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Institutional water resources management and livelihood adaptation in Kilombero rural areas, Tanzania

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Declaration

I, Edgar Liheluka, declare that this thesis is the result of my research investigation and findings. Sources of information other than my own have been acknowledged. This work has not been previously submitted to any other university than Norwegian University of Life Sciences (NMBU) for award of any type of academic degree.

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Abstract

This study attempts to understand institutional water resource management in irrigation schemes and its implication on livelihood activities in two study villages in Kilombero District, Tanzania. Mixed methods research was applied including both qualitative and quantitative research approaches. Ostrom's design principles for long-enduring Common-Pool Resources (CPRs) are employed to evaluate irrigation schemes and its implications in smallholder farmers' livelihoods. Sustainable Livelihood Approach (SLA) is brought from Ellis (2000) to analyze livelihoods and water dependence in the study villages. Design principles and SLA were used to analyze qualitative data and JMP statistical software was used to analyze quantitative data.

On-farm activities account for 77% of the household income in the total sample. Mkula and Msolwa A villages have 81% and 76% of on-farm income respectively. Rice and sugarcane are types of crops that constitute the major share of the household incomes. Non-farm (18%) off-farm activities (3%) and remittances (2%) have lower shares in the household income. Higher income families have ten times higher income compared to lower income families. Irrigation schemes yield higher returns compared to rain-fed agriculture. This is linked to water availability and access.

Land and water scarcity constrain agricultural activities in the villages. Land and water scarcity are linked to many variables including population growth per time, reduction of river flows, rainfall fluctuations, environmental pressure and similar reasons. Other limiting factors in agricultural activities include insufficient inputs access, inadequacy in farming practices, market infrastructure, lack of capitals, leveling problems in irrigation fields and other factors. Farmers applied various means to cope or adopt changes to secure livelihood outcomes. Capital diversification, renting out or selling properties, cultivating more than one crop, cultivating resilient crops, engage in wage labor, initiating rural trade and similar means are kinds of coping or adopting strategies applied by farmers in the villages.

We used an institutional water resource management assessment, following Ostrom's design principles for long-enduring CPRs evaluation and found inadequacies in clearly assigning boundaries, water rights, fulfilling duties and responsibilities, water monitoring and sanction systems. Failures in institutional water resources arrangements in all levels together with poor irrigation infrastructure caused ineffectiveness in controlling and regulating water in the catchment points and in the distribution systems. However, at the village levels smallholder

farmers reported to have a fair decision making process and there were absence of external interference on village affairs regarding water arrangements. Contestations of water use between upstream and downstream were however reported, mostly during water shortage periods (dry seasons, July to November).

The contribution of this study in practice based on the findings is that the State, various agencies, stakeholders, farmers and others should develop special attention to improve and develop irrigation projects in accessible areas because it yields sustainable livelihoods. Irrigation projects have increased productivity and provided much higher profits to the smallholder farmers in the study area. The agricultural sector employs a substantial share of Tanzanian's population can be transformed and become more productive by improving and developing irrigation projects. This will help to improve rural livelihoods by increasing food security and poverty alleviation. It is also important to find ways to increase land productivity; to produce more with less land, less water and with more environmental focus, so we won't be the last left living on this planet.

Knowledge gained in this study can be shared by interested parties in other parts in the country and elsewhere to understand the institutional managerial tasks in water resources and its implication in livelihoods.

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List of Abbreviations and Acronyms

AFDB	African Development Bank
ANOVA	analysis of variance
ASDP	Agricultural Sector Development Programme
ASLMs	Agricultural Sector Lead Ministries
BWBs	Basin Water Boards
BWOs	Basin Water Offices
CARE	Cooperative for Assistance and Relief Everywhere
CPRs	Common-Pool Resources
CRDB	Cooperative Rural Development Bank (Tanzania)
DADPS	District Agriculture Development Plans
DANIDA	Danish International Development Assistance
DFID	Department for International Development
EPINAV	Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
FMISs	Farmers Managed Irrigation Systems
GDP	Gross Domestic Product
GIS	Geographical Information Systems
IOs	Irrigators Organizations
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JMP	Statistical software (SAS)
MAKI	Magombela Kimbyoko (villages)
MKUCGA	Mkula cane-growers association

NAWAPO	National Water Policy
NEMC	National Environment Management Council (Tanzania)
NGOs	Non-governmental organizations
NIC	National Irrigation Commission
NIMP	National Irrigation Master Plan
NIP	National Irrigation Policy
NMB	National Microfinance Bank
NMBU	Norwegian University of Life Sciences
NORAD	Norwegian Agency for Development Cooperation
NTFPs	Non-timber forest products
NWSDS	National Water Development Strategy
PRA	Participatory Rural Appraisal
RBWBs	River Basin Water Boards
RBWO	Rufiji Basin Water Office
RIGA	Rural Income Generation Activities
RIPARWIN	Raising Irrigation Productivity and Releasing Water for Intersectoral Needs
RS	Remote Sensing
RWEs	Regional Water Engineers
SACCAR	Southern African Centre for Cooperation in Agricultural and Natural Resource
SACCOS	Savings and Credit Cooperative Society
SLA	Sustainable Livelihood Approach
SUA	Sokoine University of Agriculture
SUDECO	Sugar Development Corporation
SWIMNET	Soil and Water Management Research Network (ASARECA)
TANAPA	Tanzania National Parks
TAZARA	Tanzania-Zambia Railway Authority
TPC	Tanganyika Planting Company

UNCED	United Nation Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
VEO	Village Executive Officer
WCED	World Commission on Environment and Development
WUPs	Water User Permits
WWF	World Wildlife Fund

CHAPTER 1 - INTRODUCTION

1.1. Introduction

Water resources are central to the existence of the atmosphere, terrestrial environment and all living creatures. It must be preserved and used sustainably. The resource availability for different uses is diminishing corresponding to manmade and natural activities. Water resources serve several functions for people in terms of direct use. Irrigation activities utilize 70% of the world use of the all fresh water while industry and mining account for 22%. Human consumption and livestock are using 5% and 3% of the world fresh water use, respectively (Pearce & Turner 1990).

Food and Agriculture Organization (FAO.) argue that water availability is a growing concern in two major aspects, first, that a high proportion of renewable water resource is already used up and secondly, in the aspects where trans-boundary water resource management regimes cannot or are difficult to develop (FAO. 2013).

The central theme of this study is water resources and how this valuable resource is managed in rural societies to secure livelihood outcomes. The study assesses the management of water resource institutions and livelihoods adaptation in Kilombero rural areas in Tanzania. The area is introduced as agriculturally under-developed characterized by low crop productivity and inadequate water resource management (Armanios & Fisher 2012; Sokile et al. 2003). Two villages, namely, Mkula and Msolwa A were strategically selected to conduct the study. Improved irrigation, traditional and rain-fed agriculture was practiced at Mkula village and Msolwa A village practices only rain-fed agriculture. Vulnerability is a serious concern which constrains the prosperity of the rural livelihoods.

As in other parts of Sub Sahara Africa, most people is Tanzania population are farmers and are challenged by water scarcity even when the resource is available (Agwater Solutions 2012). To secure rural livelihood outcomes, traditional and small scale farming are practiced characterized by low efficiency of water uses in the country (Maganga et al. 2001). The agricultural sector that has lions' share in water use employs over 14.7 million people of the total economically active population.

In the water sector various reforms have been taking place over the time to ensure its sustainability while achieving higher crop productivity across the country. National Irrigation

Master Plan (NIMP) of 2002 provides funds to the Agricultural Sector Development Programme (ASDP) and identified a total irrigation potential area of 29.4 million hectares (Mahoo et al. 2012; Permanent Secretary Ministry of Agriculture Food and Security and Cooperatives 2011). The National Irrigation Policy (NIP) of 2010 intends to increase areas for irrigation and implementation of irrigation development across the country (Permanent Secretary Ministry of Agriculture Food and Security and Cooperatives 2011).

In the global context, fresh water resource accounts for 3% of the total global water while the remaining 97% accounts for oceans and other saline water. Two third of the fresh water is located in polar ice caps, alpine glaciers and the Antarctic continental ice sheet (VanLoon & Duffy 2011). According to VanLoon & Duffy, a global fresh water resource is distributed as follows; polar ice caps and glacier 66%, ground water 30%, permafrost 0.9% and accessible surface water 0.4%. The accessible surface and near-surface water which is 0.4% of the total global fresh water resource is uneven distributed according to human geographical locations. Water in living biomass and rivers account for 0.8% and 1.6% respectively, this include all accessible surface and near-surface water. Wetlands 8.5%, atmospheric water vapor 9.5%, soil moisture 12% and lakes 67% (VanLoon & Duffy 2011). These factors demonstrate how scarce fresh water resource is on our planet today. Special attentions about proper water management have to be addressed for different water uses.

FAO points out that at present 1.5 billion hectares of the global land surface (about 12%) is used for crop production. FAO (2013) statistics reveal limited expansion particularly for cultivation land due to various human and natural factors. Of all cultivated area 90% is located in Latin America and Sub-Sahara Africa and half of the land is located in just seven countries (FAO. 2013). World agriculture production has increased at least 3 times over the past 50 years while cultivated land has only 12% of the cultivated land. In the same time period an increment of more than 40% of the world food production has resulted from irrigation agriculture. The global food production growth is enhanced by modernization in irrigation activities, improved agricultural inputs and technological advancements. At the same time cultivated land per person gradually declined from 0.44 hectares to less than 0.25 hectares (FAO. 2013).

1.2. Background

Irrigation accounts for 85% of all total water resources withdraws in Tanzania whereby the agriculture sector contributes 25% of country's GDP and employs over 70% of nation's work

force (Minister of Water and Irrigation 2010). The irrigation development potential areas are classified into high (2.3 million hectares); medium (4.8 million hectares) and low potential are as (22.3 million hectares). A criteria for classifying the potential levels were based on water resources, land resources and socio-economic development on the particular location (Minister of Water and Irrigation 2010). According to the Minister for Water and Irrigation (2010) only 310,745 hectares had improved irrigation infrastructures in 2009 (Minister of Water and Irrigation 2010).

Kilombero valley lies in Rufiji River Basin; the area is drained by Rufiji River and its tributaries before discharging into Indian Ocean. Main tributaries are Great Ruaha River, Kilombero River and Luwengu River. Rufiji Basin and so Kilombero area have much to offer to the country's economy in terms of agriculture, livestock, fisheries, mining, hydropower and sediment transport. Strategically, the area is of great importance for crop production and food security in the country. Kilombero floodplain comprises 329,600 hectares of the 622,400 hectares that is Great Ruaha's potential irrigation area (Armanios & Fisher 2012; Mwalyosi 1990). According to Mwalyosi (1990), both large scale farming (KOTAKO 1987) and small scale farming are practiced in Kilombero Valley. Water resource monitoring in the basin has been conducted over the past 60 years. Inappropriate and unpreserved data has led to that monitoring of water resource through Remote Sensing (RS), Geographical Information Systems (GIS) and other mechanisms has not been reliable. As in other parts in the country, appropriate water resource management is a growing concern in the area today (Armanios & Fisher 2012).

Increasing demand for water resources generates serious conflicting uses of such scarce resource in Kilombero valley today. The area is lagging behind on an elaborate institutional framework to facilitate the integration of the various water resources uses (Kangalawe & Liwenga 2005). The area faces great challenges of managing and controlling water resources which contribute to the increases in conflicts over water use. The Tanzanian government and donors are working together to improve the management of water resources. The Integrated Water Resources Management (IWRM) project is working with government agencies to promote integration across sectors based upon the Dublin principles agreed in 1992 (Maganga et al. 2001; Maganga 2003). Water pollution, environmental impacts, weather variability, multiple water uses and others are components that jeopardize the existence of fresh water in the area.

Major policy transformations have occurred in the irrigation sector. The use of water dates back to the Iron Age, a good example was the traditional irrigation occurring in the northern highlands. The infrastructure was poorly designed, but were functioning in a local context (Kissawike 2008). Lately In the 1930's Tanganyika Planting Company (TPC) was introduced before it was nationalized and become the Sugar Development Corporation (SUDECO) in the 1960's. Also in 1948, the Kiangali rice irrigation farm was introduced in Morogoro Region with an area of 1000 hectares. More transformation in irrigation sector continued to occur, in 1960's and 1970's targets for developing irrigation areas were settled. In the 1980's and 1990's the government put efforts to built institutional capacity to assist both parastatals and smallholders (Minister of Water and Irrigation 2010). The experience however indicates that most of the initiated irrigation schemes were proved partial or complete failures (Kissawike 2008; Mahoo et al. 2012; Minister of Water and Irrigation 2010).

The government has developed a special emphasis on irrigation development. The growing concern of water shortage while poorly managed contributes to lower crop production in Tanzania (Lankford 2005; Minister of Water and Irrigation 2010). National Water Policy (NAWAPO) of 2002 and the National Irrigation Act 2013 have prepared to administer efficient and sustainable use of water resources.

1.3. Problem statement

"Within the Rufiji basin, the greatest water use occurs in the Great Ruaha sub-basin, and already water shortages and water use conflicts are being experienced" (Maganga et al. 2002, p 924.).

Wastage of water as smallholder irrigators do not have incentives to use water efficiently continues to magnify water problems in Rufiji Basin. Poor agricultural practices contribute to the reduction of rivers flows in the area (Maganga et al. 2002; Mombo et al. 2013). Increases upstream abstractions for irrigation are a reason for water wastage which enhances shortages and water related conflicts within and between upstream and downstream users. Unsuitable water management horizontally and vertically is accelerated by existing institutional gaps as failures in the overall framework of water management institutions (Maganga et al. 2002; Sokile et al. 2003).

Main water uses in the basin include, irrigation, hydropower generation, fishing and wildlife water supply. Others are domestic and livestock water supply and transportation (Kangalawe

& Liwenga 2005; Maganga et al. 2002). Growing water demands and inadequate integration across various water sectors in the area simultaneously escalate conflicting uses of water resources.

The government established Basin Water Boards (BWBs) and Basin Water Office (BWOs) to plan and control water utilization (Maganga et al. 2004). Rufiji Basin Water Office (RBWO) established in 1993 with foremost objectives, that "to act as principal executors of the water utilization Act No. 42 of 1974 and its subsequent amendments (namely of 1981,1989 and 1997) on water allocation and water pollution; and to carry out research pertaining to water resources management in the Rufiji River Basin" (Maganga et al. 2002, p 924.). Immediate plans were stated in the RBWO including establishing water right systems and Water Users Association as a legal institution.

Precipitation patterns have been changing and increasingly becoming risk factor to the rain-fed crop production. To secure livelihood outcomes in rural communities' farmers are now moving towards irrigation agriculture as an adaptive strategy. Lack of irrigation infrastructures and land scarcity become a constraint to farmers who wishes to diverge from unpredictable and low productivity rain-fed agriculture. Low crop production in Tanzania is also enhanced by unclear ownership of irrigation infrastructures, lack of competitiveness in irrigation development (absence of active private sectors) and lack of elaborate institutional framework to facilitate the integration of the various water uses (Kangalawe & Liwenga 2005; Maganga et al. 2002; Minister of Water and Irrigation 2010).

1.4. Objectives and research questions

This research aims to assess the efficiency of water resource management in both the improved irrigation and traditional irrigation schemes in Kilombero valley. A second aim is to assess the livelihood situation and capability of smallholder farmers to counter various shocks, risks, trends (stresses) and so on over their livelihood activities.

Specific objectives and their correspondence research questions are as follows;

To assess livelihood situation of smallholder farmers and their adoption to the various shocks, risks, trends to secure their livelihood outcomes

- What are the main household assets at Mkula and Msolwa A villages?

- What are the major activities employed by villagers to achieve the livelihood outcomes?
- What share of households' income is resulted from on-farm, off farm activities non-farm and remittances?

To examine how water dependence impact livelihood situations

- Who gets what of water?
- What type of irrigations is practiced by individuals/groups in the villages?
- How water access affects yields?
- What happens in time of scarcity, who losses and who benefits?
- What are the farmers concerns on downstream water use?

To assess the institutional management of water resource on smallholder farmers' livelihood activities

- How boundaries and limits on water resource are defined?
- How rules of governing water use developed?
- What is the individuals/groups participation on modifying the rules that govern water use?
- Do the rule-making rights of community members respected by outside authorities?
- What arrangements developed by the community for monitoring members' behavior?
- Does the sanction system present the expected outcomes?
- Do the dispute resolution means operate sustainably?
- What is the coordination status of water resource managements between village level and outside authorities from the farmers' perspectives?

1.5. Thesis structure

The thesis constructed into nine distinctive chapters as follows: Chapter two presents conceptual analysis on water resources management, institutions and livelihoods adaptation to various economic shocks. Conceptual perspective will assist to elevate actual image in water resource management, institutions and livelihoods adaptation in order to propose possible cause of action to predict an outcomes. Later the research will employ theory to research objectives.

Chapter three projects study settings detailing about locations, climate, topography, water resources, demographic and livelihood activities, water management institutions, irrigation and agricultural activities in the study area. Chapter four explains research methodology and techniques used to meet research objectives. Chapter five presents field experiences (results and findings regarding assets endowed) from the study area highlighted by research objectives. Chapter six presents the activities performed in the study villages. Chapter seven covers livelihood outcomes, vulnerability contexts and water use. Chapter eight asses water resource use and its institutional management implications in irrigation schemes. Finally chapter nine concludes the work and provides finding and elaborated recommendations from the field experiences to relevant parties.

CHAPTER 2 - CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Conceptual frameworks are intermediate theories that attempt to connect actual life aspects and the used approaches to build coherent possible ideas in order to correct or redirect where necessary. Success or failure in resource management can provide insights in a particular phenomenon so that others can learn and prosper. This research has borrowed concepts from Sustainable Livelihood Approach (SLA) and employs it to livelihoods situations in the study area in order to better analyze and understand resource management. Major components from SLA include assets, activities and outcomes which will be discussed in details later in this study. Vulnerability, external action and irrigation will also be looked into.

To asses' social organization and institution structures this study will use Ostrom's design principles on Common Pool Resources (CPRs) in order to understand the role of institutions in managing communal water resources.

2.1. Brief history of water resource management and institutions in Tanzania

As far as population growth is concerned, the resource management pressures increases. Starting from pre colonial time, during the colonial period and post independence era, the evolution of water management sanctions and institutions have passed through various stages (the details below). In all eras the coordination among water users is characterized by misuse, abuse and conflicts causing mismanagement of water resources that we also experience today (Sokile et al. 2003).

2.1.1. The pre-colonial era (before 1884)

The pre colonial period human settlements were scattered except in limited areas where specific resources were found. Such resources are typically permanent water supply, fishing activities and areas where threat was removed and peace was restored (Kikula 1997). According to Sokile et al. (2003) traditional society used customary systems to administer resource use and such rules were often changing to accommodate particular situations. In general informal rules, values and norms were applied to govern such settlements.

2.1.2. Colonial time (1984-1960)

It has been argued that statutory water law in Tanzania (by then Tanganyika) started in 1923 initiated by increasing demand for water during the 1900s. The German colonial government

was interested in irrigation agriculture in order to diversify colonial economy (Sokile et al. 2003). According to Maganga et al. (2004), various types of legal regimes existed in Tanzania often in conflict over utilization and management of water resources. The Water Ordinance of 1948 and the Water Ordinance of 1959 was introduced by British rulers. The former ordinance recognizes the right of native civilians to obstruct, abstract, or use water in accordance with their native law and custom before it was succeeded by the Water Utilization Act, 1974 (Maganga et al. 2004). The later, according to Maganga et al. (2004), define ownership of, and rights to the use of water, and it also established institutions for water supplies in urban and rural areas.

2.1.3. Post-independence era (1961- onwards)

The evolution of water resources continued to occur, the notable legislation occurred in 1974 where the Water Utilization (Control and Regulation) Act, 1974 was established to regulate rivers, internal lakes and streams (Maganga et al. 2004). The law designated National and Regional Water which was regulated by the minister responsible for water. A principal Water Office and a Central Water Board control National Water use while the Regional water supplies control Basin Water Boards (BWBs), Basin Water Offices (BWOs) and Regional Water Engineers (RWEs) (Maganga et al. 2004).

The National Water Policy (NAWAPO) was formed in 2002, attempting to develop more competition in water sector by widening participatory in water supply to community and to private sectors. The tendency was to pull out the central government in the implementation of water projects. In 2005, the National Water Development Strategy (NWSDS) initiated and assisted to have two new water acts, namely, the Water Supply and Sanitation Act and the Water Resource Management Act passed by Parliament in 2009 (African Ministers' Council on Water 2011). In 2008 particular ministry for water and irrigation formed to administer and ensure development and sustainably uses of water resources in collaboration with all stakeholders (Minister of Water and Irrigation 2010).

The National Irrigation Act, 2013 was established to encounter challengers in irrigation sector. Absence of a legal framework to protect and promote irrigation land, inadequacy within institutional framework to manage irrigation activities and poor incentives to most of individuals to manage irrigation activities are among of the drawbacks in irrigation sector which are now uncounted under the National Irrigation Act of 2013. The Act with other objectives has also established National Irrigation Commission as it mentioned in the part II

clause 3. The commission is responsible for coordinating, promoting and regulating functions in the development of the irrigation sector (Sefue 2013).

Declaration and classification of irrigation land are incorporated in the part III of the bill, part IV of the bill covers issues related to construction of irrigation infrastructures and specify persons or entities entitled to undertake the construction. Part V and VI provide details about irrigation schemes and management of irrigation schemes respectively. Sanctions to the party which intervene the act is covered in part IX of the bill (Sefue 2013).

Great efforts have been applied to manage the resource but still scholars portray inadequacy in water resource management. Critiques see little or no progress taking place. Inability to coordinate water uses to obtain effective, efficient and transparent institutional frameworks for the management of the resource has become a major drawback. Various institutions for water governs are fragmented and cause a lack of integration among water stakeholders. Maganga et al. (2004) cautions about the pluralistic legal system statutory, customary and religious laws are typically not interconnected to provide a sound legal framework. Sokile et al. (2003) are skeptical about the efficiency when concentrated institutions try to work interconnected to management the resource.

Sokile et al. (2003) provide an example of fragmented institutions that work to manage the water resources in Tanzania as follows; Water supply is administered under water engineers, irrigation under Ministry of Agriculture and Food Security. Other examples are hydropower under Ministry of Energy and Minerals, conservation of biodiversity in water bodies under Ministry of Natural Resources and Tourism and industrial discharge to water under Ministry of Industry and Commerce (Sokile et al. 2003, pg 1018.).

Capability of such fragmented institutions to deliver special attention on the resource management can be discussed. It is fact that this bureaucracy can lower efficiency under. Debates over efficiency of water resource management in micro-level or macro-level are mounted at how desperate things they are today.

2.2. Existing research on water management, irrigation, institutions and livelihoods in Rufiji Basin Area

Many studies have already been undertaken in the Rufiji Basin area in order to understand communal based natural resources management. Demands for water as a significant factor to achieve livelihood outcomes has been a central argument for several debates discussions and

supports. Government agencies, donor supports (DANIDA, JICA, AFDB and DFID) and regional institutions (SWIMNET, SACCAR, and IWMI) are conducting a range of studies on the area. University of East Anglia, Bradford University, Sokoine University of Agriculture, University of Dar Es Salaam and others are some of the academic institutions which are conducting research on the area today. EPINAV project is also one of the ongoing studies at the moment sponsored by NORAD and conducted by Sokoine University of Agriculture and Norwegian University of Life Sciences (NMBU)

Franks et al. (2013) point to that rice farming is a profitable enterprise to both smallholder farmers and larger holdings. A range of different livelihood strategies has been developed by smallholder farmers so as to diversify risks. Rain-fed crops, animal husbandry, and other non agricultural activities has been part of livelihoods supports. The study portrays that the rise in paddy production prevent a pastoral mode of production (Franks et al. 2013). It has been argued that the smallholder farmers are responsive to change in the changing conditions when they perceive the season is likely to change; they can hook up or abandon their plots. Increasing pressure on environment (mainly land and water) and growing population has lead to an increase of insecurity of livelihood activities while maximizing conflicts over the area.(Franks et al. 2004).

Recent study by Franks et al. (2013) find that irrigation water users' associations have succeeded in initiating sound arrangements for access to water. Water institutions with their own written constitutions have been well developed across the time. Elaborating about water allocation and management the study argues that, "…the actual locus of power resides in a network of powerful individuals, rather than the formal water user organizations" (Franks et al. 2013). Sound relationship between institutions and village governments is well established which enables legal arrangements in access to water to work along with informal arrangements draw both on water decisions. Several institutional initiatives are being carried out in Usangu to converge upstream water use. The Water Managers' Group, water use in sub-catchment, government and other external agencies are mentioned as assisting the initiatives and diversity of issues dealing with the water resource management. External agencies mentioned are World Wildlife Fund (WWF), RIPARWIN, a research project funded by the UK's Department for International Development (Franks et al. 2004; Franks et al. 2013).

Cleaver (2002) argues that local stakeholders face poor public management of resources, driven by corruption and conflicts. Institutions are lacking participatory actions obstructed by social and cultural structures (Cleaver 2002). According to Cleaver (2001) formal institutions have lagged behind in recognizing the depth of social and cultural interactions in cooperation relation that jeopardy social capital strength. Cleaver (2001) finds that increasing population pressures, climate variations and fluctuation in resource availability have caused peoples' migration to secure livelihoods in Tanzania. A growing population in a relative small area have resulted changes in land use and increases water demands with limited supply in Usangu area. Non existence or disappearing of traditional form of resource management in multi-ethnic Usangu basin with growing population face poor arrangements for resource regulations (Cleaver 2001).

The Rufiji Basin Water Office (RBWO) is responsible for issuing license for water abstraction (water rights) advised by Rufiji Basin Water Board (RBWB) in return for water fees in Usangu area. Introduction of water fees and water rights have brought significant impact to the water management though not all farmers are comfortable with the amount required. Farmers' fees cover water rights as well as routine maintenances of infrastructures and the costs of associations (Franks et al. 2004; Franks et al. 2013).

Lankford (2010) points to that climatic fluctuation plays a necessary role in the reduction of river flows even though rice cultivation is the main actor of water use in the basin (Lankford 2010). It has been argued that, "in normal to wet years, irrigation uses approximately 30% of water available for downstream use, whereas in the 1-in 5 drier years, irrigation utilizes nearly 50% of all water"(Lankford 2010). According to Lankford (2010) several analyses indicate that rice cultivation is not the major threats in the case of water shortage in the river system.

Lankford (2010) finds that water right is not determined in a transparent ways. Water rights are lacking consistency in assets and outcomes which causes most farmers to become unaware with their formal rights. "Relating water use to right is problematic as water is unlikely to be even metered and monitored and so farmers may take more than their rights"(Lankford 2010). According to Lankford (2010), water rights are not reconciled with available water or with downstream needs. Seasonal variations cause river flows to change dramatically, for example dry and wet seasons and from dry to wet year, so the water rights should not be static. Also, legal pluralism in the present water arrangements has become a drawback for smallholder

farmers in reaction water developments. Irresponsible farmers don't hold the responsibility of protecting water after paying their water fees, they sometimes overuse or waste.

Lankford (2010) argues that in order to have more focused strategies on the management of water in river basins it is important to understand the seasonal variation of water supply and demand. Given an example from November to mid January, it is high time for irrigators to start rice nurseries while it is still dry season, river flows are down and there is no rain yet. This incidence contributes to severe water shortages downstream. Size, scale, distance, lack of ground water, seasonality of rainfall, communication and others are the key difficulties with water management in Sub Sahara Africa.

"By enabling local communities to control water, water control is more efficiently passed to users" (Lankford 2010). According to Lankford (2010) common property mechanisms will assist local communities to reconcile water use within a sub-catchment of the large Ruaha catchment while enhancing transparency of abstraction between intakes.

It has been argued that agricultural households in Morogoro Region are practiced extended cultivation, agriculture intensification, livelihoods diversification and migration as adaptation strategies to the vulnerability context in order gain livelihood outcomes. The adaptation strategies as response to climate variability and other stressors have a major impact in environmental issues. Natural resource depletion (soil, forests and water resources) and environmental degradation pose threats to people's wellbeing (Paavola 2008).

It has been argued that better water management is believed to increase land and water productivity in return it improves poor people lives (Samad & Merrey 2006). Poor performance of irrigation system in developing countries is attributed by poor management. Big irrigation investment in 1960s and 70s did not produce the anticipated results because of the management gap (Samad & Merrey 2006). Samad and Merrey (2006) point to that unequal distribution of irrigation water, poor maintenance of irrigation infrastructures, increasing incidence in water related conflicts, information gaps, environmental impacts, lack of trained irrigation personnel has contributed low productivity in land and water in developing countries in 1980s to 90s.

The inception of International Water Management Institute (IWMI) came out with three research themes which are system management, system rehabilitation and improvement and farmer-managed irrigation system (Samad & Merrey 2006). The institute was enlighten by the

better understanding of water resource issues in 1990s which also changed world's scientists, policymakers and leadership understanding in water core issues (Samad & Merrey 2006). Developed information system base on the farmers or local knowledge transformed the approach and implementation of water strategies. Results indicated that most governments declined funds in irrigation activities, water-users' associations were established.

2.3. Theory applied in thesis

2.3.1. Sustainable Livelihood Approach (SLA)

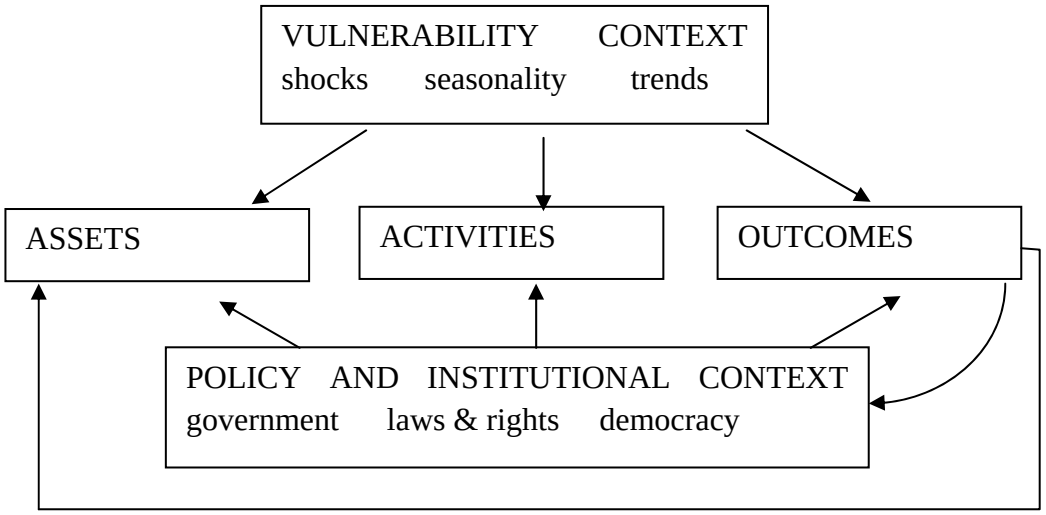
Sustainable livelihoods can be seen as a concept, or research approach depending on the use. National governments, donor agencies, scholars and others they have been using sustainable livelihoods on kind of matters related to the respective subjects. The World Commission on Environment and Development used the term sustainable livelihoods in the illumination of resource ownership, basic needs, and rural livelihood security while in United Nation Conference on Environment and Development in 1992 the term used in the light of socio-economic and environmental issues (Fisher & Brocklesby 2003). According to Fisher and Brocklesly (2003), donors such as the British Department for International Development used the sustainable livelihood approach as an operational tool on poverty reduction activities (Fisher & Brocklesby 2003).

"Livelihoods comprises the assets (natural, physical, human, financial and social capital), the activities and the access to these (mediate by institutions and social relations) that together determine the living gained by the individual or household" (Ellis 2000, p. 10)

The term livelihood expresses the capability of building satisfactory living resulted by available resources (Ellis, F. & Freeman, H. A 2005). Livelihood enlightens how available resources are commanded to make a living in a particular setting. It has been argued that the term livelihood denotes a "means of gaining a living" (Chambers & Conway 1992, p. 6)

According to Ellis and Freeman (2005) basic livelihoods framework comprises of three major parts; first part components are assets, activities and outcomes. Second part embraces the vulnerability context. Components in the third part are policy and institutional contexts (Ellis, F. & Freeman, H. A 2005) (Figure 2-1).

Figure 2-1：The Basic Livelihoods Framework



Source: (Ellis, F. & Freeman, H. A 2005, p. 4)

2.3.1.1. Assets, Activities, Outcomes

Assets. Assets or capital in the livelihoods approach refers to available resources which assist the production. Ellis & Freeman (2005) categorize five distinct types of assets/capital namely; natural capital, human capital, physical capital, financial capital and social capital.

Natural assets are "natural resource base that yields products utilized by human populations for survival"(Ellis 2000, p. 8). Natural capital includes land, water, agriculture, soil, livestock, renewable/non renewable resource, genetic resource to mention the few.

Human capital include labor, education, skills, education, health, sex and so on available to the households (Ellis 2000).

Physical assets refers to "assets brought into existence by economic production processes"(Ellis 2000, p. 8). That does include technologies, infrastructures, investment goods, and others.

Financial capital refers to the amount of money possessed by the households which includes cash, savings, loans/grants/credit access and so on (Ellis 2000).

Social capital is reciprocal within communities and it is based on the degree of trust, communal values and norms on a particular social setting (Ellis 2000; Moser 1998). Moser (1998) argues that social capital "increase reliance on informal credit arrangements" (Moser 1998, p. 8). The motion signifies the degree of inclusiveness within the society that is based

on trust. Social capital associates networks and associations which include religion, gender, castle status, roles, ethnicity and others. Social capital changes across the time (Ellis 2000; Moser 1998).

Ellis and Freeman (2005) argue that livelihoods constructions are not a straight forward issue. Rather, it involves many social and political complexities and sometimes not all activities (assets and activities) fit within sustainable livelihoods approach. The categories assist to locate courses of action or alternatives.

Assets status shape individual or household capabilities and motivations in a myriad of ways. Asset status draws attention to individuals or groups to undertake livelihood options which are open or accessible to them. Given a particular context, individuals and households can determine what sort of possessed/owned assets can produce an outcomes with (Ellis, F. & Freeman, H. A 2005; Scoones 1998).

Activities: Activities are the options people control in practice to generate income levels suitable for survival. Activities signify what people do to acquire a livelihood. They combine, substitute or diversify assets to assist individuals or households to achieve (or not) an outcomes. Activities include land cultivation, grazing animals, remittances, migration, fishing, hunting, employment with stable enumeration to mention the few. Livelihood strategies based on the existing policy and institutional arrangements to a particular area at a particular time (Chambers & Conway 1992; Ellis 2000; Ellis, F. & Freeman, H. A 2005; Scoones 1998) (Figure 2-1).

Outcomes: Outcomes are the domino effect of the activities performed by individuals or households. Examples of outcomes include earnings obtained from on-farm, off-farm or non-farm activities. Outcomes can be signified by weighing them with certain standards developed to asses various levels of outcomes. Such standards can be outcomes for living standards and wellbeing (attainment of food security, poverty line measure), outcome for quality and sustainability of natural resources (public goods, externalities) and others. Outcomes provide feedback whether constraints or opportunities to the assets and vulnerability context, and that is a continuous process.

2.3.1.2. Vulnerability Context

Vulnerability is defined as " a high degree of exposure to risk, shocks and stress; and proneness to food insecurity"(Ellis 2000, p. 62). The concept of vulnerability reflects the

relationship between the risk of the adverse catastrophic and the ability to manage risk and cope with such catastrophic events. Moser (1998) argues that adverse changes which jeopardize livelihood can be ecological (climate change, droughts, floods and so on), political (civil wars, international/regional conflicts and so on), social (chronic diseases, death and others) or economic (market) characterized by either sudden shocks, seasonal cycles or trends (Moser 1998). High vulnerability occurs when individual, household or community be unable to cope the shocks initiated by high risk of adverse events.

According to Moser (1998) and (Ellis 2000) resilience and sensitivity are elements that refine vulnerability and they are linked with agro-ecology and natural resource management literature. “Resilience refers to the ability of an ecological or livelihood system to bounce back from stress or shock …. Sensitivity refers to the magnitude of a system’s response to an external event” (Ellis 2000, p. 62). High resilience with low sensitivity in a particular household or community signifies a robust livelihood structure, and vice versa. Response to shocks in order to avoid unanticipated livelihood failures individuals, households and communities are pressed to coping or adaptation livelihood strategies.

2.3.1.3. Policy and Institutional Context

Institutions are referred as “regularized practices (or patterns of behavior) structured by rules and norms of society which has persistent and widespread use”(Scoones 1998, p. 12). Institutions have the power to mediate the complex diversity processes of achieving sustainable livelihood. Scoones (1998) points that institutions are the rules of the game and the organization are the players. Organization simply refers to individuals bounded to pursue intended objectives. Both formal and informal institutions exist in the society structures. Institutions are not static, often changing slowly and incrementally, continuous shaped and reshaped as part of social interaction process (Ellis 2000; Scoones 1998).

“The role of institutions is to reduce uncertainty by establishing a stable structure to human interaction” (Ellis 2000, p. 38). Ellis (2000) points the examples of institutions and organizations; institutions examples include laws, land tenure arrangements, customs, market in practice and others. Examples of organizations are government agencies such as police force, ministries, external services and administrative bodies. Others examples are Non-Governmental Organizations (NGO’s), associations and private companies (Ellis 2000).

2.3.1.4. Policy and governance

Ellis (2000) argues that branches of policy are set to deal with the poor people's assets in the rural communities. Education, health, credits are among the policy branches that can help the prosperity of poor rural. "Local level policy context often remains basically inimical than fascinating or supportive to self-employment at startup businesses" (Ellis 2000, p. 240). According to Ellis and Freeman (2005) permits, licenses, taxes, fees, roadblocks and others are some of the factors in institutional context that diminish the efforts of achieving better rural livelihoods outcomes (Ellis, F. & Freeman, H. A. 2005). Skepticisms about the relevance of government tasks (governance, decentralization, taxation, relative price, infrastructure and market development) to provide sound capability of rural people to escape tragic outcomes are being discussed and debated (Ellis 2000; Ellis, F. & Freeman, H. A. 2005).

A framework for micro policy analysis of rural livelihoods assists to "organize ideas into manageable categories, identify entry points and critical processes and assist with prioritizing catalysts for change that can improve people's livelihood chances"(Ellis 2000, p. 9).

2.3.2. An institutional approach to common pool resource management

Ostrom defines institutions to be "the prescriptions that human use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations, and government at all scales" (Ostrom 2005, p. 3).

Institutions are subjective to change as per time and capture important features of social life. Basic network of conventions, norms, rights and rules on which a society is based can establish sound relationship among various actors (state, firms, organizations, individuals). Interdependent choice of an individual depends on how other actors have done their homework elsewhere when sharing common pool resources governed by institutional framework. All actors simultaneously create the structure that affects their behaviors and outcomes, and that is ongoing process (Knight 1992; Ostrom 2005; Poteete et al. 2010).

2.3.2.1. Common Pool Resources Management

The term CPRs described by Ostrom (1990) as a "natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom 1990, p. 30). Ostrom (1990) describes two important terms in CPRs, namely, resource systems and resource units. The former refers to stock variables available that are producing maximum amount of a flow without interfering

stock or resource system; and the later refers to attributes from the system ready to be used by beneficiaries. Examples are acre-feet or cubic meters of water withdrawn from irrigation canal or a ground water basin, parking spaces, filled books available in libraries and so on. Examples of resource systems include irrigation canals, water bodies, bridges, libraries, and so on (Ostrom 1990).

This study portray water resource like other common pool resources are endanger of diminishing because of overuse escalated by selfish individual decision making in commons use (Adams et al. 2003; Meinhardt 2002). Ostrom (1990) seeks to understand how to obtain continuing joint benefits by group of beneficiaries who are in an interdependent situation to organize and govern themselves without been trapped in a free-ride situation (Ostrom 1990). The organization and governance of common pool resource face dilemma where a number of users have access to the resource while theory of collective action is not at place. The management of common pool resources can be viewed as a problem of collective action that reflect differences in material interests between stakeholders (Meinhardt 2002).

Poteete et al. (2010) are optimistic about collective action in the commons, they portray that neither individual private property rights nor centralized state control is requires for sustainable management of common pool resource management. Bundles of rights can work to facilitate efficient management of common pool resources but not just single right (Poteete et al. 2010).

Poteet et al. (2010) use CPRs database and present four questions to backup their point; “What difference to different property rights make? Which characteristics of a group affect the ability to organize successfully? How does the type of collective challenge influence a group’s capacity to organize an effective response? What type of regimes-institutions for sustaining collective action-are robust over time?”(Poteete et al. 2010, p. 94). These questions were asked to build up concepts through CPRs database and other experiences that it is possible to analyze variation in the success of collective actions on the commons (Poteete et al. 2010)

In theories institutions are proper instrument to provide conditions for access and proper utilization of commons facilitated by proper communication. Various literatures have been developed across the time attempting to address inadequacy in common pool resources management and attempt to find out proper measures to deal with the shortcomings (Adams et

al. 2003; Meinhardt 2002; Poteete et al. 2010). Different understanding and knowledge of resource use problems among stakeholders contradict the solution arrangements.

Fortunately, after switching back and forth discussions on commons management in social science arenas, scholars were able to articulate the design principles illustrated by long-enduring CPR institutions described extensively in Ostrom (1990) (discussed later). The eight design principles based on empirical analysis of several long-enduring CPRs are described in brief as follows; Well defined boundaries, proportional equivalence between benefits and costs, collective choice arrangements, and monitoring. Others are well established graduated sanctions, conflict-resolution mechanism, minimal recognition of rights and nested enterprises (Poteete et al. 2010) (Table 2-1). Ostrom (1990) contests that design principles are not necessary or sufficient rather they increase the probability of successful CPRs management.

Design principles illustrated by long-enduring CPR institutions

Ostrom (1990) argues that the design principles are the "essential elements or conditions that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of the appropriators to the rules in use" (Ostrom 1990, p. 90). Ostrom (1990) points to that community of individuals have relied on institutions to govern resource systems for a long time without state or market interventions. According to Ostrom (1990), further theoretical and empirical work has to be done to ascertain the relevance of the design principles to govern the commons (Ostrom 1990).

Local community is socially bound by individuals or groups living in particular boundaries where the design principles for long-enduring CPRs are applied. The community may find the common ground to manage public goods which surround them and that include both formal and informal arrangements. According to Vedeld (2002) power, rights, duties and authority lines evolves over the time constituting sets of values, norms and experience-based knowledge and competence to govern the community (Vedeld 2002).

Research and experience indicates that certain key components if administered precisely will assist local institution to operate successfully over the time. Table 2-1 illustrate success principles encompass key elements that should be in place for the common property regime to be long time enduring (Vedeld 2002). Farmers Managed Irrigation Systems (FMISs) in various areas around the globe for example Nepal, Thailand, Sri Lanka were consistence with minimum damage of natural environment, improve food security and enhancing employment (Shivakoti & Shresthe 2004).

Design principles for long-enduring CPRs presented by Vedeld (2002) based on Ostrom (1990)

Clear defined boundaries. Defining the boundaries of the CPRs and individuals who have rights to withdraw resource units can enhance self-governance in managing water resources. This is highly advocate by incentives expected by appropriators when successfully manage the resource also by preventing outsiders to benefit from other people's efforts. It is important to have control of resource units harvested so as to have sustainability in resource system. Eights design principles are illustrated in Table 2-1.

Clearly define membership and rights. Bundle of rights to appropriators will facilitate smoothly usage of CPRs.

Congruence between appropriation and provision rules and local conditions can be exercised by imposing restriction not to overuse or overexploit the resources. Equilibrium between take and give in resource units related to local conditions and to provision rules has to be maintained.

Collective choice arrangements; Efficient and effective representative system where equity in decision making is required by CPRs institutions that use this principles

Effective monitoring procedures can be well presented if those who monitor and audit CPRs conditions are accountable.

Legitimate procedures for graduate sanctions will work successfully if strict rule arrangements to violators agreed by all appropriators have reserved on place.

Accessible conflict-resolution mechanisms: Affordable cost is emphasized to resolve conflicts among appropriators or between appropriators and officials.

Recognition of local people to organize: Higher or external governmental authority should comply with local authority so as to strengthen the integrity in both horizontal and vertical authority.

Table 2-1: Modified design principles for long-enduring Common Pool Resources

Success Principles	Description
Clearly define physical boundaries	Clear relative to neighbor or competing uses
Clearly define membership and rights	Multilayered rights system and may include the right to physical access the area, the right to withdraw resources, to manage or decide on use, to exclude others and to alienate others through sales or leasing
Congruence between appropriation and provision rules and local conditions	Should be a reasonable balance between what individuals contribute and what they take out
Collective choice arrangements	Most of affected people can participate in decision making
Effective monitoring procedures	Those who monitor and audit CRP conditions are accountable
Legitimate system for graduate sanctions	There are rules against violation. Sanction depends on the offence. It should be assessed and imposed by fellow users or accountable officials
Cheap/accessible conflict-resolution mechanisms	Conflict resolution should be swift, inexpensive and fair
Recognition of rights to organize	No challenge by external government authorities; if they come in and overruled local decisions, local authority is undermined

Source: (Vedeld 2002, p. 18). Based on (Ostrom 1990).

2.3.3. Conceptual model and research objectives

The study will use the SLA and modified design principles for long-enduring common pool resources institutions to analyze research objectives. For the first objective, Sustainable Livelihood Approach will be used to assess livelihood situation of smallholder farmers and their adoption to the various shocks, risks, trends to secure their livelihood outcomes. Objective two both Sustainable Livelihood Approach and modified design principles for long-enduring common pool resources will be used to analyze and evaluate how water dependence impact livelihood situations. In objective three modified design principles for long-enduring coon pool resources will be applied to evaluate the management of water resource on smallholder farmers' livelihood in irrigation schemes. Table 2-2 is illustrating the matches of the objectives corresponding to their appropriate conceptual models.

Table 2-2: Matches of the objectives corresponding to their appropriate conceptual models

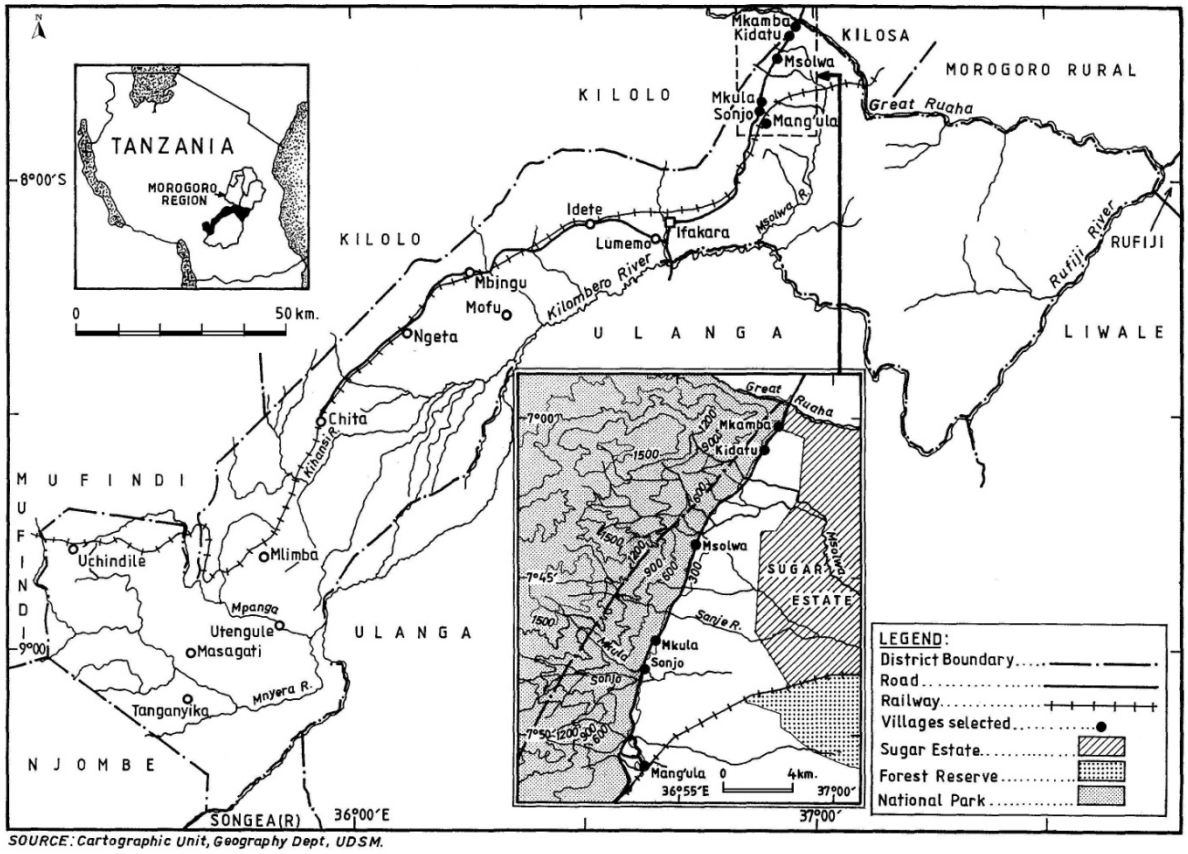
Objective Number	Objective	Conceptual Model
1	To assess livelihood situation of smallholder farmers and their adoption to the various shocks, risks, trends to secure their livelihood outcomes	Sustainable Livelihood Approach
2	Examine how water dependence impact livelihood situations	Sustainable Livelihood Approach
3	To assess the management of water resource on smallholder farmers' livelihood activities	Modified design principles for long-enduring common pool resources

CHAPTER 3 - STUDY AREA

3.1. Location

Mkula and Msolwa A villages are the case study villages for this research. The villages are located in the vast Kilombero valley and Udzungwa Mountains in Kilombero District in Morogoro Region, Tanzania (Figure 3-1). The District has a total administrative area of 14,918 square kilometers (Font et al. 2001). Most of the district lies along Kilombero Valley, a part of Rufiji Basin which extends below the Udzungwa Mountains from the East towards the south-west. Geographically, the District is bordered by Kilosa and Kilolo District on the North; Ulanga District on the South; Morogoro Rural District on the East and Njombe and Mufindi District on the West (Ngasongwa 2007; Region Commissioner's Office Morogoro 2008) (Figure 3-1). The district has the total area of 1,491,800 hectares including the area of Selous game reserve, and Kilombero wetland.

Figure 3-1: Map of Kilombero District and a case-study area



3.2. Climate

The mean annual air temperature varies between 26^0C-32^0C. The area experiences two rainy seasons from November to January and from March to May followed by a prolonged dry season. The mean annual rainfall is about 1200-1600 mm. Most areas in Kilombero valley experience floods during the rainy seasons (Region Commissioner's Office Morogoro 2008).

3.3. Topography

A large part of Kilombero District is located in a vast floodplain, between Kilombero River in the south-east and the Usagara and Udzungwa Mountains in the north-west. The relatively smaller remaining part lies in Rufiji Basin, Udzungwa Mountain as a border on the North and Selous Game Reserve on South. The larger part of the Kilombero Valley consists of alluvial plains located at an elevation of less than 300 meters above sea level (Malocho 1997; Ngasongwa 2007). The altitude of Udzungwa Mountains ranges between 200 to 2600 meters above sea level.

Kilombero District has mainly two vegetation types, wooden grassland and miombo woodland. Multilayered evergreen forest with high biological diversity is found within a small area. This area contains population of wildlife animals in national parks, game reserves and outside national park areas (Haule et al. 2002).

3.4. Water resources

The district has a significant water body in Morogoro Region which makes an equivalent of 60 percent of the Region’s total water body. The district has water surface area of 1,341 square kilometers (Font et al. 2001). The district has total number of 38 perennial and seasonal rivers. Mkula River is sourced at the Udzungwa Mountain and it drains through Mkula village and pass on several villages downstream before it is discharged to Kilombero River.

3.5. Demographic and livelihoods situation

3.5.1. Population

According to the 2006 distribution of administrative units, Kilombero District has 5 divisions, 19 wards, 81 villages and 355 hamlets. Indigenous people of Kilombero as well as in

Morogoro Region in general are mainly of Bantu origin. The dominant ethnic tribes in Kilombero District are Wambunga, Wandamba, Wabena and Wahehe (Ngasongwa 2007).

According to the 2012 United Republic of Tanzania, population and housing censuses Kilombero District has a population of 407,880. The district has an average household size of 4.3 (National Bureau of Statistics 2013). The previous censuses of 1978, 1988 and 2002 show the population of 133,013, 187,608 and 321, 611 respectively in Kilombero District implying a rapid growth (National Bureau of Statistics 2013) (Figure 3-2.)

Musamba et. al (2011) argue that population growth rate of 2.5 percent per year projects the population of 392,275 and 516,447 by the year 2010 and 2025 respectively (Musamba et al. 2011). The population statistics reveals a dramatic increase in the population in the area.

3.5.2. Transport and infrastructure facilities

Transport infrastructure in the river valley and basin areas are facing problems caused by frequent flooding during the rainy seasons. In other high altitude areas road facilities are accessible throughout the year. The railway from Dar Es Salaam to Lusaka is crossing Kilombero District (Ngasongwa 2007). Also telecommunication is well developed in the district.

3.5.3. Market and credit access

It is only 24 percent of the total households in the district is reported to engage on selling crops. Major challenges encounter crop sales are low prices, long distance from the market place and adequacy in transport facilities. Other challenges are lack of market information and lack of buyers (Chuwa 2012).

In Kilombero District major credit facility sources are family, friends and relatives which account for 45.5% of all credit facilities followed by NGO/Development projects that account for 36.4% and the banks about 9.1% (Chuwa 2012). Small scale businesses also are practices in the area.

3.5.4. Environmental income

Kilombero District has 13 forest reserves with the total area of 127,364 ha by the year 2006. The district has an estimated value of 9,717,220 TZS of harvested timber/poles in the year 2005/2006. The estimated value of charcoal in the district is 54,180,000,000 TZS in the year

2000/01-2005/06 (Ngasongwa 2007). Bee keeping is practiced in the area supported by the presence of the forest cover situated in the district. Substantial amount of honey (41,625 Kg) and bee wax (2,775 Kg) were harvested in the year 2005/2006 (Ngasongwa 2007).

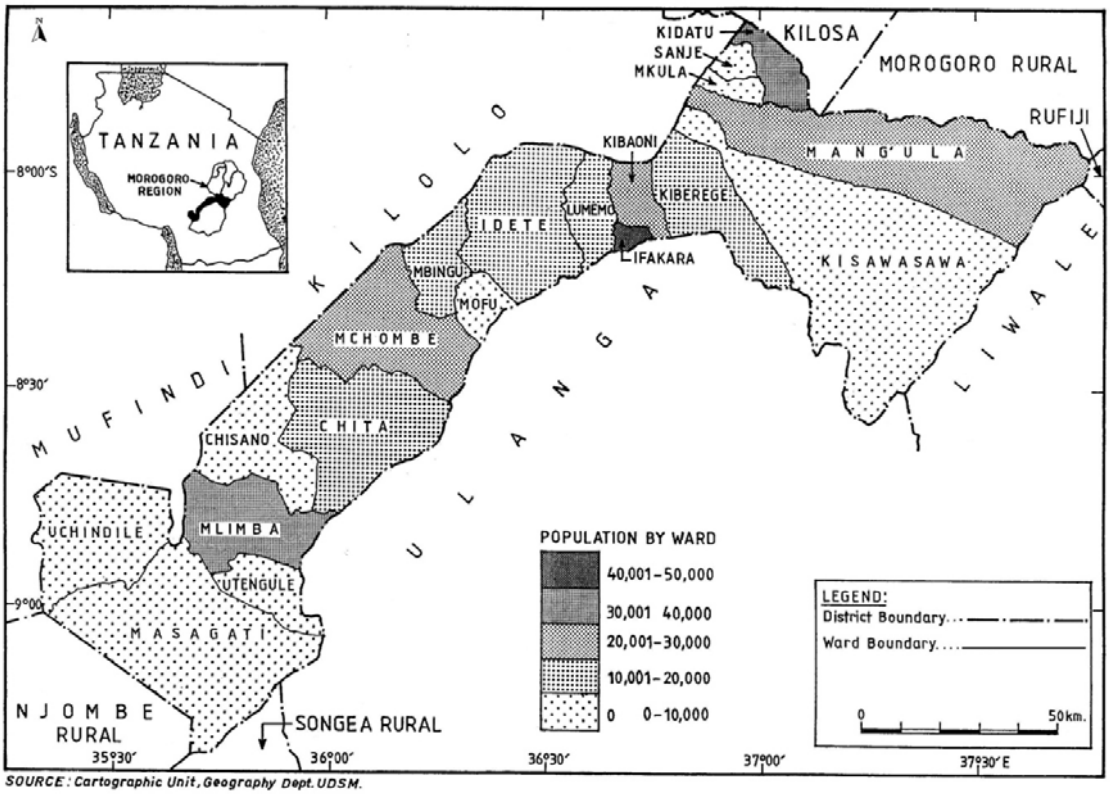
3.5.5. Other income activities

Apart from agricultural activities which employs a large number of the population, fishing and livestock keeping are other socio-economic activities in the area (Musamba et al. 2011). All fish harvested are for the domestic consumption, with no fishing processing or exportation. In the year 2005/2006 the district was having 1,100 fishing licenses, 1,300 fishermen and 75 registered fishing vessels. Fishing activity is ranked second after agriculture in the district with the annual production of 120 tons. Fishing is done mainly in Kilombero and Ruaha Rivers as well as in other small rivers. Types of fish found in the area are mostly tilapia and claries.

Cattle domestication is done by small fraction of wealthier households and pastoral societies (Maasai and Sukuma). Domestic animals found in the area are cattle, goat, sheep, pig, chicken, duck, guinea pig and turkey. (Chuwa 2012; Paavola 2008).

Wildlife and tourism is another social economic activity in Kilombero District. Kilombero Game Control Area, part of Udzungwa National Park and Selous Game Reserve are located in the district. Selous Game Reserve was designated by UNESCO as United Nations World Heritage Site in 1981 (Ngasongwa 2007). Favorite natural condition in the area favor inhabitant of variety of animals including elephant, giraffe, buffalo, hippos, zebra, bush back and lions.

Figure 3-2: Map of Kilombero District and population units by ward



Ngasongwa (2007), points out two elements that group people's economic activities in Kilombero district, namely, main occupation and industry shown in Table 3-1 and 3-2 respectively. Main occupation accounts the labor force engaged in various economic activities and main industry donates the main activities clustered into several groups (Ngasongwa 2007, p. 26, 27).

Table 3-1: Main occupation of the labor force in Kilombero District, 2002

Item	Occupation	Labor Force
1	Legislators, Administrators and Managers	493
2	Professionals	860
3	Tech. and Associate Professionals	3,787
4	Clerks	790
5	Small Business Managers	3,249
6	Service and Shop Sales Workers	2,892
7	Street Vendors	4,249
8	Craftsmen	3,064
9	Farmers	114,651
10	Livestock Keeping	1,344
11	Fisherman	566
12	Plant Operators and Assembly	842
13	Elementary Occupation	4,336
14	Others	585
	Total	140,977

Source: (Ngasongwa 2007)

Table 3-2: Main Industry of the Labor Force in Kilombero District, 2002

Item	Industry	Labor Force
1	Agriculture	113,977
2	Forestry, Fishing & Others	9,141
3	Mining and Quarrying	297
4	Manufacturing	3,124
5	Electricity, Gas and Water	426
6	Construction	1,041
7	Raw food sales (uncooked)	1,864
8	Trade and Commerce	4,422
9	Transport and Communication	623
10	Finance and Insurance	97
11	Public Administration & Education	3,960
12	Others	2,015
	Total	140,978

Source:(Ngasongwa 2007)

3.6. Water management institutions in Tanzania

Water resource management in Tanzania has undergone several reforms before and after independence. The government has established formal legal systems and has started to formalized informal arrangements for water resources management which represents the existence of the legal system. Statutory and Customary laws interplay has provided a multiple legislation and institutions framework for managing natural resources (Maganga 2003; Maganga et al. 2004). According to Maganga (2003), multiple legal arrangements such as statutory, customary and Islamic laws exist in Tanzania, also applied in the water management system

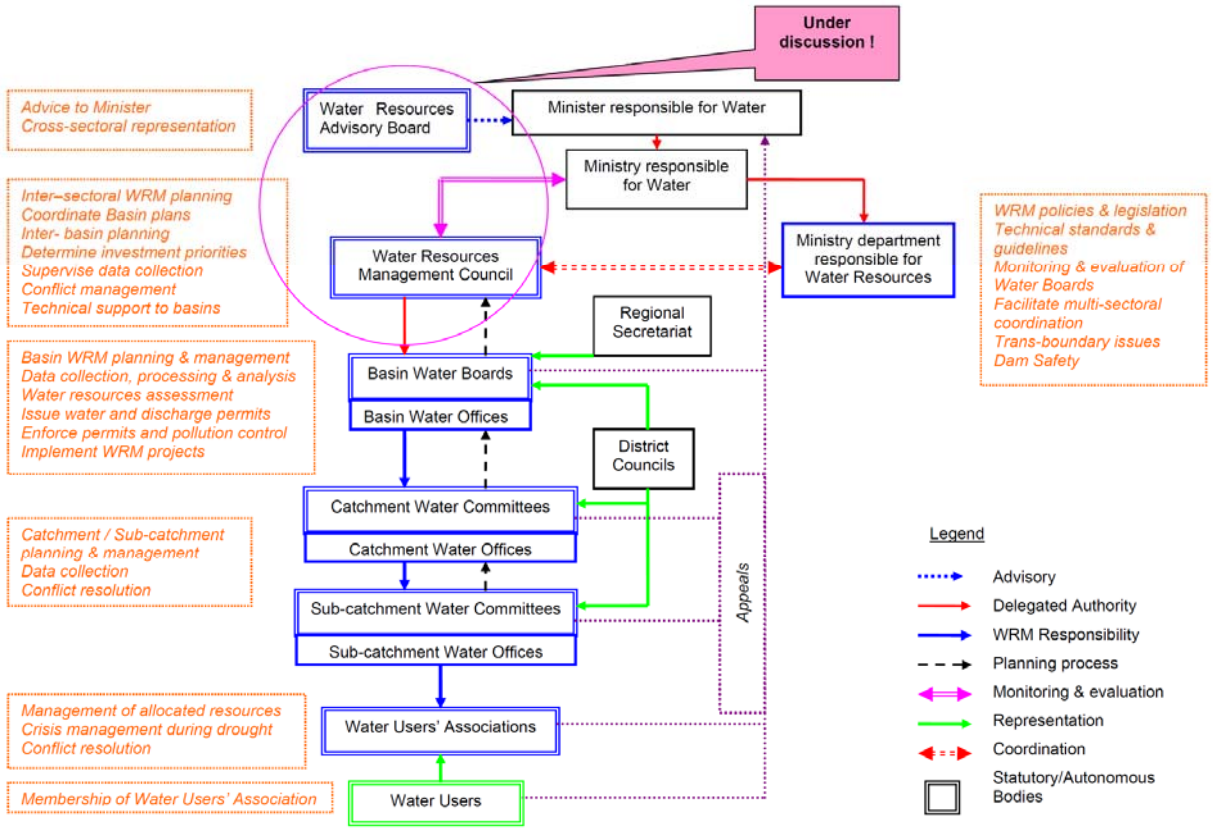
"The regulatory and institutional framework for water resources management is provided for under the water utilization (Control and Regulation) Act. No.42 of 1974, referred to as the Principal Act and its Amendment Act No.10 of 1981 and written Laws (Miscellaneous) Act. No. 17 of 1989 and General (Regulations) Amendment. The Act as amended, declare that all water in the country is vested to the United Republic of Tanzania, sets conditions on the use of water and authorizes the Principal Water Officer with authority, to be responsible for setting policy and allocation of water rights at the national level. For designated water drainage basins with established Basin Water Offices, the responsibilities are under the Basin Water Officer"(Tanzania National Website 2009) (Figure 3-3).

Since the establishment of Basin Water Boards (BWBs) and Basin Water Offices (BWOs) in Tanzania, Rufiji Basin Water Office (RBWO) was established as an institution framework to administer the efficient and transparent management of natural resources (water and land) in Rufiji Basin area (Maganga 2003; Maganga et al. 2004). The Basin Water Offices (appointed by the Minister of Water) are under the Water Councils unit of the Ministry of Water. The basin water boards are autonomous bodies and the water officer is the secretary to the board. The Office has been established in accordance with the Act No.11 of 2009. The Rufiji Basin Water Office has its headquarters in Iringa Municipal Town. The main objectives of the Office in accordance to the National Water Law are; to act as principal executors of the Water Resources Management Act No.11 of 2009 and to carry out research pertaining to Water Resources Management (RBWO 2007).

The function of the Rufiji Basin Water Offices include, administration of the water utilization law in the basin including collection of various water user fees, water rights allocation, modification and controlling of water abstractions and to legalize water use. Other functions

comprise the provision of grant, monitoring of water use, conflict resolutions, holding stakeholders meeting, researches pertaining of Water Resource Utilization and Regulation, and to protect the existing water rights (Maganga 2003; RBWO 2007).

Figure 3-3: Final institutional framework for water resources management. Source (Lowassa 2005)



3.7. Irrigation and agricultural activities

The main source for irrigation water is river and the water is accessed by gravity. Other methods of obtaining water are hand buckets, motorized pumps and hand pumps which are reported to be not so common (Chuwa 2012).

According to the National sample census of agriculture 2007/08, a total area of 1,960 ha of the planted land is under irrigation in the district. The district has an available potential and planted area of 154,516 ha and 108,112 ha respectively (Chuwa 2012). The area planted in both the long (November-December) and short rainy seasons (March-May) are 48,403 ha and 59,679 ha respectively. Main crops under irrigation schemes are sugarcane, paddy, maize, vegetables and pulses (Ngasongwa 2007). The irrigation schemes already developed and in use in Kilombero District are shown in Table 3-3.

Most of the villagers in Kilombero District are subsistence farmers of paddy and non-paddy crops. 80 percent of livelihood activities practiced under cash and food crops. Crop types grown in the area are; cereals (sorghum, bulrush, millet, and wheat), oil seeds and oil nuts (groundnuts), roots and tubers (cassava, sweet potatoes). Others are pulses (beans, mung, cowpeas, green gram,) fruits and vegetables (tomato, cabbage and onion). Fruits, vegetables and sesame seeds have become significant income generator while the cultivation of some traditional crops (cotton, coffee and sunflower) is declining. Reasons for declining includes, poor road conditions, high operational costs, low crop prices (Ngasongwa 2007; Paavola 2008). Perennial type of crop grown in the district are banana, pigeon peas, sugar cane, coconut, cloves orange, mango and cinnamon (Chuwa 2012; Ngasongwa 2007).

Ngasongwa (2007) points out five large scale cash crop production and their total cultivated areas on the brackets in hectares are as follows; sugarcane (11,071), paddy (29,6905), rubber (754.4), teak (2,112), maize (8,580), and paddy/maize (3,740) (Ngasongwa 2007). Other cash crops cultivated in the area include sesame, sunflower, palm oil, cashew nuts, mangoes and coconut. Major food crops cultivated in the area comprise paddy, maize, cassava, banana, sweet potatoes, legumes/pulses and vegetables (Chuwa 2012).

Major storage structures are sacks and open drums. The area is also developing the use of agricultural inputs and implements. Improved seeds, both inorganic and organic fertilizers are used for crop cultivations. Other inputs used are insecticide, herbicides and fungicides (Chuwa 2012).

Table 3-3: The irrigation schemes already developed and in use in Kilombero District.

Item	Scheme	Area (ha)
1	Kisawasawa	2
2	TAC	38
3	Kihoko	230
4	Mkula	51
5	Msolwa	60
6	Sonjo	480
7	Mngeta	5000
8	Ihanga	2900
9	Lumemo	60
10	Ruipa	1800
11	Idete	60
12	Kilombero Sugar Estate	6700
13	Msolwa Estate	150
14	Njagi	75
	Total	**17,606**

Source: (Ngasongwa 2007, p. 42)

CHAPTER 4 -METHODOLOGY

4.1. Research methods and techniques

Research methods involve techniques for collecting data or information intended by a researcher (Bryman 2008). This research has employed “mixed method” strategy to study water resource management and its implication on livelihood situations in Kilombero rural communities. The research addressed important questions to individuals, households, and community members in the study area based on mixed methods research technique via conceptual frameworks in order to obtain the intended information.

Mixed methods research incorporate independent methodological orientations based on both qualitative and quantitative research approaches (Tashakkori & Teddlie 2003). Qualitative research assesses quality of things using words or images whereby quantitative research deals with numbers (Berg & Lune 2012). It has been argued that a mixed methods design answer research questions that could not be answered in other ways (Tashakkori & Teddlie 2003). Bryman (2008), remarks that “mixed methods research may provide a better understanding of a phenomenon than if just one method has been used” (Bryman 2008, p. 624). It has been argued that a mixed methods approach often implement a broad survey in order to generalize results to the population and then followed by qualitative information collection through open ended interviews (Creswell 2003).

This research undergoes a case study and cross sectional or survey designs in order to establish kinds of association among various variables. A case study design “entails the detailed and intensive analysis of a single case” (Bryman 2008, p. 52). This was done in the community of local farmers in improved irrigation scheme and non-irrigators farmers. Cross-sectional design “entails the collection of data on more than one case and at a single point in time in order to collect the body of quantitative or quantifiable data in connection with two or more variables which are then examined to detect patterns of association”(Bryman 2008, p. 44). This was done when I collected data from a random sample of 109 individual households at Mkula and Msolwa A villages. The research design incorporate research questions to gather information and the conclusion drawn.

Participatory Rural Appraisal (PRA) refers to “a family of approaches and methods to enable rural people to share, enhance, and analyze their knowledge of life and conditions, to plan and to act” (Chambers 1994, p. 953). The approach aims to incorporate the knowledge and

opinions of rural people in the planning and management of water resource on the area. The approach use interviewing techniques which are focus group discussion and stakeholders' interview, key informant interview and personal interview.

4.2. Validity and reliability

Validity and reliability are important measures of evaluating social research. Bryman (2008) argues that, "validity refers to issue of whether an indicator that is devised to gauge a concept really measure that concept" (Bryman 2008, p. 151). Both internal and external validity will be looked into.

Reliability refers to the "consistency of the measure of the concept" (Bryman 2008, p. 149). When considering whether the measures are reliable, stability, internal reliability and inter-observer consistency are important factors to be regarded. This study has incorporated and considered stability and internal validity.

Internal validity in term of this study is applied to observe the causal relationship between water resource management and livelihood outcomes (on/off farm) to the smallholder farmers in Kilombero rural areas. The study attempts to be confident to what extent water resources management is responsible for the livelihood outcomes resulted from on/off farm activities.

External validity in term of this study is the concern whether the findings or results of this particular research can be generalized beyond and be applied to other cases similar in context to this research. The results of this study can be shared and add knowledge to interested parties.

Stability refers to the estimate whether the measure is stable over the time. If the research will be repeated using the same methods and measures to the same sample of the respondents and mark little variation over the time in the result obtained, is said to be stable (Bryman 2008).

Internal reliability refers to the "degree to which the indicators that make up a scale are consistent" (Bryman 2008, p. 694). Indicators used are household income, age, household size, education level of the household head, access to land and others. The importance of internal reliability is to find how close the correlation is established among respondents' answers on indicators, more precisely one indicator score tend to be related to their scores to the other indicators after an overall score has formed (Bryman 2008).

I have attempted to be as transparent and consistent as possible in the whole research process, attempting to minimize errors throughout the study. I applied a triangulation of methods, theories and data sources to cover research objectives in order to arrive at valid and reliable research conclusions.

4.3. Representativeness

This study employed random sample strategies in order to achieve a representative sample that allows for generalization of the total population in the study findings and conclusions drawn. Using both forms of data collection (PRA, survey and publications) based on mixed methods research strategies simultaneously assisted to generalize results from sample to a population (Gobo 2007; Hanson et al. 2005). A sample size of household survey of about 12% of the population at Mkula village was administered. 5% sample size of household survey of a total household population at Msolwa A village was conducted.

Issues such as gender, age, ethnical background, and others were looked. Since the central concerns of this study is on smallholder farmers and how they manage water resource, groups such as pastoralists, fishermen, charcoal makers and others were not deeply investigated. However pastoral and environmental resource activities are not practiced in the area following their prohibition by central government authority.

The selection of research methods and case study area intended to represent the smallholder farmers' livelihood situations both irrigators and non-irrigators in the whole Kilombero rural area.

4.4. Sample and sampling methods

Sample is a subset of the population. Bryman (2008), argue that sample is "the segment of the population that is selected for a research (Bryman 2008, p. 698). The sample frame for this research was the population of farmers (in irrigation and non-irrigation schemes) in the community members lived at Mkula and Msolwa A villages. "a sample only can be representative of the population included in the sample frame" (Fowler 2009, p. 19). A Probability sampling procedure was used by this research to obtain individual households for inclusion in the sample. A sound cooperation between the research team and village officials assisted to locate the population sample intended. A random selection of individual households in the village was applied. Gender, age balances and multiple livelihood strategies among the household population were considered during the sampling procedures.

The sample size of 109 households was designated in Mkula and Msolwa A villages which have the total number of 320 and 1,470 households respectively. The research designated the mentioned population sample size in relation to the available resource facilities (Personnel, funds and time).

4.5. Methods of data collection

4.5.1. Primary data collection

Primary data are raw data collected by a researcher. The choice of data collection mode was directly related to research topic, sample frame, research objectives, and resource availability. Data collection involves gathering both numeric and text information in order to present quantitative and qualitative information on the research's database.

4.5.1.1. Household survey interviewing

The research administered questionnaires on various households and at a single household in time in order to obtain needed quantifiable data. The exercise was done by the researcher to ask the questions and record the answerers. The survey was conducted for each village using both closed and open-ended questions. The target of 10 percent sample minimum level of the farmers' population was achieved. The questionnaire administered livelihood situation of each individual household interviewed and water resource use with its management related issues (The appendices). Pilot survey was administered and lead to rectification of questionnaire in order to adhere the situation and time in the study area without damaging the research objectives. The survey was done by moving from single household on time to the next determined by the category of the farmer needed. All households structured to be interviewed in a particular day were informed with an appropriate time prior the visit. The maximum of eight and minimum of five households were targeted per single day.

With the help of village officials (Village Chairman and Village Executive Officer) particular officials were selected to located and introduce (the researcher) to the kind of households I (a researcher) have identify for an interview. Earlier before this exercise we had the self introductory meeting with the Village Councils on both villages at different times. We were honored to meet and chat will village council members and they accepted us and promised to provide full cooperation and support during the whole period of the research. The introductory meetings in both villages were held on 19th September, 2012.

We also held various meetings with distinguished village committees in order to familiarize with the livelihood situations and water management related issues in the villages (will be

discussed later on other methods of data collection). These earlier efforts give us more confidence and farmers were highly motivated to engage voluntarily in the interviews and discussions.

Strengths of the this data collection mode includes; whenever done accurately, it can build close relationship and enlist cooperation between the researcher and the respondents powered by personal contacts during the interviewing discourse, interviewer have the chance to notice nonverbal actions which help to track down the respondent action or reaction. It also gives the chance of probing (Fowler 2009).

Potential weaknesses of survey interviewing includes, long time consuming to accomplish one case, survey questions are strict with no variation of wording in order to remain on the track of the question and answer (Fowler 2009).

4.5.1.2. Focus group discussions

Focus group is "an interview style designed for small groups of unrelated individuals, formed by an investigator and led in a group discussion on the particular topic or topics" (Berg & Lune 2012, p. 164). As part of PRA, focus group discussions were employed in order to learn and gather information through discussions about conscious or unconscious psychological and socio-cultural experiences about livelihoods situation and water resource use among various farmer groups. The interviews were conducted in a form of group discussion among six to ten respondents in an unstructured way where the participants were free to express ideas and concerns. The discussion includes an extensive overview of water resource management, rights, responsibility, authority, investments and livelihoods. Also, the discussions seek the suggested solution to common water problems. The discussion was done under the guidance of a moderator.

With the assistance of village officials six different groups were formed at Mkula village and three groups at Msolwa A village. Each group had a distinct character and the group dynamism was the heart of the data. The interviewed groups at Mkula village consists the following characters; improved irrigation scheme farmers, tradition irrigation scheme farmers, women group, farmers who are government or private employees and the last character was farmers who engage in livestock keeping. Five of the six groups were fairly represented by gender and age balances. The essence of having such group characters was to capture the overviews for understanding and practical participations in their livelihood strategies and water management.

At Msolwa A village the groups were elder adult farmers, women group and young farmers. The essence was to gather the experiences of these groups in relation to livelihood situations and water related issues.

Generally, the discussion was productive, all members in each group were motivated to share their experiences, and the discussion lasted longer exceeding time structured (60 minutes), of course on their own consent (which was an advantage to the researcher because I get the opportunity to observe the interactions and discussions among the informants). Everybody was keen to share what he/she knows, in some cases overlapping the topic. The data collected in each group represent single unit and group dynamics mark data intensity.

Strengths of focus groups data collection technique include highly flexibility context, save time, gives a room to generate new ideas, it is socially oriented and it provides insights on the current position of the topic, subject at hand. It is a useful technique where a one-shot collection is necessary to collect necessary research information, face to face contact gives the moderator an insights of nonverbal actions and simple sampling strategies (Berg & Lune 2012).

Potential weaknesses of focus groups data collection techniques include the possibility that the members may not express their honest and personal opinions about the topic discussed, easy for the unskilled facilitator to have less control over the group members and they deeply influence the quality of the data. Other limitations include time wastage discussing irrelevant issues and findings may not be adequate to make projections due to small sample size and heterogeneity of individuals (Berg & Lune 2012; Bryman 2008; Maxwell 2005).

4.5.1.3. Key informant interviews

Key informant technique is “an ethnographic research method which was originally used in the field of cultural anthropology and is now being used more widely in other branches of social science investigation” (Marshall 1996, p. 92). Key informant interviews were an essential part of PRA for the investigation and data collection because of their personal skills and position in the society. The exercise of locating key informant was successfully conducted.

Four key informants provided expertise information in the study area. The study conducted in-depth interviews with the following key informants, RBWO head officer in his office at Kibaoni area, Ifakara town, and Kilombero District irrigation engineer at the District

Commissioner office at Kibaoni area, Ifakara town, Mkula village irrigation technician and Msolwa village irrigation technician.

Advantage of key informant data collection technique includes that highly data quality can be gathered in a relatively short period of time compare to other techniques (Marshall 1996).

Limitations of key informant data collection technique include uncomfortable interaction between the informant and the researcher may damage the data quality, error in identifying wrong key informants may cost the study and the key informants may be influenced by biasness (Marshall 1996).

4.5.1.4. Stakeholders analysis

Stakeholder analysis is "an approach, a tool or set of tools for generating knowledge about actors - individuals and organizations - so as to understand their behavior, intentions, inter-relations and interests; and for assessing the influence and resources they bring to bear on decision-making or implementation processes" (Varvasovszk & Brugha 2000, p. 338).
Stakeholders' analysis as part of my PRA was used to analyze the attitudes of stakeholders towards water resource management in irrigation schemes.

The stakeholders' analysis was conducted with Mkula village irrigation committee and Msolwa A Village Council. The analysis was successful done. Structured and unstructured interviews were administered during the course.

The strength of stakeholders analysis includes, it is a snapshots tool of the current phenomenon concerning the topic on the table (Varvasovszk & Brugha 2000).

Potential weakness of this tool is that stakeholders interests, position and alliance in a complex and unstable settings may impact the analysis (Varvasovszk & Brugha 2000).

4.5.1.5. Participants observations

Maxwell (2005) argues that "observation can enable you to draw inferences about this perspective that you couldn't obtain by relying exclusively on interview data (Maxwell 2005, p. 94). The investigation continued by observing research related activities in the normal life at the villages. I spent time chatting friendly with local people in various living environments, on farms, in local brew bars, in ceremonial occasions (funerals, primary school graduation) and similar areas. I become part of them and they accepted me. Close observation in farms

and households was successfully done even though I had busy time schedule and quite limited time.

The advantage of this tool is that it provides direct access to the social phenomenon under consideration, it assists triangulation of information, and social human behavior related to the subject is easily spotted.

Potential weakness of this tool is that conclusion drawn is based only on researcher's best understanding and perspective which may foster biasness. Also the observer may influence those who are observed and time consuming and costly.

4.5.2. Secondary data collection

Secondary data refers to the preexisting data for the purpose different from that of the originally collected. The data was collected in the various sources, which includes government agencies (TANAPA, RBWO, District Commissioner statistics bureau).

Other sources were academic institutions and organization (Sokoine University of Agriculture (SUA), University of Dar Es Salaam and WWF. Also various journals and publications have relevant information.

4.5.3. Data analysis

JMP computer software is employed by this research to conduct a descriptive statistical analysis of household survey. The quantifiable data collected were coded and recorded into JMP software.

4.5.3.1. Calculation of Incomes

Gross income was calculated by summing up all incomes in a particular household which categorized into on-farm income; off-farm income, non-farm income and livestock income (Equation 1). Costs are all expenditures incurred by a household during the process of crop cultivation which includes initial capitals, inputs expenditures, labor costs (hired only), transportation costs, water fees paid and other related costs. Net income is equal to gross income minus total costs. The income calculations were based on the values of previous year of the data collection (2011).

Equation 1

$$Y_t = \sum_{i=1}^{n} Y_c + Y_o + Y_n + Y_l \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (1)$$

Where, Y_t = Net household income

Y_c = Net crop income

Y_o = Net off-farm income

Y_n= Net non-farm income

Y_l = Net livestock income

On-farm income is derived from sum of all income resulted from crops income (yields produced multiplied by market price) (Equation 2). Yields accounted from owner-occupied land and land accessed through cash or share tenancy.

Equation 2

$$Y_c = \sum_{i=1}^{n}[(B_i P_i) - (K_i)] \quad \text{..... (2)}$$

Where, Y_c = Net crop income

B_i = yield of crop i

P_i = Market price of crop i

K_i = Total production cost of crop i

Off-farm income includes earnings from labor offered in both permanent and part time employment to the farming activities. Income obtained from local environmental resource sources is also accounted in off-farm income. Such resources include charcoals, house building materials, firewood, wild plants and others (Equation 3). Labor payments in kind and other non-wage labor contracts are not included in this category because they are difficult to measure.

Equation 3

$$Y_o = \sum_{i=1}^{n}[W_i + (E_i - C_i)] \quad \text{..... (3)}$$

Where, Y_o = Net off-farm income

W_i = Total off-farm wage or salary in labor i

Ei = Market price of environmental resource i

C_i = Total costs of environmental resource i

Non-farm income incorporate all earning obtained from other sources apart from farm related activities. Ellis (2000) refers non-farm income to non-agricultural income sources (Ellis 2000). Non-farm income includes non-farm rural wage or salary employment in government, private or self employment, rental income obtained from leasing land or property and remittances (Equation 4). Remittance refers to cash income transfers between households. Remittances are of two kinds, remittance received and remittance out and both can be received or given from or to urban or abroad.

Equation 4

$$Y_n = \sum_{i=1}^{n} \left[S_j + L_j + (R_j - Q_j)\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \text{(4)}$$

Where, Y_n *= Net non-farm income*

S_j *= Total non-farm wage or salary in labor j*

Lj *= Leasing price of property j*

Rj *= Remittance received from individual j*

C_j *= Remittance given to individual j*

Livestock income (livestock sold multiplied by the market price (Equation 5). Produce from the livestock for example milk and eggs multiplied by market price were added into the livestock income.

Equation 5

$$Y_l = \sum_{i=1}^{n} [(L_i P_i) + (N_i C_i) - (K_i + Mi)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

Where, Y_l *= Net livestock income*

C_i *= Total livestock in category i*

Pi *= Market price of livestock i*

N_i *= Produce of livestock i*

Ci *= Market price of produce from livestock i*

K_i *= Total production costs of livestock i*

M_i *= Total production cost of produce from livestock i*

Credits from reputable financial institutes and other social groups used for crop cultivation were not included in the total income.

4.5.3.2. Household income groups

Three distinct income groups were divided in order to analyze special features in each individual group. The groups are divided according to higher income, middle income and lower income group, one third in each.

4.5.3.3. Statistical presentation

The study will assess livelihood situation of smallholder farmers and their adoption to the various shocks, risks, trends to secure their livelihood outcomes by applying multiple regression analysis to estimate the statistical relationship between dependent variables (Y) and explanatory variables (X_1, X_2.....X_K) (Equation 6). Dependent variable is the income and dependence and explanatory/control variables includes, household size, age, sex, tribe, education level, social network, land owned, land utilized, farming practice, water access, distance to water canal, input used, crop grown and rainfall distribution. Income is a function of water use (Table 4-1). Table 4-2 illustrates design principles which will evaluate the managerial tasks in water resources.

Equation 6

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots + \beta_K X_{ki} + e_i \quad (6)$$

Where, Y_i = the probability of income dependence

β_0 = *regression constant*

β_1 = *regression coefficient for variable X_1*

β_K = *regression coefficient for variable X_K*

K = *number of independent variables*

e_i = *error term*

Table 4-1: Variable used for analysis of household income dependency and adaptive strategies

Variable	Description	Expected sign(s)
Household size	Total number of members living in a particular household	+
Age	Age of the household head	+
Sex	Sex of the household head	+/-
Tribe	Tribe of the household head	+
Education	Education of the household head	+
Social network	Role played by social network involved	-
Area owned	Total number of area owned	+
Area Utilized	Total number of area utilized by the household	+
Farming Practices	Type of farming practices (improved irrigation, traditional irrigation or rain-fed agriculture)	+/-
Water access	Available amount of irrigation water required to produce maximum yields	+/-
Credits	Access to credit facilities	+

The study will also look at the management of water resource on smallholder farmers' livelihood activities. Design principles for long-enduring CPRs presented by Vedeld (2002) based on Ostrom (1990) will be used to evaluate the irrigation schemes.

Table 4-2: Design principles used for the evaluation of successful water management

Variable	Description	Expected Sign(s)
Fair physical boundaries	Clearly defined physical boundaries	+
Increased competition	Congruence between appropriation and provision rules and local conditions	+/-
Fair water rights	Clearly defined membership and rights	+
Unequal water rights	Others have more water rights than others/effective monitoring procedure	-
Excess water drawn	Others draws more water than others/effective monitoring procedure	-
Poor water distribution	Inadequate monitoring procedure by local officials/effective monitoring procedure	-
Alienation of others	Clearly defined boundaries	+
Amount of water drawn is enough	Collective choice arrangements	+
Traditional water system	Recognition of rights to organize	+
More water access to rich	Inadequate monitoring procedure by local officials	-
Water fees is low	Congruence between appropriation and provision rules and local conditions	+
Strong monitoring	Effective monitoring procedure	+
Sanctions are imposed	Legitimate system for graduated sanctions	+
Conflicts are resolved	Accessible conflict-resolution mechanisms	+
Satisfactory water management system	Collective choice arrangements	+
Central authority interfere local decisions	Recognition of rights to organize	-
Local authority have enough power on decision	Recognition of rights to organize	+

Information gathered through PRA session, secondary data, survey, key informants, and stakeholder analysis were systematically processed to present the findings. The study is confident enough on how it has established relationship among various data collection techniques/ methods employed (qualitative and quantitative) to present findings guaranteed by the objectives of this research.

4.6. Scope, constraints and empirical field reflections

This study was conducted in the year 2012 but the income data gathered was based on the previous year of the research (2011). The study strategically covers the assessment of water resource management and its implication to livelihood situation limited to the local community of smallholders farmers in Kilombero rural areas. It is important to recall that the major theme of this study is about livelihood situations of smallholder farmers and water resource management, thus prior investigation was focused on the livelihood earnings obtained from water related activities (irrigation activities). Other livelihood activities were partially investigated in order to aggregate the total amount of households' incomes. River basin management perspective is addressed by referring to the available data found during fieldwork and other publications.

This research is presenting the finding analysis by making comparisons within various distinct variables. The variables include, household rice total income, household total incomes, households' wealth groups and water dependence resulted from diverse activities (powered by assets endowed) pursued by individuals and households in the case study area (Msolwa A and Mkula villages). Initially, this study planned to conduct the research by comparing water management between two improved irrigation schemes situated at each village based on the information I received prior to the site visitation. After visiting the site, I found one improved irrigation scheme and one traditional irrigation scheme exist in the case study area. Both improved and traditional irrigation scheme are situated at Mkula village. At Msolwa A village, only rain-fed agriculture is practiced. Village officials reported that the existing irrigation infrastructure has been abandoned since 1979 when Chinese moved from the area and since then it has never operated.

Fieldwork was conducted from mid-September to mid-November 2012. Before starting fieldwork I consulted key persons at Sokoine University of Agriculture, from EPINAV project team, Prof. Vedasto Muhikambele, Prof. George Kajembe, Dr. Gimbage Mbeyale, Dr. Josiah Katani, Dr. Japheth Kashaigili and Devotha Mosha. They both at their own time assisted to comment on the research proposal and other field related ideas which helped to clarify some missing links regarding fieldwork. They also introduced me to gate keeps at Kilombero district to validate my research permit.

I completed all necessary procedures for obtaining research permit at the district headquarter at Kibaoni area, Ifakara town. We had self-introduction (me and my research assistant Mr.

Nzunda Mawazo from SUA) to the village officials. I also presented the major purposes of my visitation. We were welcomed by village officials at both villages.

The fieldwork was challenging at first few days, because it was my first time experience, but as the time passed by I mastered it better. The PRA went very well except to some few occasions where people felt like they have been spied. Others were having opinions that I was doing political work, campaigning for political posts at their areas. Others contested that we were there to acquire our own goals and nothing we can do to improve their livelihoods. Others expected to receive financial support from us especially during field visitation of Professor Paul Vedeld.

The survey was also gone very well. I have being conducting interviews by paying a visit to the respective respondents' houses. In some few cases I spent longer time at a single household exceeding the time planned. I sometimes required to break at the middle of the interview to give them time to attend some home activities (unexpected) and come back to continue. I administered seven households per day as maximum and two households per day as minimum. Being at their homes give me a chance to observe life situations around.

Another challenge was the readiness of the respondents to disclose their full income data. It was not an easy task for them to release directly information about their income sources. They were attempting to avoid sharing information about their incomes. I overcome this by not rushing to ask about income unless I observed it was the right time to do so. My fluency in Swahili language assisted to bridge the communication gap, and with no third part involvement during the interview the situation becomes better. The case of means and time was another straight forward issue when spending three months at the fieldwork.

Getting hold of people from RBWO at Ifakara, District Irrigation Engineer office and other officials was difficult. I attempted several times, and one time I was lucky to have an appointment with District Irrigation Engineer and RBWO official. I had a successful and sound interview with District Irrigation Engineer. I had a very limited time with the RBWO officer, he had a very busy schedule, and I didn't explore fully what I wanted.

During my fieldwork I spent some times in social gatherings to esteem values and customs of people of that area. I participated in two funeral ceremonies followed the occurrence of sudden death of village members. I also invited in the graduation ceremony of standard seven

at Mkula village. The occurrences of those incidences solidified the relationship with my hosts.

Another experience which is important to mention here is the way I facilitated sound relationship with people around. I respected them by showing concerns on their values and instincts (time, social status, age status, gender, equity and others). I was sometimes compensating their time spent with me. I provided material things like soda, cookies, candies, sugar, air time for their mobile phones, piece of soap and similar items in small portions. I knew it was very little but it was appreciated by the recipients.

I managed to collect all data by myself that experience cheered me up. My research assistant left the field after one week because of other commitments. Before his departure he provided enormous contribution, thus he was already familiar with the field environment because of several visitations before. He assisted to find the accessible accommodation, contacts facilitation to some few key persons at the district office and at the villages. He also assisted to record data on the week we spent at the field together.

I have leant from the experience that it is important to prepare daily reports and progress report during fieldwork. I didn't fully equip to do that. I didn't updated my daily reports on regular bases, now time is consumed attempting to memorize and match the occasions. If I could prepared my daily reports and progress report on a regular basis I could have saved time. I am looking forward to administer that on my next fieldwork.

4.7. Ethical concerns

This study is conducted with prior regards of ethical issues. Ethical principles pointed by Bryman (2008) provided benchmark for the validity and reliability of this study. According to Bryman (2008), ethical principles violation happens when the following occurs harm the participants, lack of informed consent, an invasion of privacy, and deceit issue if involved (Bryman 2008).

Harm to participants; this study didn't cause any physical harm, loss of self-esteem and others to individuals, households, or organization participated in either way during the whole research process.

Lack of informed consent; All individuals and households were participated based on their free consent after been informed the purposes and objective of the research. This study provided the room to refuse to corporate to anyone who was willing to do so. The names and

places of the individuals and households participated are anonyms because I didn't consulted them to allow their names to be used on the study.

Invasion of privacy; the study didn't attempt to violate or invade privacy of any individual or household. Bryman argues that "the right to privacy is a tenet that many of us hold dear and transgressions of that right in the name of the research are not regarded as acceptable" (Bryman 2008, p. 123). This research has followed the same pattern of respecting privacy.

Deception occurs when the researcher is presenting his/her own work and attempt to fake it the actual fact at the scene. It is not intention of this study to provide false information, every detail addressed here is the participants' understanding based on their freely contribution.

4.8. Definition of major terms and justifications

Household; For the purpose of this study household refers to "conventionally conceived as a social group which resides in the same place, shares the same meals, and make a joint or coordinated decisions over resource allocation and income pooling" (Ellis 2000, p. 18). For the same purpose this research has accounted any household which involves many wives and does not resides under a single roof as an independent household. Households differ in definitions depending on the cultural settings of a particular area. This study has employed the above definition in order to investigate livelihoods through theories and conceptual frameworks to understand social phenomenon in smallholder farmers water resource management and institution implications of the diverse livelihoods.

Plot size; The measurement unit used by this study to measure plot size was "hectare".

Water use for crop production; This study employed simple terms (enough water, not enough and excess water) to assess water use in the households' plots. The reasons for employing the simple terms are the difficulties of measuring the amount of water used to a particular plot which involves special device units (parshall flumeo, current meter and similar devices), advanced expertise and time frame (the whole cultivation processes).

Rainfall distribution; The study employed simple term (enough rainfall, not enough and excess rainfall) to asses' rainfall distribution in the households' plots. The reasons for using those terms are the difficulties of measuring the previous year amount of rainfall at a particular plot at a time. Another reason is lack of expertise to measure rainfall amount in the particular plot.

Yield levels for multiple cropping; The study accounted separately each crop cultivated and aggregate the total earnings of each individual crop involved after taken an account of costs involved.

Land, labor and capitals; on the discussion part (chapter 5) the analysis will use land (natural assets), labor (human and social assets) and capitals (financial and physical assets) to represent assets endowed in the study area.

Improved irrigation scheme; "is an existing irrigation scheme that is subjected to work to works resulting into better irrigation infrastructure and performance" (Minister of Water and Irrigation 2010, p. XV). The infrastructure (canal walls, intakes and gates) is improved and built using concretes which saves water leakages.

Traditional irrigation scheme; "is an irrigation scheme with irrigation system comprising of temporary infrastructure and/or facilities that are not technically constructed/installed" (Minister of Water and Irrigation 2010,p. XV). The canal walls are built by mud which causes immense water leakages.

CHAPTER 5 -ASSETS IN THE STUDY AREA

This chapter presents results and discussion based on the research objectives and research questions. The first objective is the Livelihood situation of Smallholder farmers and their admissions will be discussed through livelihoods conceptual framework. The second objective is an analysis of the water dependence impact on livelihood. The third objective is the management of water resources and impact on smallholder farmers' livelihood activities. The two first uses the sustainable livelihoods conceptual framework and the third will be assessed under the modified design principles for long-enduring common pool resources approach.

5.1. Household access to assets

Asset refers to anything tangible or intangible that can be owned or controlled to produce value. In the livelihood approach, resources are referred to assets or capitals (Ellis, F. & Freeman, H. A 2005). Different scholars have described assets in various ways. This study follows Scoones (1998) and Ellis (2000) patterns on how they described assets. Five main categories of capitals which include natural capital, physical capital, human capital, financial capital and social capital are borrowed from Ellis (2000) and employed to study livelihoods. I will analyze the assets categories by use of four measures that include household total income, locations, and wealth groups and by type of agriculture or farming practices.

Total household income: Total household income is a variable that will be used to analyze the livelihood situation in the study villages. The aggregate of all earning obtained (after cost deduction) from various sources and resources are indicated in the total household income. Socio-economic factors which support to generate household income are illustrated in Table 5-1. The asset status in villages reflects what people do to make a satisfactory living and are influenced by risk factors as well as institutional and policy contexts. The implications of risk factors as well as policy and institution arrangements on the utilization of available assets will be covered later in this chapter.

The regression analysis shows the connection between household size, male sex head of the household, household head education, total area owned and access to common are significant to explain household total income ($p < 0001$, RSq 0.39, RMSE=2.3e+6) (Table 5-1). Large size of household signifies more labor force. Male sex head of household can be linked to that male own more assets than female. Household education indicate the more education the more qualified personnel. More owned land to an individual farmer signifies an increase in

earnings. Any additional to the common (livestock) signifies an increase on household total income.

Table 5-1: Socio-economic factors by total household income in the study villages at Kilombero District, Tanzania 2012

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3166737.1	2235729	1.42	0.1600
Sex	77462.079	628662.7	0.12	0.9022
Age	4160.3591	19244.73	0.22	0.8293
Household Size	274834.05	89132.09	3.08	0.0027*
Male Household Head[1]	-767480.1	376672.1	-2.04	0.0444*
Household Head Education	353810.62	91416.86	3.87	0.0002*
Existing Credit/Loan[1]	132891.88	263283.6	0.50	0.6149
Total Area Owned in Hectares(0,10.9268)	2647689.3	1314888	2.01	0.0469*
Total Area Utilized in Hectares	-402359.1	301298.3	-1.34	0.1850
Access to Commons[1]	-822913.5	321066.5	-2.56	0.0120*
Access to Motorbike[1]	1003944.5	554883	1.81	0.0736
Access to Bicycle[1]	327591.53	281101.9	1.17	0.2468
Electricity Access[1]	-366297.3	246926.1	-1.48	0.1413
NGOs Social Network[1]	451361.7	240239.2	1.88	0.0634

*N=108, * indicate Significant differences in the household total income ($p < 0.0001$, RSq 0.39)*

Locations: Location is a measure that used to study variations in socio-economic status between two case study villages. The variations will assist to understand the households' incentives when choosing range of endowed assets to pursue livelihoods. Two villages which are the case study of this study are Mkula and Msolwa A. Table 5-3 illustrate fit model for socio-economic factors by location. The locations enable us to understand various livelihood strategies employed by individual households based on assets endowed, vulnerability context as well as policy and institutional context.

Regression analysis indicates that existing credits, total area utilized access to common and electricity are significant socio-economic factors in location. Table 5-2 addresses variations in the socio-economic factors by locations. Mkula village has more existing credits than Msolwa village this can be because of irrigation activities. Msolwa village have more land than Msolwa. This can be explained by that irrigation land is very limited and the land has been distributed in small plots but can still produce more than large plots do out of irrigation schemes. Msolwa village have higher number of commons and that can be explained by the market access favored by location and population size at Msolwa A Village. Access to electricity can be explained by the factor that the supplied electricity infrastructure is more distributed at Msolwa A and that makes the connection fees low than at Mkula village.

Table 5-2: Socio-economic factors by location in the study villages at Kilombero District, Tanzania, 2012

Term	Mkula Village	Msolwa Village
Mean Age	50.16	52.57
Mean Household Size	5.36	5.86
Male Head of Household (%)	71.79	85.71
Median Household Head Education	7	7
Existing Credit/Loan (%)*	51.28	20
Median Total Area Owned in Hectares(0,10)	0.91	2.02
Median Total Area Utilized in Hectares*	0.8	2.02
Access to Commons (%)*	61.54	94.29
Access to Motorbike (%)	2.56	5.71
Access to Bicycle (%)	51.28	77.14
Electricity Access (%)*	28.21	51.43
NGOs Social Network (%)	53.85	44.29
Mean Household Total Income (TZS)	4,033,459	2,332,169

*N = 108, * indicate Significant differences between locations (p < 0.0001, RSq 0.31, Prob> ChiSq 0.44)*

Table 5-3: Fit model for socio-economic factors by location in the study villages at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-1.5704437	2.3005896	0.47	0.4948
Age	-0.0111082	0.0208765	0.28	0.5947
Household Size	-0.119365	0.1049181	1.29	0.2552
Male Household Head[1]	0.27895897	0.3798517	0.54	0.4627
Household Head Education	-0.0752437	0.1011359	0.55	0.4569
Existing Credit/Loan[1]	-0.8741406	0.3042907	8.25	0.0041*
Total Area Owned in Hectares(0,10.9268)	-2.685964	1.5510851	3.00	0.0833
Total Area Utilized in Hectares	0.8229725	0.3619054	5.17	0.0230*
Access to Commons[1]	1.42681024	0.4285955	11.08	0.0009*
Access to Motorbike[1]	0.81156711	1.1040701	0.54	0.4623
Access to Bicycle[1]	0.12588295	0.3186338	0.16	0.6928
Electricity Access[1]	0.67324515	0.311748	4.66	0.0308*
NGOs Social Network[1]	-0.4591859	0.2946597	2.43	0.1191

*N = 108, * indicate Significant differences between locations (p < 0.0001, RSq 0.31, Prob> ChiSq 0.44)*

Households' wealth groups: The household wealth group was done by dividing the households into three wealth groups (higher, middle and lower) one third on each. Two groups contain 33 members and the remaining group contains 34 members. The household's wealth group variable is used to measure welfare in the study area as illustrated in Table 5-5

(fit model for socio-economic factors by wealth group). Table 5-4 addresses the variations of socio-economic factors in wealth groups in the study villages.

Regression analysis indicates that household size, household head education and access to commons have significance in households' wealth groups. We have found that the higher income group has more land, existing credits, and larger household size compared to other groups. Poor people have less land, less credit facilities, and relatively low education of the household head.

Table 5-4: Socio-economic factors by wealth groups at the study villages in Kilombero District, Tanzania, 2012

Term	Higher Income Group	Middle Income Group	Lower Income Group
Mean Age	50.36	52.54	52.26
Mean Household Size*	6.8	5.3	4.9
Male Household Head (%)	80.56	86.49	75
Mean Household Head Education*	7	6	5
Existing Credit/Loan (%)	50	18.92	25
Mean Total Area Owned in Hectares(0,10,9268)	3	1.7	1.7
Mean Total Area Utilized in Hectares	2.97	1.76	1.65
Access to Commons (%)*	66.67	94.59	86.11
Access to Bicycle (%)	72.22	70.27	61.11
Electricity Access (%)	66.67	43.24	33.33
NGOs Social Network (%)	63.89	45.95	33.33
Mean Household Total Income (TZS)	5,851,736	2,485,414	498,165

*N = 109, * indicate Significant differences among households' wealth groups (p < 0.001, RSq 0.24, Prob>ChiSq 0.74)*

Table 5-5: Fit model for socio-economic factors by wealth groups at the study villages in Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	4.01626878	2.8926572	1.93	0.1650
Age	-0.0075273	0.0270356	0.08	0.7807
Household Size	-0.3863739	0.1615423	5.72	0.0168*
Male Household Head[1]	0.82900541	0.465265	3.17	0.0748
Household Head Education	-0.3956186	0.1508782	6.88	0.0087*
Existing Credit/Loan[1]	-0.304121	0.3356102	0.82	0.3648
Total Area Owned in Hectares(0,10.9268)	-1.0171812	2.1095348	0.23	0.6297
Total Area Utilized in Hectares	-0.3460269	0.4521869	0.59	0.4441
Access to Commons[1]	1.33142353	0.4417382	9.08	0.0026*
Access to Bicycle[1]	-0.0557474	0.4086612	0.02	0.8915
Electricity Access[1]	0.22896188	0.3575292	0.41	0.5219
NGOs Social Network[1]	-0.2669764	0.3323292	0.65	0.4218

*N = 108, * indicate Significant differences among households' wealth groups (p < 0.001, RSq 0.25, Prob>ChiSq 0.74*

Type of agriculture: By type of agriculture I refer to improved irrigation, tradition irrigation and rain-fed agriculture. In the study villages these three types of agriculture are dominant. Improved irrigation is practiced to areas which have an access to river water and improved irrigation infrastructures (concretes walls and gates). Traditional irrigation use river flow but in contrast to the former, the irrigation infrastructures are poorly designed and poorly built using mud and dung which cause immense leakage of water. Water flow to irrigation farms depends on gravity in both improved and traditional irrigation farming practices. Rain-fed agriculture is an accessible means to those farmers who have limited access to improved and traditional irrigation agriculture. Table 5-7 illustrate fit model for socio-economic factor by farming practices. Table 5-6 presents socio-economic factor by farming practices. Existing loan and access to common indicate significance in the types of agriculture.

Table 5-6: Socio-economic factor by farming practices in the study villages, at Kilombero District, Tanzania, 2012

Term	Improved Irrigation	Traditional Irrigation	Rain-Fed Agriculture
Mean Age	49	54	52.7
Mean Household Size	5.4	7.3	5.5
Male Head of Household (%)	82.54	92.31	71.88
Mean Household Head Education	6.5	6.2	5.8
Existing Credit/Loans (%)*	53.13	15.38	23.81
Mean Total Area Owned in Hectares(0,10)	1.9	2.8	2.2
Mean Total Area Utilized in Hectares	1.7	2.5	2.2
Access to Commons (%)*	62.50	92.31	90.48
Electricity Access (%)	34.38	46.15	46.03
Access to Bicycle (%)	50	84.62	73.02
NGOs Social Network (%)	59.38	38.46	42.86
Mean Household Total Income (TZS)	4,531,997	3,379,308	2,070,823

*N = 108, * indicate Significant differences among farming practices (p < 0.04, RSq 0.18, Prob > ChiSq 0.93)*

Table 5-7: Fit model for socio-economic factor by farming practices in the study villages, at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	4.01626878	2.8926572	1.93	0.1650
Age	-0.0075273	0.0270356	0.08	0.7807
Household Size	-0.3863739	0.1615423	5.72	0.0168*
Male Household Head[1]	0.82900541	0.465265	3.17	0.0748
Household Head Education	-0.3956186	0.1508782	6.88	0.0087*
Existing Credit/Loan[1]	-0.304121	0.3356102	0.82	0.3648
Total Area Owned in Hectares(0,10.9268)	-1.0171812	2.1095348	0.23	0.6297
Total Area Utilized in Hectares	-0.3460269	0.4521869	0.59	0.4441
Access to Commons[1]	1.33142353	0.4417382	9.08	0.0026*
Access to Bicycle[1]	-0.0557474	0.4086612	0.02	0.8915
Electricity Access[1]	0.22896188	0.3575292	0.41	0.5219
NGOs Social Network[1]	-0.2669764	0.3323292	0.65	0.4218

*N = 108, * indicate Significant differences among farming practices (p < 0.04, RSq 0.18, Prob > ChiSq 0.93)*

5.2. Natural capital

Natural capital refers to natural resources that are utilized by people to generate means of livelihoods. Natural capital comprises land, water and biological resources that have effects on human welfare. This section will cover the discussion about natural capital endowed in the study area. The analysis of these natural capitals is discussed through four measures that include household total income, household locations, household wealth groups and type of agriculture. Each socio-economic factor will be discussed in the radiance of these four measures.

5.2.1. Analysis of natural capital by total household income

I ran the regression analysis to investigate natural capital in the study villages. The results indicate total land owned and access to commons is significant natural capitals in total household income.

Land by total household income: The average (mode) of 0.8 ha is indicated to be owned by an individual household in the total sample. A positive statistical relationship between total owned land and household total income is shown.

It is important to explain how land is acquired by individuals. As in other part of the country people in the study villages have deep and enduring connections to the land through birth, ancestors and burial grounds. Over t time, farmers have obtained their farms or plots through various means. Means for occupying or owning a land differ according to the situations. Most people have obtained their land through being provided by the village authorities (42%)

followed by land owned through inheritance (37%). Purchased land and hired land is not so common access means for occupying land according to the empirical evidence in the villages (Table 5-8).

Table 5-8: Proportional distribution of means of owning land in the study villages at Kilombero District, Tanzania, 2012

Description	**Inherited Land**	**Given Land**	**Purchased Land**	**Hired Land**	**Average Total Land (Ha)**
Total Sample	37%	41.66%	12.96%	8.33%	1.6
Mkula Village	64.1%	25.64%	10.2%	0%	0.9
Msolwa A Village	21.7%	50.72%	14.49%	13%	2.0

Currently land shortage is a growing concern; many people are complaining about land shortages according to the focus group discussions. About 36% of people have less than one hectare in the total sample and by the same token the proportional of 67% of the sample shows that households farm are located away from the villages. People are subjected to move far away, between 20 and 50km searching for cultivation land. Areas such as Lungongole, Kiberege, Kisawasawa, Ibiki, Zignali, Liegama, Kisaki, Kilulumo and other have informed to be the best option available, though their locations are remote to the villages. Travelling to and fro consumes more resources (time and cash) the costs are unbearable to many households, especially the poor. We have found that at land through inheritance is common at Mkula village common compared to Msolwa A village. This can be explained by that land scarcity at Mkula especially in irrigation areas makes selling or buying very difficult. At Msolwa A land provision through village government is common.

Access to commons by household total income: Access to commons is significant factor in the household total income. The findings indicate positive relationship between access to commons and household total income. According to the empirical evidences 83% of the total sample has an access to the commons.

5.2.2. Natural capital by location

Land by location: The results show the average (median) owned land size of 0.9 ha (Mkula Village) and 2.02 ha and (Msolwa A village). Land occupied through village provision or clan domination based on the customary arrangements has been practiced for ages. Mkula and Msolwa A villages are among villages reformed through people's the resettlement plan established by the government during 1970's (Kikula 1997), though the villages existed even before the operation. Most of the elder people who lived in the village for most of their lives have occupied their lands through those means.

Msolwa A village shows a higher number of people who acquired land through village authority or customary arrangements land provision compared to the Mkula village where heritage is key. According to the stakeholders' analysis the situation is explained by the fact that Mkula village is regarded as a traditional village compared to Msolwa A village which is regarded as a more modern village influenced by ujamaa policy.

Households, who own the land, split their land into small portions and provide them to their family members through inheritance. This group contains men and women who inherited land from their ancestors and will be expected to pass the same land to the coming generation. Passing the land occupation to the next generation has been practiced for a long time.

Land inheritance is more common at Mkula Village compare to Msolwa A village, because that most residents at Mkula village originates from the village according to focus group discussions. As the time passes land then, continue to diminish due to successive subdivision at inheritance.

Land leasing or purchases is another means for occupying or owning a land. Individuals who migrated recently to the villages and those who were not provided or entitled to own land or farm by village officials obtained land through these means. The purchasing or leasing prices are uneven; they depend on mutual agreements between individuals based on their own free consent. This means is not so common in villages because within the villages few individuals have the capacity of hiring land. Another factor is that land scarcity could makes selling or renting land constrained.

Shortage of land within villages can partly be explained by the location of the villages. The villages are located at the middle of Selous Game Reserves, Udzungwa Mountain National Parks and Illovo Sugar Company plantations on the Eastern side. This situation limits the

expansion of cultivation land to the bursting rural population. Some few individuals who are able to migrate searching for suitable cultivation land are doing so and have left behind many individuals who have no incentives to do so. The situation is more critical for poor families. Poor people in the villages are most vulnerable to land scarcity and higher prices on hired land.

Access to commons by location: Access to commons is indicated as a significant factor for obtaining livelihoods in the study villages. The results shows that Mkula village 62% report to have access to commons and At Msolwa A village 94% of households have an access to commons. As we have seen on the discussion above poultry is the most common domestic animal found in the villages.

5.2.3. Natural capital by households' wealth groups

Land by households' wealth groups: The results show that higher, middle and lower level income groups own an average (mean) size of 3, 1.7 and 1.7 hectares of land respectively. Owning relatively bigger land seems to result in higher income. But the empirical evidence shows that not all owned land is utilized for crop production, part of the land is abandoned (especially by lower income group) because of various reasons including financial constraints and farm locations. The findings indicate that higher, middle and lower income groups utilize the average (mean) size of 2.97, 1.76 and 1.65 hectares of the total land owned respectively. Higher income group utilizes almost all owned land which signifies the larger area owned the more returns from farm activities.

Access to commons by households' wealth groups: The results shows that the households which have an access to commons and their correspondent wealth groups in the brackets are 67% (higher income group), 95% (middle income group) and 86% (lower income group) As I have discussed above poultry is the common activity in the study villages. The averages quantity of poultry kept by wealth group are 6.97 (higher income group), 8.78 (middle income group) and 8 (lower income group).

The variation can be explained by the fact that poultry as other domestic animals are immediate assets that can be converted into cash. Poultries are kept locally which makes it an easy and low cost production for even low income families. Keeping poultry in the study villages is affordable, providing nutrients and food security as well as easily converted into cash. These circumstances make keeping poultry to be more convenient especially to the lower level income group.

5.2.4. Natural capital by type of agriculture

Land by type of agriculture: The findings indicate that the average (mean) size of 1.9, 2.5 and 2.2 hectares of land are used for improved irrigation, traditional irrigation and rain-fed agriculture respectively. Land is scarcer in improved irrigation compared to traditional irrigation and rain-fed agriculture. About 29%, of households are engaged in improved irrigation which is by far most profitable. Traditional irrigation and rain-fed agriculture employ 11.92% and 57.8% respectively in the total sample.

Large numbers of households are in rain-fed agriculture. Most of those farms are located away from the study villages. The remarkable characteristic of remote farms is that there is much low production than in the closer fields. Remote farms are subjected as less measure by improper management as well as endanger of theft, animal destruction and similar reasons. Farmers do apply more efforts in the closer crop fields compared to the remote crop fields (Closer fields are the land/farms which are located within the village areas). Closer fields are mainly managed under improved and traditional irrigation type of agriculture which generates more returns but land is limited. So the synthesis here is that land in remote area is more accessible compared to closer areas but the challenge is less control in term of proper management and high risk of losses.

Access to commons by type of agriculture: The results indicates that households which have an access to the commons with their corresponding type of agriculture in the brackets are 63% (improved irrigation) 92% (traditional irrigation) and 90% (rain-fed agriculture).

5.2.5. Natural capital by livestock

In the study area poultries are dominant domestic animals in the household. The average quantity of poultry and their corresponding type of agriculture households found in the study village are 8 (improved irrigation), 7.3 (traditional irrigation) and 7.95 (rain-fed agriculture). The variations can be explained by the fact that maintaining poultry stock is affordable to most households including poor families. Poultry also provides a source of food in households also it can easily be converted to cash. Rain-fed agriculture provides less returns compared to other types of agriculture households also are linked to low income group. So the large proportions of poultry are kept by households in the rain-fed agriculture households which are characterized to be low income. Low income households keep more poultry than higher income households.

5.2.6. Summary of natural capital

The total cultivated area owned by an individual household is a significant asset to sustain livelihoods in the villages. However, farming activities generally rely on some cultivation techniques (inputs application, proper land utilization and others) to maintain land quality and enhance sustainable crop cultivation.

Problem of land and water shortages is observed in the villages. The arrangement for land tenure in rural areas especially villages is not well established which create unequal land distribution. Customary arrangements provided by local authorities are an alternative means to entitle the land ownership in rural areas. The state remains as a provider of legitimacy for land claim through formal or informal arrangements in Tanzania. The 1999 land tenure reform addressed the recognition and registration of existing land use practice and customary arrangements (Ikdahl 2013).

The access to the commons is also an essential natural asset which is significant for generating household earnings. Poultry is common in the study villages.

5.3. Physical capital

We discuss here physical capital under the four household characteristics which include household total income, locations, household wealth groups and type of agriculture.

Ellis (2000) argues that physical capital is manmade assets resulting from the economic production processes. In the study village's access to electricity, bicycles and motorbikes are indicated as significant physical assets in livelihood strategies. Other physical assets found in the area include houses, irrigation infrastructures, and roads to the villages and to the farms, house furniture. Agricultural tools found are hoe, machete, axe, carving knife and so on. Generally the agricultural tools accessed are very low in less of capital investment level. Facilities of heavy machines like tractors and others are hired from neighborhood areas. Few power tillers were found.

5.3.1. Physical capital by total household income

Access to electricity by total household income: The findings indicate that 43% of the households have access to electricity. The number signify that the Kilombero area have the availability of electricity facility in rural areas which is crucial for obtaining livelihoods. According to focus group discussion the electricity facilities in the villages was developed in the late 1990's. Famers argued that electricity power is a significant factor in livelihood

processes. The remaining 57% of the households do not have access to electricity; they argued that the situation impacts their livelihoods.

Access to motorbike by total household income: Motorbike access indicates significance in explaining total household income. The findings demonstrate that about 5% of the total sample posse's motorbikes. Motorbikes are private means of transportation in the villages which facilitate faster movement of people and produce. Motorbike facilitate movement in effective ways compared to other means (public transports, bicycles or by foot). For example, it is possible to make a patrol by using a motorbike in both closer and remote fields within a short period of time compared to other means. Few individuals however have an access to motorbikes because of the cost involved.

Access to bicycle by household total income: Bicycle is affordable to most of the rural individuals and it's well used to facilitate movements of produce and people. 67% of households own bicycles.

5.3.2. Physical capital by location

Access to electricity by location: Mkula and Msolwa A village households have 28% and 51% access to electricity respectively. The availability of electricity from the national grid has been provided since late 1990's in the area. The difference can be explained by the fact that At Msolwa A the electricity infrastructures are spreader all around the village so the connection fees are less compared to Mkula village. The electricity connection fees are higher at Mkula village because few people are connected to the network, so more funds are needed by single households to get connected.

Access to Bicycle by Location: At Msolwa A village 77% households own bicycles compared to Mkula village which is 51%. This can be because they have enough income to spend on bicycles and also more need for guarding agriculture produce.

5.3.3. Physical capital by households' wealth groups

Access to electricity by wealth groups: Access to electricity distributions by wealth groups is varying (higher income group (53%), middle income group (43%) and lower income group (33%)). Electricity is a useful source of power to pursue a range of activities, and in the villages it is used as source of light. Electricity access is linked to households with relatively higher incomes in the villages. To be connected to the power supply requires a substantive

economic capacity. That could explain the variations of access to electricity in household wealth groups.

Access to bicycles by wealth group: Little variation is shown between higher and middle income groups. The differences is shown between the lower income group which have low size of households that posses bicycles (61%) to other income groups which is above 70%. The existing difference can be explained by that higher income group have more economic capacity than lower income group though bicycles are affordable items.

5.3.4. Physical capital by type of agriculture

Access to electricity by farming practices: The average numbers of households which have an access to electricity in the types of agriculture category are 34% (improved irrigation), 46% (traditional irrigation) and 46% (rain-fed agriculture). The details are inconsistency so they don't give many explanations.

Access to bicycle by farming practices: The large size of households that own bicycles are indicated from traditional irrigation (85%) and rain-fed agriculture (73%). This can be because bicycles are affordable items which make plausible for households with different farming practices to have an access on them. Also according to the focus group discussions it shows a class to own bicycle in the village, a sign of success.

5.3.5. Summary on physical capital

Range of physical assets in the study villages which includes productive and unproductive assets are combined when individual household are pursuing various livelihoods. Productive assets such as roads, irrigation canals, tools, machines, and telecommunication and so on are more or less accessible to all farmers. Access to electricity, motorbike and bicycles are the physical capitals which have variations among different groups of households. The study has little information about how electricity facility is used to improve socio-economic status on household incomes.

Unproductive physical capitals include houses, furniture, and others are also found in the villages. These assets are generally used to provide essential shelter to household members.

5.4. Human capital

Human capital will be presented by discussing human capital socio-economic factors under four measures which includes household total income, location, household wealth group and type of agriculture. The regression analysis showed significance in household size and

household head education in the human capital categories. Human capital as referred to Ellis (2000) represents labor available to the household; it associated skills, age education and health. Local knowledge is used by farmers to understand various circumstances embedded on their livelihood strategies. Other compliments in human capital category which are also useful in livelihood strategies are age of household head and sex head of household.

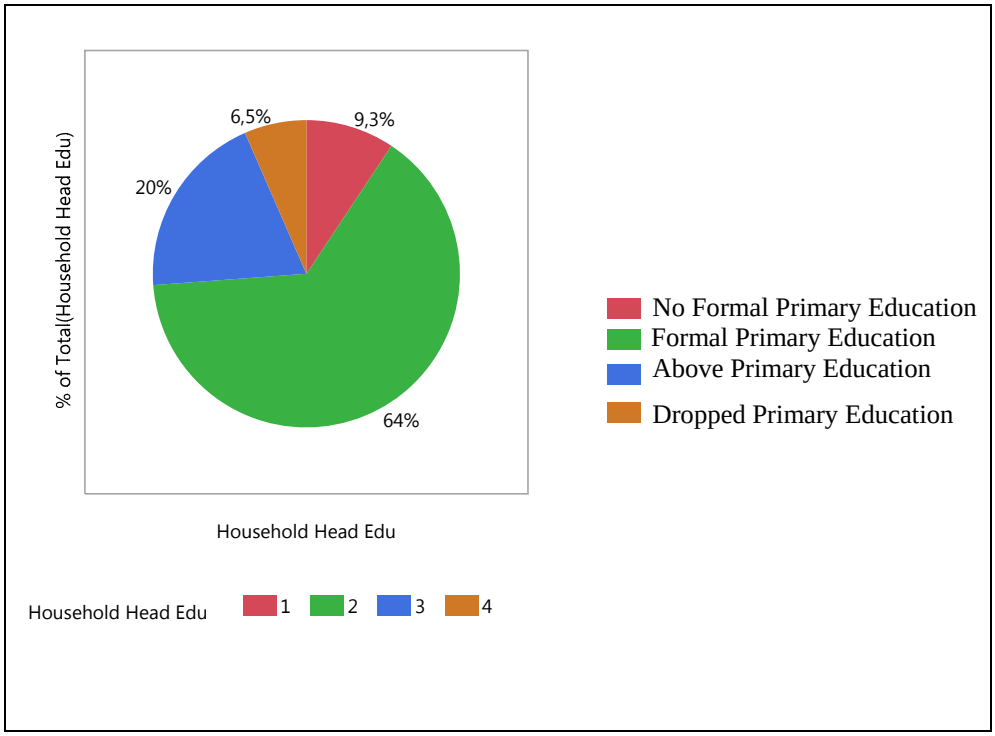
5.4.1. Human capital by household total income

Household size total household income: The greater the size of the household the more labor force in that particular household. The findings show that household size is a significant human capital in total household income. The average household size of 5.6 members is indicated in the total sample.

Using own labor reduces labor costs which lower the cash cultivating costs. According to PRA analysis, farmers use their own labor in their fields, hiring labor is done at minimum and when necessary. The study counted total number of household members includes children and adults. According to the focus group discussions, all members of the families would participate in the family cultivation activities.

Household head education by household total income: The regression analysis test shows that household head education level has a positive relationship with household total income. The study has generation four variable for categorizing years of schooling to group levels of education as follows; zero years of education (no formal primary education), completed seven years of primary formal education (formal primary education), above seven year of primary education (above formal primary education) and individuals who dropped primary education (dropped primary education). The study didn't cover informal and other customary education arrangements because it is difficult to measure. The distribution of levels of education is illustrated in Figure 5-1.

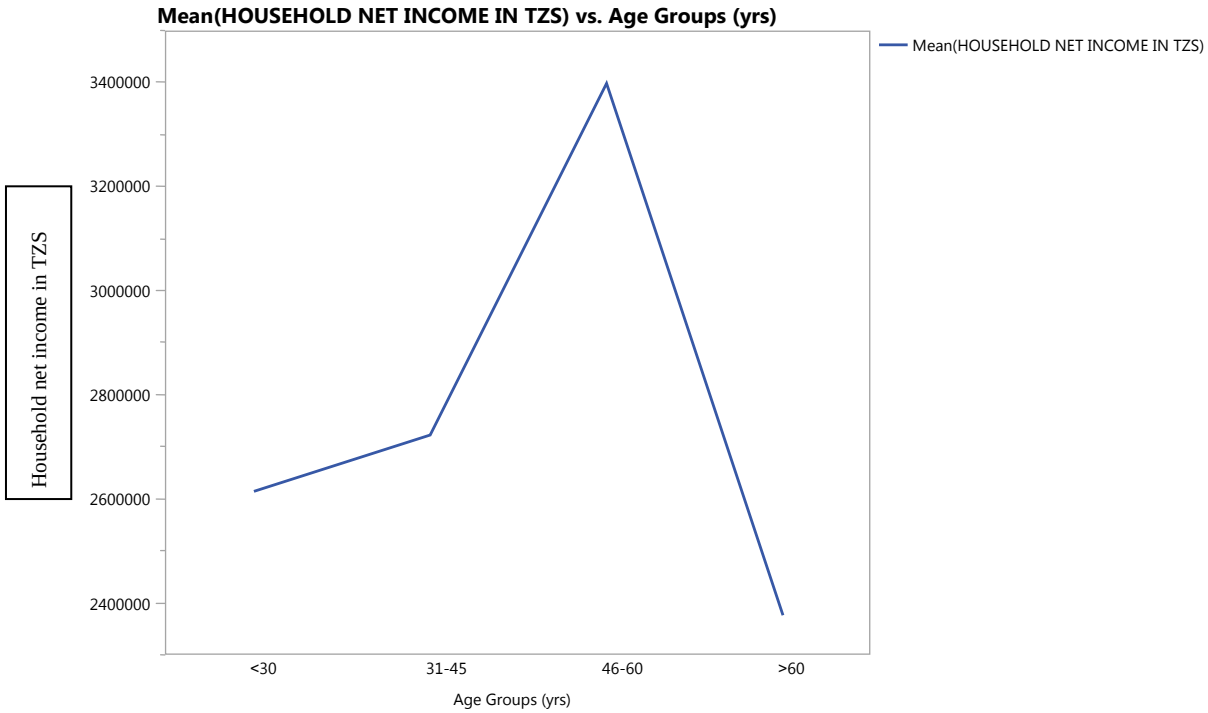
Figure 5-1: Level of education by household total income in the study villages at Kilombero District, Tanzania, 2012



Male head of household by household total income: 81% Male headed household was found. Few females are household heads. It is quite normal for cultural and customary arrangements that men are the head of the in Tanzania. Female headed are in such situations that a woman is single, divorced or widow. The direct observation in the study area suggests that in most cases women are active participants in farming activities more than men. During the household survey at the study field, most questions were responded by wives/women. Husbands/men were having difficult time to memorize various details regarding farm activities because of less participation compared to women.

Age Groups by Household Total Income: The age groups was created by dividing the household head in to four groups based on their ages in term of years as follows 1 = (below 30), 2 = (31- 45), 3 = (46 – 60), and 4 = (60 above). The groups was divided according to the experience that as the age increases individuals tends to increase economic capacity before declining as the people become older. The average age in the total sample is 51.7 years. The distribution of age groups by household total income is illustrated in Figure 5-2.

Figure 5-2: Age groups by household total income at the study village at Kilombero District, Tanzania, 2012



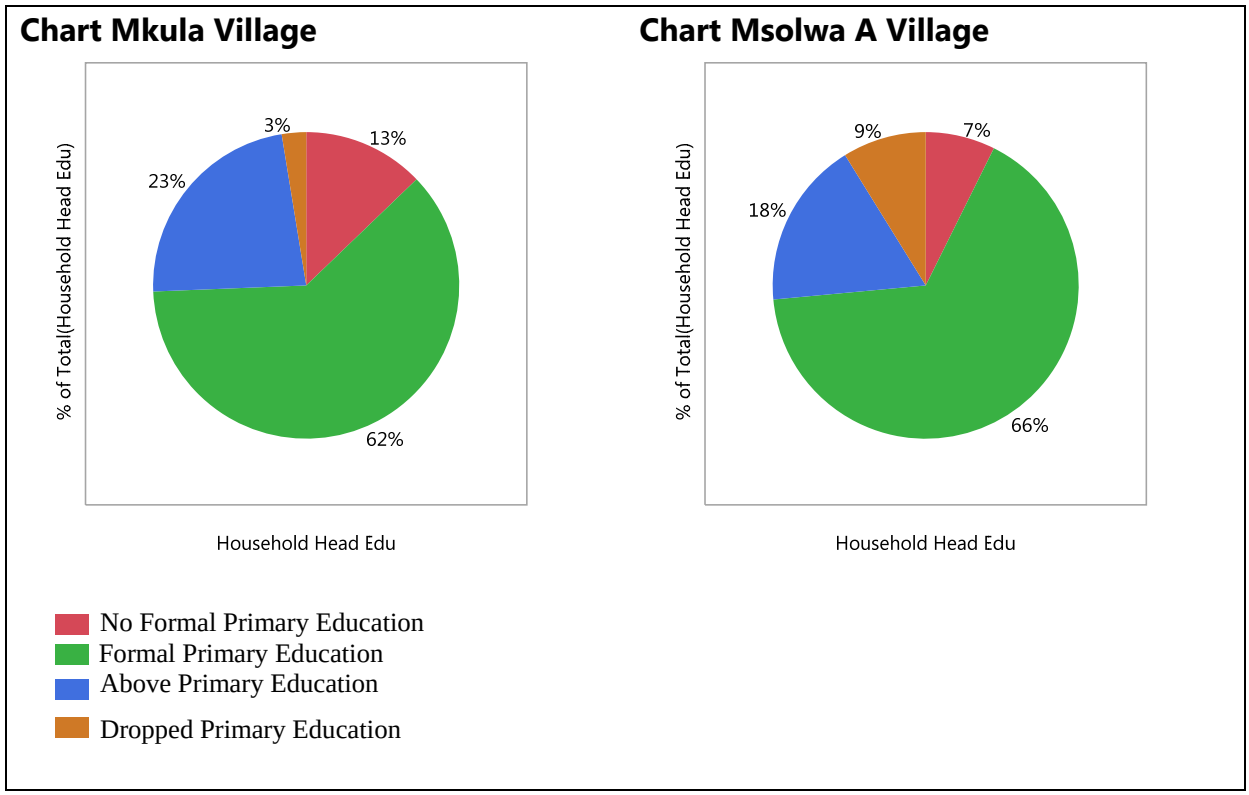
The results indicated that higher income seem to be at the age between 46 to 60 years. The situation can be linked to the size of labor force (number of children) available to the household's head within that age group compared to other age groups, younger (below 30) or older (above 60). The phenomenon reflects that the adult matured person is relatively more physical productive compared to young or older person.

5.4.2. Human capital by location

Household size by location: At Mkula and Msolwa villages the household size is 5.36 and 5.86 members respectively. The larger households the more labor force in the farms. All farmers were found hiring part time labor in different aspects where possible.

Households head education by location: The findings indicate education is an important aspect in the household for enhancing income generation. The level of education is categorized into no formal education, primary formal education, above primary education and those who dropped primary education as illustrated in Figure 5-3.

Figure 5-3: Level of education by location at the study area at Kilombero District, Tanzania, 2012



At Mkula village people have more above primary education compared to Msolwa Village. More years of schooling rise human capital which sharpens skills acquired to practice various occupations.

The issues of years of schooling goes along with being free of illness that contributes to the rise of human capital, so someone can be productive all the time. At Mkula village, no health centre existed; they rely on other neighborhood health centers from closer villages such as Sonjo or Kidodi. At Msolwa A village one health centre exists. For referral cases, people of both villages attend at Ifakara or Mikumi hospitals.

Male head of household by location: Male headed of household (represent quality of available labor force) in the villages show dominance than the female head of household. The results show 72% and 86% of the male head of household at Mkula and Msolwa A villages respectively. Most able body persons are employed in farming activities because in the area other economic activities such as mining, fishing, pastorals, and forestry are limited.

Age groups by location: Mean age for household's head at Mkula village is 50 years and 53 years at Msolwa A village. The difference is shown in the age group of below 30 years who are young between villages. Mkula village have more young people compared to Msolwa A village. More migration is indicated at Msolwa A village than in the other village.

5.4.3. Human capital by households' wealth groups

Household size by wealth groups: The larger household's size signifies higher chance of more labor within the households. The findings show that higher income group has higher average (6.8) of household members followed by middle income group (5.3) and lastly lower income group (4.9).

Household head education by wealth groups: Household head education shows significance in the study villages according to the empirical findings. The average of seven, six and five years of schooling is indicated at the higher, middle and lower income groups respectively. The distribution of level of education according to wealth groups is indicated in Table 5-9.

Table 5-9: Level of education by households' wealth group in the study villages in Kilombero District, Tanzania, 2012

Description	Higher Income Group	Middle Income Group	Lower Income Group
No Formal Primary Education	2.86%	11.11%	13.89%
Formal Primary Education	51.43%	72.22%	69.44%
Above Primary Education	37.14%	13.89%	8.33%
Dropped Primary Education	8.57%	2.78%	8.33%

Lower income group contains higher number of people who haven't attended formal primary education. The situation signify that more investment in education and training increase human capital which is significant for producing quality labor.

Male head of household by households' wealth groups: The results show that the lower income group has 75% of the male head of the household. Middle and higher income groups are having 87% and 81% of male head of the household. Generally, the male head of the

household is common in the area; the variation can be explained by the fact that incidences of female being single are the results of either being single, divorced or widow. The marital status is high in the study area with the proportion of 77%.

Age groups by households' wealth groups: The findings indicate that 51% of the higher income group are in the age group 3 (46-60) which also are the ones which have higher income in the total sample (Table 5-10). Lower income group is more concentrated (44%) at the age group 2 (30-45) (Table 5-10). The results sail along with expectation that higher income people are in the age group 3 (46-60). Also the low income group is at the age group 2 (30-45) where this group is at the take off stage, as the time passes they could advance to middle income group and higher income group. Table 5-10 illustrates proportions of age groups by household wealth groups.

Table 5-10: The proportions of age groups by household wealth groups in the study villages at Kilombero District, Tanzania, 2012

Description	Below 30	31-45	46-60	Above 60
Lower Income Group	2.78%	44.44%	33.33%	19.44%
Middle Income Group	2.7%	29.73%	43.24%	24.32%
Higher Income Group	5.71%	22.86%	51.43%	20%

5.4.4. Human capital by type of agriculture

Household size by type of agriculture: The findings indicate that improved irrigation have an average household size of 5. The traditional irrigation and rain-fed agriculture have an average household size of 7 and 5 respectively. The details are inconsistency to provide much explanation. Though we understand that the more number of household members the more labor size. Some people who lived longer in the village have more access to irrigated land than people who migrated recently to the village. This is because the irrigated land is more profitable so it is difficult to be surrendered.

Household education by type of agriculture: There are no much differences between education and access to irrigated land. Generally most people have lower education level (Table 5-11).

Table 5-11: Education level by farming practices in the study villages at Kilombero District, Tanzania 2012

Description	No formal primary education	Formal Primary education	Above primary education	Dropped primary education
Improved Irrigation	12.50%	59.38%	25%	3.13%
Traditional Irrigation	7.69%	61.54%	15.3%8	15.38%
Rain-Fed Agriculture	8.2%	68.85%	16.39%	6.56%

Male head of household by type of agriculture: Male head of household is more dominant to traditional irrigation 92% followed by rain-fed agriculture 83% and lastly improved irrigation 72%. More female head of household are in improved irrigation. It is plausible that female with higher income can control the household without male assistance.

Age groups by type of agriculture: The results indicate that the age group 3 (45-60) have the great dominance in both types of agriculture, thus improved irrigation (38.71%), traditional irrigation (61.54%) and rain-fed agriculture (41.24%) (Table 5-12). This age group it contains maturity people while other groups contains younger and older people. The experience and local knowledge of this age group make them to be more competent to the available resources utilization to strengthen the livelihoods.

Table 5-12: Age groups by farming practices in the study villages at Kilombero District, Tanzania, 2012

Description	Below 30	31-45	46-60	Above 60
Improved Irrigation	6.45	35.48	38.71	19.35
Traditional Irrigation	7.69	15.38	61.54	15.38
Rain-Fed Agriculture	1.59	33.33	41.27	23.81

5.4.5. Summary on human capital

Human capital is an essential element for pursuing range of occupations in the human welfare by producing effective labor quality. Labor refers to the aggregate of human physical and

mental effort used in creation of goods and service. Labor quality is enhanced by investing more in education, training, skills and health. In the study village's education, household size male head of household and age arise as significant variables embedded in human capital to support livelihoods in households. Better results were advocated in most cases which forms of human capital were increased. We now move on to the next section where we will look on financial capital.

5.5. Financial capital

I will discuss socio-economic factors associated to financial capital in the light of the four variables which includes household total income, location, wealth groups and type of agriculture. The stock of cash which the household has an access is regarded as financial capitals (Ellis 2000). Existing credit in term of loans is type of financial capitals in the study area. Forms of financial capital such as loans or saving do not offer direct profit; they need to be converted through investment to produce more values.

5.5.1. Financial capital by total household income

Existing credit in the form of loans by total household income: The results indicate that 31% of the total sample does use credit facilities. Generally credit facilities are very low in the study villages. During PRA sessions people argued that credit facilities offered by financial institutions are not smallholder farmer friendly. Credit conditions and terms favor business people than farmers. Most farmers were skeptical about formal credits because they offer little or no progress to small scale farming. They were requesting the government to establish special banks for small scale farmers.

Financial institutions which are found in the villages are CRDB Bank, NMB Bank and TIPAWU SACCOS. Other financial institutions are FINCA, CARE and Kilombero SACCOS. Credit durations and amounts vary according to the situation and also the status of the applicant. The credit duration ranges between six months and three years. Range of interest rates is 8% to 21% per term.

5.5.2. Financial capital analysis by location

Existing credit in form of loans by location: The findings indicate that existing credits are significance in the category of location to household total income. The empirical indicates that 51% of households at Mkula village are having existing credits in the form of loans. At Msolwa A village only 20% of households are having existing credits in the form of loans.

The variation can be explained by fact that improved irrigation which is intense at Mkula village provide better environments for credit facilities offered by financial institutions compared to Msolwa village where improved irrigation is not accessible.

5.5.3. Financial capital by households' wealth groups

Existing credit in form of loans by wealth group: 50% of higher income group members have existing credit in the form of loans. Middle income group members have 19% and lower income group members are having existing credit in form of loans of 25%. The existing credit has an important role to the higher income group on maintaining the livelihoods.

5.5.4. Financial capital by type of agriculture

Existing credit in form of loans by type of agriculture: The distribution of existing credit in form of loan in the type of agriculture and their proportions in brackets are improved irrigation (53%), traditional irrigation (15%) and (24%). The fact that improved irrigation is sustainable compared to other types of agriculture and that explain why it has a relationship with credit facilities.

5.5.5. Summary on financial capital

Generally credit facility is not well established, also education on how to spent credit funds is low in the villages. A little is known on how these credit funds in form of loan were spent. It is not so clear if the credit was spent on consumption or on investments. I received different answers from different small scale farmers during the interviews on how they spent the credit funds. An informant argued that he spends part of the credit funds to pay household debts. Another individual argued that he purchased brick to finish building his house using credit funds. Households lack education on how to spent credits and others forms of cash (savings and transfers).

During PRA session it has been argued that facilities offered by banks and other financial institutions are not useful to farmers. Farmers believe that banks and other financial institutions credit facilities make more harm than good in small scale farming. It is difficult to argue if the credit funds are fruitful to farmers or not. The following section will cover social capital.

5.6. Social Capital

Social capital refers to networks and associations within communities and between households tied through social relation. Various networks and associations exist in the study

villages premised under the relationship of trust and order. NGOs social network has emerged among other networks to be common in the household processes. Family network, church networks and so on are the types of network found in the villages. I will present socio-economic factor based on social capital through household total income, location, wealth groups and by type of agriculture.

5.6.1. Social capital by total household income

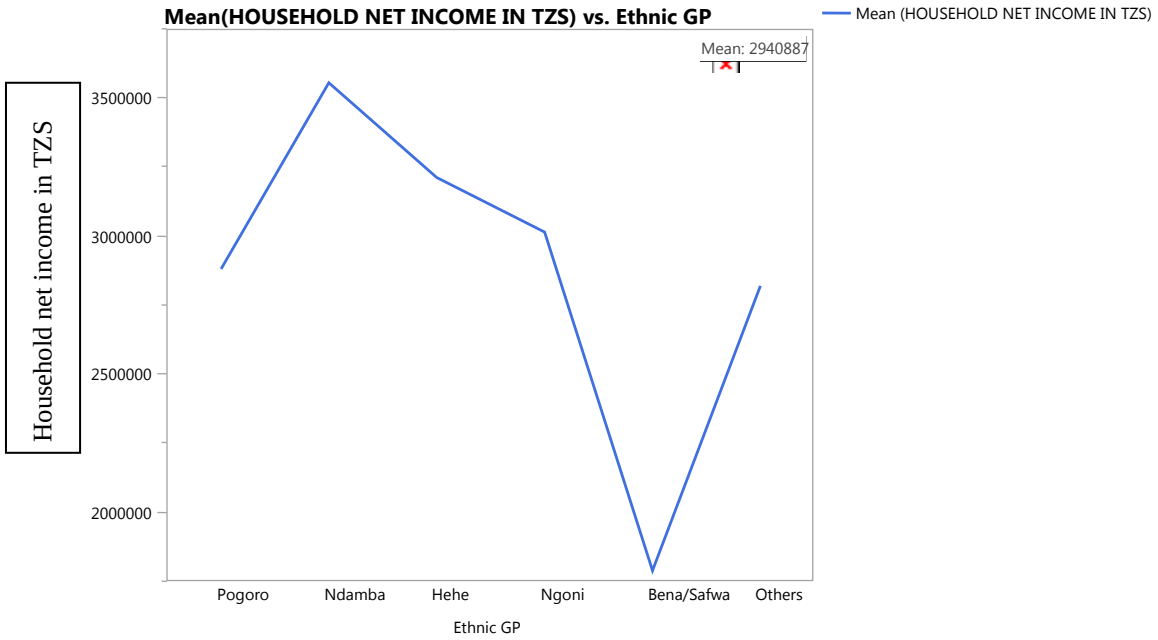
NGOs social network by total household income: The proportions of 48% of the total sample are indicated to have NGOs social networks. Households are organizing themselves based on trust derived from social relationship to build coherent organizations. Over 20 social organizations have been found in the study villages.

These organizations represent small scale farmers in various dimensions and most of them are voluntary based. The following are NGOs social networks found in the study villages; MUCGA UKWELI GROUP, UDZUNGWA SACCOSS, MUCGA ITEFA GROUP, JIPE MOYO, MUCGA NYALUBUNGO GROUP, KCGA BEGA KWA BEGA GROUP , MUCGA UMOJA GROUP and UCHUMI MSOLWA UJAMAA.

Others are UCHUMI KILIMO, KAMBARAGE GROUP, SHEIK, BLOCK MU3, POWER TILLER GROUP, ELNINO GROUP, UWAMKU, KIMBYOKO GROUP, VIKOBA GROUP, CARE GROUP, UVUMILIVU and UZALISHAJI MBEGU. These networks maintain common interests of the participants.

Ethnicity by total household income: More than 26 tribes were found in the study area. The study has grouped the tribes in to six different groups according to their population number in the villages. The first two groups contain the indigenous of Kilombero District (Ndamba, Ndwewe, Pogoro and others) the third group contains Hehe from Iringa Rural District which bordered with Kilombero District. Ngoni is the fourth group (people from South Tanzania). Next group is Bena and Safwa originally from Mbeya Region and the last group comprises other tribes from different locations in the country (Figure 5-4.).

Figure 5-4: Ethnic groups by total household income in the study villages at Kilombero District, Tanzania, 2012



Ndamba and Pogoro are indicated to have higher income than other tribes. This can be linked to the accessibility of strategic land including irrigated land. Bena and Safwa are reported to be employed in sugarcane production as wage labor.

5.6.2. Social capital by location

NGOs social network by location: At Mkula village a higher proportional household (54%) are engaged in such organizations compared to Msolwa A village which is 44%. The differences can be explained by the fact that irrigation activities have distinguished independent organizations apart from other organizations from cane out growers at Mkula village. This makes Mkula village to have more households engaged in NGOs social network compared to Msolwa A village.

Examples of organizations that are based on sugarcane production which is practiced in both villages that includes MKUCGA GROUP, MUCGA UKWELI GROUP, KCGA BEGA KWA BEGA GROUP and others. Specific organizations for irrigation activities include UWAMKU, KIMBYOKO GROUP, and others. VIKOBA GROUP and CARE GROUP are kind of organizations serve as financial institution. These groups are organizing basket funds where organization members can keep and borrow cash.

Ethnicity by location: Msolwa village indicate higher number of indigenous and Hehe people compare to other groups. The variations show that at Msolwa have more emigrants compared to Mkula village (Table 5-13).

Table 5-13: Ethnic groups by location in the study villages at Kilombero District, Tanzania, 2012

Description	Pogoro	Ndamba	Hehe	Ngoni	Bena/Safwa	Others
Mkula Village	18.42%	39.47%	10.53%	10.53%	2.63%	18.42%
Msolwa Village	28.87%	4.29%	28.57%	8.57%	17.14%	12.86%

5.6.3. Social capital by households' wealth group

NGOs Social Network by Households' Wealth Group: Higher income groups indicate higher proportions (64%) of engagement in NGOs social networks followed by middle income group (44%) and lastly lower income group (33%). The variation can be explained by that individuals of higher economic status will be more attracted to organizational size.

Ethnic groups by households' wealth groups: Generally the variations are not much to suggest significance in households' wealth groups. Ngoni people indicate lower number in the higher income group compared to other ethnic groups (Table 5-14).

Table 5-14: Ethnicity groups by households' wealth group in the study villages at Kilombero District, Tanzania, 2012

Description	Pogoro	Ndamba	Hehe	Ngoni	Bena/Safwa	Others
Higher Income Group	19.44%	19.44%	19.44%	8.33%	11.11%	22.22%
Middle Income Group	33.33%	11.11%	27.78%	13.89%	8.33%	5.56%
Lower Income Group	22.22%	19.44%	19.44%	5.56%	16.67%	16.67%

5.6.4. Social capital by type of agriculture

NGOs social networks by type of agriculture: Improved irrigation farmers show higher a share (59%) in NGOs social network followed by rain-fed agriculture (43%) and lastly traditional irrigation (38%). The situation can be elaborated by that higher income households are more involved in NGOs social networks this can be linked to improved irrigation because it provides more economic support to the household total income than other

types of agriculture. The difference between rain-fed agriculture and traditional irrigation can be explained by that rain-fed agriculture practiced a range of socio-economic activities which include rice, sugarcane, maize, cassava and so on while in traditional irrigation sugarcane is limited. Sugarcane is not practiced in traditional irrigation so it reduces number of social organizations.

Ethnic groups by type of agriculture: Ndamba people are more active in improved irrigation compared to other groups (Table 5-15). The difference can be explained by that indigenous are majority in the irrigation activities. Hehe people have higher number in rain-fed agriculture which is linked to sugarcane production.

Table 5-15: Ethnic groups by type of agriculture in the study villages at Kilombero District, Tanzania, 2012

Description	Pogoro	Ndamba	Hehe	Ngoni	Bena/Safwa	Others
Improved Irrigation	22.58%	35.48%	9.68%	12.90%	0%	19.35%
Traditional Irrigation	23.08%	15.38%	46.15%	0%	15.38%	0%
Rain-fed Agriculture	26.98%	6.35%	23.81%	9.52%	17.46%	15.87%

5.6.5. Summary of social capital

Social networks are crucial factors in maintaining relationship within the community and between households. In the villages NGOs social networks are proving many effects in socio-economic life of households. The engagement and involvement of people in the networks reflect the degree of necessities of social organization to maintain human well being.

Indigenous people are more active in improved irrigation compare to other ethnic groups while migrants have concentrated more on the rain-fed agriculture.

CHAPTER 6 -MAIN HOUSEHOLD INCOME ACTIVITIES

Activities are carried out by an individuals or groups to acquire material welfare in the livelihood process. Individuals or groups are acting to secure basic necessities of life which include food, shelter and clothing. In the SLA framework; households will consider different activities to reach goals driven by self motivation. Utility maximization, profit maximization or risk averse strategies are kinds of motivations which subject an individual to reach the decision on what to produce, how much, how and when based on the available assets (Ellis 2000).

To present the household activities in livelihood processes, four broad categories of activities will be discussed. The categories of activities include farm income activity, non-farm income activity, off-farm income activity and remittances. Four variables will be used to study the household main activities in the study villages which include overall or household total income, location, and households' wealth groups and by type of agriculture.

6.1. On-farm income activities

This part will present analytical discussion about main activities in the category of on-farm income activities. The analysis of these on-farm income activities will be in the light of household total, location, household wealth group and by type of irrigation agriculture. Farm income activity comprises all activities which generate income from farming which include crop cultivation and livestock products.

Farm income is derived from household output produced multiplied by the local market price. Incomes generated from livestock and cash income from outputs sold are also included in the farm income category. Costs/expenses incurred were deducted from gross income in order to obtain net income figures. The cultivation costs involve all associated in crop production. To obtain the total cultivation costs, the study has aggregated all expenses from farming preparation, seeding, weeding, variable inputs, hired labor (own labor does not included), harvesting, packaging, freight, storage and others.

The range of crops found in the study villages includes rice, maize, cassava, sweet potatoes, pulses/beans and banana. Others are vegetables (tomato, cabbage and onion), sugarcane, sesame and mango.

6.1.1. Total household production activities by crops

Total household income is one of the four variables that will be used to analyze on-farm income activities. The main on-farm income activities that will be analyzed include rice, sugarcane maize others crop productions and livestock. Other crop production includes sweet potatoes, sesame, vegetables and fruits. Generally these crops are produced at low levels in the villages. That is why they have been combined in the analysis.

6.1.1.1. Rice production activities

Rice production is a dominant crop in the study villages and a central focus of this study. About 95% of the total sample is engaged in rice cultivation. This can be linked to the fact that rice is serving as both staple food and cash crop.

Individuals are motivated to grow rice by the incentives available from rice markets. Ngasongwa (2007) point to that Morogoro Region is one of the major producer of rice in Tanzania (Ngasongwa 2007). According to focus group discussions, rice has been grown in the area for a very long time. Many other crops were introduced after rice. It was unknown when rice production started in the area.

The farmers pack the harvested rice in sacks of 100kg equivalent to 0.1 ton. The quantity harvested was measure by counting sacks of the harvested rice from the plots/farms. The results show the averages of 0.88 tons of rice were sold and 0.59 tons was consumed in the total sample. The results show that more rice is sold than consumed within households.

Rice is cultivated in both improved irrigation, tradition irrigation and in rain-fed agriculture. According to focus group discussions water shortages subject households to grow other crops apart from rice. Most individual households prefer to grow rice, but they fail because access to water is limited. Other crops (sugarcane, maize, potatoes, sesame, fruits and vegetables) require less water than rice.

6.1.1.2. Sugarcane production activities

Sugarcane production is practiced by small scale farmers and it serves as a pure cash crop. The production doesn’t require much water in comparison to rice, and relies only on rain-fed small scale farming. The activity is well established in the area because of access to the sugarcane market (Illovo Sugarcane Company) The sugarcane income offers the highest shares in the net household earnings in the total sample. About 64% of the total sample is

engaged in sugarcane cane production. Sugarcane production is well established around the study villages. A large area in this part of Kilombero District is under sugarcane cultivation. The small scale sugarcane production is done under rain-fed farming. For large scale farming which is done by Illovo Sugar Company irrigation is done under highly advanced technology with sophisticated tools and machines under high physical and financial capital inputs.

Sugarcane capital inputs are reported to have bearable costs during the cultivation process because of special incentives offered by Illovo Sugar Company to cane out-growers. Some of the initial costs and inputs costs are provided by the company and deducted on the farmers' payments after the harvesting.

6.1.1.3. Maize production activities

Most maize farms are located in remote area where sugarcane and rice fields are not established. Maize production is linked to rain-fed agriculture because maize is more resilient to water shortages than rice. Only 22% of the households in the total sample are engaged in maize cultivation.

Maize production is low in both as cash and a subsistence crop. The farmers pack harvested maize in the sacks weighing 100kg. The average production of 0.049 ton of maize was sold and the average of 0.091 was consumed. Maize production is thus a minimal crop occupation in the study area.

6.1.1.4. Other crops production activities

Other crops found in the study villages are sweet potatoes, sesame, vegetables and fruits. Apart from paddy and sugarcane production other crops within the study villages are produced in small quantities as subsidiary under rain-fed production. These crops are resilient to water shortages, so households are growing these crops as backups if anything happen to the main crops (rice or sugarcane).

The number of people who are engaged in other of crops (apart from rice, sugarcane and maize) is low, (Table 6-1.) because most farmers have employed much of their efforts on the marketable crops. A poor market for other crops is one factor why people have less priority for such crops. Also, according to PRA, the surrounding physical environment subjects individuals to grow sugarcane or rice. If the whole area is surrounded by rice or sugarcane fields then it became so difficult to grow alternative crops even if someone wishes to do so. It is physically difficult to grow other crops on the same land with rice or sugarcane.

Mangoes are fruits found in the area but they have a very low cash market because almost every individual household owns one and the market is limited. But now mango trees are in danger following the burn of engaged of people on the surrounding forests due to conservation purposes. People are using mango tree as a source of firewood and power.

Table 6-1: Households that engaged in other crops by household total income in the study villages at Kilombero District, Tanzania, 2012

Description	Sweet Potatoes	Sesame	Banana	Vegetable	Cassava
% of Households	4.6%	1.83%	3.67%	4.59%	4.59%

6.1.1.5. Livestock keeping activities

Livestock found in the study villages are cattle, goat, pig, poultry, duck, pigeons and rabbit. Livestock offers a unique contribution in human diet through its diversity of products (meat, cheese, milk, eggs and skin) but there are few number of household engaged on this. Only 7% and 5% of household were found keeping cattle and keeping pig in the total sample respectively. In the total sample only one household was found keeping a goat. Other animals such as cat and dog are also found in the villages but they have no commercial values. Equitable domestic animal found in the villages is poultry as we have seen earlier in chapter five.

Rural Income Generation Activities (RIGA) of FAO has indicates that 60% of rural households keep livestock that include poorest households (Conway et al. 2012). The situation is different in the study villages, livestock keeping is at minimal. Three major factors can explain the reasons for livestock to have less contribution in the total household income in the study villages.

First, the majority of the inhabitants in the study villages are non-pastoralists by origin. Indigenous people in the study villages include Mbunga, Ndamba, Pogoro, Ndwewe and Ngindo who are not pastoralists by origin. Another group is people from South (Hehe, Bena and Safwa) that are not used to do livestock keeping. Another group comprises Ngoni, Pare, Rangi and Ndengereko are also not used to animal husbandry.

Second, the study villages are surrounded by crop fields, national park and game reserves (Selous Game Reserve and Udzungwa Mountain National Park) which signify low access to animal grazing land. Land for pasture is problematic.

Third, the absence of buffer zones between villages and the reserves/parks raise serious tension between villagers and Tanzania National Parks (TANAPA) authority. The border between villages and park has almost zero distance, so wild animals and humans trespass each others' areas. The tension is initiated by overlapping activities between wildlife as well as humans. Villages complain about the wild animal's destruction on their crops/properties. They also complain about restrictions imposed for them not to enter in the park/reserve to do activities. These situations affect people's livelihoods. Few individuals are practicing animal keeping and obtaining fodders for their animals is a challenging issue. Zero grazing is an alternative to individual's households who are motivated and have incentives to graze animals.

6.1.1.6. Summary of on-farm income activities

To sum up the above discussion I argue that rice and sugarcane production are the major activities which contain large number of households perusing household strategies. Other crops are less important and low intensive. Maize production remains as a crop which is mainly grown in the remote areas because of land scarcity in the villages. Livestock is also a marginal activity. The analysis is moving to the next part where analysis of on-farm activities will be covered by locations.

6.1.2. Analysis by location

6.1.2.1. Rice production by location

At Mkula Village 100% of households are engaged in rice cultivation while at Msolwa A village only 93% does. Mkula village households have more access to irrigation water motivating many households to grow rice even outside the irrigation schemes. Rice production is an intense activity in Mkula village and is a sole crop permitted to be grown in the improved irrigation scheme. The scheme has ruled that all irrigation water extracted from Mkula River and flow through irrigation canals will be used only for rice cultivation. Strict rules have been developed to preserve this arrangement.

At Mkula village 82%, 8% and 10% of farming practices are from improved irrigation scheme, traditional irrigation scheme and rain-fed agriculture respectively. At Msolwa A village 84% of farming practices is done under rain-fed agriculture. The existence of Mkula Irrigation Scheme favor modern irrigation farming practices where a relatively higher percentage of people are engaged on compared to the other village.

Sources of both domestic and irrigation water is Mkula River from Udzungwa Mountains and it drains across the village to other downstream areas. According to the Kilombero District Irrigation Engineer Mkula River discharge was 0.34 cm^3 per second measured as maximum flow in 2005. Other rivers drain across the village is Sonjo and Msufini Rivers and both are sourced at Udzungwa Mountains.

Mkula Scheme officials have targeted rice irrigated area of 254.3 hectares while the current area under rice irrigation is 205 hectares. About 91 households are engaged at Mkula irrigation scheme according to scheme officials. People experience water shortages during the dry seasons and excess water during the wet season. The improved irrigation scheme equipped with better infrastructures, constructed using concrete and better gates compared to the traditional infrastructures with less control of water use is prevalent.

Many people also cultivate rice in Msolwa A village even without having modern irrigation activities. The activities are established to the wetland areas. Itefa and Nyamigadu are wetland areas which favor crop production including rice in all seasons around the year at Msolwa A village.

Rice serves the purpose of both cash and subsistence crop. At Mkula village rice sold is very high compared to Msolwa A village. The average of 2 tones at Mkula was sold while at Msolwa A village the average was 0.22 (Table 6-2).

Table 6-2: The average of rice quantity sold by location in the study villages at Kilombero District, Tanzania, 2012

Level	**Mean**
Msolwa A Village	0.22286
Mkula Village	2.06154

The measures are in tons

At Mkula village the rice quantity consumed is also higher than in Msolwa A villages. The average of 0.55 tons is shown at Msolwa village and at Mkula village the average of 0.66 tons is indicated. The variation can be explained by two reasons. First is the existence of irrigation scheme and Mkula village. Second Msolwa A village rice production serves more as staple food than cash crop (Table 6-3).

Table 6-3: The average of rice quantity consumed by location in the study villages at Kilombero District, Tanzania 2012

Level	Mean
Msolwa A Village	0.554286
Mkula Village	0.658974

The measures are in tons

6.1.2.2. Sugarcane production by location

The findings indicate that 66% of households are engaged in sugarcane production at Msolwa A village and 62% at Mkula village. At Mkula village rice production is more intense than sugarcane. But still many households prefer to also grow sugarcane because of the available incentives offered from the sugarcane market. Low cost of production as per time still pulls people to cultivate sugarcane. Individuals are combining the activities to maximize profit and to secure personal goals. Farmers also were able to utilize their labor more freely as irrigated rice fields may not require all their labor input.

Msolwa A Village shows high number of involvement in sugarcane production. This can be explained by that the available market structure and absence of substitute activities that yields more than sugarcane within the village.

6.1.2.3. Maize production by location

The results show that 30% of households at Msolwa A village are engaged in maize cultivation. At Mkula village only 7.69% of people are engaged in maize cultivation. The figure is relatively low at Mkula village because irrigation activities produce more income which keep people busy and maintain focus on rice. It is possible that households here use more efforts (resources) in irrigation activities than in the less suitable maize.

The average maize quantity sold is 0.044 tons and 0.058 tons at Msolwa A and Mkula village respectively. The average of maize quantity consumed is 0.132 tons at Msolwa Village and 00.15 tons at Mkula village. At Msolwa village the results indicates that maize is more for subsistence than as a cash crop, while this is opposite at Mkula Village.

6.1.2.4. Other crops by location

The participation of people in other crops is very low, (Table 6-4). This is because other higher income crops are more accessible which make genuine reasons for most of people to stick to the profitable crop production.

Table 6-4: Households that engaged in other crops by location in the study villages at Kilombero District, Tanzania, 2012

Description	Sweet Potatoes	Sesame	Banana	Vegetable	Cassava
Mkula Village	5%	0%	5%	3%	5%
Msolwa A Village	4%	3%	3%	6%	2%

6.1.2.5. Livestock by location

The same characteristics are happening in village locations in terms of livestock keeping as in the overall analysis. Both villages are faces the same problems of having less incentives of keeping animals. No variation in terms of villages because very low number of people are keeping animals under the zero grazing. About poultry, we have already seen earlier.

6.1.2.6. Summary of on-farm income activities by location

People in both villages are engaged in rice and sugarcane production. But the difference is that, rice production is more intense at Mkula village while sugarcane and maize productions are intense at Msolwa A village. Generally households are more active to the kind of activities which offer higher returns in their respective area. Other crops and livestock keeping are not very important.

6.1.3. On-farm and households' wealth groups

Household wealth groups was created by dividing the total households in to three income groups (one third) of 36, 37 and 36 households according to their total incomes. The wealth groups include higher income group, middle income and lower income groups. These groups will be used to analyze rice, sugarcane, maize and other crops production using the location. Livestock will be covered as well in this part.

6.1.3.1. Rice production by households' wealth groups

The differences are not so large between the three groups (97%, 95% and 94%); this is because the main economic occupation of small scale farmers in the villages is rice cultivation. All income groups are fully participating in the rice cultivation.

The differences are found in the rice quantity sold and quantity consumed. The average of 1.8 and 0.9 tons are indicated quantity sold and quantity consumed respectively. The higher

income group sold and consumed much larger quantity compared to other groups (Table 6-5 and 6-6).

Table 6-5: The average of rice quantity sold by household wealth groups in the study villages at Kilombero District, Tanzania, 2012

Level	Mean
Lower Income Group	0.2
Middle Income Group	0.6
Higher Income Group	1.8

The measures are in tons

Table 6-6: The average of rice quantity consumed by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012.

Level	Mean
Lower Income Group	0.3
Middle Income Group	0.4
Higher Income Group	0.9

The measures are in tons

6.1.3.2. Sugarcane production by households' wealth Groups

The involvement in sugarcane is say that the higher income group (89%), middle income group (68%) and in the lower income group (36%). The situation can be explained by that sugarcane production has a high connection with land size owned in terms of rising income level. Also Sugarcane production also serves as a cash crop, so all quantity harvested are expected to be sold. The higher income group is linked to own more land compared to low income people. This explains the consistent pattern on engagement of household wealth groups in sugarcane production. We have seen earlier that higher income groups are also very active in NGOs social networks which represent them in various ways, and now they are leading in the engagement in sugarcane production.

6.1.3.3. Maize production by households' wealth groups

Few households are growing maize. The findings show that higher, middle and lower income groups are having 21%, 24% and 20% of engagement in maize cultivation respectively. Maize production is a minor activity in the villages.

6.1.3.4. Other crops production by households' wealth groups

Generally the involvement of wealth groups in these types of crops is very low (Table 6-7). Neither of the group is having above 6% of involvement in other crops production. There are no significant differences among wealth groups.

Table 6-7: Households that engaged in other crops by location in the study villages at Kilombero District, Tanzania, 2012

Description	Sweet Potatoes	Sesame	Banana	Vegetable	Cassava
Higher Income Group	3%	3%	11%	6%	6%
Middle Income Group	5%	3%	0%	2%	2%
Lower Income Group	6%	0%	0%	6%	6%

6.1.3.5. Livestock by households' wealth group

Generally the involvement of wealth groups in livestock keeping is not giving significant explanations. It is difficult to generalize the findings following the number of individual's households who are keeping domestic animals in the study villages. For example only one household is keeping goat and few households are keeping cattle in the total sample.

6.1.3.6. Summary of on-farm activities by household's wealth groups

Generally higher income groups are dominating in rice and sugarcane productions compared to other wealth groups. Maize production, other crops and livestock keeping are less significant and there is less difference between location and households' wealth groups.

6.1.4. Analysis by type of agriculture

The study has grouped different type of agriculture practiced in the study villages in to three groups that includes improved irrigation, traditional irrigation and rain-fed agriculture. The analysis will cover the main crop activities found in the study area which includes rice, sugarcane, maize and others crops. Livestock will also be looked at.

6.1.4.1. Rice production by type of agriculture

The results are significant because in both improved irrigation and traditional irrigation 100% of the households are engaged in rice production. In rain-fed agriculture 94% of households produce rice. Rice cultivation has dominated all areas where water is abundant including wetlands and irrigation fields. Rice cultivation attracts more attention in these areas because other crops can be grown in dry areas under rainfall.

Rice quantity sold indicates high number in improved irrigation compared to other types of agriculture. The average of 2.3 tons is shown in improved irrigation (Table 6-8). The situation explains that water is a significant factor in the rice production.

Table 6-8: The average of rice quantity sold by type of agriculture in the study villages at Kilombero District, Tanzania 2012

Level	Mean
Improved Irrigation	2.3
Traditional Irrigation	0.5
Rain-fed Agriculture	0.2

The measures are in tons

Rice quantity consumed is larger in traditional irrigation scheme households compared to other types of agriculture. The differences can be connected to fact that in traditional irrigation rice serves as subsistence than cash crop while sugarcane serves basically as cash crop (Table 6-9).

Improved irrigation schemes maintain the infrastructures in a way water leakages are low compared to traditional irrigation (Figure 6-1 and 6-2). Infrastructures in traditional irrigation are poorly built using mud/dung and peace of logs which cause immense water leakages (Figure 6-2 and 6-3).

Table 6-9: The Average of rice quantity consumed by type of agriculture in the study villages at Kilombero District, Tanzania, 2012

Level	Mean
Improved Irrigation	0.6
Traditional Irrigation	0.9
Rain-fed Agriculture	0.4

The measures are in tons

Figure 6-1: Improved Irrigation Infrastructure at Mkula Irrigation Scheme in Mkula Village at Kilombero District, Tanzania, 2012

Source: Fieldwork 2012

For traditional irrigation Mkula village rely on the multiple rivers (Mkula, Sonjo and Msufini rivers) that drain across the area known as MAKI. MAKI is an area where traditional irrigation is practiced at Mkula village. The name is formed from initial letters of two villages namely Magombela which is the part of Mkula village and Kimbyoko. On this area rice production is the sole crop produced. According to the key informants, the MAKI scheme has a total area of 320 hectares under traditional irrigation. The smallholder farmers have developed the management system which helps to arrange and control water and land allocations.

At Msolwa A village households' rely on wetlands in the popular areas known as Itefa and Nyamigadu where rice production is dominant. Wetland supports various crop cultivations on almost around the year (dry and rainy seasons). The areas have random crop cultivation ranging from rice, sugarcane, maize, beans, tuber crops, vegetables and others.

Figure 6-2: Traditional Irrigation infrastructure at MAKI in Mkula Village at Kilombero District, Tanzania, 2012

Source: Fieldwork 2012

Msolwa A village has a higher share of traditional irrigation farming practices. In rain-fed land rice is a seasonal crop which is mostly cultivated once per year. In these areas water shortage poses threats to the rice production. Farmers utilize fewer resources in cultivating rice in rain-fed land.

Rice is cultivated more than once in irrigated land in a year. The availability of water supports rice production in both dry and wet seasons in irrigated fields. The same situation is also happening in wetland areas. Modern irrigation infrastructures assist to maintain better rice production pattern compared to wetlands and in traditional irrigation

Figure 6-3: Traditional irrigation infrastructure at MAKI in Mkula village at Kilombero District, Tanzania, 2012

Source: Fieldwork 2012

6.1.4.2. Sugarcane by type of agriculture

The results show that 63% of households which are in improved irrigation are engaged in sugarcane production. About 69% and 65% of households are engaged in sugarcane from traditional irrigation and rain-fed agriculture respectively. These results indicate that large number of households from different types of agriculture is engaged in sugarcane production. Sugarcane employs over half of the households in each type of agriculture. Sugarcane production can be ranked number two after rice production on the engagement of households on the type of agriculture.

6.1.4.3. Maize production by types of agriculture

Improved irrigation households have 9% engagement in maize production. Traditional irrigation households show a highest number (33%) of households which are involved in maize production. Rain-fed agriculture households have 26% engagement in maize production. The difference can be explained by that in improved irrigation the household opt to use the available resources/assets including land, time and similar resources to the types of crops which generate relatively higher incomes. Because of that maize production receives little attention compared to other products. However, maize production is not completely abandoned, it is practiced but at a low scale to accomplish some other personal goals like food security or task being a risks management strategy.

It is expected that households in rain-fed production will engage more in maize production because maize production has a limited chances to be grown in irrigation schemes. But even in areas under rain-fed the competition between sugarcane and maize still persists. Few households do engage in maize production.

6.1.4.4. Other crops production by type of agriculture

Generally other crops that include sweet potatoes, sesame, vegetable and cassava are not targeted to be cash crops. They are grown as small scale within the same farms with maize or small garden within residential areas. For example I observed that within the house plots people tend to have kitchen gardens where a range of vegetables are grown. Mainly these crops are for home food consumptions and not for the market.

6.1.4.5. Livestock by type of agriculture

Livestock keeping is a limited activity in this part of Kilombero District for the reasons already discussed in chapter five. Livestock keeping activity is almost none existing in the study villages.

6.1.4.6. Sum up of type of agriculture by on-farm income activities

People with improved irrigation produce more rice while people with traditional irrigation also do rice production. The same people also engage in sugarcane and other crops. People with rain-fed agriculture engaged more in sugarcane production and do other crops to sustain other personal goals.

6.2. Off-farm income activities

This part will analyze off-farm income activities. The analysis of off-farm income activities will be in the light of total household income, location, and households' wealth groups and by type of agriculture. Off-farm income activities comprise all activities of earning income within the agricultural sector apart from crop income that include wage labor and local environmental resources (firewood, charcoal, medicine plants and wild plants, fish income). Labor payments in kind are not included because it was difficult to measure.

6.2.1. Analysis by household total income

The study will present general overviews of off-farm income activities. Labor and environmental resources will be covered.

6.2.1.1. Labor by household total income

In the study villages, few households (4.6%) were engaged in wage labor on other peoples' farms in the total sample. The willingness of people to offer wage labor is low, this is because rural wages are relatively low. Most people are doing other income activities as their main occupation and wage labor becomes a subsidiary activity. Labor in the study villages was done by assigning a particular task(s) to an individual. The process is initiated by a bargaining process concerning available tasks and wages. This is done between farm owners and a potential laborer. The wage is based on the type of work agreed.

6.2.2. Off-farm activities by location

By Location I refer two villages namely Mkula and Msolwa A villages. The analysis will cover off-farm activities (labor and environmental resources) in this part.

6.2.2.1. Labor by location

The labor activity has a low number of households according to the results obtained from the database in both villages. The situation can be because the survey was based on the households' heads and this group contains less number of people who offer labor for wage. It is difficult for the household heads to devote all their time and energy offering labor for wage because the rural wage is insufficient to sustain a family wellbeing. A majority of household heads spent time on their own crop fields or other activities. Other family members (not household heads) may offer labor service for wage.

The difference is shown at Msolwa A village which indicates more people (7.14%) went into paid labor. The variation can reflect kinds of assets endowed in each village. The motivation of engaging in labor is expected to be low if access to other higher income activities exists.

6.2.3. Analysis by households' wealth group

Wealth groups refer to high income group, middle income group and lower income group.

6.2.3.1. Labor by households' wealth group

In households' wealth group the difference is shown. Lower income group have larger number (8%) of people who offer wage labor followed by middle income group (5%). No one was found offering wage labor in higher income group. The results suggest that higher income group tend to be employer of other income groups.

6.2.4. Analysis by type of agriculture

6.2.4.1. Labor by type of agriculture

The differences are shown in the labor by type of agriculture. The households on rain-fed agriculture farms indicate to have all reported individuals who aid paid labor in the study villages. Improved and traditional irrigation show zero number of households that went into paid labor. The situation can be linked with kind of earnings obtained from different types of agriculture. The more income generated from type of agriculture, the likely lower involvement in wage labor. The results suggest that if households from rain-fed agriculture tend to be employee then the improved and traditional irrigation will be the employers.

6.2.5. General analysis on local environmental resources

Local environmental resources (fish income, firewood, medicine plant and wild plants) have an average of 3.1% on the household net income in the total sample. The environmental resources have a small contribution to the total household income because of the nature of the location of the villages as discussed earlier. No forest existed around the villages which has an open access for non-timber forest products (NTFPs) activities since 2010. Available forests around the village's lies within Udzungwa National Park and Selous Game Reserves and remaining areas are dominated by humans' settlements and crop fields.

During my fieldwork in 2012 the issue of environmental resources was extremely serious because of its sensitivity for rural livelihoods. It costs a lot to travel say more than 20 to 30 km to find the next available forest to obtain environmental resources including fuel-wood.

The nature of the common crops available in the villages (rice and sugarcane) do not support trees, as the vast areas around are covered by sugarcane plantations and rice fields. So even in crop fields environmental resources are not possible to be obtained and this continues to push further the scarcity of environmental resources.

According to PRA people used available trees around their areas for fuel-wood and for other socio-economic activities. Mango trees became a foremost target on that mission because of their availability in the residential areas. Other alternatives applied are by gathering pieces of coconut residuals, dead leaves and other available materials that can be used as source of fire.

The situation is highly problematic to most families, especially the poor. Wealthy households diversify their livelihoods and assist to attack the problem in myriad ways. Charcoal and electricity are the alternative sources of energy in some households. These power source alternatives are limited to few individuals because they are too expensive to ordinary rural

people. An informant argued that the cost of building houses has piled up because poles and timber are not accessible anymore from the closer forests.

Fodders are obtained from areas around the villages for those few individuals who graze animals. As we have discussed earlier livestock keeping is a marginal activity in the area, so less problem with fodder in the small scale grazing. Also, fodders can be obtained from crop residuals from the farms.

6.2.6. Summary of off-farm income activities

Generally the off-farm income activities are very low in the study area. The main occupations for almost all households are agriculture activities, so off-farm activities receive low attention. Environmental resources are problematic at the moment. In term of location, Msolwa village households went for more paid labor than in Mkula village. Wealthy households are not engaged in wage labor but the low income people do jump Mkula. Also we have experienced that improved and traditional irrigation households do not offer their labor but the rain-fed agriculture households do.

On local environmental resources, the situation is controversial in the study area, and little is known about the future of that community. The farmers argued that since 2010 their livelihoods have been shaken to a great extent following the burning human activities in Udzungwa Mountains National Parks and Selous Game Reserves. The forests were available for people around the villages.

6.3. Non-farm income activities

Non-farm income activities refer to non-agricultural income activities that generate means of household survival, includes rural trade or non-farm rural self income (kiosk, food vendor, local brew, second hand clothes and others), employment (non-farm rural wage or salary) and rental income obtained from leasing a land or property. Other activities are transfers to rural households (remittances) and others (pensions and cash obtained from associations).

6.3.1. Non-farm income activities and total household income

This part will cover general analytical overviews of the non-farm income activities which include rural trade, employment, others (pensions and cash obtained from associations), rental income and remittances. Rural trade, employment and others shows significance in explaining household total income.

6.3.1.1. Rural trade/non-farm rural self income activity

Rural trade in the study villages comprises running kiosk, food vendor, selling local brews and selling second hand clothes. In the total sample the rural trade account for 15% of the households who engaged in non-farm income activity category. Running kiosk was done by both sexes while local brew was mostly done by women. Selling second hand clothes was a newly introduced trade; the traders claimed that the trade is successfully established in the villages.

6.3.1.2. Employment

Employment comprises non-farm self, firm or government employment, where special skills are required to pursue the task. Self employment found in the study area was tailoring, carpentry masons, brick making, and hand gravel crushing. Government employments found in the study villages are teachers, nurses, and medical officers, irrigation technicians and village officials. About 9% of households are engaged in employment in the total sample. The findings show employment also has significance in the household total income. Within the study villages apart from primary and secondary schools, dispensary and village office, there are no existing firms or industries that provide employment. Self employment is a marginal business.

6.3.1.3. Others income activities

Pensions and cash from associations is another means of generating household incomes. The findings indicated little number of retired people in the villages. Most retired people live under care of their sons, daughters or related family members. Some retired people have the tendency of returning to their homeland at the end of their service terms in government or firms. Most retired people found in the study villages are often able enough to work and were engaged in agricultural activities. They reported that pension received is insufficient to sustain rural livelihood and that is the reason which make them engage in agricultural activities at late ages.

Cash obtained from associations is another activity that is going on in the study villages. The study finds that more individuals organize themselves and start a basket fund where they donate and borrow cash under their own arrangements. Women are more engaged in this activity than men. They named these associations VIKOBA, a Swahili term. Many women reported to be satisfied with these arrangements and admitted they are useful in their

livelihoods strategies. CARE group is another kind of association which serves the same as VIKOBA.

6.3.1.4. Non-farm activities and rental income activities

A rental income activity has relatively small number of households engaged. The figures shown are low because households have limited assets to offer. According to PRA some individuals households tend to rent their land out for a certain period of time because of the financial status which makes them unable to engage in cultivation. They will often reclaim their land soon after recovering from financial crisis. Rental income activities are not common in rural areas; it seems to take place by chance. Rental income has about 6% households in the total sample.

6.3.1.5. Remittances

Urban-rural transfers indicate high numbers of households who receive it in the total non-farm activity. Urban-rural remittances arising from various places, it was difficult to trace particular places which they were flowing from. Little is known on how individual households spent received remittances. The study doesn't have the clear information whether cash from transfers are used in household consumption or on investments. About 19% of the households are receiving remittance in the total sample.

According to the personal interviews, the successful family members reside outside (urban) the villages are responsible for the transfers. They send funds back home to support various livelihood activities.

6.3.2. Non-farm activities by location

Table 6-10: Non-farm income activity by location in the study villages at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	1,2063155	0,2951074	16,71	<,0001*
Rural Trade	-1,9661e-7	1,5038e-7	1,71	0,1911
Rental Income	-3,6249e-7	1,4592e-6	0,06	0,8038
Employment	-1,6429e-7	2,2803e-7	0,52	0,4712
Remittances	-3,9563e-6	2,5618e-6	2,38	0,1225
Others	-1,507e-6	1,9521e-6	0,60	0,4401

*N=94, * indicate significantly differences between location in off-farm income activities. (P < 0.0001), RSq=0.07*

6.3.2.1. Rural trade activity

Rural trade activity shows little significant in location (Table 6-10). Rural trade is more established at Mkula village compared to the other village according to the findings. At Msolwa A village where the total households' number is five times bigger than Mkula village, business is well established but note that many of the businessmen/businesswomen are not farmers and were not included in this survey. About 27% of households were engaged in rural trade at Mkula Villages and 10% in Msolwa A village.

6.3.2.2. Rental income activity

Rental income is very low in both villages. About 7.6% and 5.71% of households were engaged into rental income activity at Mkula and Msolwa A villages respectively. Msolwa A village shows less number of households participated in rental income activity but more average annual income than Mkula village. This can be because rental properties at Msolwa may have more values than the properties from the other village.

6.3.2.3. Employment

At Mkula village about 8% of households are employed compared to 10% at Msolwa A village. Both numbers indicate that employment is not common in villages. But the difference between the two villages can be explained by the size of the villages. It expected to have more employment at Msolwa A villages because of the population sizes between the two villages.

6.3.2.4. Remittances

More people are receiving remittances at Mkula village about 15% compared to the other Msolwa village 3%. The difference shown can be explained by the argument that most people at Mkula have their origins in the villages according to PRA, and so family members who live away from the villages tend to support their families back home. At Msolwa A the situation is a bit different, most people have their origins away from the villages so they are expected not to receive money from other relatives rather they are expected to do the opposite if they can.

6.3.2.5. Other income activities

Other income activities comprise pension and income from NGOS social networks. This is also very low in the villages. About 5% and 4% households are in this category at Mkula and Msolwa A villages respectively. If retired person is expected to go back home likely Mkula village will host more people than Msolwa A village. So pension flows will be more at Mkula village. Also the cash circulation through NGOs social networks (VIKOBA, CARE and

others) is likely to be more for smallholder farmers of Mkula village because of the existing multiple established economic activities (irrigated rice, sugarcane, rural trade and others) which bust the level of income.

6.3.3. Analysis by households' wealth groups

The findings shows low figures and that give less significance explanation. Table 6-11 illustrate nominal logistic fit model for household wealth groups in non-farm income activities.

Table 6-11: Nominal logistic fit model for households' wealth groups in the study area at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	1,0788756	0,3660154	8,69	0,0032*
Rural Trade	-1,2886e-6	6,037e-7	4,56	0,0328*
Rental Income	-2,9942e-6	2,1774e-6	1,89	0,1691
Employment	-7,0916e-7	4,4205e-7	2,57	0,1087
Remittances	-7,2817e-6	4,548e-6	2,56	0,1094
Others	-5,8979e-7	2,1072e-6	0,08	0,7796

*N=94, * indicate significantly differences among households' wealth group in off-farm income activities. (P < 0.002, RSq=0.13)*

6.3.3.1. Rural trade activity

Rural trade shows significant difference between households' wealth groups (Table 5-12). The differences is consistent, the rural trade is controlled by high income individuals. The proportions in wealth groups for rural trade shows that lower income group (6%), middle income group (16%) and the higher income group (25%).

Table 6-12: Rural trade activity by wealth groups in the study villages at Kilombero District, Tanzania 2012

Level	Least Sq Mean	Std Error	Mean
Lower Income Group	77777,78	222830,74	77778
Middle Income Group	189189,19	219798,88	189189
Higher Income Group	900000,00	222830,74	900000

*N=109, * indicate significantly differences among households' wealth group in off-farm income activities. (P < 0.0208, RSq=0.070)*

6.3.3.2. Rental income activity

Generally the rental income activity is low in the area. Rental income activity has the following proportions in the wealth groups; lower income group (6%), middle income group

(11%) and higher income (3%). The differences can be explained by that higher income group have less property to rent than the other income groups because they have the financial capacity of utilizing all their properties. Middle income group indicate to have more rental income than other groups. This can be because they rent expensive properties.

6.3.3.3. Employment

The employment is very low in the area. The proportions of employment in the wealth groups show lower income group (8%), middle income group (8%) and higher income group (11%). The difference is not big though higher income group shows a bit bigger size than other groups.

6.3.3.4. Remittances

The remittances are also very low in the area. The proportions of remittances in the wealth group show that lower income group (25%) middle income group (1%) and higher income (19%). The average annual income in the wealth group in the remittance indicate that 24,722TZS (lower income group), 31,081TZS (middle income group) and 108,056TZS (higher income group) ($p=0.1629$, $RSq=0.03$). The difference can be explained by the argument that higher income receives more transfers than others because they may have relatives who have enough to offer back to their families.

6.3.3.5. Other income activities

Other income activities are very low in the area. The proportions of other income activities on wealth groups indicate that lower income groups (6%), middle income group (3%) and higher income group (6%). The difference is just minor to comment significant argument

6.3.4. Non-farm activities by type of agriculture

Improved irrigation, traditional irrigation and rain-fed agriculture are three variables which form type of agriculture for different households. Rural trade, rental income, employment, remittances and others are components in non-farm income activities that will be analyzed in this part. Table 6-13 illustrates nominal logistic fit for type of agriculture.

Table 6-13: Nominal logistic fit for type of agriculture in the study villages at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-1,5132251	0,3516272	18,52	<,0001*
Rural Trade	2,08313e-7	1,5346e-7	1,84	0,1747
Rental Income	2,37675e-7	1,6081e-6	0,02	0,8825
Employment	2,83619e-7	2,412e-7	1,38	0,2396
Remittances	4,81543e-6	2,8409e-6	2,87	0,0901
Others	1,80476e-6	2,019e-6	0,80	0,3714

*N=93. * indicate significantly differences among type of agriculture in off-farm income activities. (P < 0.05)*

6.3.4.1. Rural trade

The households have different irrigated land; improved irrigation households (25%), traditional irrigation households (15%) and rain-fed agriculture households (11%). The differences can be because of the economic capacity generated from irrigation activities are higher than in other types of agriculture. High income received from improved irrigation favor rural trade.

6.3.4.2. Rental income

The activity is relatively low in the villages, about 6% of households are engaged in rental income on improved irrigation and rain-fed irrigation contains 8%. For traditional irrigation households no one was engaged in rental income activities. The differences shown and can be because in traditional irrigation there is less properties to rent.

6.3.4.3. Employment

As we have discussed earlier, level of employment is low following absence of operating firms that can offer formal employments. The proportions of employments in different households are shown as follows; Improved irrigation households (9 %), traditional irrigation households (15%) and rain-fed irrigation households (6%).

6.3.4.4. Remittances

About 22% of households receive remittances in traditional agriculture, traditional irrigation has 15% and rain-fed agriculture is having 19%. The figures are low and less significance differences.

6.3.4.5. Others (Pension and funds obtained from social networks)

Pension and funds obtained from social networks is relatively low in the area. About 6% of households from improved irrigation are engaged in this category. About 4% of households

are from rain-fed are indicated to be engaged and no households from traditional irrigation is shown according to the data obtained. No differences.

6.3.5. Summary of Non-farm Income Activities

Generally non-farm income activities in the study villages are low. Rural trade is mostly significant in household total income. To small scale farmers in the study area non-farm income activities are subsidiary and others do not engage at all on that activity. About 45% of households are not at all engaged in non-farm income activities in the total sample. This can be explained by that livelihood strategies are composed of various activities and on that households vary in the profile of assets which they hold. Assets possessed signify which course of action an individual household will and can follow. When many households are not engaged in non-farm income activities this indicates that most households devote their efforts (time, energy and similar resources) to the assets which provide higher earnings. In the study area non-farm income activities tie up less numbers of people.

The main occupation for rural communities is agricultural activities in both Mkula and Msolwa A villages. The agriculture sector employ over 70% of nation's work force and contribute 25.7% of Tanzania's GDP while contributing 30.9% of export earnings (Minister of Water and Irrigation 2010).

CHAPTER 7 - LIVELIHOOD OUTCOMES, VULNERABILITY CONTEXTS AND WATER ACCESS

7.1. Livelihood outcomes

All activities that generate means of household outcomes can be categorized into on-farm income, off-farm income, non-farm income and remittances when aggregating total household incomes. According to Ellis (2005) basic livelihoods framework livelihood outcomes are further influenced by policy and institutional contexts. External forces such as the state, market, laws and rights, democracy government and other factors impact patterns for livelihood strategies in the study villages. Vulnerability contexts also subject individual households to adjust adaptation and continue to make a living in the evolving socio economic, institutional and environmental context. Minor variations in prices, macro policy and national/international economic trends can cause severe impacts to rural livelihood strategies.

Water availability and access are among of the crucial factors which can determine yields in farming activities. Others factors such as input applications, farming skills, soil texture weather conditions and others are also important. In this chapter the analysis of water access and use and its implication for different types of livelihoods in the study villages will also be presented. This will be done by looking at water income dependence and water access for different households.

Table 7-1: Total household income and socio economic characteristics in the study villages at Kilombero District, Tanzania, 2012

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1218362.2	1539028	0.79	0.4306
Age	5920.042	19187.73	0.31	0.7584
Duration Stayed (Yrs)	-12512.2	18858.87	-0.66	0.5087
Household Size	205620.65	88272.88	2.33	0.0220*
Male Household Head[1]	-595031	319334.2	-1.86	0.0656
Present Address[1]	-982685.7	281705.9	-3.49	0.0007*
Household Head Education	376249.49	88413.11	4.26	<.0001*
Total Area Owned in Hectares(0.1)	1797099.8	732302.7	2.45	0.0160*
Ethnicity Groups[1]	172313.88	456104.5	0.38	0.7065
Ethnicity Groups[2]	-299245.9	563167	-0.53	0.5964
Ethnicity Groups[3]	965578.43	448600	2.15	0.0340*
Ethnicity Groups[4]	380277.27	651177.8	0.58	0.5607
Ethnicity Groups[5]	-602205	578237.3	-1.04	0.3004

*N=105, * indicate significant differences in the total household income ($p < 0.0001$, RSq 0.41, RMSE=2.2e+6)*

Household size is one of the five relationships which are statistically significance in total household income (Table 7-1). The more people in a single household the more labor can contribute to outcome. Ethnic group 3 (Wahehe people) is indicated to have general higher income than the rest of the ethnic groups in the household total income. Wahehe people are linked to be successful traders in the country. Education level is also increase human capital by having more year of schooling. More years of schooling implies more qualified personnel in various occupations which assist to raise production and household total income ($p < 0.0001$, *RSq 0.41, RMSE=2.2e+6*).

To examine the significance of differences among various activities in various groups an ANOVA test was run. The results are shown in Table 7-2 (location), Table 7-3 (households' wealth groups) and Table 7-4 (type of agriculture). For the total sample the proportions of income sources is indicated as follow; on-farm income sources (78%), off-farm (3%, non-farm (17%) and remittances (2%). The results suggest that on-farm income sources have a lion's share in the household total income.

Location

There is a statistical difference in the total income between villages. The villages have different livelihood strategies but on-farm and non-farm income are the two broad incomes in both villages (Table 7-2). It is also clear that on-farm income in Mkula is crucial in the differences in income.

Table 7-2: Annual income sources by location in the study villages at Kilombero District, Tanzania, 2012

Income sources	Msolwa A (N=70)		Mkula (N=39)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income (TZS)	% Total
On-Farm*	1,768,626 (2,087,851)	76%	3,252,562 (2,524,264)	81%	2,299,575.50 (2,353,218)	77%
Off-Farm	95,328.60 (240,827)	4%	40,512.80 (136,617)	1%	75,715.60 (210,518.02)	3%
Non-Farm	441,357 (1,506,111)	19%	636,538 (1,599,499)	16%	554,403.67 (1,562,737.50)	18%
Remittances	26,857 (66,279)	1%	103,846 (331143)	2%	54,403.67 (206794.01)	2%

Total	2,332,168.60	100	4,033,458.80	100	2,984,098.44	100

*N = 109. * indicates significantly differences between locations (p = 0.0013, RSq 0.13, Prob > ChiSq 0.0855), standard deviation in brackets*

Households' wealth groups

There is much difference among households' wealth groups in the study area. Higher income group have 10 times higher total income than the lower income group. Looking at shares of income, lower income group have less on-farm and more off-farm and even non-farm (Table 7-3).

Table 7-3: Annual income sources by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012

Income sources	Lower Income Group (N=36)		Middle Income Group (N=37)		Higher Income Group (N=36)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
On-Farm*	297,915 (1,143,377)	60%	2,059,062 (1,010,526)	83%	4,548,431 (2,312,097)	78%	2,299,575.50 (2,353,218)	77%
Off-Farm	73,027.80 (194,272)	15%	67,973 (182,701)	3%	86,361.10 (253,948)	1%	75,715.60 (210,518.02)	3%
Non-Farm*	102,500 (376,633)	20%	327,297 (811,650)	13%	1,108,889 (2,425,372)	19%	554,403.67 (1,562,737.50)	18%
Remittances	24,722 (49,713)	5%	31,081 (80,235)	1%	108,056 (344,125)	2%	54,403.67 (206794.01)	2%
Total	498,164.8	100	2,485,413	100	5,851,737.10	100	2,984,098.44	100

*N = 109. * indicates significantly differences among households' wealth groups (p < 0.0001, Rsq 0.91, Prob > ChiSq1), standard deviation in brackets*

Improved irrigation households have much higher incomes than rain-fed agriculture households and traditional irrigation households. There is more on-farm income from traditional irrigation households than other activities (off-farm, no-farm and remittances). Traditional irrigation households have more income from non-farm activities. (Table 7-4)

Table 7-4: Annual income sources by farm households in the study villages at Kilombero District, Tanzania, 2012

Income sources	Improved Irrigation households (N=32)		Traditional Irrigation households (N=13)		Rain-Fed Agriculture households (N=64)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
On-Farm*	3,669,653 (2,596,010)	81%	2,988,615 (2,559,369)	88%	1,474,575 (1,785,048)	72%	2,299,575.50 (2,353,218)	77%
Off-Farm	48,281.30 (149,993)	1%	46,076.90 (85,655)	2%	95,453.10 (250,093)	5%	75,715.60 (210,518.02)	3%
Non-Farm	692,188 (1,731,443)	15%	317,692 (715,590)	9%	460,000 (1,563,007)	22%	554,403.67 (1,562,737.50)	18%
Remittances	121,875 (363,881)	3%	26,923 (66,506)	1%	26,250 (63,558)	1%	54,403.67 (206794.01)	2%
Total	4,531,997.30	100	3,379,306.90	100	2,056,278.10	100	2,984,098.44	100

*N = 109. * indicates significantly differences among types of agriculture (p = 0.0001, RSq 0.16, Prob > ChiSq 0.97), standard deviation in brackets*

7.1.1. On-Farm Income

On-farm income was aggregated from crop production and livestock incomes. The results show that on-farm income activities have the largest amount (77%) into the household income. The results reveal that small farm agriculture is the primary and most important means of household livelihoods. This means that land, water access and labor are crucial factors of production. Households within the study villages have devote most their time, energy and similar resources in small farm agriculture. Livestock have a 3% share of the household income.

7.1.1.1. On-farm Income by Location

At Msolwa A village, on-farm income accounts for 76% in the household total income (Table 7-2). Rice income (22.63%) and sugarcane income (57.68%) are the foremost sources of income on on-farm income category. At Mkula village, on-farm income accounts for 81% of the household income. (Rice and sugarcane income source account for 62.40% and 33.14% income on on-farm income category respectively (Table 7-5). The differences can be explained by that irrigation activity which is done at Mkula village offer higher returns on rice production. At Msolwa A village an absence of improved irrigation shift the attention to

sugarcane production. Farm income is highly supported by these two crops and other crops contribute less. The distributions of crops and livestock income on on-farm income are illustrated in Table 7-5.

Table 7-5: On-farm annual income sources by locations in the study villages at Kilombero District, Tanzania, 2012

Income sources	Msolwa A (N=70)		Mkula (N=39)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total
Rice*	400,640 (578,030.72)	22.63	2,033,869.20 (1,444,221.20)	62.40	985,006.42 (1,251,377)	42.83
Sugarcane	1,021,042.90 (1,630,964.10)	57.68	1,080,205.10 (1,766,171.80)	33.14	1,042,211 (1,672,673.8)	45.32
Maize	123,271.43 (238,340)	6.96	62,820.51 (241,627.69)	1.93	101,642.20 (240,172.22)	4.42
Sweet Potatoes	12000 (75,327.31)	0.68	11,025.64 (64,104.97)	0.34	11,651.38 (71,213.21)	0.51
Sesame	16571.43 (116,865.91)	0.94	0 (0)	0	10,642.20 (93,751.79)	0.46
Banana	18,571.43 (124,286.79)	1.05	28,205.13 (123,434.87)	0.87	22,018.35 (123,496.75)	0.96
Vegetables	60,714.29 (376,568.49)	3.43	10,256.41 (64,051.41)	0.31	42,660.55 (304,353.12)	1.86
Cassava	18,000 (102,499)	1.02	16,666.67 (74,633.61)	0.51	14,073.40 (93,126.32)	0.61
Livestock	99,343.29	5.61	16,410.26 (60675.46)	0.50	69,690 (299,007.18)	3.03
Total	1,770,154.77	100	3,259,458.92	100	2,299,575.50	100

*N = 109. * indicates significantly differences between the locations (p <0.05), standard deviation in brackets, RSq 0.43.*

7.1.1.2. On-farm income by households' wealth groups

Among lower income group, on-farm accounts for 60% of household incomes. Middle and higher income group's account for 83% and 78% of on-farm income category respectively (Table 7-3) On-farm income is thus the dominant livelihood strategy among the wealth groups, but more so among the higher income group. For the lower income group rice maize

and livestock are the high income servers. They have less land and capital access. For the higher group, it is rice and sugarcane. There households have more access to land, to irrigation water, labor and credit.

Other crops are showing relatively low figures, (Table7-6). Generally livestock in the study area is having a low income proportions. In terms of households' wealth groups lower income group indicated to have higher income proportions (17%). This can be explained by the factor that poultry is a common activity which is relatively done by low income families (Table 7-6).

Table 7-6: On-farm annual income sources by households' wealth groups in the study villages at Kilomero District, Tanzania, 2012

Income sources	Lower Income Group (N=36)		Middle Income Group (N=37)		Higher Income Group (N=36)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
Rice*	206,247.22 (318308.89)	69	859,900 (1,093,617.9)	42	1,892,347.20 (1,418,995.9)	41.55	985,006.42 (1,251,377)	42.83
Sugarcane *	-44,861.11 (984,752.68)	-15	898,729.73 (774,549.35)	43	2,276,750 (2,259,523.80)	49.99	1,042,211 (1,672,673.8)	45.32
Maize	32,972.22 (112,465)	11	121,513.51 (275,277.35)	6	149,888.89 (281,934.42)	3.29	101,642.20 (240,172.22)	4.42
Sweet potatoes	12,222.22 (66,809.37)	4	6,216.22 (33,111)	0.50	16,666.67 (100,000)	0.37	11,651.38 (71,213.21)	0.51
Sesame	5,555.55 (33,333.33)	2	25,945.95 (157,823.03)	1	0 (0)	0	10,642.20 (93,751.79)	0.46
Banana	0 (0)	0	0 (0)	0	66,666.67 (209,761.77)	1.46	22,018.35 (123,496.75)	0.96
Vegetable*	16,666.67 (73,678.84)	6	27,027.23 (164,399)	1	84,722.22 (499,831.32)	1.86	42,660.55 (304,353.12)	1.86
Cassava	18,333.33 (78,467.46)	6	6,756.76 (41,099.75)	0.50	27,777.78 (136,509.78)	0.61	14,073.40 (93,126.32)	0.61
Livestock	51,556.38 (139,574)	17	116,486.49 (394,251.80)	6	39,666.67 (304,864.37)	0.87	69,690 (299,007.18)	3.03
Total	298,692.48	100	2,062,575.89	100	4,554,486.10	100	2,299,575.50	100

*N = 109. * indicates significantly differences among households' wealth groups (p <0.05), standard deviation in brackets, RSq 0.54.*

7.1.1.3. On-farm income sources by type of agriculture

Among improved irrigation households 81% of the total incomes are from on-farm income sources. Traditional irrigation and rain-fed agriculture account for 88% and 72% respectively on-farm income sources (Table 7.4). 62.71% of income is yields from rice in improved irrigation households. Sugarcane income is well pronounced in traditional irrigation (52.85%) and rain-fed agriculture farms (56.85%) (Table 7-7). This is because most of sugarcane fields are located in areas out of irrigation sites.

Table 7-7: On-farm annual income sources by types of agriculture households in the study villages at Kilombero District, Tanzania, 2012

Income sources	Improved irrigation households (N=32)		Traditional irrigation households (N=13)		Rain-fed irrigation households (N=64)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
Rice*	2,306,715.60 (1,433,988.20)	62.71	818,000 (573692.90)	27.32	358,075 (1,418,995.9)	24.32	985,006.42 (1,251,377)	42.83
Sugarcane	1,231,656.30 (1,913,490.10)	33.49	1,586,384.60 (2,072,664.90)	52.99	836,953.13 (1,433,255.60)	56.85	1,042,211 (1,672,673.8)	45.32
Maize	76,562.50 (265,483.24)	2.08	148,076.92 (254,276.25)	4.95	104,750 (226,083.14)	7.13	101,642.20 (240,172.22)	4.42
Sweet Potatoes	937.50 (5,303.30)	0.03	46,153.85 (166,410.06)	1.54	10,000 (55,663.39)	0.68	11,651.38 (71,213.21)	0.51
Sesame	0 (0)	0	73,846.15 (266,256.09)	2.47	0 (0)	0	3,125 (25,000)	0.46
Banana	34,375 (135,858.98)	0.93	76,923.07 (277,350.10)	2.57	4,687.50 (37,500)	0.32	22,018.35 (123,496.75)	0.96
Vegetable	0 (0)	0	30,769.23 (110,940.04)	1.03	66,406.25 (393,605.10)	4.51	42,660.55 (304,353.12)	1.86
Cassava	7,812.50 (44,194.17)	0.22	61,538.46 (221,880.08)	2.06	13,437.50 (63,750.97)	0.91	14,073.40 (93,126.32)	0.61
Livestock	20,000 (66,623.64)	0.54	151,923.08 (485,813.49)	5.07	77,797.34 (321,575.18)	5.28	69,690 (299,007.18)	3.03
Total	3,678,059.40	100	2,993,615.36	100	1,472,106.72	100	2,299,575.50	100

*N = 109. * indicates significantly differences among types of agriculture (p<0.05), standard deviation in brackets, RSq 0.37.*

7.1.1.4. Sum up of on-farm income sources

As we have seen from the discussion, sugarcane and rice production provide higher returns than other crops. The presence of rice irrigation activities developed in the irrigation schemes serves high rice income. The situation favors people within irrigation schemes. It has also attracted other individuals to cultivate rice even outside the irrigation schemes. And secondly, the availability of sugarcane markets motivates individuals to employ efforts in sugarcane production.

Other crops incomes (maize, sweet potatoes, banana, vegetable and cassava) have very marginal proportions of the on-farm income, as well as of the household total income. The situation may be linked to the absence of secured markets for these crops. Low market subjects small scale farmers to divert to other crops which have higher returns. According to the PRA, other crops are grown as subsidiary whenever households have enough capitals to diversify, though this is not documented on my database (Table 7-8).

Livestock incomes are low is also low following low number of domestic animals (cattle, goat, pig and others). Poultry however is very common in the study area but still livestock incomes are low.

7.1.2. Off-farm income sources

Off-farm income is derived from wage labor and environmental resources. Local environmental resources income is obtained from fish, fuel-wood, medicine plants and other forest products incomes (Table 7-8).

The results show that off-farm income has a marginal share (3%) of the household total income, (Table 7-2). Off-farm income accounts for 4% of the household total income at Msolwa A and 1% at and Mkula village. According to the farmers, off-farm income activities are practiced by limited sizes of the households. The activity is considered as a subsidiary and employs low number of households. The nature of this category (off-farm income activity) has subjected many individual households to opt other accessible livelihood strategies which offer better returns.

Table 7-8: The proportions of off-farm income sources in the study area at Kilombero District, Tanzania, 2012

Off-Farm Income Sources	Proportions of Off-Farm Income Sources
Labor	35.14%
Fish	0.73%
Fuel Wood	30.23
Medicine Plants	7.09
Forest products	26.81
Total	100

Two broad situations impact the off-farm income and cause it to provide low contribution to the total household income.

First, rural wage labor and other forms of income obtained by offering labor services (average annual income of 26,605.51TSZ) within agriculture are result lowly to sustain livelihoods.

Second, the villages lie in the plain corridor between Selous Game Reserve and Udzungwa Mountains National Park. The rest of the area is surrounded by crop fields. The area is being bordered by the vast area of these two landscapes that limit an open access to the forest resources such as firewood, charcoal, house building materials, environmental plants, animal fodders and others. Most villages in Tanzania have direct access to the forest products and so access to environmental resources is different at Mkula and Msolwa A villages.

Sugarcane production require massive amount of labor power during harvesting time, but in the villages almost none of the individual members are engaged on that. The contractors for sugarcane harvesting have their offices outside the villages and employ people from there and come to work in sugarcane farms in the villages. This situation limits employment opportunities for the village members.

7.1.2.1. Off-farm income sources by location

The figures are relatively low in both villages. Off-farm incomes have 4% share in the total household income at Msolwa A village. At Mkula village the share is even less (1%).

7.1.2.2. Off-farm income sources by households' wealth groups

The lower income group has more income from wage labor and other forest products while the higher income group has more income from fuel-wood. Generally off-farm income has low share in the total household income.

7.1.2.3. Off-farm income sources by types of agriculture households

Improved irrigation households have no income from labor and forest products while the rain-fed agriculture households have more income from wage labor and forest products.

7.1.2.4. Sum up of off-farm income sources.

Off-farm income sources are very low in the study villages (3%). As it has discussed earlier off-farm activities are clearly not profitable.

7.1.3. Non-farm income sources

Non-farm income sources have a total proportion of 18% of the households' total income. Also non-farm activities are limited in the villages but still higher than off-farm income. The natures of the non-farm activity in the study villages are strategies to strengthen household income, but is not the major employer for the majority of households. The employment opportunities are almost zero, just a few individuals working under government departments. Rural trade, rental activity and others (pension, NGOs) are implemented as strategy to diversify risk associated in the main occupation. On non-farm income sources, rural trade account for 70% followed by employment 40% in the total non-farm income. The remaining non-farm income sources are very low.

Households are bounded by other livelihood activities including on-farm activities which also limit resources to participate in non-farm activities. Participation in multiple activities by farm families is the common practice in the everyday life in the study villages.

7.1.3.1. Non-farm income sources by location

Generally the non-farm income sources in the villages are low, it account for 19% at Msolwa A village and 16% at Mkula Village. The regression analysis didn't indicate significance in no-farm income sources by location ($p < 0.05$, RSq 0.007). The ANOVA test was run and provides the results as indicated in Table 7-9.

Rural trade and employment indicate to have the highest proportions in both villages. At Msolwa A, village rural trade accounts for 68% and employment 44% of the total non-farm income sources. At Mkula village rural trade account for 72% and employment 37%.

Table 7-9: Non-farm annual income sources by locations at the study villages at Kilomero District, Tanzania, 2012

Income sources	Msolwa A (N=70)		Mkula (N=39)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income (TZS)	% Total
Rural Trade	308,571 (1,365,277.43)	68	528,205.13 (1,395,660.30)	72	387,155.96 (1,373,836.3)	70
Rental Income	24,285 (188,299.57)	6	8,205.13 (137,398.23)	1	18,532.11 (171,333)	3
Employment	199,285.71 (773,590)	44	269,230.77 (1,105,287.3)	37	224,311.93 (901,840.06)	41
Others	-79,357.14 (284,153.87)	-18	-68,846.15 (368,837.90)	-10	-75,596.33 (315,401.33)	-14
Total	452,784.57	100	736,794.88	100	554,403.67	100

7.1.3.2. Non-farm income by households' wealth groups

Non-farm income sources indicate the following proportions in the household total income by households' wealth groups; lower income groups (20%), middle income group (13%) and higher income group (19%).

Within the non-farm income sources rural trade and employment income sources perform better than the others, (Table 7-11). The regression analysis didn't indicate significance in non-farm income sources, ($p < 0.05$, RSq 0.06). An ANOVA test was run and the results are illustrated in Table 7-10.

It seems to be a fact that lower income group have relatively highest income share from employment from others wealth groups

Table 7-10: Non-farm annual income sources by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012

Income sources	Lower Income Group (N=36)		Middle Income Group (N=37)		Higher Income Group (N=36)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
Rural Trade	77,777.78 (355,456.34)	64	189,189.19 (473,043.04)	55	900,000 (2,248,809.20)	74	387,155.96 (1,373,836.3)	70
Rental Income	10,555.56 (123,177.06)	8	31,891.89 (165,157)	9	12,777.78 (216,947.80)	1	18,532.11 (171,333)	3
Employment	8,888.89 (300,264.43)	73	155,405.41 (639,854.99)	46	430,555.56 (138,951.57)	36	224,311.93 (901,840.06)	41
Others	-55,277.78 (248,840.01)	-45	-34324.32 (232,218.06)	-10	-138,333.30 (428,135.49)	-11	-75,596.33 (315,401.33)	-14
Total	121,944.45	100	342,162.17	100	1,205,000.04	100	75,715.60	100

*N = 109. * indicates significantly differences among households' wealth groups (p<0.05), standard deviation in brackets, RSq 0.06*

7.1.3.3. Non-farm income sources by types of agriculture

Non-farm income sources indicate the following proportions in the household total income by types of agriculture; Improved irrigation (15%), traditional irrigation (9%) and rain-fed agriculture (22). Generally the figures are very low. The regression analysis test didn't indicate significant in non-farm income sources ($p < 0.05$, RSq 0.015). The ANOVA test provides the results as illustrated in Table 7-12

Table 7-11: Non-farm annual income sources by type of agriculture in the study villages at Kilombero District, Tanzania, 2012

Income sources	Improved irrigation households (N=32)		Traditional irrigation households (N=13)		Rain-fed agriculture households (N=64)		Total (N=109)	
	Income (TZS)	% Total	Income (TZS)	% Total	Income TZS	% Total	Income TZS	%Total
Rural Trade	550,000 (1,505,045.30)	69	230,769.23 (599,144.69)	66	337,500 (1,425,337.60)	71	387,155.96 (1,373,836.3)	70
Rental Income	4,375 (140,848.52)	1	-16,923.08 (41,509.96)	-5	32,812.50 (199,160.69)	7	18,532.11 (171,333)	3
Employment	328,125 (1,215,553)	41	165,384.62 (439,405.19)	48	184,375 (789,055.85)	39	224,311.93 (901,840.06)	41
Others	-83,750 (406,795)	-11	-30769.23 (110,940.04)	9	-80,625 (293,747.68)	-17	-75,596.33 (315,401.33)	-14
Total	798,750	100	348,461.54	100	474,062.50	100	75,715.60	100

*N = 109. * indicates significantly differences among types of agriculture (p <0.05), standard deviation in brackets, RSq 0.015*

Rural trade and employment maintain higher position in all types of agricultural households. There are not many differences between the three types.

7.1.3.4. Sum up of non-farm income sources

Generally the households in the study villages are faced by limited options in the income. But they are able to generate 18% of income from non-farm activities.

Rural trade and employment income sources dominate non-farm income sources. Though the employment chances are limited but the few chances available do compete with other sources.

7.1.4. Remittances

Remittance has low share (2%) in the household total income according to ANOVA test. Transfers are not well established in the area. It could be a rapid problem or that households are sufficient with the received incomes or that other relatives living out the area have no means to send transfers back home. No significant differences between location, wealth groups and by type of farming households.

7.2. Vulnerability contexts

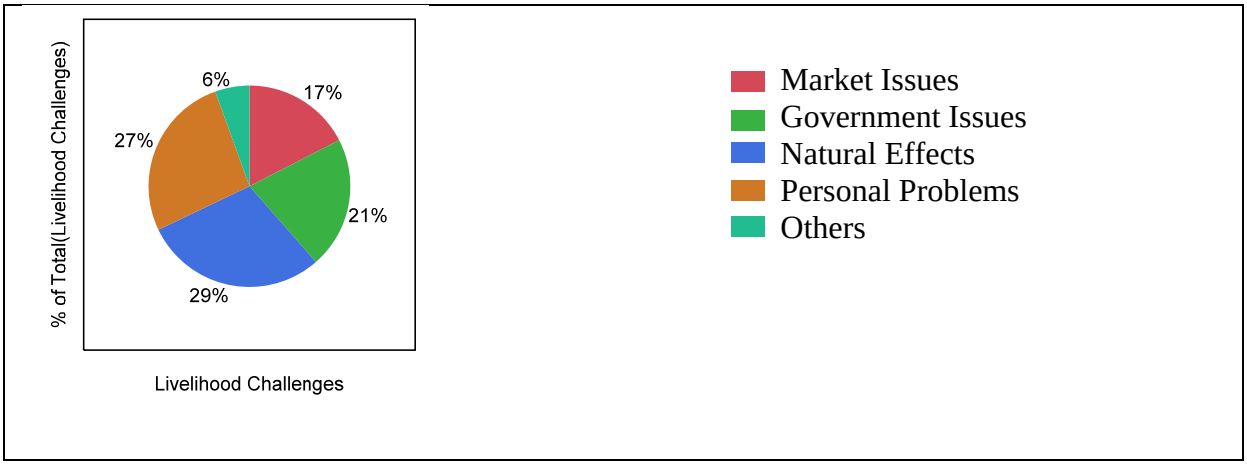
Many households are skeptical to the way things are moving in the context of income generation, but are still enthusiastic and motivated to survive in various life situations in a changing world. The farmers have made the successful claim that in order to gain livelihood in their local areas, agriculture is the key activity and it is important to manage various expected risks, shock and trends.

The framework for micro policy analysis in rural areas (Ellis 2000) illustrate components of trends and shocks that hold livelihood strategies. Shocks in the study villages such as drought, floods, pests and diseases have changed the community on how to implement their activities based on the available assets/resources. Population growth in the study villages influence resource uses by altering migration and settlement dispositions. Migration settlement dispositions continue to transform the area from land abundance to land scarcity. Changes in population patterns, migration trends, technology, macro policy, global process and others transform the rural livelihood opportunities and constraints.

Households reported various livelihood threatening situations. The study categorized livelihoods threatening situations into four groups according to reports obtained from the households. The categories are market related issues, government concerns, natural effect and personal problems (Figure 7-1).

Marker related issues comprises crop price fluctuations, access to credit facilities, inflation, unaffordable interest rates, presence of middlemen and others. Government (relationship with forests authority, no means for fuel-wood and others) related issues includes lack of financial capital, corruption, unemployment, unfaithful agricultural agents, poor farming practices , lack of agricultural expertise and others. Natural effects includes, land and water shortages, rainfall (shortage/access), weather variations, temperature variations, pest effects, exhausted land, and others. Personal problems include health issues, deaths,

Figure 7-1: Distribution chart livelihood challenges in the study villages at Kilombero District, Tanzania, 2012



7.2.1. Seasonality

Seasonality has a direct impact on livelihoods strategies. The crop production cycle rely on rainfall patterns and temperature variations. Rain-fed agriculture is mostly affected by rainfall pattern variations. Individual households who depend on rains for survival whether on-farm or off-farm reported that unpredictable rainfall (shortage/excess) victimize rural livelihoods. One example was Kihansi floods in 2010 affected many farmers around the area. The floods swiped away and destroyed almost all lowland crops. According to PRA for the past 10 to 20 years farmer's livelihoods have been vulnerable because of season and weather variations.

Households reported to experience more droughts than before, the prolonged dry seasons increase cost of the production. According to local experiences the rainfall seasons were from February to May then a bit in September before late November to February. Farmers knew well their farming calendars but less than before. Currently major changes has occurred, each year have their own characteristics. The situation makes farming predictions according to the local calendar knowledge very difficult compared to how it has been done before according to report from local people.

A farmer shared a remarkable historical experience that during 1970's and 80's the land and water was unlimited resource to them. She argued that it happened in a time when they were unable to harvest all paddies from their fields because of the tremendous amount of produce beyond their harvesting capacity which even forced them to abandon some of the produces in the fields. She claimed that during that time, the land was very fertile and productive and the weather condition was better to support agricultural activities. She continue to argue that

currently, the population growth is unbearable which cost the environments, land, water, biodiversity and even causes outbreak of diseases. She believes that in the near future the worse was still to come.

People from irrigation schemes complain about decelerating river volumes as the time passes. An informant argued that several years back Mkula River was flowing over the Mkula Bridge but not anymore. Water and land scarcity is a serious concern in the area today. Water shortages are talk of the day for smallholder farmers in their rice fields. Water related conflicts are an exclusive subject in the irrigation scheme. According to focus group discussions, personal interviews, stakeholders' analysis and key informant interviews, water and land shortage is a burning issue and especially during dry seasons (June to mid November). Individual's farmers are willing to do any means to get access to water. Water User Association (WUA) and other scheme arrangements assist to maintain order and peace.

Pest insects and weed effects are reported to be a notorious concern which reduces the production. The presence of white flies, armyworms, mouse, birds and others (*in local language common pests/insects known as ving'wawa, kimyanga, kimbwengu, uliyunga, smati*) cost productions. Little control over these pest and weed effects is reported.

7.2.2. Risk management and coping strategies

Ellis (2000) point to that risk management and copying strategies are two ways used to encounter vulnerability. The former is said to have the managing strategy prior to the expected risk or disaster and the latter is on how to deal with the risk or disaster incidence after it has occurred.

7.2.2.1. Risk management

The diversification within and outside on-farm activities is among risk management strategies applied by smallholder farmers. Farmers argue that land and water shortages subjected them to engage in other on-farm productions which do not acquire great amount of water to buffer the unstable weather conditions and secure food availability. A good example is how own land is distributed and how one grows a variety of crops in the individual households, say paddy, maize, sugarcane and cassava grown in the same cultivation seasons in either the same or different lands in order to cope with the embedded risks of the agricultural sector.

It has been observed that part of the harvested crops especially rice and maize are stored (20%-30%) and part are sold depending on the size of the household. This can be linked to a

conscious risk management strategy by the households. At Mkula village rice production is indicated as major crop to store values in order to sustain expected risks. At Msolwa A villages most households strengthen sugarcane production because is the accessible strategy to deal with expected risks, to generate cash which can be saved “for a rainy day”.

Households’ wealth groups have different strategies for managing risks. Low income families rely on human and social capital rather than other type of capitals. They can work a lot to manage savings which can serve as security for the expected risks. Cash and savings can be substituted to other forms of capital over which households have a control. Higher income families rely on financial capital to deal with expected risks. For example higher income families can replace a sick person by hiring wage labor.

In types of agriculture different risk management strategies are practiced. Rain-fed agricultural households tend to grow various crops on the same or different land with a major focus on resilient crops such as cassava. This is done is order to improve food security.

In improved and traditional irrigation farms rice is cultivated more than once in a year. This can also be linked to kind of risk management strategy. Smallholder farmers cultivate other crops, say maize and sugarcane in order to manage expected catastrophes. However, not all time risk management strategy work out, it can sometimes backfire. If the risk management strategy fails then the alternative can be a coping strategy.

7.2.2.2. Coping strategies

Coping strategy can be linked to short-term reactions against unexpected shocks in the livelihood activity and outcomes. Successful coping imply less vulnerability and vice versa. In the villages individuals are surrendering assets in order to cope with the prevailing situations. Households are selling or renting out properties (land, bicycles, poultry and others) in order to solve or minimize some crisis.

Others migrated away for some times and returned after recovery. In the villages around 20% of households migrated away for various reasons including sickness, drought, land scarcity and others. The situation was unbearable to them and forced to leave the village.

Common crisis/shocks found in the study villages include weather variations, price fluctuations, pest/herb/insect effects, water shortages, restriction of human activities in the forests. Different groups have different strategies for copying these crises.

By locations, the coping mechanisms are more or less the same, thus, weather variation at Msolwa A village is coped through growing range of crops (maize, cassava, sweet potatoes) which a resilience to drought in order to avoid serious crop failures. The same is applied at Mkula village. Price fluctuation is coped by storing the produce until the price stabilizes, but not all households can afford this. Some families become prone to the situation and are forced to engage in rural trade (food vendor, opening kiosk) or they turn to wage labor. Pest, insects and weed effects are coped by consulting the available experts seeking advice on which measures can be used to solve the problems. Special pesticides, insecticide and herbicides found in the study area used by farmers include "*Thiodan, Round up, Kungfu, Caret, Dazban, Kilomo Kwanza and others".*

Water shortage is affecting irrigation activities. The shock could be met by strengthening water allocation arrangements into optimal water utilization to all scheme members. Obtaining local environmental resources (fuel-wood, poles, fodders and others) is also still a pending issue to most families in both villages. People are still in shock about the restriction on forest an access was to use available trees around residential areas and other accessible material that can be used to make a fire or other activities.

Looking at households' wealth groups, the weather variation seems to hit hard into the lower income group more than other groups. The situation can be linked to lower economic capacity to cope and this subjects low income families to engage in wage labor, rental activities and rural trade. Higher income families own more assets which can be used to substitute and diversify range of activities.

Price fluctuation by the households' wealth group again impact at large extent the low income families. This is because of low savings to sustain until the price is stabilized as the higher income families do.

Pest, insect and weed effects are treated almost the same as they do in two locations. The existing difference is about the financial capabilities of the households. Others are benefiting from government subsidy but others remain vulnerable. About local environmental resources, low income families are potential victims of the arrangements. Higher income families have other alternatives following their financial positions compared to low income families.

7.2.3. Brief analysis of the most vulnerable households

The regression test didn't indicate any relationship between the 10% of the lowest income households and vulnerability contexts. The characteristics of most vulnerable households are illustrated in Table 7-12. The socio-economic factors of the most vulnerable households are shown by location, the total poorest households and the total population. (Table 7-12)

Table 7-12: Socio-economic factors to the most vulnerable group by location in the study villages at Kilombero District, Tanzania, 2012

Source	Msolwa A Village (72.73%)	Mkula Village (27.27%)	Total Poorest	Total Population
Mean age	50.12	42.66	48.54	51.72
Mean household size	4.6	1	3.64	5.67
Mean household head education	4	4.6	4.1	6.1
Mean total area owned in hectares(0,1)	1.56	0.7	1.3	2.1
Mean total area utilized in hectares	1.65	0.47	1.3	2.1
Households engaged in rice cultivation (%)	1	1	1	95.40
Households engaged in maize cultivation (%)	37.5	0	27	21.50
Households engaged in cane cultivation (%)	12	0	0.9	64.22
Mean on-farm income (TZS)	201,000	378,166	249,318	2,229,575.50
Mean off-farm income (TZS)	141,875	0	103,181.82	75,715.59
Mean non-farm income (TZS)	-18,750	120,000	-2,727	554,403.67
Mean total income (TZS)	355,375	547,500	372,500	2,940,887.40

*N = 11. * indicates significantly differences between location (p =0.06), standard deviation in brackets, RSq , Prob >ChiSq 1*

7.2.3.1. Most vulnerable group by location

The group contains 10% of the lowest income in the study villages. Msolwa A has older people than in Mkula village. The average size of households in the total sample was 5.67 and the total poorest households have the average of 3.46. There is difference between villages, where Mkula village have smaller household size (1) compared to Msolwa A village (4.6). Smaller household size indicates less labor. Level of education is also very low in both villages and no differences indicated between villages. (The education level is low compared to the mean total of 6.1).

The poorest households own smaller land with the average of 1.3 ha compared to mean total of 2.1 ha. There is difference between the villages, at Mkula the poorest own the average of 0.7 ha and it shows they utilized less (0.47) than what they own. At Msolwa A the poorest own the average of 1.56 ha. The poorest households have smaller land but still they depend on agriculture. Rice production is the only activity which employs all poorest households (100%) and in both villages. Maize production has employed poorest households (27%) than in the total population (21.50%). This also differs between villages, where at Msolwa A the poorest

households are having 37.50% in maize production compared to Mkula village where no poorest household is indicated in maize production. Sugarcane production also employs very low number of the poorest households (0.9%) compared to the total population (64.22%). This also differs in villages, where no poorest households engaged in sugarcane production while at Msolwa A only 12% of the poorest households do.

Major share of household income is coming from on-farm sources in the most vulnerable group (249,318TZS) as it does in the total population (2,229,575.50TZS). In the villages also the major household income is from on-farm sources but there is difference, Mkula has more income (378,166TZS) than Msolwa A (201,000TZS). Most vulnerable households Mkula have more average total income (547,500TZS) compared to Msolwa A village (355,375TZS).

Generally the income is very low and that shows the poorest households are more vulnerable to various expected risks, shock and trends. Most vulnerable group they lack natural, physical, human, social and mostly financial capitals. Weather variations, land scarcity, are the major shortfalls to the poorest households, and accessible coping strategies is to engage in wage labor and sell or rent out the properties. Risk management strategy includes diversification of crop production (rice, maize, sugarcane and others).

7.2.4. Policy and institutional context

In the livelihood framework, policy and institutional contexts mediate with available endowed assets to provide outcomes which can determine degree of sustainability. The policy and institution context which include government, laws and rights as well as democracy constrain or facilitate livelihood outcomes in many ways. The scope of rural households to determine and make a choice on the range of accessible social-economic activities depends on institutional arrangements. Public sectors, markets, social, cultural, norms and expectations are institutional arrangements that are expected to determine the degree of livelihood sustainability (Freeman & Ellis 2005).

7.2.4.1. Formal institutions and legal framework

Village Land Act No.05 of 1999 and Forest Act of 2002 are two acts which give authority and power to the Village Council to control land use within the village boundaries which is not exclusive protected by the central government. As we have seen earlier, central government has the legitimacy ultimate authority over the land. The 1999 land tenure reform reorganizes and registers existing land use practice and customary rights. Legislation about land tenure is recognizing customary rights, but still no title deed has been offered to local farmers in rural

area (Ikdahl 2013). Without title deed to individual farmers land owned became less value and that cause less investments. The situation is contradicting rural livelihoods in various ways including difficulties in obtaining credit facilities from financial institutions. In other parts of Morogoro Region and other areas, lack of secure tenure has initiated serious concern between farmers and pastoralists, also in Kilombero.

These formal and legal frameworks have both positive and negative implications on rural livelihoods. As we have seen earlier in the discussion that the establishment of other developmental programs (national parks, game reserves, sugarcane plantation) denies access to various resources found on those reserved areas. Reported cases on crops and property destructions by wild animals from parks impose costs into the livelihoods of vulnerable groups. The outcomes which are obtained from various sources are highly impacted by the trends and shocks.

From a positive point of view the technical innovations and new trends have transformed the agricultural activities by bringing up better technologies in farming practices and in others livelihood activities, the conservation of areas has encouraged hunting and tourism activities which support to raise the government revenue toll. Environmental preservation is also achieved.

Political stability in the study area as in other parts of Tanzania is supported by macro policy through government and other actors that provide accessible benchmarks for socio-economic activities to flourish. The existences of rather sound village governments and other above authorities promote peace, stability, freedom and security to the people and their properties. Public services (roads, schools, health centers and others) are accessible by many people because of the existing democratic administrative structure also under the care of the government.

At Msolwa A village there is a land dispute between Village Council and an individual landlord. The case is about part of land which is currently under Village Council that claimed by an individual landlord that it belongs to him. According to the Village Executive Officer the land was confiscated by government and provided to the village since 1978. The case is still going on in court.

7.2.4.2. Informal institutions and statutory forms

Inadequacy in clear boundaries and use rights in both villages caused some informal arrangements to take place. For example how plot boundaries are defined and recognized, where one plot does starts and where the next plot ends is not mentioned in the legislation. The decisions rely on mutual informal arrangements by passing by-laws. The recognition of who own which part of land relies completely of elders to point at a particular location without any formally written documentation.

Generally absence of secure tenure in the situation where land shortage is highly sensitive concerns and something has to be done. The mixtures of ethnic groups in the area indicate that people are interested in the area for various reasons. Around 26 different tribes were found in the villages. At Mkula villages about 30% of all households are from other part of country while the remaining is indigenous to the area. At Msolwa A village the study found that about 70% of all households are from other parts of the country. Gathering of different ethnic groups in the area increases competition in resources, especially land and water.

The average duration stayed in the village is around 34 years. The average duration stay between villages is 37 at Mkula and 32 at Msolwa A village. According to the personal interviews elders are highly respected in the villages and they receive special attention in the whole community. Elders have high influence in social matters (disputes, conflicts) in restoring peace and stability according to informal local arrangements. In some cases youngsters can offer their labor in kind to elders' farms (free of charge) to show respect or appreciation.

In both villages, the study witnessed sound relationship between formal and informal arrangements in domestic water allocations. With the help of other higher authorities both villages have successfully installed intakes for domestic water uses. This is how water allocation is done in the villages; any interested village member is allowed to tap water from water points by submitting an application to the village office. The village office provides the total connection costs including all equipments needed, and then after the cost has been paid the connection will be done immediately. The Village Council also supplies public water points for those who are unable to meet the connection costs. Informal arrangements work well on distributing and governing water administered by Village Council and elders in the villages.

I found an interesting case at Msolwa A village about someone who was caught violating water arrangements, VEO through village elders caught the suspect and detained the suspect in one of the village office room. The next morning the suspect was handled over to police. This was done in absence of police because in the area police station is located several kilometers away from the village.

7.2.5. Infrastructure and market accessibility

Market fluctuations are reported to be a drawback issue in rice and sugarcane productions. Market access and availability are two major concepts that constrain the small scale farmers in their livelihood strategies. For example sugarcane production has a single annual harvest and if anything happen during the year, there is little chance for the adjustments. Farmers are complaining about the monopoly domination from a single available market. Farmers reported that is difficult for them to tag a price on their products.

Absence of common rice markets cause middlemen to flourish in the rice business. Influence of middlemen lower the rice price which makes the farmers to be more vulnerable. Experience shows that during harvesting periods the supply is greater than demand which cause the price to be very low. The situation leaves no choice to farmers rather that selling their produce at low prices. At this period farmers are highly in need of cash to cover the households and farming expenses following prolonged period of cash outflows in farming activities. Smallholder farmers cannot afford to wait until the price is higher, because they don’t have any savings left to sustain the period. The situation denies farmers to arrange prices for their produce and they are subject to sell at low market prices.

Rice production is furthermore reported to be challenged by lack of agricultural inputs (fertilizers, herbicides, pesticides and others) in the area. Government subsidy for the inputs is reported to be a periodically controversial issue. Farmers complain about the distribution order and quality of the supplied inputs. Some agents entitled to deal with inputs supply are reported to be corrupt and unfaithful. Small scale farmers are viewing this problem as an institutional failure at it seems the problem is escalating and little has been done to alleviate the concern. Small scale farmers expect the government to intervene in order to resolve the situation.

Market structures for other crops grown (maize, sweet potatoes, cassava, vegetable and others) in the villages are conducive for the small scale farmers. It is very difficult for farmers

to access markets for these products. Poor storage facilities affect the quality of the produce and that subjects the crops to be impossible to sell in the available market.

Credits in form of loans facilities are minimal in the area. It has been reported that the credit conditions imposed by financial institutions are difficult to be met by small scale farmers. The interest rates around 8 to 21 percent per year are major constraint to small scale farmers. Farmers called the government to establish special banks and other related financial institutions to support small scale farming.

The farmers argued that the crop productivity is becoming lower overtime. Current crop production in one hectare is not even half of what it has been over the past 20 years on the same area according to PRA. It is difficult to link one particular problem to the low production trends, but reduced farm sizes, less water access may be important factor. Telecommunication facility is well established. Mobile phones are extremely useful for people living in the study area. Mobile phones are more than just communications; they serve as devises for cash transfers and other useful means. Availability of and access to mobile phone services has made almost every individual to posses one. Telecommunication services have transformed rural livelihoods in so many ways.

7.2.6. Sum up of livelihood outcomes and vulnerability contexts

Household outcomes reflect the ability and capability of livelihood strategies employed. Still the results indicate low life standards in rural livelihoods. Most households are living under standard poverty standard measures. On-farm activities are the most important income generators in the study villages enhanced by irrigation activities and the available market structures. Policy environments seem to make lot of improvements compared to several years back (1970's), land reforms, irrigation acts, and others, but still a lot is still needed to be accomplished.

Most rural families are subjected to vulnerability contexts. Weather variation, land and water shortages, pest/insect/weed effects and others are kind of shocks which cost household productions. Diversification indicates that livelihood is manageable by engaging in many activities rather than just one activity.

7.3. Water availability and access

Water availability and access are among of the crucial factors which can determine yields in farming activities. Others factors such as input applications, farming skills, soil texture

weather conditions and others are also important. In this chapter the analysis of water access and use and its implication for different types of livelihoods in the study villages will also be presented. This will be done by looking at water income dependence and water access for different households.

Irrigation activities in the study villages are reported to consume more river water than others uses which include domestic water use and water used for bricks making. It is reported that the area has water access around the year through multiple rivers that drain across Mkula village. Mkula River is linked to Mkula irrigation scheme. Mkula and Msufini Rivers are linked to MAKI traditional irrigation scheme also at Mkula village. These rivers are reported to have an annual flow but vary in river water during dry and wet season.

7.3.1. Water income dependence

To find out about water income dependence, we investigated what share of total household income is resulted from irrigation activities. This was done by calculating the percentage of income obtained from irrigation activities from the total household income. We looked at rice income because it is the sole crop for irrigation water use.

7.3.1.1. Water income dependence by types of irrigation

The results show that irrigation activities yield 44% of the total household income. Improved and traditional irrigation have an average of 50% and 24% of income from irrigation activities respectively (Table 7-13). Half of income is derived from irrigation activities to the families that are engaged in improved irrigation scheme. The situation indicates that irrigation water income dependence is much higher in this community. Variations in river volumes mean that the livelihoods of these people could be shaken too. Households that are engaged in traditional irrigation schemes have more income from non irrigation activities. The water dependence income level in much higher in improved irrigation families compared to traditional irrigation families.

Table 7-13: Water income dependence by types of irrigation in the study villages at Kilombero District, Tanzania, 2012

Source	Improved irrigation N= 28		Traditional irrigation N = 13		Total Sample N=41	
	Average	%	Average	%	Average	%
Irrigation Income	2,242,175	49.3	1,221,077	34	1,918,412	45
Non irrigation Income	2,308,357	50.7	2,3932,31	66	2,335,269	55
Total Household income	4,550,532	100	3,614,308	100	4,253,681	100

Water dependence analysis of the households that engaged in irrigation activity by types of irrigation in the total sample, the amounts are in Tanzanian Shillings

7.3.1.2. Water income dependence by households' wealth groups

The lower income groups in that has relatively higher water dependence (74%) compared to the middle income group (55%) and higher income group (42%). This can be because the lower income group has little capital to diversify which subject them to employ more resources into the irrigation activity (Table 7-14). It is also shown (7.1.1.2) that the highest share of on-farm income is earnings from rice production in the lower income group (Table 7-7). Even though the lower income group has higher water income dependence they still have lower irrigation earnings (565,167TZS) compared to other wealth groups (Table 7-14). The situation indicate that without water lower income group would be more affected that the other groups.

Table 7-14: Water income dependence by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012

Source	Lower income group N=6		Middle income group N=13		Higher income group N=22		Total Sample N=41	
	Average	%	Average	%	Average	%	Average	%
Irrigation income	565,167	74	1,427,569	55	2,577,523	42	1,810,589	45
Non irrigation income	197,333	26	1,170,770	45	3,606,454	58	2,324,795	55
Total Household Income	762,500	100	2,598,339	100	6,183,977	100	4,253,681	100

Water dependence analysis of the households that engaged in irrigation activity by households' wealth groups in the total sample, the amounts are in Tanzanian Shillings

The higher income group has lower water dependence compared to the other wealth groups. This may be explained by that the higher income families are linked to larger capital access which allows them to diversify in other income activities. As we have seen above (7.1.1.2), sugarcane income has the highest share in higher income group in the on-farm activity. In case of the low water access the higher income group will be affected but not as much as the other wealth groups (lower and middle income groups).

7.3.2. Summary on water income dependence

Water is a central determinant of livelihoods in the study villages. The findings reflect that without irrigation water, nearly half of the income in the households will disappear. The study also finds that water income dependence is much higher in Mkula than in Msolwa A village because of intensity of irrigation activity at Mkula village. At Msolwa A village; households depend only on rainfall for crop cultivation.

7.3.3. Water access for different households

This part looks at the relationship between water allocation and yield level in different households. The accessible measure used was to compare yield variations per hectare both in improved and traditional irrigation and in rain-fed agriculture. This is because in all three types of agriculture, households have access to agricultural inputs (fertilizer, herbicides,

pesticides, water and others) and other services. However it is clear that other variables also are crucial in explaining exact yield per hectare.

The major difference between types of agriculture is the volume and frequency of water access in each type of agriculture around the year. The alternative of obtaining the water volume flowing in the crop fields was very difficult for two major reasons. First, small holder farmers were not maintaining records or measures of water volumes entered/exited in their farms and secondly the research time spend in the field was not enough to track down the water volume flowing in farms over the whole season. This is the reason for choosing crop yield variations per hectares between the three types of agriculture when examining the relationship between water allocation and yields. We also examined the costs incurred (inputs and others) per hectares in order to understand the yield variations alongside to water access.

How do small scale farms receive water in improved, traditional irrigation and in rain-fed agriculture? In improved irrigation schemes, water was allocated by opening and closing the main gates and other sub-gates according to the arrangements scheduled by scheme leaders (in local language is called *zamu*). When gates were opened farmers who were entitled to receive water in the particular time/day opened mini-gates in their plots/farms to allow water inflows. Water then stays in the farms for a particular time depending on the farm needs before allowed back into the irrigation canal system. The estimated time for each part was three days in two zones before closing the gates and that was a continuous process. I will return to this on the next part when analyzing the institutional arrangements on irrigation schemes.

Traditional irrigation has more or less the same water controlling mechanisms as in the improved irrigation but it differs in the quality of irrigation infrastructure. Traditional irrigation infrastructure is extremely poor and that causes inadequacy in water allocation though the scheme has the same controlling arrangements. Local farmers reported that farm water management is problematic because of poor irrigation infrastructure. Remarkable characteristics in the traditional irrigation according to the local people is that the land is fertile and wet all around the year which craves less agricultural input applications.

In rain-fed agriculture, farmers relied only on rainfall distribution in their crop fields. There are no arrangements for harvesting rainfall water. The occurrence of rainfall variations caused vulnerability to small scale farmers.

7.3.3.1. Water access and rice yield by types of agriculture in the total sample

Holding other factors constant, we examined yields per hectare in each type of agriculture. The findings indicate that improved irrigation scheme has average yields of 6 ton per hectare followed by traditional irrigation (2.1 ton/ha) and rain-fed agriculture (1.1 ton/ha). In the total sample, the rice quantity harvested per hectare was 2.7 ton (Table 7-15). The improved irrigation has much this higher yields per hectare compared to other types of agriculture. This implies that water access is a significant determinant to the rice quantity produced. Traditional irrigation has more or less access to water as it is in improved irrigation but differ in controlling mechanisms during water allocation and that causes lower yields compared to improved irrigation. Much water is wasted in traditional irrigation. In rain-fed agriculture water access is very low and that can cause low rice production. It was also noted that improved irrigation households' have more costs per hectare (559,128TZS) compared to traditional irrigation households (280,049TZS) and rain-fed agriculture households (186,832TZS) (Table 7-16). Yield variations can also explained by input application, that higher income families can afford input costs compared to lower income families. This indicates that water access and input applications together can determine exact yields per hectare.

Table 7-15: Rice yields per hectare by types of agriculture in the study villages at Kilombero District, Tanzania, 2012

Source	Improved irrigation		Traditional irrigation		Rain-fed Agriculture		Total Sample	
	Average	N	Average	N	Average	N	Average	N
Total Sample	6	31	2.7	12	1.1	60	2.7	103

The measures are in tons

Table 7-16: Rice total costs per hectare by type of agriculture in the study villages at Kilombero District, Tanzania, 2012

Source	Improved irrigation		Middle income group		Rain-fed Agriculture		Total Sample	
	Cost	N	Cost	N	Cost	N	Cost	N
Total Sample	557,350	31	320,144	12	184,562	60	313,039	103

Costs are in Tanzanian Shillings

7.3.3.2. Water access and rice yields in types of agriculture by location

There were no functioning irrigation infrastructures at Msolwa A village during my field trip. Rain-fed agriculture is the only available type of agriculture found in the village with the average of 1.1 ton/ha (Table 7-17). Many households at Msolwa A village depended on rain-fed agriculture and few were practicing farming activities in wetland area which support crop cultivation thought the year. People were free to move in other locations searching for suitable crop cultivation areas. At Mkula village, the higher share of rice quantity produced resulted from improved irrigation (6.1 ton/ha) followed by traditional irrigation (2.1 ton/ha) and rain-fed agriculture (1.1ton/ha).

Mkula has an average of 5.5 ton per hectare in the total sample. The variations in crop yields can be explained by accessibility of water in each type of agriculture. Improved irrigation is shown to have more access to water than other types of agriculture which is linked to improved irrigation infrastructure and management (Table 7-17).

Yields differ in rain-fed agriculture between Mkula and Msolwa A villages. Mkula villages has higher yield average (2.1ton/ha) compared to Msolwa A village. This can be because the households at Mkula village are more specialized in rice production even out of irrigation while the households at Msolwa A village are more specialized in sugarcane production (7.1.1.1 and Table 7-5).

Table 7-17: Rice yields per hectare in types of agriculture by location in the study villages at Kilombero District, Tanzania, 2012

Source	Improved irrigation		Traditional irrigation		Rain-fed agriculture		Total Sample	
	Average	N	Average	N	Average	N	Average	N
Msolwa A	0	0	0	0	1.1	57	1.1	65
Mkula	6.1	31	2.5	12	2.1	5	5.5	39

The measures are in tons per hectare

7.3.3.3. Water access and rice yields in types of agriculture by households' wealth groups

The rice yields per hectare are higher in irrigation activities compared to rain-fed agriculture for all wealth groups (Table 7-18). The variations can also be explained by volume and frequency of water accessible in all three types of agriculture. We also find that higher income group utilizes more inputs applications compared to other groups as indicated in costs

(437,781TZS) incurred per hectares (Table 7-19). This can also explains yield variations between wealth groups when collaborated by access to water. Improved irrigation has adequate water access compared to other types of agriculture because it has better irrigation infrastructure. Rain-fed agriculture depends on rainfall alone.

Table 7-18: Rice yields per hectare in types of agriculture by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012

Source	Improved irrigation		Traditional irrigation		Rain-fed agriculture		Total sample	
	Average	N	Average	N	Average	N	Average	N
Lower income group	3.2	5	2.5	2	0.7	27	1.1	34
Middle income group	7.3	9	1.4	6	1.4	21	2.8	35
Higher income group	6.2	17	3.9	4	1.5	14	4.1	35
Total sample	6.1	31	2.4	12	1.1	62	2.7	103

The measures are in tones per hectare

Table 7-19: Rice total costs per hectare by households' wealth group in the study villages at Kilombero District, Tanzania, 2012

Source	Higher income group		Middle income group		Lower income group		Total Sample	
	Cost	N	Cost	N	Cost	N	Cost	N
Total Sample	437,781	34	298,632	12	199,425	60	313,039	103

Costs are in Tanzanian Shillings

7.3.4. Summing up

Water resource is highly important factor in agricultural activities in the study villages. The findings indicate that when holding other factors constant, water availability and access make the difference in crop yields. It is also clear that application of inputs and other farming skills increase yields too. We looked at cost incurred per hectare in order to understand the relationship between cultivation costs and yields. We found that households which incurred relatively higher costs in the farming activities yield more that the households which utilized low costs

CHAPTER 8 - WATER RESOURCE USE

This chapter presents an analysis of irrigation schemes as a social institution uses the design principles for long-enduring CPR presented by Vedeld (2002) based on Ostrom (1990). Irrigation activities in the study villages have water access around the year through multiple rivers that drain across Mkula village. Mkula River is linked to Mkula irrigation scheme. Mkula and Msufini Rivers are linked to MAKI traditional irrigation scheme also at Mkula village. These rivers are reported to have an annual flow but vary in river water during dry and wet season. Farmers' reflections on upstream and downstream water concerns will also be discussed.

8.1. Institutional water management in irrigation schemes

This part presents the results of analysis of the irrigation schemes, both improved and traditional schemes using the design principles for long-enduring CPR presented by Vedeld (2002) based on Ostrom (1990). The designed principles may improve the understanding regarding institutions at work when governing irrigation water in the schemes.

8.2. Flashback and status of the schemes infrastructure

In the study villages, irrigation activities started during 1979 when Mkula Irrigation Scheme (Improved irrigation) was established. MAKI Traditional Irrigation came into the existence in 1994 after local people started to experience land shortages in the area. According to the local people before there were no human activities in the current traditional irrigation area (which was wetland) because land was sufficient in the surrounding areas which supported a range of human activities.

The establishment of Mang'ula Mechanical Machine Tools company and introduction of TAZARA (railway company) across the Kilombero area (from Dar ES Salaam to Lusaka) during the 1970s and the establishment of Ujamaa policy all together are linked to the increase of population in this part of Kilomber District. During the survey, over 29 tribes were recorded in the study villages where indigenous people occupy low numbers. This indicates that many people have their origins out of this area and have migrated in.

The mentioned activities attracted a large number of people but the available employment facilities didn't support large number of people and that turned many people to agricultural activities. Increased population has increased environmental pressures in the area according to

the local people. Currently, water use has been reported to be increased tremendously which causes strong influences of human activities in rivers. Introduction of some crops which are not environmental friendly and frequently occurrences of fire initiated by local people during farming preparation are linked to environmental degradation in the area. There is for example a local believes that fire increases yields and reduces weed problems.

Currently, the improved irrigation occupies 254 ha with a total number of 91 members and traditional irrigation has 320 ha with 120 farmers. Today the area is experiencing land scarcity as we have discussed earlier. Local people claimed that the irrigation activities came here later in contrast with other areas such as Usangu where the irrigation started early (1930) because the area had self sufficient food result from sufficient water, land and favorable weather conditions. The area was also inhabited by a very low population. Water and land shortages, weather variations and limited employment chances subjected bursting population to engage more in irrigation activities.

Successful irrigation development relies upon improved performance in organization and management, planning and designing of irrigation infrastructures. Inadequate in scheme infrastructure as discussed earlier is one among of other factors that constrain successful irrigation development. The situation is more critical in traditional irrigation than in improved irrigation. Status of irrigation infrastructure is a key determinant of physical water management in the irrigation schemes. At Mkula irrigation scheme (improved irrigation) have improved irrigation infrastructure compared to MAKI irrigation scheme (traditional irrigation).

In traditional irrigation, poor infrastructure limits water conveyance and hydraulic water distribution structures. During dry seasons water discharge is influenced by poor intake mechanisms in the irrigation system. This cause huge water loses. Water control during wet seasons is also difficult following poor infrastructure which fails to obstruct non-required water in farms. The area become over flooded and little can be done. When the wet season ends the intake reconstructions begin following the destruction made by flooded water. This is announced repeated exercise according to farmers.

In improved irrigation (Mkula Irrigation Scheme) water control is not as critical as in traditional irrigation. Reported challenges are on sub-canals which are more or less equipped with poor infrastructure. The main canals and intakes are well built using concrete which help to maintain and control required water volume across the rice fields.

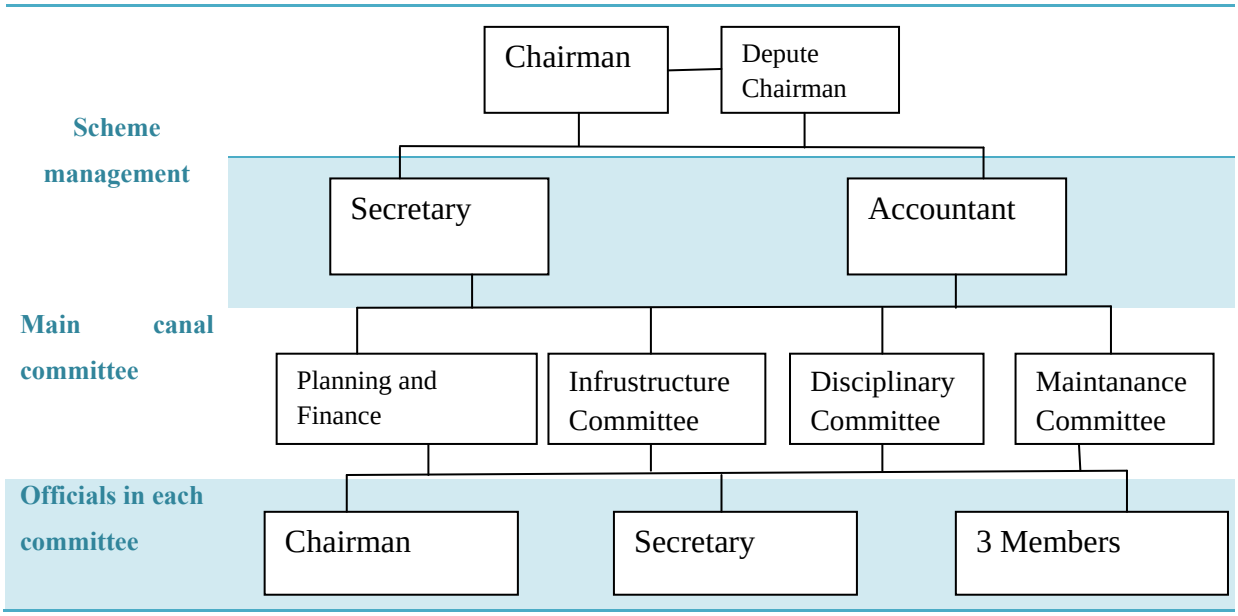
In both types of irrigation schemes leveling in the whole area is reported to be a serious concern. The whole area in both schemes (MAKI and Mkula Irrigation Scheme) is reported to be unleveled. The situation is problematic following water discharges that depend entirely upon gravity. This causes unequal water supply in the irrigation area. On-farm water balancing within a particular plot is also problematic; farmers reported that lower side of the plot contains more water than the elevated side of the same plot.

8.3. Organization structures in the schemes

Both schemes (Mkula and MAKI Irrigation Scheme) have their own written constitutions recognized by the responsible ministry, (During fieldwork it was Ministry of Home Affairs). The election for scheme leaders occurs once in every three years in both schemes following the rules that govern irrigation schemes in Tanzania. Both schemes have the same administrative structures which have the elected chairman, vice chairman, secretary, bursar, and different committees and other board members.

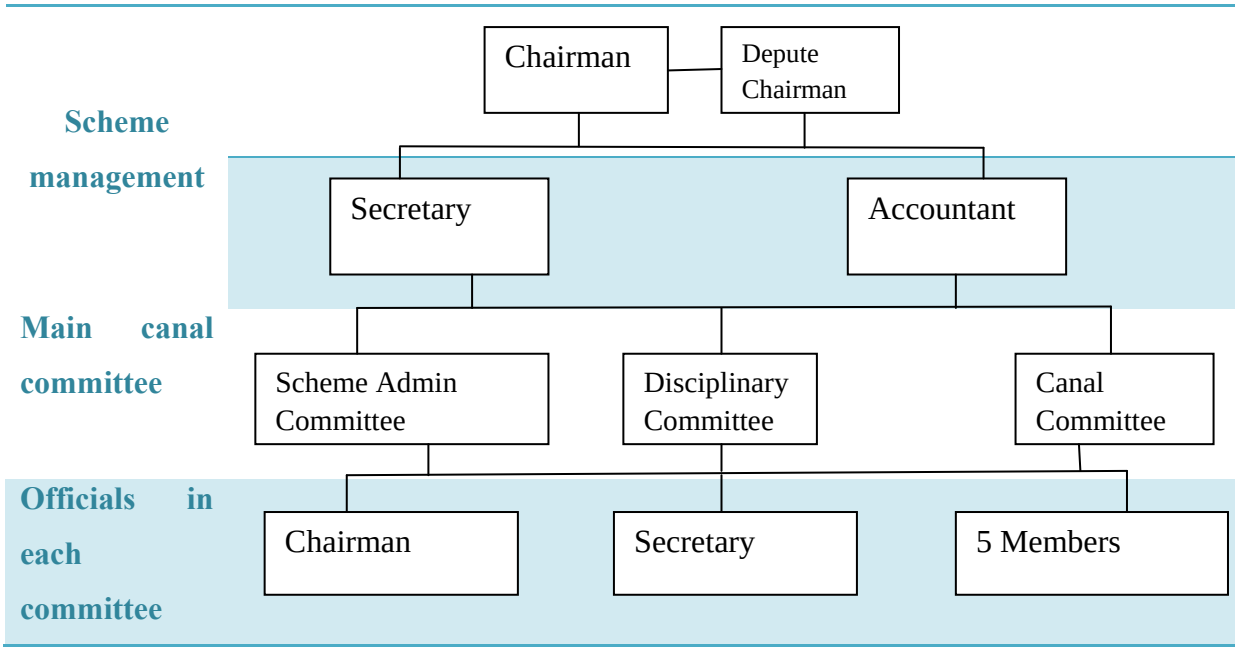
Mkula Irrigation Scheme has four committees as follows, planning and finance committee, infrastructure committee, maintenance committee and disciplinary. Each committee has chairman, secretary and three members among scheme members (Figure 8-1). MAKI Irrigation Scheme has three different committees as follows, scheme administration committee, disciplinary committee and canals committee. Each committee has chairman, secretary and five members (Figure 8-2).

Figure 8-1: Mkula Irrigation Scheme (Improved) organization structure in the study villages at Kilombero District, Tanzania, 2012



Source; Fieldwork, 2012

Figure 8-2: MAKI Irrigation Scheme (Traditional) organization structure in the study villages at Kilombero District, Tanzania, 2012



Source: Fieldwork 2012

These leaders are elected by scheme members through voting under the supervision of the village government, thereafter village officials will notify the higher authorities which include wards, district and other higher levels about the elected leaders.

The chairman and deputy chairman head the organization. Daily basis activities which include water distribution in canals, monitoring, and maintenance and collection of water charges are under the secretary and responsible committees.

Rufiji Basin Water Office (RBWO) is responsible for issuing Water User Permits (WUPs) and also it receives the collection water charges from the responsible parties. The scheme management formulates by-laws and adopts other arrangements designed by scheme developers, example governments or agencies.

8.4. Water management as an enduring CPRs

This part will analyze the institutional management of water resources employing design principles for long-enduring CPRs. The analysis will be presented also by types of irrigation and households' wealth groups.

Table 8-1: Irrigation water management by types of irrigation (Improved and traditional irrigation) in the study villages at Kilombero District, Tanzania, 2012

CRP Principle	Institution and management	Improved irrigation	Traditional irrigation	All	Overall adherence
1	Boundaries are clearly assigned?	61	54	56	No
	❖ Should others be restricted?	54	61	68	Yes
2	Rights and memberships are clear and fairly distributed?	52	53	53	Yes
	❖ Some have more water rights?	73	62	68	No
3	Everyone carryout their duties?	47	66	61	No
	❖ Water charges are paid regularly?	52	100	77	No
4	Fair say in decision making?	84	64	70	Yes
5	Is monitoring system effective?	59	70	65	No
	❖ Is water management system satisfactory?	66	47	58	No
	❖ People take more water than allowed?	83	76	84	Yes
	❖ Rich people have more water access?	66	62	65	Yes
6	Does system of sanctioning works well?	56	61	56	Yes
7	Internal conflicts are managed and resolved fairly?	60	53	57	Yes
	❖ Conflicts over water use are common				
	❖ Conflicts are resolved quickly?	83	76	81	Yes
	❖ Does water competition increase?	72	76	66	Yes
	❖ Do you get rights amount of water?	91	76	88	Yes
		50	50	50	Yes/No
8	Does external authority interfere local water arrangements?	87	59	77	No
	❖ Does local authority have power on water?	76	88	81	Yes
	❖ Traditional water management system function?	51	83	79	Yes

Table 8-2: Irrigation water management by households' wealth groups in the study villages at Kilombero District, Tanzania, 2012

CRP Principle	Institution and management	Improved irrigation	Traditional irrigation	All	Overall adherence
1	Boundaries are clearly assigned?	61	54	56	No
	❖ Should others be restricted?	54	61	68	Yes
2	Rights and memberships are clear and fairly distributed?	52	53	53	Yes
	❖ Some have more water rights?	73	62	68	No
3	Everyone carryout their duties?	47	66	61	No
	❖ Water charges are paid regularly?	52	100	77	No
4	Fair say in decision making?	84	64	70	Yes
5	Is monitoring system effective?	59	70	65	No
	❖ Is water management system satisfactory?	66	47	58	No
		83	76	84	Yes
	❖ People take more water than allowed?	66	62	65	Yes
	❖ Rich people have more water access?				
6	Does system of sanctioning works well?	56	61	56	Yes
7	Internal conflicts are managed and resolved fairly?	60	53	57	Yes
		83	76	81	Yes
	❖ Conflicts over water use are common	72	76	66	Yes
	❖ Conflicts are resolved quickly?	91	76	88	Yes
	❖ Does water competition increase?	50	50	50	Yes/No
	❖ Do you get rights amount of water?				
8	Does external authority interfere local water arrangements?	87	59	77	No
	❖ Does local authority have power on water?	76	88	81	Yes
	❖ Traditional water management system function?	51	83	79	Yes

8.4.1. Boundaries

Distribution; Boundaries of the CPRs refers to the organizing for collective action (Ostrom 1990). Boundaries specify the individuals who can use water resource and also set extraction intakes. Scheme members through their scheme administration are responsible for organizing and specify all individuals who are entitled to use water extracted and use irrigation infrastructure. This was done by assigning special water allocation through main, sub and tertiary canals. This helped to limit and manage water allocation to the various plots within irrigation system. However challenges were also reported, other unplanned water uses occurred. Individuals (scheme and non-scheme members) who live closer to the canals also use water for other purposes. Also non scheme members were reported to use water which flows through the irrigation infrastructure.

Externally RBWO is responsible to set external boundaries for drawing water at Mkula River by consulting other bodies such as responsible Minister, National Environment Management Council (NEMC) and Tanzania National Parks (TANAPA). TANAPA is consulted because the river is sources within the park protected area. It was reported that 70% of water used for HEP downstream (Kidatu and Mtera hydro power) is sourced at Udzungwa Mountains. The water permit process issued by RBWO is reported to involve other bodies including NEMC which offer environmental impact assessment report under the responsible Minister. To ensure preservation of National parks, Nature Reserves and Catchment Forest in Udzungwa Mountains, a park ecologist is consulted to guide the environmental researchers. The findings are circulated and if environmental impact assessment report has passed then the permit can be issued. June 2011 the forest was officially closed for human activities.

Administration: The administration is responsible to set rules and regulations for governing water use. Both improved and traditional irrigation have their own written constitutions which are recognized by responsible bodies in local and central governments. The administration allocates and distributes water to all plots under the irrigation system. The infrastructure committee is responsible for setting internal boundaries in Mkula Irrigation Scheme while the same is done by a Canal Committee in MAKI Irrigation Scheme. The farmers reported that water flow varies into the farms at different seasons of the year. Water shortages occur during dry seasons and water excess is experienced during wet seasons. Externally RBWO in collaboration with other bodies is responsible for setting boundaries for drawing water by providing Water User Permits (WUPs) in order to manage the river flows for other downstream water use.

Participation: The scheme administration ruled that all scheme members have the responsibility of maintain irrigation infrastructure and to make minor regular repairs. I observed that in improved irrigation scheme farmers are more reluctant to take individual responsibility for maintaining irrigation infrastructure compared to the traditional irrigation scheme. In both types of irrigation small scale holders are more active in voting during the elections.

Conflicts: Many of the reported water conflicts associated with water distribution and allocations' following few individuals cross the line and extract more water than they should. The situation is tenser in improved irrigation compared to traditional irrigation. During PRA sessions a farmer reported that he stayed awake all night guarded with a machete in order to

ensure he get right amount of water. He claimed that there are few some individuals who violate the water arrangements by extracting more water into their plots with little or no regards to others. Water conflicts are reported to occur mostly during dry seasons than in wet seasons. In wet seasons the reported water conflict cases include the diversion of water to other people's plots because during that time there is excess water flows.

Level of success (summing up): In types of irrigation the overall adherences (56%) show boundaries were seem as not clearly assigned. 61% of households in improved irrigation schemes commented that boundaries were not clearly assigned while 54% in traditional irrigation schemes commented the same (Table 8-1).

In the households' wealth groups, the lower income group (62%), middle income group (54%) and higher income group (47%) stated that the boundaries for drawing water were not clearly assigned. Ostrom (1990) argued that it is possible for few appropriators to extract more unit resources that it should. This was also reported but the set boundaries assisted to minimize the magnitude of the problem (Table 8-2). So the higher income group less occupied with unclear boundaries.

8.4.2. Rights and memberships

Distribution: RBWO is the responsible organ for issuing water rights in irrigation schemes after the applicant qualifying necessary requirements. In both schemes there were inadequacies in the formal arrangements according to RBWO officials. Water user fees are aligned with the volume of water extracted from the river. This also has difficulties in the actual implementations according to personal observations. Legal pluralism is the exact term that can illustrate the actual situation regarding memberships and rights in the study area.

Memberships and rights in the schemes are recognized after passing necessary criteria which include owning/renting cultivated land within the irrigation area. Having cultivated land in the irrigation scheme is among criteria for qualifying to be recognized as a member in the scheme where individuals enjoy all the benefits equally. Other criteria include both initial and regular water user fee payments and others stated in the scheme constitutions. At Mkula irrigation scheme the entrance fee is 40,000TZS and each hectare contributes 20,234TZS annually. Other people who are not scheme members are also reported to use irrigation water which is actually prohibited.

Administration: The scheme administration ruled that the distribution of water should be fair, transparent and equal to all scheme members. The scheme leaders use periodic irrigation schedules to allocate and distribute water to all entitled members according to the arrangements. However this exercise is not as smooth as it sounds, it has been reported that some members are violating the rules attempting to extract more water by various means including force, theft and similar means. This is quite a common experience during dry seasons as farmers reported. The scheme leaders enforce the rules under the Disciplinary Committee in order to eradicated water related conflicts. Improved irrigation (Mkula Irrigation Scheme) is said to have better administrative arrangements than the traditional irrigation (MAKI Irrigation Scheme).

Participation: All scheme members participate in various decision-making processes as stated in reports. Scheme members come to concession on how to distribute water through main, sub and tertiary canals under responsible committee. Also, the members participate in general elections which elect scheme leaders administered by the village government.

Conflicts: During water stresses conflicts regarding rights and memberships are commonly experienced by the farmers. Domestic water use in irrigation canals is pointed out by farmers to be a common problem. Few individuals are reported to conduct personal domestic water use (washing clothes, utensils, watering kitchen gardens) in irrigation canals. During FGDs one respondent pointed that some individuals are using water from irrigation infrastructure for other purposes because the canals pass closer to their residential area which makes easy options for using water rather than travelling longer distance. This kind of problems is more common in improved irrigation than in traditional irrigation. This is because the boundaries are more clearly assigned in improved irrigation compared to traditional irrigation.

Level of success (Summing up): 53% (Table 8-1) of the small holder farmers claimed that rights and membership are clearly and fairly distributed and not many differences between traditional irrigation (52% and 53%).

By wealth groups, lower income group (60%), middle income group (70%) and higher income group (63%) reflected that memberships and rights are clearly and fairly distributed (Table 8-12). In general it was clear that no member had more water rights than others. Farmers also reported that others (non-scheme members) should be restricted from using water from irrigation infrastructure.

8.4.3. Duties and responsibilities

Distribution: The District Council recognizes all activities pursued in irrigation scheme through district irrigation engineer and other technical officials. RBWO has the responsibility of issuing Water User Permits and to keep annual water charge collections. The water office has the responsibility for administering principles and other regulation of water extraction. This is done by governing all intakes from the river to ensure water is tapped as per procedure to safeguard other river use downstream. Farmers are the owner of the schemes and are responsible to pay water user fee. Farmers in irrigation schemes have the duties of maintaining irrigation infrastructures by making regular cleanliness in canals and to report any canal breakages. Scheme administration has the responsibility of arranging minor repairs in irrigation infrastructure. Major repairs and maintenance fall under central government. Mkula Irrigation Scheme pays annual water charges of 108,000TZS to RBWO. MAKI Irrigation Scheme has no arrangements of paying water charges to RBWO.

Administration: Daily management and supervision in the schemes is under the scheme officials of the main canal committees. Technical problems in the schemes are administered at the ward and district level. Part of the annual water charges are collected by scheme officials through Planning and Finance Committee and present to RBWO and other part are retained for infrastructure maintenance and repairs. In traditional irrigation, water user fees is not implemented as we a have seen earlier.

Participation: The level of participation in fulfilling duties and responsibilities is reported to be relatively low at all levels. The farmers complained that the government officials in the higher authorities have abandoned them. Farmers reported that they have problems in their irrigation infrastructures but little has been done. Farmers in improved irrigation are reported to be inflexible in collective actions. Many farmers are reporting to have less care about exercising their common duties; their willingness to cooperate is very low. I observed that many farmers tend to spend time in their own plots busy only on water diversion structures with little regards to the whole irrigation system. They reflect on that the maintenance activities in irrigation canals are for others and not the farmers. A water charge is another problem that farmers don’t wish even to discuss. Many farmers have admitted that they are not paying regular water user fee. In traditional irrigation there is no arrangement yet for paying water fees yet.

Conflicts: Scheme officials reported to have regular confrontation with many farmers who attempted to avoid participating in maintenance activities. A farmer reported that self motivation for participating in maintenance and others related public services is low. He argued that many farmers tend to dodge and that demoralizes others. This experience is in both types of irrigation.

Level of success (Summing up): The level of participation in duties and responsibility is reportedly low. All adherences (61%) claimed that little has been done in regarding duties and responsibilities. In improved (47%) and traditional irrigation (66%) the farmers claimed that there is little participation in carrying out duties and responsibilities (Table 8-1).

It is not a big variation between income groups and views on participation. Lower income group (64%), middle income group (54%) and higher income group (60%) see lower participation in carrying out duties and responsibilities (Table 8-2). They also stated water charges are not regularly paid. Both schemes have inadequate in collective action, but the situation is serious in traditional irrigation schemes.

8.4.4. Participation and decision making

Distribution: Farmers are directly affected by operational rules and that leads the participation to modify these rules. Regular maintenance and cleaning of irrigation infrastructure is scheduled by scheme leaders in order to maintain the quality of the canals to secure water flows. Regular water charges also are essential tool that create financial capacity to the schemes to support daily operations.

Administration: Scheme officials represented by various committees in daily operations arrange periodic meetings to discuss matters concerning irrigation in general. The participation of scheme members in decision making is reported to be relatively very high. Farmers reported that decision making process functions well.

Participation: Every scheme member has right to participate in various meetings and assemblies. During PRS sessions many farmers steward that they have fair and equal opportunities in decision making process. They reported that there is no interference from higher authority regarding various matters in the irrigation activities.

Conflicts: No acute conflicts were reported. Minor conflicts concerning duties and obligations are reported to common. Farms are condemned to have low self motivations in collective actions. For example in small scale farmers reflected that the water payments which they

claim to pay exclude them to participate in regular maintenances and canal cleanness. Planning and Finance Committee commented that the received water collection is very minimal to manage all maintenances and other obligations. Infrastructure committee is responsible for administering regular canal cleanness and water distribution and allocation.

Level of Success (Summing up): Overall adherence (70) indicates satisfactory participation and fair decision making in daily operation in the schemes. 84% of farmers in the improved irrigation scheme claimed that there is fairness in participation and decision making. 64% of the farmers in the traditional irrigation argue the same (Table 8-1).

74% of the farmers in the lower income group reported fairness in participation and decision making. 77% and 79%of farmers from middle and higher income groups respectively, claimed that there is fairness in participation and decision making (8-2).

8.4.5. Monitoring

Distribution: Daily water distribution depends on the arrangement scheduled. RBWO ruled that all water after flowing across irrigation fields must be channel back to the river system. All scheme members are entitled to get water as stated in the irrigation schedule equally and fairly.

Administration: Daily water allocation and distribution in improved irrigation scheme fall under Infrastructure Committee and under Canal Committee in traditional irrigation. In improved irrigation, water was allocated in two zones each three respective days with eight hours within sub zones. These committees under the supervision of scheme secretary are responsible for monitoring water schedules and distribution.

Participation: Almost all farmers are monitoring water allocation flowing to their plots. They spent time in monitoring water across tertiary canals to ensure adequate flows in their farms. Farmers also monitor the regulation of water which is already entered in their respective plots before releasing them back to the irrigation system.

Conflicts: Monitoring water distribution is reported as a source of many conflicts occurred in the irrigation schemes especially in tertiary canals. Few individuals violate the rules and intentionally extract water more than allowed for. Actions of a few individuals who obstruct water for their own benefits interferes the whole system and cause unnecessary inconvenience. The situation is reported to be severe during water shortages periods. 84% of the farmers claimed that people are extracting more water than they are allowed. 83% of

respondent in improved irrigation claimed people take more water that they allowed and 76 in traditional irrigation claimed the same.

Level of success (summing up): Overall adherence (65%) claimed ineffectiveness in monitoring. 59% and 70% of respondents in improved and traditional irrigation claimed ineffectiveness in monitoring respectively (Table 8-1).

63% of lower and middle income group claimed ineffective in water monitoring while in higher income group it was 53% (Table 8-2). Repetitions of stealing water by some identifiable individuals raise questions over the capability of responsible committee in monitoring water distribution effectively.

8.4.6. Sanctions

Distribution: All farmers who violate operational rules should be assessed against graduated sanctions. RBWO has the ultimate authority over issuing water rights and is also obliged to impose graduated sanctions in the respective river basin. In irrigation schemes, the Disciplinary Committee is responsible for dealing with sanctions to a certain level before referring the complex cases to other higher authorities.

Administration: Graduated sanctions and penalties are imposed by the Disciplinary Committee in irrigation schemes for guilty parties regarding water rules regulations. Both formal and informal arrangements in sanctions are used to resolve water related problems. I observed that many water related cases were resolved through informal local arrangements. Elders and some scheme officials are called to dissolve disputes related to water stresses. Farmers prefer informal arrangements for solving water related problems because is less cost and create harmony within the community rather than say take offender to court.

Participation: Guilty parties are expected to be penalized according to the stated by-laws but mostly this is not happening. I found that legal pluralism functions in villages which always results in dilemmas and not course of action to be followed. There was a reported case of that two people who were rumbling over water allocation and this was resolved locally by elders, whereas the case was in the supposed to be a criminal case. This kind of experience creates tolerance within the community and makes many farmers to divert from their obligations, duties and responsibility. Others take advantage of the situation and continue to steal water; others are not paying their regular water charges.

Conflicts: Externally, RBWO is the equitable organ to formulate principles of regulating and controlling water allocations. Rivers are expected to serve both upstream and downstream water use but the main challenge remain in the incentives of monitoring the whole river system. In irrigation schemes related water conflicts are still common despite having sanctions. The sanctions attempt to suppress the occurrences of regular water conflicts.

Level of success (Summing up): According to the farmers the sanctions needs more reshaping and improvements in order to work more effectively. Many people (56%) claimed that the system of sanctioning works well. Both improved and traditional irrigation 56% and 60% respectively, claimed that system of sanctions worked well (Table 8-1).

In wealth groups, lower income group (62%), middle income group (53%) and higher income group (60%) claimed also system of sanctions worked well (Table 8-2).

8.4.7. Conflict resolution mechanism

Distribution: In irrigation schemes, many conflicts are linked to low access to water in time of high need. Individual farmers are reported to attempt various means to ensure water flows on their plots. This causes lot of stress and conflicts especially during water shortage periods. Conflict resolution mechanisms should be embedded on the nature of the conflicts. For example internal water conflicts are mostly resolved through customary arrangement in rather harmonized ways.

Administration: Again Disciplinary Committee is the lowest level of resolving internal conflicts and if failed the case can be referred to Village Council and further to Ward Executive Councils up to the district level.

Participation: Most reported cases were solved through discussions and negotiations by farmers through local and scheme leaders. No reported case was at the court level. Water conflicts between upstream (Mkula Village) and downstream (Magombela village) were also reported as a common experience. During FGDs farmers reported they are always confronted by downstream water users regarding water uses.

Conflicts: Conflicts are common in the area but are reported to be fairly manageable. The farmers attempt to keep sound relationships among themselves. Local conflict resolution mechanism through discussion and negotiations are reported to be favorite options. Water stresses between upstream and downstream water use were managed by having regular meetings between the two village governments.

Level of success (Summing up): Farmers agreed that conflicts over water use are common but also that these conflicts are resolved quiet quickly. Overall (57 %) claimed that internal conflicts are managed and resolved fairly (Table 8-1). Conflict resolution mechanism is claimed to be in place by farmers in improved irrigation (60%) and in traditional irrigation (53%).

Lower (49%), middle (69%) and higher income group (68%) claimed that conflict resolving mechanisms function well (Table 8-2).

8.4.8. Right to organize

Distribution: Scheme farmers are the ultimate owner, implementer of the irrigation schemes and the direct beneficiary of the water policy. RBWO functions as a legitimate body for issuing Water User Permits and charging water fees. Farmers through village officials are managing and organizing their daily operation with little or no interference from external interference. Irrigators Organizations (IOs) are the lowest appropriate level of management of irrigation schemes. IOs main functions include management, distribution and conservation of water for irrigating their schemes. Other functions include acquisition of Water User Permits, resolution of conflicts and collection of water charges for operational and maintenance and payment of water user fees to RBWO (Minister of Water and Irrigation 2010).

Administration: The zone irrigation officer and district irrigation engineer are the external authorities that collaborate on certain responsibilities with scheme management authority in these small scale farming schemes. Key stakeholders includes Agricultural Sector Lead Ministries (ASLMs) and Development Partners. The ASLMs consist of Ministry responsible for Water and Irrigation; Ministry responsible for Agriculture Food Security and Cooperatives; Ministry responsible for Livestock Development and Fisheries; Ministry responsible for Trade Industry and Marketing and Prime Minister's Office, Regional Administration and Local government (Minister of Water and Irrigation 2010).

Participation: Sound relationship without external interference is actually reported in the villages. Local people have good collaboration with Kilombero District Council, agencies donors and other stakeholders in making vital decisions regarding developmental programs. For example at Mkula village in 2010, one of the water gate was reconstructed; the cost was 43 million Tanzanian Shillings. Part was funded by District Agriculture Development Plans (DADPS) and the remaining part by local people through volunteering. The decision on how to allocated the funds from the donor (DADPS) was done independently by village members

through their regular assemblies and meetings. Technical assistance was provided by DADPS and some official from Kilombero District Council.

Conflicts: The farmers reported no interference the decision in local scheme management from external authority regarding water resources.

Level of success (summing up): As much as 77% people in the total sample claimed that the local authorities have control over local scheme management and no interference from external authority concerning water resources. And the improved and traditional irrigation farmers 87% and 59% respectively claimed no interference of external authority on the decision made by local scheme management (Table 8-1).

Higher income group (84%), middle income group (67%) lower income group (89%) claimed there is no external interference on the decision made by local scheme management (Table 8-2). And also it was reported that traditional water management system function well.

8.5. Upstream and downstream water use concerns

Mkula River is sourced at Udzungwa Mountains (within Mkula boundary) and drains across Mkula village as it discharges downstream. Mkula River is used for irrigation activities and for domestic purposes in the village. Irrigation activity has a separate intake apart from the domestic use according to village officials. Farmers have been historically relying on this river for their various livelihood strategies. Irrigation activity uses much water compared to domestic use. RBWO ruled that all water intakes should tap part of the river water and retain other parts. It is also ruled that all water used in the irrigation schemes should be channeled back to the river system. This is for the benefit of downstream users.

During PRA sessions, most small holder farmers in the village seemed to have little concern for downstream water users. In one of the FGDs, a member argued that since the river has sourced at his village it was valid for them to utilize the river with no or little regards over downstream use. He also questioned the validity of water user fee; according to him water flows naturally, with or without paying water fee still the water will flow and end up in the ocean. He argued that “why should I pay water user fee because if a pay or otherwise still the water will flow and pour water into the ocean”. I observed that many farmers had similar kinds of reflections.

Water shortages are mostly experienced during dry seasons (June to mid November) according to local people. At this time of the year the area lacks rainfalls which cause a

reduction in river flows. This is the exclusive time of the year, where small holder farmers apply much effort and other means to maintain water access in their farms. It is the period where water related conflicts are highly occurred. We did not cover downstream uses and their concerns, but we understand that increases water scarcity upstream means more severe water tensions downstream.

8.6. Summary

The analysis of institutional water resources management in irrigation scheme in the study villages is administered through legal pluralism. The existence of legal pluralism causes the community to adopt or abandon the arrangements that seem to foster or jeopardy the coherent governing mechanism in a local context accordingly. The scheme water management was examined through the designed principles for long-enduring CPR. In one hand according to long-enduring CPR analysis, inadequacies in assigning boundaries, carrying out duties and responsibilities and monitoring systems were observed. In another hand adequacies in rights and membership; participation and decision making; sanctions systems; conflict resolution mechanisms and rights to organize were also observed.

Shortages of water upstream due to increase water obstruction for various uses including irrigation reflect similar or more water tension downstream.

CHAPTER 9 -CONCLUSIONS AND RECOMMENDATIONS

9.1. Comparison of findings

This study has presented an analysis of livelihood adaptation and institutional water resources management in the study villages at Kiolmbero District, Tanzania. Sustainable livelihoods are achieved through access to a range of livelihood resources (different capitals) and the findings display how the combinations of livelihood strategies influence livelihood outcomes in the study area.

In contrast to others studies (Kamanga et al. 2008; Kangalawe & Liwenga 2005; Vedeld et al. 2007), the findings in this study demonstrate relatively low environmental income dependence the household incomes in the study villages. All surrounding forests within the villages' areas are protected areas (under conservations purposes). This limits environmental income activities which turns people to agricultural activities for livelihood strategies. Scarce land subjected people to introduce agricultural activities in areas which were abandoned before. Areas such as MAKI (the current traditional irrigation location) in Mkula village and Itefa in Msolwa village before were not developed for human activities because these areas were wetlands. Today the areas are occupied by agricultural and other livelihood activities.

Land shortages in the area are linked to the increasing population in both natural birth and through in migration. Similar situations were found in the study done at Idete and Signali located in Kilomero District by Kangalawe and Liwenga (2005). Local population growth affect resource use (especially land and water) as was seen in the study villages. The in migration trends following the establishments of sugar and steel companies and also the influence of railway across the area have attracted large numbers of in migrants. These in migrants turned to agricultural activities due to limited labor employment and lower permanent opportunities in the companies.

In contrast to other areas such as Usangu, Kilosa and other similar areas, livestock, pastoral is a marginal activity in Kilombero District. The results show that the pastoral activities are not developed at this part of Kilombero District. The area is rich in agricultural resources including arable land which support the cultivation of both subsistence and cash crops in various scales. Sugarcane and rice production are the main crops found in the area where rice serves for both staple food and cash crops while sugarcane is exclusively cash crops.

The waste of water uses is curved by failures in institutional water resources arrangements together with poor irrigation infrastructure. This situation caused inadequate controlling and regulating water in the catchment points and in the distribution systems. Similar situations are reported in the study done at Mkoji sub catchment that Water rights did not control water withdrawals. People still overused water compared in the water rights permit. RWBO is held responsible for being inactive in administering and monitoring water allocations. This partly is linked to unreliable data on river flow volumes (McCartney et al. 2007). The willingness to pay water charges in the study villages is very low. According to McCartney et al (2007), at Mkoji, the overall willingness to pay is increasing.

Cleaver (2001) argues that " institutional bricolage , a process by which people consciously and unconsciously draw on existing social and cultural arrangements to shape institutions in the response to the changing situation" (Cleaver 2001, p. 26). She also points to that institutions mediate relationships between people, natural resources and society (Cleaver 2012). The contestation of designed principle and other frame works for common property resource management and collective action analysis helps to improve our understanding in common pool resource management. I observed that the community in the study villages was keen to promote good governance of natural resources by adjusting according to the prevailing situation. Livelihood strategies change in response to the changes in resource flows, policy, environment, demography, economic, social, culture and others. The actual scene in the study villages showed that people are flexible in both ways (to adopt or to abandon) the arrangements which suits or costs their social, cultural or economic environments.

We also found that the upstream (Mkula village) water abstraction due to irrigation raises conflicts with other water use downstream (Magombela). This is similar to the study carried out by Mwakalila (2004 and 2005) (Mwakalila & Noe 2004; Mwakalila 2005).

9.2. Conclusion

Assets: Various capitals are diversified in different ways in order to secure livelihood outcomes within the households. The ability to combine the possessed basic capitals ensures sustainable livelihoods. Land and water access are part of natural capital which have direct impact on the livelihood strategies in the study villages. It is clear that access to the available capitals (physical, human, financial and social) mediate the ability to control the exact livelihood outcomes. The capitals which determined livelihood outcomes for different

households in the villages apart from land and water include the availability and access to credit facilities, motorbikes, bicycles and electricity. Education status, household size, engagement in civil societies and age structure maintained and enhanced livelihood outcomes.

Activities: The livelihoods of small scale farmers in the study villages entirely rely upon agricultural activities. Irrigation activities and rain-fed agriculture are both found in the study villages. Sugarcane and rice are the main crops which the households are mostly engaged at large. Pastoral and environmental activities are not well developed by households in the study villages. 95% and 64% of the households in the total sample are engaged in rice and sugarcane production effectively. Non-farm activity includes rural trade, rental, employment and others is the second largest activity which households engaged on.

Outcomes: On-farm income contributed 77% in the total household income followed by non-farm income of 18%. Sugarcane and rice income are the dominant cash earnings in the study villages. Off-farm and remittances incomes have lower shares of the total household income. Agricultural activities has employed larger number of people in this part of Kilombero District, this is also true in the whole country. Mkula village has more annual average income (4,033,459 TZS) than Msolwa A village (2,332,169 TZS). This can be because of irrigation activities practiced at Mkula village. Msolwa A village is more intense in sugarcane production while Mkula village is much more specialized in rice production.

We have also found that wealthier families have more income capacity as a result of owning larger capitals compared to lower income groups. Higher income group has an average annual income of 5,851,737 TZS while middle and lower income groups have an average income of 2,485,413 TZS and 498,165 TZS respectively.

Irrigation schemes yields more than rain-fed agriculture for type of crops which entirely rely on water like rice and similar crops. Improved irrigation yields more compared to other types of agriculture. Improved irrigation households have an average annual income of 4,531,997 TZS. Traditional irrigation and rain-fed agriculture carve 3,379,307 TZS and 2,056,278 TZS respectively. The differences can be explained by water availability and access among types of agriculture. The more water access the better yields, improved irrigation have better water controlling mechanisms compared to traditional irrigation. Rain-fed agriculture depends only on rainfall.

Vulnerability contexts: People have diversified their capitals in order to cope with and recover from shocks, risks and trends. We observed that households are cultivating multiple crops to cope with risks underlying on single crops cultivation. People divided owned land into various activities and cultivate resilient crops to secure the outcomes if something should happen. We have also observed that some people have started rural trade to cope with expected shocks in agricultural activities. Others went into wage labor or rent the property to recover from the stresses. Segments of the population who were unable to cope or adapt to the situation became most vulnerable and fled the area. Over the time people in the study have become resilient to weather variations which impact the outcomes by having the temporary adjustments (coping). The coping strategies involved renting or selling of properties, helped by relatives or government and similar means. People adopted for unsettled weather variation by engaging in irrigation activities, others established successful rural trade and others cultivated types of crops resilient to the disturbing forces.

Water use and its implication in livelihoods: We also investigated water income dependence and water access to different households. 44% of the total household income depends on irrigation activities in the total sample. In this community water income dependence is high especially for rice irrigators and lower income group families. Rice production is the only crop which is grown in irrigation schemes. Sugarcane production requires less water compare to rice production and it solely depends on rainfall.

We compared yields variations per hectare in different groups in order to understand water access to different households. Improved irrigation households have more yields per hectare (6 tons) compared to traditional irrigation households (2.7 tons) and rain-fed agriculture households (1.1 tons). Improved irrigation has better water controlling mechanism compare to traditional irrigation because improved irrigation has better irrigation infrastructure. This indicates that water availability and access determine the yield levels when holding other things constant.

Institutional water resource management: Institutional water resource management in irrigation schemes has inadequacies in clearly assigning boundaries, water rights, fulfilling duties and responsibility, monitoring and sanctioning systems. However in the village levels smallholder farmers reported to have freely and fair decision making processes and absence of external interference on village affairs regarding water arrangements. Since the establishment of RBWO in 1993 and becoming officially responsible for issuing water rights, less has been

done. The foremost objective of water rights is to facilitate better control and regulation of water in the river intakes. RBWO has the responsibility of sanctioning new water withdraws, to prevent over-abstraction and to stop unauthorized abstraction in both ground and surface water. Failures in institutional water resources arrangements in all levels together with poor irrigation infrastructure caused ineffective in controlling and regulating water in the catchment points and in the distribution systems. This causes wastage of water which could be saved. Smallholder farmers are lacking incentives in controlling water because they lack proper education in water resource management and proper farming practices. Scheme leaders were lacking formal education in water management.

Irrigation projects: Agricultural activity is a heart of livelihood strategies in rural areas including the households in the study area. Necessary adjustments in agricultural sector (improvements in agricultural policies, institutions and similar means) should be developed to improve rural livelihoods following large population in the country is employed in this sector. Irrigation activities yields sustainable livelihoods as we have seen in the study villages, so it is time now to promote irrigation projects in accessible areas. For rural people where economic activities are limited compared to urban areas, irrigation schemes are significant and necessary concern for increasing food security together with poverty alleviation. It is possible to improve yields if farmers will change positively how to produce, what to produce and when to produce.

9.3. Recommendations

Since agriculture is the exclusive driving economic force in the study villages significantly, local irrigation efficiency should to be improved. To accomplish that, this study recommends that the governments, donor agencies, stakeholders, farmers and others need to develop short and long term plans. Short term plans can deal with current challenges in irrigation schemes which include water resource managerial problems, leveling problems, poor intakes and tertiary canals and similar problems in improved irrigation schemes. In traditional irrigation scheme necessary measures have to be taken to rehabilitate the schemes to improved levels because irrigation activities yield sustainable livelihoods. This can increase the irrigated yields with better water productivity and efficiency.

Long term plans can introduce new irrigation projects within the Kilombero area including the study village area. Kilombero area is well endowed with arable land, favorable weather

conditions and multiple rivers flows across the area (Malocho 1997; Ngasongwa 2007; Paavola 2008; Region Commissioner's Office Morogoro 2008).

In water resource management we also recommend that necessary approaches have to be developed to ensure availability and access to proper education on managerial tasks in this valuable and scarce resource (water) in all levels. The existing legal and regulatory framework guiding irrigation development need to be active on enforcing rules patterning this scarce and finite resource (water) which is shared among various economic and social sectors. We have observed inadequacy in managerial tasks and skills regarding water in all levels. I have observed that inadequacy in institutional water resource management has multiple causes which include policies and politics and not necessarily caused by weather variations. It is possible to use water resources differently because we know the limit of the resources that we have by inventing new ideas.

One has to work together with small scale farmers on how to manage water resources, how to develop good farming practices and improve market infrastructure need in order to benefit the farmers.

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APPENDICES

Appendix 1: Questionnaire for the household survey

Introduction

I am a student at University of Life Sciences in Norway, and I am studying International Relations. I am conducting a research for my MSc degree at the University. The research is about how local irrigation agriculture is influenced by management and governance mechanisms of water resource in rural communities in Tanzania. Also the research will study about the situation of farmers' livelihood in the area in regards to irrigated agriculture. The study setting will be at selected villages in Kilombero district in Morogoro region. It is my wish that you will voluntarily spending your valuable time with me, answering my questions. The information will only be used for the academic study at the mentioned university. The information given will be strictly anonymous and confidential for the purposes intended. I will not use your name in my report. Please feel free to assist me by filling up the following questions.

Household Survey

Section 1: General Information		
Date:		
Interviewer's name:	**Interview period: from**	**to**
Respondent name		
Age:	**sex:**	**Place of birth:**
Present address:	**Duration stayed:**	
Total household no:		
Status in the house:	**Occupation**	
Tribe/Ethnicity/Clan		

Section 2: Life History

1. What is your family's background?
   ……..
   ……..
2. Where did you come from?
   a. Born here
   b. Come from somewhere
3. Any major changes life situation in this area lately?
   ……..
   ……..
4. How was your economic activities changed over the time?
   ……..
   ……..
5. What have become more difficult for your wellbeing?
   ……..
   ……..

6. What have become easier in your wellbeing?
   ……..
   ……..
7. Have you ever emigrated from the village?
   a. No
   b. Yes
      If yes, why? (Answer 7 and 8).....
8. What was your overall experience out?
   ……..
   ……..
9. Why did you return?
   ……..
   ……..
10. Are you member of any organization or institution in your village?
    a. No
    b. Yes
11. How do you describe your status in your village?
    a. Membership in Village Council
    b. Elder of the clan
    c. Trustee position
    d. Villager

Household income and expenditure (Use figures from last year)

No	Name	Age	Sex	Marital Status	Yr of Schooling	Work (Last year's work & income in TZS)						Farm Size
						On Farm		Off Farm		Non Farm		
						Crop	$	Crop	$	Act	$	
1												
2												
3												
4												
5												
6												
7												

Part B. Other household income and expenditures questions:

a. Dou you receive some money from any family members/ friends away from home?
   1. No
   2. Yes If yes, how much in TZS? ……. (Last year)

b. Do you lend out money?
   1. No
   2. Yes, if yes how much in TZS? …… (Last year)

c. Do you have any existing loans?
   1. No
   2. Yes, if yes how much interests do you pay in TZS? …… (Last year)

d. Did you hire any labor last year?
   1. No
   2. Yes

Form of labor	Number of people	Purpose of hire	Duration days/ hours	Cost per hour/day	Other expenses
Permanent					
Part time					
Others					

Section 4: Land Access and Tenure

	Total land owning of the household (ha)?.....	How land is acquired?	Inherit (ha)	Bought (ha)	Others (ha)
	If you don't have ownership or access, describe why?.....				
	How much land is hired (ha)?	If hired, rent paid in TZS (last year)			
	How much land is rented (ha)?	If rented, rent received in TZS (last year)			
	Access to the area and Land (ha)?	How this access right is acquired?			
	Access to common grazing land (ha)?	How this access right is acquired?			
	What is the distance from your	Plot (a).....			

	farm to the main or secondary canal ……..	Plot (b)……. Plot (c) ……

For farmers: Land use, crop production and income.

Land use and production

Plant	Crop Grown	Area grown (ha)	Qty Sold	Qty Consumed	Qty for Fodder	Market price/ Kg	Seed cost	Pesticides		Fertilizer		Crop loss			Other costs (specify)	Water uses		
								Qty	Cost /Kg	Qty	Cost/ Kg	Qty	Value	Reasons		Source	Qty/ Access Duration	Shortage
1																		
2																		
3																		
4																		
5																		
6																		

Section 5: Water Uses

1. List source of water that is/was used for production and consumption

Water Access Points								
No	Source	Right	Describe how right acquired?	Duties	Distance	Means of Extraction	Means of Access	Fees
1								
2								
3								
4								
5								

2. Details of domestic water uses (Previous year)

Domestic Water Use						
Source Liter per Liter	Dry Season		Wet Season		Collected by	Shortage
	Source	(%) of Water	Source	(%) of Water		
Drinking						
Cooking						
Washing Utensils						
Washing cloths						
Person Hygiene						
Others						

Section 6: Water Access and Irrigation Water

1. Please describe your opinions on the following statements in relation to water availability in your area

Statements	**Strongly agree**	**Agree**	**In different**	**Disagree**	**Strongly disagree**	**Don't know**
Present physical boundaries for drawing water are fair						
Competition among various water users over access is increasing						
Current rights structure for drawing water in fair						
Other people have more water rights						
People usually draw more water than they are allowed						
Present arrangements does not give you sufficient water that you need						
Others should not have rights to draw water from irrigation						

canals						
I get amount of water that I need on my plot						
Despite of formal water right arrangement, tradition system functions						
Rich people in the village have more access to water than poor.						
Current water drawing fee is low						
I get fair say in decision making process of local water access arrangement						
Monitoring of water access and distribution is very strong						
Those who stealing water are often found and punished by authorities						
Conflicts over water resources is very common						
Conflicts are resolved very quickly						
Conflict resolutions are usually managed and done fairly						
Water management system is very strong and satisfactory.						
Central authority often interferes in local water management concerns						
Local authorities have greater decision making power over local water resources						

2. How do you describe amount of irrigation water flowing to your plot/farm
   a. Too much b. Fair c. Not Enough d. I don't Know
3. What is the distance from your farm to water source (main/secondary canal)?
   a. Less than 5 meters
   b. Above 5 meters less than 10 meters
   c. Above 10 meters less than 15 meters
   d. Above 15 meters
4. How do you describe rainfall distribution for the past four years
   a. Too much b. Fair enough c. Too Little d. Not at all

Section 7: Assets, Livestock and Other Source of Income to the Household

1. Amount of livestock owned, sold, lost or consumed (Previous year)

Livestock	Beginning Stock	Stock Lost	Stock Consumed	Stock Sold	Stock Purchased	Market Price	Expenses (Specify in TZS)	Closing Stock
Cattle								
Goat								
Sheep								
Poultry								
Others								

2. Others sources of income to the household (Previous year)

Product	Total Qty Collected	Total Qty Consumed	Qty Sold	Market Price
Fuel Wood				
Other Forest Products				
Livestock fodder				
Medicine Plants				
Fishing				
Water				
Grants				
Others (Specify)				

Section 8: Household Capital

1. Please feel free to provide details of assets that you posses

Assets	Year of purchase	Purchase price	Current value (Apprx)
Land			
House			
Agriculture tools (Specify)			
Car / Motorbike			
Electricity generator			
Water pump			
House furniture			
TV/Video			
Music system/ Radio			
Freezer/Refrigerator			
Reserve water tank			
Bicycle			
Others (Specify)			

2. Does the household have access to the following infrastructure facilities?

Facilities	Since (year)	Availability 1 No 2 Yes	Access 1 No 2 Yes	If not, explain how it affects life situation
Electricity				
Gas				
Telephone/Mobile				
Road to the village				
Road to the farm				
Clean water				
School				
Health centers				
Recreation centers				
Others (Specify)				

3. Do you have access to credit facilities?
   a. No
   b. Yes

   If No, please explain why ……..

   If Yes, list the provider

Credit Amount	Available from	Available for what purposes

4. Please provide the list the current or last year's household loans either borrowed or given

Loan Amount	Rate/Condition	Year	1 Taken 2 Given	Loan from	Purpose of the loan	Routine assistance from your social network		
						Strong	Average	Weak

Section 9: Social Networks

1. Which of following includes in your social networks?
   a. Family
   b. Friends
   c. Church/Mosque
   d. NGOs
   e. Local Officials

Please state effectiveness of the following statements in regards to your daily life situation					
Situation	Very strong	Strong	Average	Weak	Very weak
How strong is your Network (s)					
Role played by your network (s)					

Income and satisfaction

Please state effectiveness of the following statements in regards to your income and daily life situation					
Situation	Very satisfied	Satisfied	Weak	Very weak	Don't know
How satisfied are you with current level of your household income?					
Is income enough to support your basic needs					

1. Which source of your household income do you consider to be most important and reliable? Why is it so ……
   ……
   ……
2. Which source of your household income do you consider to less reliable? Why is it so
   ……..
   ……
   ……
3. What are other sources which can help to rise up you income? List down
   ……..
   ……
   ……
4. What are the most challenging aspects in your production or income generation? Rank 1-5, 1 being most serious

Rank	Challenges
1	
2	
3	
4	
5	

5. Can you propose suggestion for the above challenges you have identified?

No	Suggestions
1	
2	
3	
4	
5	

6. Mark factor(s) you consider can increase your income level or production

Factors	Mark
Land ownership	
Access to more land	
Capital access	
Labor access	
Technology access	
Access to agriculture inputs	
Increase in water availability	
Others (specify if any)	

Section 10: External Factors

1. Assessment of various external conditions in relation to income and production

Effects	Strong agree	Agree	Neutral	Disagree	Strong disagree	Don't know
Environmental changes pose threats to your production and income						
Population increase has created competition in production and resources						
Newly introduced technology has help to increase production						
Market conditions have improved sales						
Market conditions have improved income						
Globalization affects your production and income						
National and local politics influences your production and income						
Others (Specify)						

2. How best can you agree with the following statements

Situation	Strong	Average	Weak	Very weak	Don't know
2. How well have you prepared to cope with the above external effects					
3. Those external effects do not pose any threat to my production and income					

Appendix 2: Focus Group Discussion

Participants information				
Date: **Moderator:**				
Location:		Discussion period:		
Names:	Address:	Occupation/group:	Age:	Sex.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Agenda			
No	**Particular**	**Responsible people**	**Duration**
1	Introduction; covers objectives of the gathering, main topics and guidelines	Moderators	5-10 minutes
2	Self introduction	All members	5- 10 minutes
3	Begin discussion (topic in order)	Moderators and members	45 Minutes
4	Any contribution related to topic	All members	5-10 minutes
5	Conclusion and setup of the upcoming meeting if any	Moderators	5-10 minutes

Please feel welcome to this important focus group discussion. We really appreciate your participation on this important gathering. We have gathered here to discuss and sharing views about understanding and improving water resource management in your village/area. I assure you that your answers will be totally confidential and your names will not be used in any report.

Main and sub topics which will be included in our discussion are as follow:

1. Extensive overview of water management
   a. How do you describe the current water management systems compare to the past ones?
   b. What are the major problems of water management facing you today?
   c. How water related problems have been solved over the time?
   d. What is your perception about irrigation water uses compare to other uses?

2. Rights
   a. How water rights are distributed among various uses today?
   b. How do you describe the evolution of water rights?
   c. How do formal and informal rights function along?
   d. Who have been denied water rights and why?
   e. Is there any group or individuals who have more water rights than the other? Why is it so?
   f. What is the level of satisfaction to various water users in relation to water rights allocation?

3. Responsibilities
   a. How do the following committed to fulfill their responsibilities? (Farmers, village authority, basin authority, governments and others)
   b. How do you describe the efficiency and effectiveness of building and maintenance of the infrastructures?
   c. How do you describe water fees compare to the service rendered?

4. Authority
   a. What is the situation of water decision making to local people?
   b. Do you make your own decisions regarding water resource management?
   c. Who often interfere your decision? Why?
   d. Can external authority overrule decisions that are made locally?

5. Investments
   a. What are the major investments which depend on water resources in your village?
   b. How best could they be serviced so to increase more production?
   c. What level of competition on investments you have today?
   d. What is the level of economic development you have today compared to the past?
   e. Do you have newly introduced technology in your production means today?

6. Livelihoods
   a. Is livelihoods situations improved over the time?
   b. Which aspects support a large share in your income?
   c. What is the level of contribution of irrigation agriculture to your livelihood?
   d. How do people manage livelihoods during draughts/ floods seasons?

7. Suggested solution to the common problems encountering the following;
    a. Water access
    b. Water rights
    c. Participation and decision making
    d. Monitoring
    e. Conflicts
    f. Livelihood
    g. Irrigation water
    h. Water resource management

Appendix 3: Stakeholders Analysis

Stakeholder's perpectives		
General Information		
Date:	**Interviewer's name**	
Organization's/Group's Name:	**Interview period: from**	**to**
Interviewee's Name:	Designation:	
Age:	**sex:**	**Place of birth:**
Present address:	**Occupation:**	

1. Brief history of the organization/group
2. What are the main activities, mission and vision of the group?
3. What motivated the organization/group to get involved in these activities?
4. How to join membership in the group?
5. What type activities are performed by members?
6. What is the strength of the group?
7. What are the perceptions of village's people towards the group?
8. What are the perceptions of outsiders towards the group?

Water related issues

1. Please describe the following water related issues in your area today compare to the past.
   a. Water access
   b. Water rights
   c. Duties and responsibilities
   d. Participation and decision making
   e. Monitoring
   f. Sanctions
   g. Conflicts

2. How do you describe current water resource management systems compare to the past ones?
3. How transparency and legitimate the present water institutions are?

Livelihoods

1. How much in (%) of peoples' income depends on irrigation water?
2. How people cope with water shortage (Drought) and water excess (Floods) in the area?
3. What are the major constraints for a successful water management policy in relation to peoples' livelihood?
4. Does irrigation agriculture provide enough yields compare to the effort employed?
5. How does local society cope with immigrants in the area?

Appendix 4: Key Informant Interview

Personal Information

Section 1: General Information			
Date:		**Interviewer's name**	
Respondent name		**Interview period: from**	**to**
Age:	**sex:**	**Place of birth:**	
Present address:		**Occupation:**	

1. Access (Over last 10 years)
   a. What is the history of water management in your area?
   b. How were the water distributional arrangements you have in your area?
   c. Do you get enough water according to your needs?
   d. What are the main water uses in your area?
   e. Which are main activities which uses much water today?
   f. How water distribution is controlled among competing users?
   g. Who is the responsible for defining water boundaries and limits?
   h. Do you satisfy with the current water distribution systems?
   i. What are the outcomes and dependence?

2. Rights
   a. What types of water rights are available to various users in your area?
   b. Who defines and decides those rights?
   c. How do you get access to water rights?
   d. Does water rights distributed to various water users fairly?
   e. Is there any particular group or individuals who have special privileges to water rights compared to others? Why?
   f. Is there any particular group or individuals who are excluded from water rights? Why
   g. Do the formal water rights work better than the traditional ones?
   h. Are you satisfied with the current water rights systems?

3. Duties and Responsibilities
   a. What are the main requirements/duties which are obliged to various water uses in the village?
   b. How those duties are assigned to various water users?
   c. Who is in-charge for assigning those duties?
   d. What are the general responses from water users to their responsibilities?
   e. Who is responsible for building and maintaining water infrastructures such as canals water pumps and others?
   f. How effective and efficient is current water fee collection and managements?

g. Do you feel there is a reasonable balance between what individuals contribute and what the take out?
h. How do you compare water management responsibilities between present and old ways?

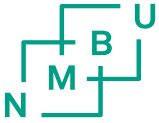
4. Participation and Decision Making
   a. Do you feel represented to the management of water resources in your area?
   b. What is you participation in the entire system of decision making regarding water resource management?
   c. Compare to past, do you feel losing power on the decision making on water resource managements?
   d. What are the major changes in participation process over the time? That causes these changes?
   e. Do village responsible leaders have enough power to negotiate your best desires with other responsible authority in your area?
   f. Who has the ultimate power on decision making in the area?
   g. Is there anyone who is excluded from participation of water resource management?

5. Monitoring
   a. Who is responsible for monitoring water resources in the village?
   b. How can you describe the effectiveness and efficiency of monitoring water resources in your village?
   c. How transparent is the current monitoring process?
   d. Do you satisfy with the current water resources monitoring?

6. Sanctions (Legitimate system)
   a. Do you have strong rules against violation or breaching of agreements/laws?
   b. Who is responsible for imposing sanctions?
   c. How do people sanctioned after violating certain agreements or arrangements today and in the past?
   d. How efficient and effective is the system?
   e. Describe how legitimate and transparent the sanction process is?
   f. How often over last five years sanction were imposed?

7. Conflicts
   a. Do water resource conflicts exist in your area?
   b. How often conflicts do occurs?
   c. Who is responsible for administering conflict resolutions?
   d. How conflicts are managed now compare to the past?
   e. Which of the following water resource aspects emerge more conflicts? (Access, distribution, water rights, maintenance, fees, decision making and others)
   f. Is it expensive to solve one case of water conflicts?
   g. How long approximately a case can take place up to arrive into solution?

8. Livelihoods and irrigation water
    a. How water access affects local irrigation agriculture?
    b. How people's livelihoods depend on irrigation agriculture?
    c. Have you experienced water shortage in your irrigation agriculture? How do you cope with the situation?
    d. Do the responsible authorities adjust water policies according to your needs?
    e. What are the major constraints for successful water management policies into your livelihoods?
    f. Do people engage in other activities escaping irrigation agriculture? Why?
    g. Does irrigation agriculture provide enough yields compare to the effort employed?



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