Key Informants and Focus Group Discussions

1. What is the name of your organization/association/institution/club/church/partnership/group.....When did it start.....
2. How did you start your organization, partnership?
3. What are the factors that made you form the named organization in 1 above?
4. What were the objectives of the organization?
5. What activities are done by the organization?
6. What should one do (Criteria) to become a member of the organization?
7. What rules bind members from leaving the organization?
8. What are the dos and don'ts associated with your organization?
9. What are the benefits of being a member of this organization?
10. What are the problems does the organization face?
11. What do you think could be the solutions to these problems?
12. How have the members benefited by their being in the organization (testimonies form individual members)
13. What do you know about climate change?
14. How is your organization contributing in climate change adaptation?
15. Are there any other organizations that you're linked with? Mention them
(Those within the village and those outside your village)
16. What issues do network your organization to others in the village?
17. Is there any comment you wish to add?

Appendix 3: Household questionnaire

Questionnaire No. _____

Village____ Ward _____Division_____ Town _____District _____Region

Name of Interviewer: _____ Date: _____ Time Start: _____ Time end: _____

SECTION A: Demographic Information.**Tick the most correct answer and where appropriate fill in the blanks**

A1. Gender 1. Male [] 2. Female []

A2. What is your age in years?

- | | |
|-----------------|-------|
| 1. 18 – 25 | [] |
| 2. 26 – 50 | [] |
| 3. 50 and above | [] |

A3. What is your marital status?

- | | |
|--------------------|-------|
| 1. Single | [] |
| 2. Married | [] |
| 3. Widowed | [] |
| 4. Other (specify) | [] |

A4. Education level?

- | | |
|------------------------|-------|
| 1. No formal education | [] |
| 2. Primary School | [] |
| 3. Secondary School | [] |
| 4. Post Secondary | [] |

A5. What is the major source of household income?

- | | |
|-------------------------------|--------------------|
| Crop farming only | Irrigation farming |
| Livestock keeping only | Salary/wages |
| Crop and Livestock
keeping | Trading |

A6. How much do you earn per month?

- Below 40, 000
40,000- 100,000
100,000- 200,000
Above 200,000

A7. Size of the household and education levels (*Write 1 for Primary levels, 2 for Secondary level, 3 for college levels, 3 for university level and 4 for Informal level*)

Age group	Only members	family	Education levels
--------------	-----------------	--------	------------------

	Male	Female	Male	Female
0 – 9				
10 – 18				
19 – 50				
Over 50				

SECTION B: Local peoples’ Perception about community based organizations, and climate change in relation to livelihoods

Now I would like to ask you some questions concerning what you know about climate change adaptation practices.

B1. What do you think could be the cause of drought / water shortage condition?

B2. If that is the cause what how has it affected your livelihood?
 1. 2 3.....

B3. What do you do to overcome to adapt the effects?
 1.....2.....3.....

B4. Do you have membership in any organization(s) in the village?
 1. Yes [] 2. No []

B5. If Yes, Mention

B6: What benefit do you get by being a member of that organization(s) in B5

B7. What problems does your organization face?

B6. If No what are reasons for not being a member

B7a. What are main sources of livelihood in the household?

Main Occupation/main source of income	Rank 1-10 Occupation	Rank 1-10 Income
Crop production		
Sale of crops		
Off farm income		
Sale of forest products		
Livestock production		
Fisheries		
Employment		
Remittances		
Commercial loans		
Borrowed funds from relatives		
Others specify		

1 the most important and 10 the least important

B7b1 What capital assets do you own, that help you adapt climate impact risks? (tick the asset you own).

- Assets
- Renting house
- Bicycle or Motor cycle
- Land or farms
- Live stocks (poultry, goats, sheep, cattle).
- Shop
- Share
- Mobile Phone
- Others (Mention any other assets)

B7b2 Are there changes that are taking place over time and why?

B8. What do you do when your livelihood does not well?

.....
SECTION C: Family Networks

1) Do you have relatives in the village? 1. Yes [] 2. No []

If 'no': Go to 2

a) Do you help each other with farm- and/or other **work**? 1. Yes [] 2. No []

If 'no': Go to 2

b) Do you give or receive **food** to/from these relatives? 1. Yes [] 2. No []

If 'no': Go to 2

c) Do you give or receive **cash** to/from these relatives... 1. Yes [] 2. No []

.....

d) Have these forms of mutual aid increased, decreased or stayed the same over time?.....

.....

2) Do you have relatives outside the village (but in Mwanga district)? 1. Yes [] 2.No []

If 'no': Go to 3

a) Do you help each other with **farm-** and/or other **work**? 1. Yes [] 2.No []

.....

b) Do you give or receive **food** to/from these relatives? 1. Yes [] 2.No []

.....

c) Do you give or receive **cash** to/from these relatives 1. Yes [] 2.No []

.....

d) Have these forms of mutual aid increased, decreased or stayed the same over time?.....

.....

3) Do you have relatives outside the Mwanga district 1. Yes [] 2.No []

If 'no': Go to 4

a) Do you help each other with farm- and/or other work? 1. Yes [] 2.No []

.....

b) Do you give or receive food to/from these relatives? 1. Yes [] 2.No []

.....

c) Do you give or receive cash to/from these relatives. 1. Yes [] 2.No []

.....d) H

ave these forms of mutual aid increased, decreased or stayed the same over time?.....

.....

4) Do you have relatives who live outside Tanzania? 1. Yes [] 2.No []

a) Do you receive help from them (money, consumer goods,
explain trend)?.....

5) Do you have other close person (family friend) 1. Yes [] 2.No []

b) If Yes, how do you benefit in your
friendship?.....

B9. I have asked you lots of questions, do you have any comments or question to ask me?
.....

This is the end of our interview. Thank you very much for your cooperation.

Appendix 4: The Annual Total Rainfalls in the study area (1973 to 2010):

The Mwanga District Annual Total Rainfalls noted from 1973 to 2010 at Nyumba ya Mungu Dam (1977-2010) and Kisangara (1973-1976) Weather Stations (Lowland zone) and Lomwe Secondary School (Highland zone) Weather Station (1977-2010).

Year	Annual Total Rainfall	
	Highlands zone	Lowland Zone
1973	868.35	624
1974	1109.26	371
1975	742.33	322
1976	1267.53	487
1977	933.1	456.1
1978	854.7	794.3
1979	1199.51	584.3
1980	1121.9	367.1
1981	1254.11	403.1
1982	1291.26	598.9
1983	988.6	198.1
1984	1208.8	332.1
1985	1602.7	367.4
1986	1130	410.3
1987	768.6	231.9
1988	1531.8	408.9
1989	979.3	458.4
1990	1377.5	410
1991	1028.9	186.8
1992	1093.5	246.1
1993	1131	338.9
1994	1400.7	401.4
1995	1174.1	328.5
1996	903.1	359.5
1997	1525.5	338.8
1998	1218	632.1
1999	1850.9	84.3
2000	968.4	63.2
2001	973.2	119.8
2002	1200.8	190
2003	694.8	170
2004	1068	166
2005	596.2	167.7
2006	871.7	550.7
2007	681.3	291.6
2008	766.7	369.1
2009	321.6	178.4
2010	671.6	413.1
Mean	1091.064	362.7259
Total	40369.35	13420.9