

**EFFECTS OF HUMAN SETTLEMENT AND ACTIVITIES ON WATER
RESOURCES IN MOROGORO REGION**

A CASE OF MLALI WARD IN MVOMERO DISTRICT

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RESOURCES IN MOROGORO REGION**

A CASE OF MLALI WARD IN MVOMERO DISTRICT

**BY
MOHAMED SEMDOE**

**A Dissertation Submitted in Partial Fulfillment of the Requirement for the degree of
Master of Science in Environmental Management (MSc EM) of the Mzumbe
University**

2015

CERTIFICATION

We, the undersigned, certify that we have read and hereby recommend for acceptance by the Mzumbe University a dissertation entitled **“Effects of Human Settlement and Activities on Water Resources in Morogoro region.**

Major Supervisor

Internal Examiner

Accepted for the Board of Institute of Development Studies (IDS)

.....

DEAN/DIRECTOR, FACULTY/DIRECTORATE/SCHOOL/BOARD

DECLARATION

I, Mohamed Semdoe, declare that this thesis is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

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DEDICATION

I dedicate this dissertation to my wife, Mrs. Zena Mvungi; children, Halima Semdoe, Zakaria Semdoe, and Badra Semdoe; parents, Mr. Bakari Semdoe, and Halima Mwakolo; brothers, Mr. William Msafiri, and his family; relatives; and friends.

ABBREVIATIONS AND ACRONYMS

CAC	Command-and-Control
DPs	Distribution Points
EU	European Union
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GWP	Global Water Partnership
HBS	Household Baseline Survey
IWRM	Integrated Water Resources Management
KI	Key Informant
MOROWASA	Morogoro Urban Water and Sanitation Authority
N	Nitrogen
NAWAPO	National Water Policy
NGOs	Non-Governmental Organizations
NWSDP	National Water Sector Development Programme
P	Phosphorus
PRA	Participatory Rural Appraisal
RWH	Rain Water Harvesting
SPSS	Statistical Package Social Science
UN	United Nations
UNEP	United Nation Environmental Program
UNFPA	United Nation Population Fund
UNICEF	United Nation Children Fund
URT	United Republic of Tanzania
USGS	United States Geological Survey
WHO	World Health Organization
WUA	Water User Association
WWF	World Wide Fund

LIST OF SYMBOLS

⁰ Degree

et al and other

ibid As above

Km³ Kilometer cubic

% Percentage

ABSTRACT

This study aimed at assessing the magnitude of the effects of human settlement and activities on water resources in line with the roles of IWRM Approach on ensuring equitable, economically sound, and environmentally sustainable management of water resources and provision of water services. The study objectives were specifically to assess the effects of human settlement and activities on water supply, water distribution, and water quality; the capacity of local institutions on water resources management, the effectiveness of fees system on water resources management, and the stakeholder's involvement on planning water resources management.

Both quantitative and qualitative data were collected and analyzed with the aid of Statistical Package for Social Sciences (SPSS). The study was conducted using cross-sectional design where a total of 88 representative households were selected and interviewed. The study also involved two Focus Group Discussions to gather information necessary for in-depth analysis.

The findings show that, the study area is dominated by agricultural activities as the main source of income. Human activities effects include; the problems in water supply, distribution, and quality which leads to slowing down of domestic and commercial activities; risk in drinking untreated water from open wells or surface waters; workload of women in the households becomes very heavy; too much time is wasted in search of water; of which only 40.9% of the respondents travel a short distance to access water services, also 31.8% of the respondents spent about 60 minutes in finding and fetching water for their families. Some water borne-diseases outbreak like diarrhea and cholera have been experienced in the study area.

IWRM approach is not well rooted at village level, although few aspects of approach have been well implemented in the study area. Additionally, the study finds that; the National Water Policy (2002) is not much publicized to the local community; therefore, the local leaders in the study area especially at village and ward levels are not aware about the policy.

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CHAPTER ONE

INTRODUCTION

1.0: Introduction

This chapter provides background information for the study and conceptualizes the research problem. It also defines the research objectives, research questions, scope of the study and significance of the study.

1.1 Background Information

The world's population is currently above 7 billion people and it's expected to grow rapidly to reach 9 billion people by the year 2050 (UNFPA, 2011). Despite the fact that the total water quantity (water balance) in the world is not increasing, available water resources have to serve these increasing population. This means that natural resources including water sources are in continuous stress due to increased water demand for domestic, industrial, and agricultural purposes. Further challenges for water valuable are the high level of pollution of water sources, high costs of purifications as well as the protection, conservation, and maintenance of fresh water resources and their regeneration service. World Water (2006) argued that the use of water varies greatly from country to country, region to region and different economic sectors. Total annual water use for developing countries by region is estimated as follows; Africa 213 km³, Asia 2,189 km³, Central and South America 265 km³, and Oceania 0.17km³, giving a total of 2,668km³. This is out of a global total withdrawal of about 3,325km³.

On a world basis, agriculture accounts for about 70% of all annual water withdrawals; industry about 20% and domestic use about 10% (Cosgrove & Rijsberma, 2000). Based on variation on world development thus there are large regional difference (UN, 2005).

Most of the water diverted for human use in Africa is used for irrigated agriculture (WWF, 2002). Overall, the agricultural and mining sectors employ the largest number of Africans. Around two-thirds of Southern Africa's population is dependent on agriculture for employment.

Over 81% of annual water withdrawals in the Asia-Pacific region in the recent past (1998-2002) have been used for agriculture (Alexander & West, 2011). Although the percentage of water withdrawal for agriculture may be high, the actual volume used varies widely between countries. In the EU as a whole, energy production accounts for 44% of total water abstraction, primary serving as cooling water (EEA, 2009). Twenty-four per cent of abstracted water is used in agriculture, 21% for public water supply, and 11% for industrial purposes.

In Tanzania, it is estimated that only 58.7% of the rural population and 84% of the urban population have access to a reliable water supply (URT, 2010). Major water sources include; rivers, springs, lake, ocean, dam, swamp, wetlands, boreholes, and shallow wells (NAWAPO, 2002). The principal uses of water are; domestic, agriculture and other social economic activities. Water demand for agriculture range between 30 and 45 percent, the rest are for domestic, and other social economic activities (URT, 2008). Report on Water and Sanitation in Tanzania (2002) analyzed long-term trends for drinking water sources for piped water, well water and surface water. Trends over the period 1978 to 2000 do not reveal significant changes in the percentage of households served by piped or well water. However, the population has grown from 17 million in 1978 to around 32 million in 2000 so the absolute number of households served has nearly doubled. Rural-urban disparity throughout the period is very large. Households using piped supplies in urban areas being around 80% compared to rural areas with piped supplies in the 20-25% range for the same period.

It has been estimated that about 3.1 percent of a total area in Morogoro region is covered by different water bodies. Out of six district councils of the Region, only three districts of Kilombero, Ulanga, and Morogoro have significant water bodies. Kilombero District alone has a total area of 1,341 km² and equivalent of 60 percent of the Region's total water body (PMO-RALG, 2007). The main sources found in the region include; dams, springs, shallow wells, rain harvesting, and bore holes serve about 1,753,362 people.

The principal uses of water are domestic and agriculture. The main source of water body that dominates almost in every district is shallow wells. According to water and sanitation in Tanzania (2006) report revealed that 70.2% of households in Morogoro region using

improved water sources for drinking while 70.7% living within 15 minutes of their drinking water source in the dry season and households beneath the basic needs poverty line.

Mlali ward, particularly Kipera and Mlali villages have permanent and temporary rivers, springs, bore holes, shallow wells, and wetlands as major water sources (Reconnaissance survey in Mlali ward, 2014). About 15,000 people in Mlali and Kipera villages are served by existing water sources for domestic and agricultural purposes.

1.1.1. An Overview of the Global Water Problems and Solutions

Water is essential for human life, development, and environment, but it is a finite and vulnerable resource which has quantitative limitations and qualitative vulnerabilities (PAI, 1997). Water is a regional resource, but water shortage is becoming a global issue due to increasing population, economic growth, and climate change. PAI (1999) estimated that, there were 31 countries with a total population of 458 million people which faced water stress in 1995. More seriously over 2.8 billion people in 48 countries will face water stress by 2025.

It is estimated that two out of every three people will live in water-stressed areas by the year 2025 (WWAP, 2009). In Africa alone, it is estimated that countries will be experiencing water stress (below 1,700m³ per capita per year) by 2025. Sub-Saharan Africa accounts for more than third of that number, with about 330 million people without access to safe drinking water (WHO/UNICEF, 2010). The incidence of water-related and water borne diseases such as Cholera, Malaria, Guinea worm, and river blindness is high in Africa, mainly due to limited access to water and sanitation; Schistosomiasis (or bilharzias) is endemic in a total of 46 countries (Boelee & Madsen, 2006).

Some studies (McCartney, 1999; and Cosgrove, 2000) proposed solutions to water related problem include; the construction of dam is a key solution for water problems especially shortage of water. Dams offer development benefits through hydropower, drinking water supplies, flood control, and recreation opportunities. IWMI (2013) emphasized use of participatory approach for the efficient use of water to enhance water productivity and livelihood improvement.

It can be used to address issues such as climate change, natural disasters, pollution hazards, environmental degradation, deteriorating soil health for attaining food and livelihood security, and alleviating poverty.

1.1.2. Water crisis in urban and rural Tanzania

Despite significant investment in the Water Supply services since the early 1970s, water supply coverage is not satisfactory. In rural areas the percentage of households using surface water (dams, lakes, ponds, rivers, and stream) has dropped from just under 30% in 1991 to around 17% in 2000. This is positive as surface water sources are associated with higher health risks than other sources. While in urban areas about 84 percent have access to water supply services (URT, 2010). Poor water infrastructures, catchment degradation, and more pressure on water resources contributing insufficient water supply (URT, 2008). Households Baseline Survey (2001) recorded female headed households whereby 7% more likely to be using piped water than male headed households. Surface water use by female headed households was also 5% lower than that for male headed households. HBS (2001) revealed that school aged children living within 15 minutes of their drinking water source were 12% more likely to be attending school than children living over one hour from their source of drinking water. National Bureau of Statistics (2000) had showed that; in rural areas 51% of households above the poverty line were using unprotected sources compared to 57% of households below the poverty line; a relatively small difference. In contrast, though only 12% of urban households were using unprotected sources, those households were twice as likely to be below the poverty line.

1.1.3 Water related problems in Kipera and Mlali Villages

Kipera and Mlali villages are situated in rural Tanzania; they are experiencing similar water related problems as stated by National Water Policy (2002). Despite the presence of village water committees and the implementation of rural water supply projects in the respective villages, the problems associated with insufficient water supply; insufficient water distribution; and poor sanitation and hygiene still persist (Interview with Village Leaders, 2014).

The quantity and quality of water resources in Kipera and Mlali villages has been decreasing due to the population growth and development of agriculture practices. Expansion of farmland and irrigation for vegetables and paddy cultivation both intercepts and consumes a great amount of water (Interview with Ward and Village Leaders, 2014).

The communities in Mlali ward especially in Mlali and Kipera villages collect water from various sources include; piped water through water gravity scheme; bore holes and; shallow wells (Interview with Ward leaders, 2014). Regarding water infrastructures, Kipera village consist water storage tank of 175,000 litres that serve about 175 households per day; while Mlali village consist water storage tank of 375,000litres that serve about 375 households per day (Interview with Village leaders, 2014). The existing water infrastructures in Mlali and Kipera villages do not support the need of the entire populations since, there are no enough water storage facilities; water pipes are old that could not support proper water distribution. The principal uses of water are domestic and agriculture, but water supply is insufficient often resulting into water use conflicts and low crops productivity (Interview with Ward and Village leaders, 2014).

1.1.4. Water Resources Management System in Tanzania

In Tanzania, the water resources management is governed by the Water Resources Management Act No. 11 of 2009. The Act is meant to ensure that water resources in the country are protected, properly used, developed, conserved, managed, and controlled.

The Act sets the fundamental principles that should be achieved like; meeting the basic needs of the present and future generation; promoting equitable access to water and the principle that water is essential for life and that safe drinking water is a basic human right; promoting the efficient, sustainable and beneficial use of water in the public interest; and facilitating social economic development. The local institutions such as village councils; ward development committees; and districts councils are potential organs to enforce the law in their area so as to attain sustainable water resources management

1.2. Statement of the problem and justification

Efforts to improve water supply in urban and rural areas of Tanzania have been undertaking since, early 1970s (URT, 2010).

However, poor water infrastructures, catchment degradation, and more pressure on water resources contributing insufficient water supply (URT, 2008). The United Nations Comprehensive Freshwater Assessment report, (1999) shows that, humanity now uses, directly or indirectly, more than half of the world's accessible water supply and the demand for water is rising with increasing population, higher living standards, and the extension of water utilizing industries such as mining and metal-processing, cement production, wood processing and irrigation-based agriculture. UN (2008) reported that during the period from 1950 to 2005 the rural population of less developed countries increased from 1.4 billion to 3 billion. The situation has contributed to negative role including; environmental degradation. At present, 47% of the global populations are people living in rural areas.

Regarding the importance of water as a key driver of economic and social development, a number of studies (Saleth & Dinar, 1999; GWP, 2003; World Bank, 2004; Moriarty et al, 2004; Lloyd et al, 2005; UN, 2005; and Mukhtarov, 2007) have been conducted so as to create water solution options. Although, to my knowledge, no studies that focus on effects of human settlement and activities on water resources in line with the roles of IWRM approach have been conducted at the village level of Tanzania.

Therefore, there is a need of conducting more studies so as to assess the magnitude of the effects of human settlements and activities on water resources in line with the roles of Integrated Water Resources Management (IWRM) Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali ward in Mvomero district in Morogoro region, Thus, the research findings will help to develop ideas that will fill the gaps in National Water Policy (2002) and enhance strengthening of sustainable water resources management efforts in respective villages as well as the whole country.

1.3. Objectives of the study

1.3.1. Main objective

To assess the magnitude of the effects of human settlement and activities on water resources in line with the roles of Integrated Water Resources Management Approach on

ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services.

1.3.2 Specific Objectives

1. To assess the effects of human settlement and activities on water supply, water distribution, and water quality.
2. To assess the capacity of local institutions on water resources management;
3. To assess the effectiveness of fees system on water resources management;
4. To assess the stakeholders involvement on planning water resources management.

1.4. Research questions

1. How do human settlement and activities affect water supply, water distribution, and water quality?
2. What is the capacity of local institutions on water resources management?
3. How do fees systems affect water resources management?
4. How are the stakeholders involved on planning of water resources management?

1.5. Scope of the study

The study was conducted in two selected villages of Kipera and Mlali in Mlali ward located in Mvomero District so as to assess the impacts of human settlement and activities on water resources in line with the roles of Integrated Water Resources Management Approach on ensuring sustainable water resources management.

The study area was selected because it is expanding fast in term of population growth such that; in 1988 the population was 13,470; in 2002 was 17,724; and in 2012 was 23, 320 with growth rate of 2.4 annually (Population and Housing Census Report, 1988, 2002 & 2012).

1.6. Significance of the study

It is expected that the findings of this study should be important in various ways as follows: It will enable potential stakeholders to understand the roles of the society towards water resources management; to study individual behaviour and social action towards

water resources management; to evaluate social problems related to water resources, effects of water problems on society, and to find out possible solutions; to explore social reality and explain social life; and develop theories through research findings.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter provides review of literature related to impacts of human settlement and activities on water resources. It presents definitions of key terms, theoretical literature, and conceptual framework of the study.

2.1. Water resources availability

Water is the most widespread substance on earth. It covers more than 70% of the world's surface (Shakhashiri, 2011). It forms oceans, seas, lakes, rivers, and the underground water. According to UNEP (2002) the total amount of water on the Earth is about 1400 million km³. About 97.5% of this amount is saltwater and only 2.5% or about 35 million km³ is fresh-water. The greater portion of fresh-water (around 69%) is in the form of ice and permanent snow cover in the Antarctic, the Arctic and in the mountainous regions. Around 30% exists as fresh groundwater, only about 0.3% of the total amount of fresh-water on the earth is concentrated in lakes, rivers, soil moisture, and relatively shallow groundwater basins where it is most easily accessible for economic needs and extremely vital for water ecosystems.

2.1.1. Global Water Resources Quantity and Distribution by Region

2.1.1.1. Glaciers and ice

Average Arctic sea ice extent for the month of November, 2008 was 10.63 million square kilometers (4.10 million square miles). Ice extent for the month of November, 2008 was 580,000 square kilometers (220,000 square miles) greater than November, 2007 but 680,000 square kilometers (260,000 miles) less than the 1979 to 2000 November average (NSIDC, 2008).

2.1.1.2. Groundwater

Groundwater represents over 90% of the world's readily available freshwater resource (Boswinkel, 2000). About 1.5 billion people depend upon groundwater for their drinking

water supply (WRI, UNEP, and World Bank, 1998). The amount of groundwater withdrawn annually is roughly estimated about 600-700 km³, representing about 20% of global water withdrawals (WMO, 1997).

2.1.1.3. Rivers

Freshwater ecosystems comprise a small but pivotal fraction of the Earth's surface with lakes considered to cover <3% of the continents (Downing et al, 2006) and rivers considered to cover around 10% that of lakes (Cole et al, 2007).

2.1.1.4. Water quality

Water quality is a term used here to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical, or biological characteristics of water; for example limits on the concentrations of toxic substances for drinking water use, or restrictions on temperature and pH ranges for water supporting invertebrate communities (Meybeck et al, 1996).

2.2. Human Settlements

The world today consists of half population lives in urban areas (WWAP, 2009). The projection shows that by the middle of this century all regions will be predominantly urban, with the tipping point anticipated to be reached in Eastern Africa slightly after 2050. This exceptional urban expansion poses an array of critical, water-related challenges, from access to basic services to environmental and human security. Urban expansion directly affects water availability and quality as growing cities have a greater per capita demand for water and tend towards unwieldy institutional setups.

2.3. Human activities

Human activities commonly affect the distribution, quantity, and chemical quality of water resources (Winter et al, 1998). The range in human activities that affect the interaction of ground water and surface water is broad. Agricultural water use accounts for about 75% of total global consumption, mainly through crop irrigation, while industrial use accounts for about 20%, and the remaining 5% is used for domestic purposes (UNEP, 2002).

2.4. Theoretical Framework

2.4.1 Theoretical Literature Review

The theoretical literature review helps to establish what theories already exist; the relationships between them; to what degree the existing theories have been investigated; to develop new hypotheses to be tested; and the unit of analysis can focus on a theoretical concept or a whole theory or framework (Rangarjan, 2013).

This study employs one theory on Integrated Water Resources Management (IWRM) that emerged in 1992.

2.4.2. Introduction to the concept of the Integrated Water Resources Management (IWRM)

As Moriarty, Butterworth, and Van Koppen (2004) define IWRM as integrated and ‘joined-up’ management. It is about promoting equitable access and efficiency for the greatest benefit for the greatest number of people, to achieve more sustainable utilization of water including for a better environment. Due to global water crisis, therefore (Agenda 21, Article 18 and GWP, 2006) emphasized the significant of water management by sectors.

The idea of using IWRM concept for sustainable water resources management has emerged since Dublin and the Rio summits in 1992 within the framework of Sustainable Development (Bellamy, 1999; GWP, 2003; GWP, 2005, Wolsink, 2005; and DIE, 2006). However, this agreement has recently been called into question by some authors who claim that the previous examples of water management in the 20 century are very relevant to the current IWRM discourse.

The Dublin conference (1992) recommended four principles aimed at guiding global water management and development efforts: Those principles are as follows;

Principle 1- “Ecological”: It calls for a holistic approach to WRM, “linking social and economic development with protection of natural systems” (ICWE, 1992). Recognizing the catchment area or river basin as the most appropriate unit for WRM, Principle 1 calls for coordination across the range of human activities that use and affect water in a given river

basin. IWRM approaches incorporate this principle into its emphasis on integration between all concerned water sectors.

Principle 2 “Institutional”: This participatory approach is to raise awareness of water issues among policy-makers and the general public. It emphasizes subsidiary- management decisions should be taken at the lowest appropriate level, with central government retaining regulatory and support roles. It advocates increased accountability of management institutions and full consultation and involvement of users in the planning and implementation of water projects. The capacity of certain disadvantaged groups may need to be enhanced through training and targeted pro-poor development policies for full participation.

Principle 3 “Gender”: The approach emphasizes the important synergy that exists between gender equity and sustainable water management. Worldwide, women play a key role in the collection of water for domestic-and often agricultural-use, but in many societies, women are excluded from water management decisions. IWRM includes an emphasis on empowering women in its focus on participatory management and capacity building.

Principle 4 “Economic”: Known as the “instrument principle,” the approach emphasizes the importance of economic tools in helping achieve efficient and equitable use of water resources. The human right to access clean water and sanitation at affordable prices must be recognized, but the scarcity of water demands that economic perspectives should not be ignored. In conditions where water is especially limiting, where supply augmentation is not a feasible option, economic tools should play a large role in determining how limited water resources should be distributed efficiently and equitably.

Managing water as an economic good is also a key to achieving financial sustainability of water service provision, by making sure that water is priced at levels that ensure full cost recovery; IWRM emphases on economic and financial sustainability.

Tanzania has adopted and use IWRM approach through various initiatives including formation of National Water Sector Development Programme (NWSDP) (2006-2025); National Water Policy (2002); and National Water Law based on revised Water Act no. 42 of 1974 (draft 2007) (UN, 2008).

NWSDP aims at equity of access, water management capacity, proper maintenance of water sanitation systems, use of environmentally sound technologies, and effective water tariffs, billing and revenue collection mechanisms

2.4.2.1. IWRM approaches

Moriarty et al (2004) showed that IWRM focuses on promoting more equitable access to water resources and benefits that are derived from water in order to tackle poverty; ensure that scarce water is used efficiently and for the greatest benefit of the greatest number of people, coordinate the planning of projects and activities that have both a direct and an indirect impact on water resources; and achieve more sustainable utilization of water, including for a better environment.

The goal of sustainability is to be achieved through coordination, equity, and efficiency. According to (GWP, 2003; World Bank, 2004a; Saleth & Dinar, 1999/2004; Moriarty et al, 2004; Lloyd, 2007; and Mukhtarov, 2007) the main operational aspects of IWRM come in the form of integrated planning, governance and economic considerations that are meant to lead to sustainability.

2.4.2.1.1. Integrated Planning (coordination):

AWWA (2001) defines Integrated Water Resource Planning as a holistic approach to the management of water systems combining water supply, water demand, water quality, environmental protection and enhancement, rate structure, financial planning, and public participation.

Metropolitan Water District of Southern California (2004) had shown the positive role of Integrated Water Resource Planning in Central Valley, California whereby, the program enhances the sustainable agriculture practice.

2.4.2.1.2. Governance (equity)

Water governance refers to the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water service, at different levels of society (Global Water Partnership, 2002). Moriarty et al

(2004) elaborated that this entails a transparent, accountable, and ultimately well-functioning institutional framework that is required to regulate the use and abuse of water. In IWRM this can involve the decentralization of power, and formal and informal institutions that take into account the needs of all users, and are able to find some kind of satisfactory balance (an element of social fairness is often included e.g. women's right and local participation). In the world of IWRM, only by having a well-functioning institutional framework based on notions of equity that take into account all users, can water be properly regulated. "equity "amongst all stakeholders is important for good governance because the idea is stakeholders feel like they are both getting a fair deal and are empowered to manage the resources.

Pierre and Peters (2000) argued that governance analytical approach used to describe and assess reality towards water resources management. It reflects a shift in power from national government alone to local level, transnational organizations and civil society, and private actors. The governance eliminates bureaucratic on water resources management, thereafter create an interaction between interdependent collective actors on different levels; local, regional, national, and international (Benz, 2004b, 2007). Saleth and Dinar (1999) revealed that at the local level, water agencies, formal and informal local governance bodies interact with each other and set the framework at which water users orient themselves.

2.4.2.1.3. Economics (efficiency)

Moriarty et al (2004) defined Economics (efficiency) as efficiency for the greatest benefit thus money is the chosen tool used to help regulate demand. For example, in conditions of water scarcity, users have a quota (or right) to use a certain amount of water which they must pay for using more than the agreed quota leads to an increase in charges and possible a fine. While consideration is meant to be given to the poorest members of the community, ultimately the fees charged must be enough to pay for the costs of governance and planning to be economically sustainable. Those above defined elements are meant to lead to sustainability. Olmstead and Stavins (2009) argued that cost-effective water conservation policies would typically require raising water prices in some form or another,

rather than implementing technology standards or rationing policies, the two most common prescriptive, or command-and control (CAC), approaches.

Timmins (2003) compared mandatory low-flow appliance regulation with modest water price increase and found that under all but the least realistic of consumptions, prices were more cost-effective than technology standards in reducing groundwater aquifers lift-height in the long run.

Grafton and Ward (2008) find that mandatory water restrictions in Sydney, Australia, in 2004-2005, resulted in economic losses of \$ 235 million, about \$ 150 per household, or one-half the average household water bill in Sydney in that year. Brennan et al (2007) also demonstrate that outdoor watering restriction generates efficiency losses. Mansur and Olmstead (2007) compared residential outdoor watering restrictions with drought pricing in the short run in 11 urban areas in the United States and Canada, findings shown the significance of price-based policies.

As Brennan, Tapsuwan, and Ingram (2007) revealed that the economic costs of a two-day per week sprinkling restriction in Perth, Australia (relative to a price-based approach), are just under \$100 per household per season, while the costs of a complete outdoor watering ban range from \$347-\$870 per household per season. Although non price conservation programs can reduce water consumption, both economic theory and the emerging empirical estimates suggest that using prices increases or reduce demand, and allowing consumers to adjust their end-uses of water, is more cost-effective than implementing non price demand management programs.

2.4.2.1.4. Sustainability

Moriarty et al (2004) defined sustainability as achieving more sustainable utilization of water. This is typically cited as the end result of the successful application of the other elements.

Smith (2010) applied the concept in the systems view including; long duration, reasonable use rate, moderate solutions, and flexibility. For long duration, he argued that public policies that are intended to be permanent are aimed at the idea of long duration.

Over many years, for example there were methodically intervened in the natural hydrologic system, especially in Western states, to move water from its origin to where they want it to be. As time has progressed, they have discovered that the policy becomes more difficult; adverse impacts have been discovered, and now they are rethinking the whole policy. But, by now there are major population and economic centres in areas that could never sustain them without engineering intervention. For reasonable use rate, he argued that; it would seem obvious that a natural resource like water cannot be used indefinitely at a greater rate than it can be renewed, which usually occurs via natural processes. Yet, they history of water use is replete with examples of water use that have regarded the resources as boundless. Ground water depletion has been, and in some cases continues to be, a major problem. The idea of “water mining” regards water as a resource to be used until exhausted, and ignores renewal entirely. In many cases deep water aquifers of various kinds contain water that takes thousands of years to reach the aquifer, so that the renewal rate is less than the pumping rate by many orders of magnitude. For moderate solutions, he argued that, moderate public policies are those which tend to avoid extreme solutions to problems about water resources. Extreme solutions are those in which inordinate efforts are undertaken, often meaning very large investments in facilities. Liberal application of water, fertilizers, and pesticides to agricultural regions has led to runoff, soil erosion, and nonpoint sources contamination.

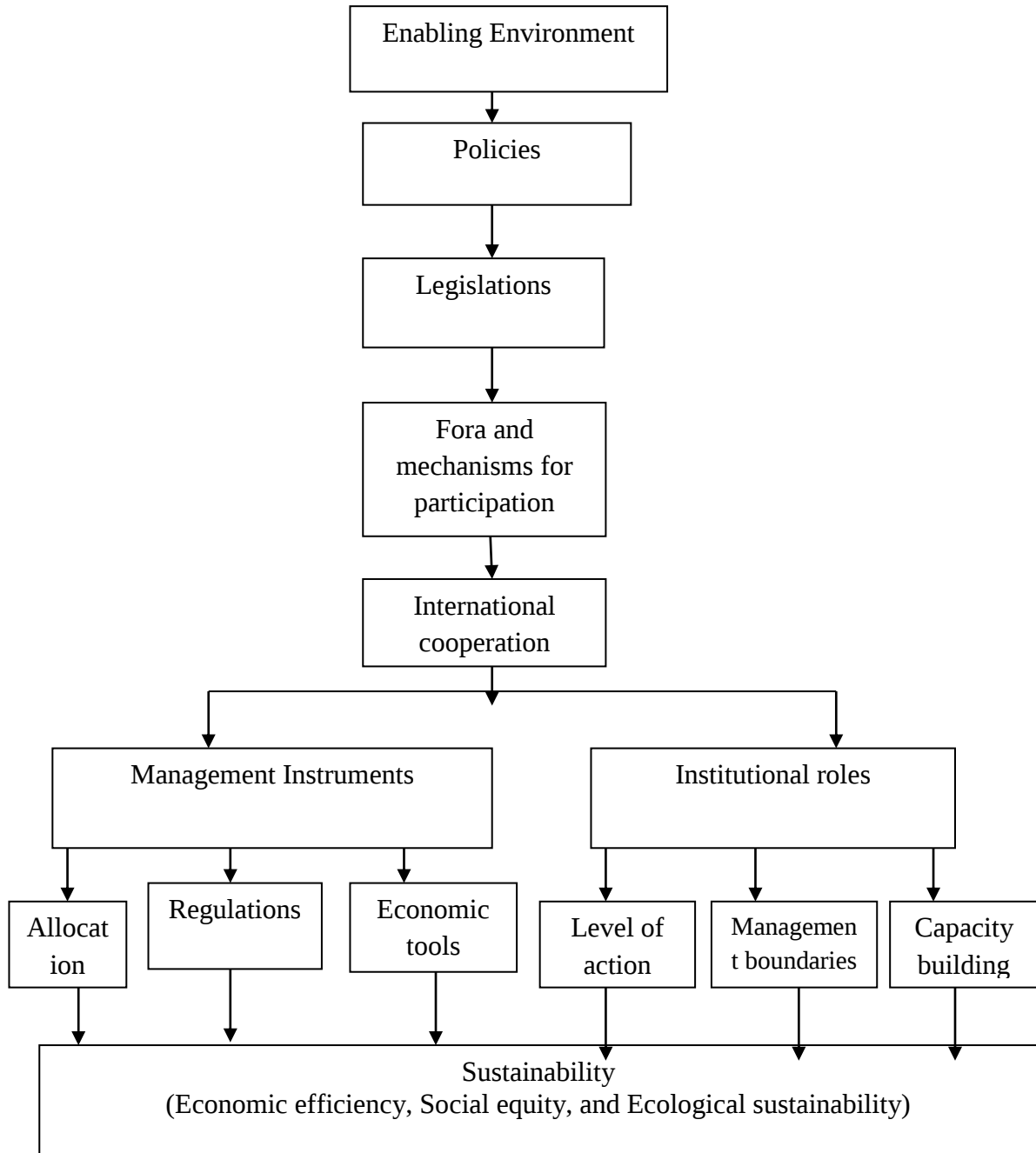
The extreme cases tend to be those of too great a concentration or density of human activity. In this kind of decision making trap, each step seems to be relatively harmless, yet over time accumulated decisions lead to serious problems. For flexibility, he argued that, because public policy decisions are regarded as the solution or end of a problem, little thought is often given to what might be done to address an action that turns out to be a serious mistake. The problem with such cases is commitment to some course of action without regard for unintended consequences. Because it is not possible to know everything when a decision is made, they should anticipate the need for revisiting the problem, and be careful about making commitments that are difficult to modify. Periodic monitoring and determining how to reserve; the policy becomes important.

They should be able to learn lessons from experience but stay on the path of improving sustainability. These notions have seldom been part of public water policy, but would go far to avoid some of the problems they see today.

2.4.3. Theoretical Framework

GWP (2005) clarified that an IWRM approach requires positive changes in the enabling environment, in institutional roles, and in management instruments. Furthermore, moving toward an enabling environment of appropriate policies, legislations, and strategies for sustainable water resources development and management; putting in place the institutional framework which the policies, legislation, and strategies can be implemented; and setting up the management instruments required by these institutions to do their job.

Figure 2.1 Pillars of Integrated Water Resources Management (IWRM) approach
(Source: Global Water Partnership (2005)).



a) Enabling Environment. This category consists of three sub-categories: Policies to set goals for water use, protection and conservation. Policy development is important for setting national objectives for managing water resources and delivering water services. Policies should embody the IWRM concepts of integration, decentralization, participation, and sustainability, taking a holistic view of water's value and considering

potential users of water, land uses, and water quality. Legislative framework to translate water policy into law. This covers ownership of water, permits, and rights to use water, and the legal status of water user groups. Financing/incentives to allocate financial resources to meet water needs. Financing and incentive structures are needed to fund capital-intensive water projects, support water service delivery, and provide other public goods such as flood control and preparedness. They can be resources from the public sector, private finance, and joint public-private partnership (GWP, 2003a).

- b) Institutional Roles. This category consists of two sub-categories: Creating an organizational framework. Tools focus on developing the institutions needed to manage water resources within an IWRM framework, shifting from top-down, centralized management to decentralized and participatory management. Such institutions include river and Lake Basin organizations, regulatory bodies, enforcement agencies, coordinating apex bodies of user associations, and public and private service providers. These organizations need to be given clear rights and responsibilities, and allow integration between them. The accountability of these water management organizations must be ensured, with attention given to gender issues. Building Institutional Capacity: Developing human resources is an integral part of developing effective water institutions at all levels, as regulatory bodies, civil society organizations, service providers, and central and local government officials will all need to be educated in IWRM principles and trained in the skills and tools of effective water management. Capacity-building should focus particularly on strengthening the ability of women and other disenfranchised groups to participate in water management.
- c) Management Instruments. Once the proper enabling environment and institutions are in place, these instruments address specific management problems. This category consists of eight sub-categories:
- Water Resources Assessment to understand resources and needs, involving data collection and analysis in order to inform decision-making with a comprehensive view of water resources and water users.
 - Plans for IWRM to combine development options, to assess impact of resource use and human interaction. They can be national, regional, sectoral and basin plans.

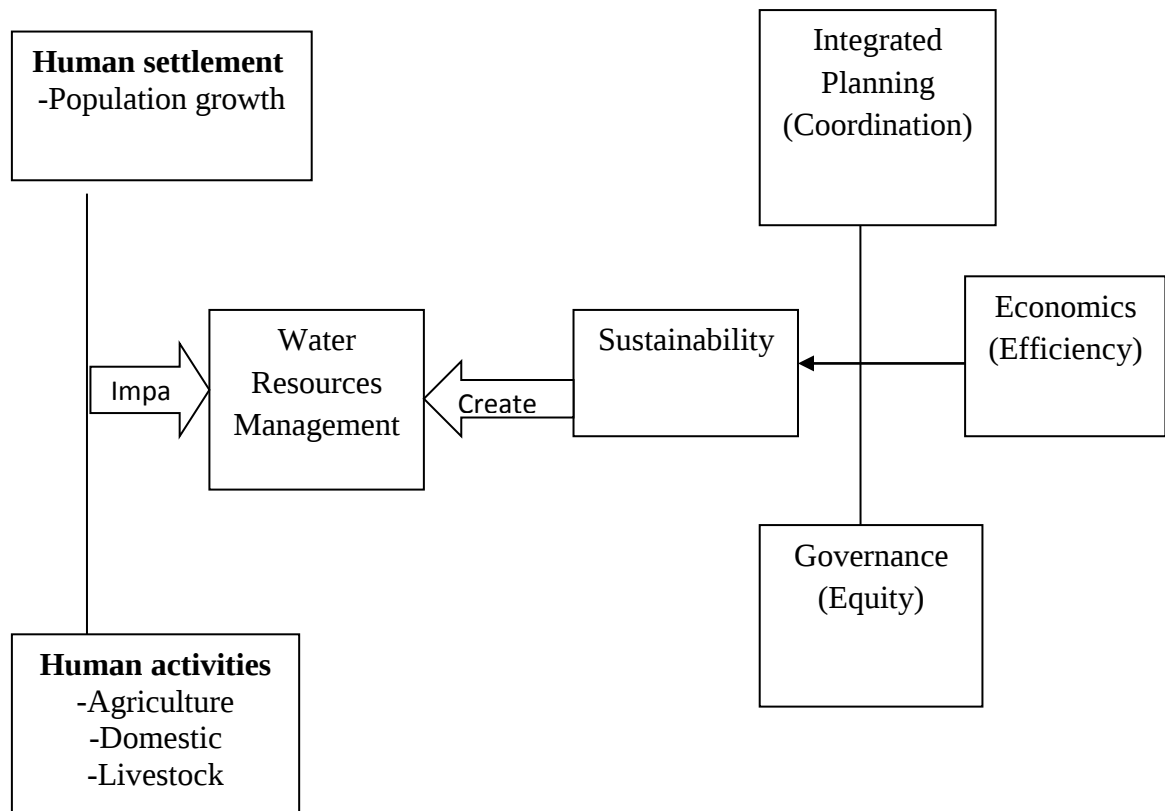
- Efficiency in Water Use to manage demand and supply, to improve supply efficiency, increase water reuse. Subsidies and regulation to encourage technology improvements, price signals, improved metering, and public awareness campaigns to change user behavior are all instruments that can be used to improve efficiencies.
- Social inclusion to promote general public awareness, stakeholder participation, and transparency of institutions, in order to better enable the public to take a participatory role in IWRM.
- Conflict Resolution to manage disputes and ensuring sharing of water benefits
- Regulatory and economic instruments to allocate water, set water use limits use prices for efficiency and equity. Regulatory tools include emission standards, technology standards, and price controls, while economic tools include pollution charges, targeted subsidies, and markets for water use rights or pollution permits.
- Information Management and Exchange to share knowledge for better water management

The above IWRM tools illustrate the multifaceted approach by IWRM in order to put Dublin Principles into practice. Many of the tools are complementary, and successful application of one tool to a given problem may depend on simultaneous application of a number of other tools. For example, successful implementation of emission standards or fees will depend on a fully empowered monitoring and regulatory agency.

2.4.4. Conceptual Framework of the study

Conceptual framework is an abstract representation, connected to the research project's goals that direct the collection and analysis of data (Rangarjan et al, 2013). Thus conceptual framework is the way ideas are organized to achieve a research project's purpose. In this study, conceptual framework represents the relationships between water users (Human settlements and activities; water resources; and implication of IWRM approach towards sustainable water resources management in the respectively study area.

Figure 2.2: Diagrammatical conceptual framework of the study



Source: own construct, 2015

With respect to diagrammatic representation of the concept in the above figure, dependent variable (water resource management) shows relationships with independent variables that made up of aspects like human settlement, human activities, and IWRM approaches. Water resources management as (Dependent variable) is determined by the influence of effective and efficiency use of IWRM approach and the magnitude of human settlements (population growth) and human activities towards water resources as (Independent variables). In addition to that when human settlement expand in- term of population growth then demand for water increasing concurrently cause the decline of water quantity as well as quality. Besides uses of water for human activities include; agriculture and livestock contribute on degradation of water resources as well. For instance irrigation scheme and large herds of cattle consume more water that lead to degradation of water resources if there is no further action/efforts taken towards sustainable water resources management. Moreover, effectively application of principles of IWRM approach include, integrated

planning (coordination); Economics (Efficiency); and Governance (Equity) resulting into sustainability of water resources.

2.4.5. Empirical Literature Review

2.4.5.1: Effects of human settlement on water resources

World Water Assessment Programme (2009) report indicates that, already today, half the world's population lives in urban areas. By the middle of this century all regions will be predominantly urban, with the tipping point anticipated to

be reached in Eastern Africa slightly after 2050. This unprecedented urban expansion poses an array of critical, water-related challenges, from access to basic service to environmental and human security.

Urban expansion directly affects water availability and quality, as growing cities have a greater per capita demand for water and tend towards unwieldy institutional setups. This can often result in pollution and a mounting exposure to water-related disasters and health risks.

As Joint Monitoring Programme (2010) finds that, two main water problems are affecting the sustainability of human settlements in different regions: the lack of access to water and sanitation, and increasing water-

related disasters. These problems have incommensurable consequences on human health and well-being, safety, the environment, economic growth and development.

Though water supply and sanitation coverage increased between 1998 and 2008, the growth of the world's urban populations jeopardizes those results. For example, partly because of rapid increases in the urban population, a growing number of people in urban areas defecate in the open..

2.4.5.2: Effects of human activities on water resources

Shiklomanov (2013) has noted that, human activity inevitably affects the environment. It cause changes in plant cover and natural landscapes, and transforms water system by making different hydraulic structures; the rate of freshwater use is very high.

Great quantities of products from human activity are gradually accumulating in water bodies, in soils and on the earth's surface-this is already an obstacle for socio-economic development in many regions and countries.

2.4.5.2.1: Effects of agricultural development on water resources

Agriculture has been the cause of significant modification of landscape throughout the world (Winter, 1999). Tillage of land changes the infiltration and runoff characteristics of the land surface, which affects recharge to ground water, delivery of water and sediment to surface-water bodies, and evapotranspiration. All of these processes either directly or indirectly affect the interaction of ground water and surface water.

2.4.5.2.2: Effects of livestock on water resources

Strauch, Kapust, and Jost (2009) urged that, higher livestock densities may be beneficial in actively herded systems but without proper management, overgrazing may result in the deterioration of stream banks and surface water quality. Livestock tend to heavily graze vegetation near water sources and the subsequent disruption of the soil surface and reduced plant cover increase surface runoff and soil erosion.

Additional, livestock tend to deposit a greater amount of waste close to water sources than they create in other areas of the range.

From the studies I have done, to the best of my knowledge, I did not come across a study that dealt on the effects of human settlement and activities on water resources in Morogoro region particularly at Mlali ward in Mvomero district, This study therefore is intended to fill the gap by assessing the magnitude of effects of human settlement and activities on water resources; the capacity of local institutions on water resources management; the effectiveness of fees system on water resources management; and the stakeholders integration on water resources management using Kipera and Mlali villages as a case study.

CHAPTER THREE

RESEARCH METHODOLOGY

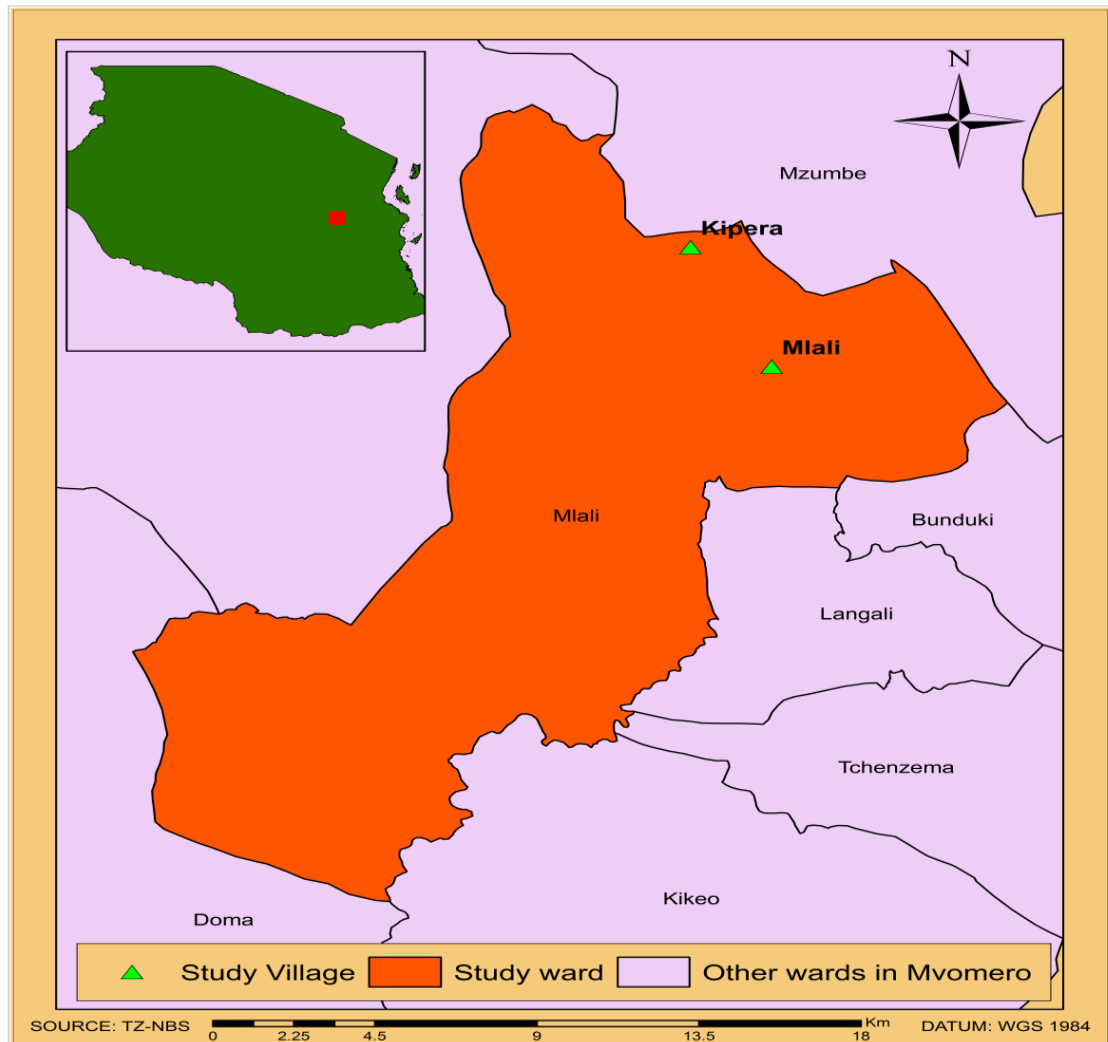
3.0. Research Methodology

This chapter presents the methodology of the study. It specifically presents description of the study area, research design, sample size, and sampling techniques, methods of data collection and data analysis.

3.1. Description of the Study Area

The study was carried out in Kipera and Mlali villages in Mlali ward which is among the seven wards of Mvomero district in Morogoro region. It is found on the southern part of Mvomero district bordering Morogoro Urban to the south and Morogoro rural to the East. Kilosa district borders the study area to the west. The ward is 30 km to the west of Morogoro Municipality. Mlali ward is on lowlands adjacent to the Uluguru Mountain. The climate in the area is semi-arid with annual rainfall ranging from 500-800mm. biophysically; lowland and river valleys are the predominately agro-ecological zone of the ward (URT, 1997). The elevation is between 520 and 760 meters above sea level. The Mlali ward lies in Latitude. -6.9667°, Longitude. 37.5500°.

Figure 3.1: Map of the study area



3.2. Research Design

Kothari (2004) defined research design as the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. It translates the study from the desk research purpose to field research, visualizing about its practicability (Ndunguru, 2007). Thus the research design guides the researcher on how to address the problem and provide appropriate measures as it provides direction of what to measure. In this study, the cross-section research design was adopted so as to study community social problems in a single point in time. Both qualitative and quantitative data were collected.

3.3. Sample Size and Sampling Techniques

3.3.1 Sample Size

The sample size for this study was drawn from the households in Kipera and Mlali villages which are about 2666 using the Yamane (1967) formula as presented below;

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n= Sample Size

N=Size of study population or sampling frame

e=Error of the prediction/detection 0.1

Hence

$$n = \frac{2666}{1 + 2666 \times 0.1^2}$$
$$2666/27.66$$

$$n=100$$

Therefore, the total sample size was 100 respondents which included 88 respondents from the community and 12 key informants as presented in Table 3.1 below.

Table 3.1: Composition of the sample size

S/n	Category of respondents	Sample Size
1.	Village Executive Officers	2
2.	Village Chairperson	2
3.	Water User Association Leaders	4
4.	District Water Engineer	1
5.	Ward Leaders	2
6	Wami/Ruvu Basin Officer	1
7	Community	88
Total		100

3.3.2 Sampling Techniques

To interview the entire population is not practical due to different reasons like its characteristics (heterogeneous or homogeneous), and availability of time or even accessibility or cost (Adam and Kamuzora, 2008).

For these reasons a representative sample was chosen for the study where both probability and non-probability sampling was used to obtain the respondents. In probability sampling, simple random sampling and systematic sampling techniques were employed because

every item (Key informant/Expert) have an equal chance of inclusion in the sample while in non-probability sampling; purposive sampling was used because the particular units (sample size) selected typically represent the entire community

3.3.2.1 Purposive Sampling

Purposive sampling is a method in which a researcher purposely targets a group of people believed to be reliable for the study (Ndunguru, 2007). This sampling technique was used to sample key informants so as to collect specific information on human settlements and activities; water related problems; and application of IWRM approach. The target groups included; the Village Executive Officers, Village Chairpersons, Water User Association Leaders, Ward Leaders, District Water Engineer, and Wami/Ruvu Basin Officer.

3.3.2.2 Simple Random Sampling and Systematic Sampling

The simple random sampling is the technique whereby every member of the population has an equal chance of being included in the sample (Cohen, 1980). This technique was used to sample the Kipera and Mlali community where the first respondent was selected randomly by using simple random sampling and the rest were selected by using a systematic sampling after fixed intervals (n/N^{th}) of the sampling frame. Systematic sampling ensures every member of the population included and also bias is minimized.

3.4 Methods of Data Collection

Data collection refers to the gathering specific information to serve or prove some facts (Cohen, 1980). Data collection is important in research as it allows for the dissemination of accurate information and development of meaningful programmes.

In this study, two sources of data collection were used; these are primary and secondary sources.

3.4.1 Primary Data Collection

Primary data is first-hand information obtained from the field by the researcher. For this study, primary data were collected using triangulation way of which Qualitative, PRA, and Quantitative approaches was used. Shih (1998) argued that triangulation is used for

confirmatory and for completeness purposes. In that case, Key informant interview, observation, and focus group discussion tools for Qualitative approach; transect walk, and daily calendar tools for PRA; and household survey tool for Quantitative approach.

3.4.1.1. Qualitative Approach

This approach comprises tools such as; Key informant interview, observation, and focus group discussion which were used in this study.

3.4.1.1.1 Key Informant Interview

In this study, face to face interview was used to collect data from Village Executive Officers, Village Chairperson, Water User Association Leaders, Ward Leaders, District Water Engineer, and Wami/Ruvu Basin Officer. It also helped in the provision of more clarification of the subject matter and made the findings more comprehensive

3.4.1.1.2. Observation

Observation involves direct observation of what is happening without asking respondents questions or clarifications; under the observation method, the information is sought by way of the investigator's own direct observation. The information obtained under this method relates to what is currently happening; it is not complicated by either the past behavior or future intentions or attitudes (Adam & Kamuzora, 2008). The actual environment (water resources) and livelihood activities in the study area were observed and recorded by camera and note book.

3.4.1.1.3. Focus Group Discussion

This study involved 16 people (8 male and 8 female) with different age group and socio-economic activities. Pair wise rankings technique was used to collect relevant information from randomly selected members of community. Pair-wise ranking allows community members to determine collectively their most significant problem or issue.

3.4.1.2. Participatory Rural Appraisal Approach

In this study, three tools of PRA employed include; transect walk and daily calendar so that as to explore detailed information in the respective study area.

3.4.1.3. Quantitative Approach

In this study, questionnaires which comprise open and closed- ended questions were administered to the community. The reason for using questionnaires is due to the fact that questionnaires collect more information in a short time in a large community. Kothari (2004) comments that; the researcher can easily administer questionnaires, given the fact that the method is economical enough to collect a considerable amount of information at a relatively low cost in terms of money, time, and materials.

3.4.2 Secondary Data Collection

In this study, secondary data were collected through review of various documents related to impacts of human settlements and activities on water sources from the Mzumbe University Library, District Water Department, Wami/Ruvu Basin Office, and Internet.

3.5 Data Analysis and Presentation

According to Kothari (2004), data analysis is a process, which implies editing, coding, classification, and tabulation of collected data. Both quantitative and qualitative analyses of data were used. Quantitative data were analyzed through the use of Statistical Package for Social Sciences (SPSS) version 20 while qualitative data involved the use of factual and logical interpretation of data. The data were presented in the form of charts, graphs, and tables.

CHAPTER FOUR

FINDINGS, ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents the research findings, analysis and discussions of the results obtained through questionnaires, interview, observation, focus group discussion (FGD), transect walk, and documents. The findings are presented in line with specific objectives which were: to assess the effects of human settlement and activities on water supply; to assess the effects of human settlement and activities on water distribution; to assess the effects of human settlement and activities on water quality; to assess the capacity of local institutions on water resources management; to assess the effectiveness of fees system on water resources management; and to assess the stakeholders involvement on planning water resources management. Such analysis provides the basis for recommendations of ways to help local communities have access to good and quality water and enhance sustainable development.

4.2 Demographic and Socio-economic Characteristics of the Study Respondents

This part provides the summary of the study population characteristics. In any community, demographic and socio- economic characteristics play an important role in analyzing the population livelihood development. Generally this part provides information about the number of respondents in a study area, age, sex, education level, and main livelihood activities.

4.2.1 Respondents by sex

A total number of respondents interviewed from household survey were 88 (n=88) in both villages; they were instrumental in the provision of quantitative data. Two focus group discussions (FGD) were conducted, whereby 16 community members (men and women) participated. Participants pertaining to key informant (KI) interview were selected from village council leaders, ward leaders, and district leaders. Key informant interviews were conducted that 12 participants were involved. The 12 key informants provided qualitative data aiming at understanding the impact of human settlement and activities on water resources management; the information collected was used to supplement the information

gathered from the communities. Table 4.1 shows the distribution of residence of the respondents in their respective villages, the findings show that; 56(63.6%) of the respondents were in Mlali village while; 32(36.4%) of the respondents were in Kipera village. The study involved more respondents from Mlali village (compared to Kipera village) because Mlali village is more peri-urban and highly populated than Kipera.

Table 4.1: Distribution of respondents in the study area

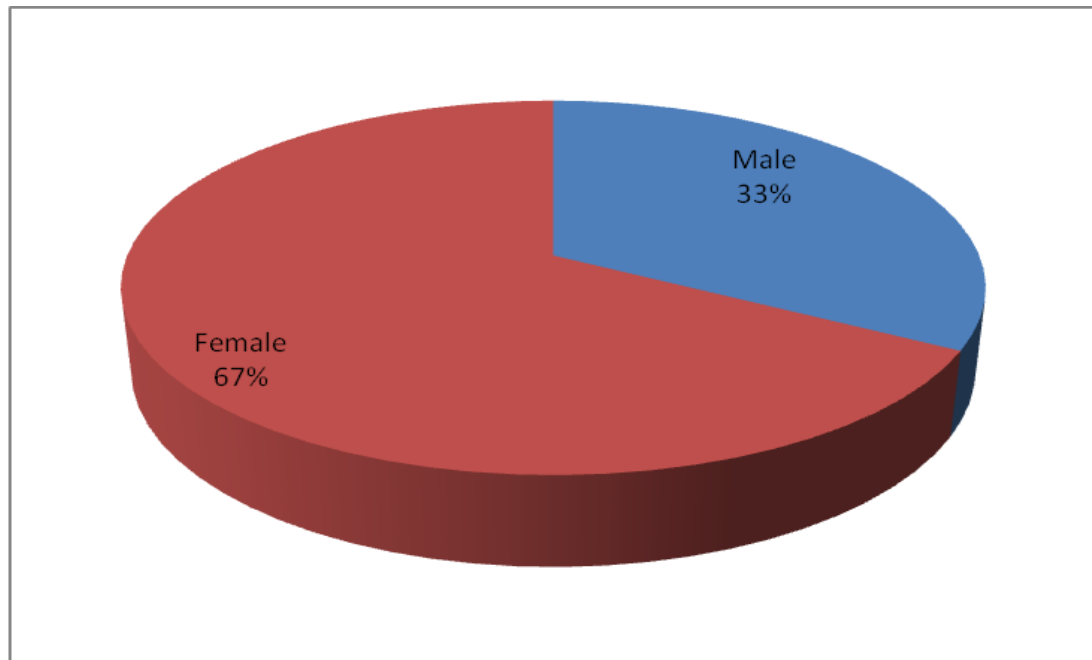
Village	Frequency (n)	Percent (%)	Valid Percent	Cumulative Percent
Mlali	56	63.6	63.6	63.6
Kipera	32	36.4	36.4	100.0
Total	88	100.0	100.0	

Source: Research findings (2015)

Respondents by sex

Figure 4.1 shows the distribution of the respondents by sex, the findings show that; 29 (33%) were male and 59 (67%) were female.

Figure 4.1: Respondents by sex



Source: Research findings (2015)

Results reveal that; a greater number of women (67%) had a greater representation in expression of the information concerning the water resources management and other related issues in the study than men (33%) respondents. The number of female is higher

because is attributed by African culture especially in rural areas where women and girls are responsible for collecting water for household use. Also the study found more female headed family than male headed family in the study area. The sex ratio helped the researcher to collect precise and potential information concerning the impacts of human settlements and activities on water resource management. Most of the women were ready to give any information about their livelihood, since they are normally available at their households and also they are the major water users, unlike men who are not directly involved in the daily domestic activities and issues related to water resources management as well.

4.2.2 Age of Respondents

The table 4.2 shows distribution of respondents by age in the study area. Three groups were considered in this study: the first group was that of 18-30 years, second group was of 31-60 years and the last one was of 61-100 years. Table 4.3 presents the distribution of respondent by age. Results show that about 38.6% of respondents were aged between 18 to 30 years, 54.5% were aged between 31to 60 and 6.8% were aged between 61 to 100 years.

Table 4.2: Distribution of respondent by age in study area

Age group	Frequency	Percent
18-30	34	38.6
31-60	48	54.5
61-100	6	6.8
Total	88	100.0

Source: Research findings (2015)

The result revealed that; the respondents who aged between 31- 60 years were involved more in discussions concerning the impacts of human settlements and activities on water resources management in the study area. It helped the researcher to collect more useful informations since; the respective age group has enough experience in water resources problems and management as well.

4.2.3. Household Size

Four groups were considered in this study: the first group was that of 1-3 size; second group was of 4-6 size; third group was of 7-9 size; and fourth group was of beyond 10

sizes. Findings show that; 24 (27.3%) of the respondents have 1-3 members of household; 50(56.8%) of the respondents have 4-6 members of household; 12(13.6%) of the respondents have 7-9 members of household; and 2(2.3%) of the respondents have beyond 10 members of household as indicated in table 4.3.

Table 4.3 Household Size

Household size	Frequency	Percent
1-3	24	27.3
4-6	50	56.8
7-9	12	13.6
>10	2	2.3
Total	88	100.0

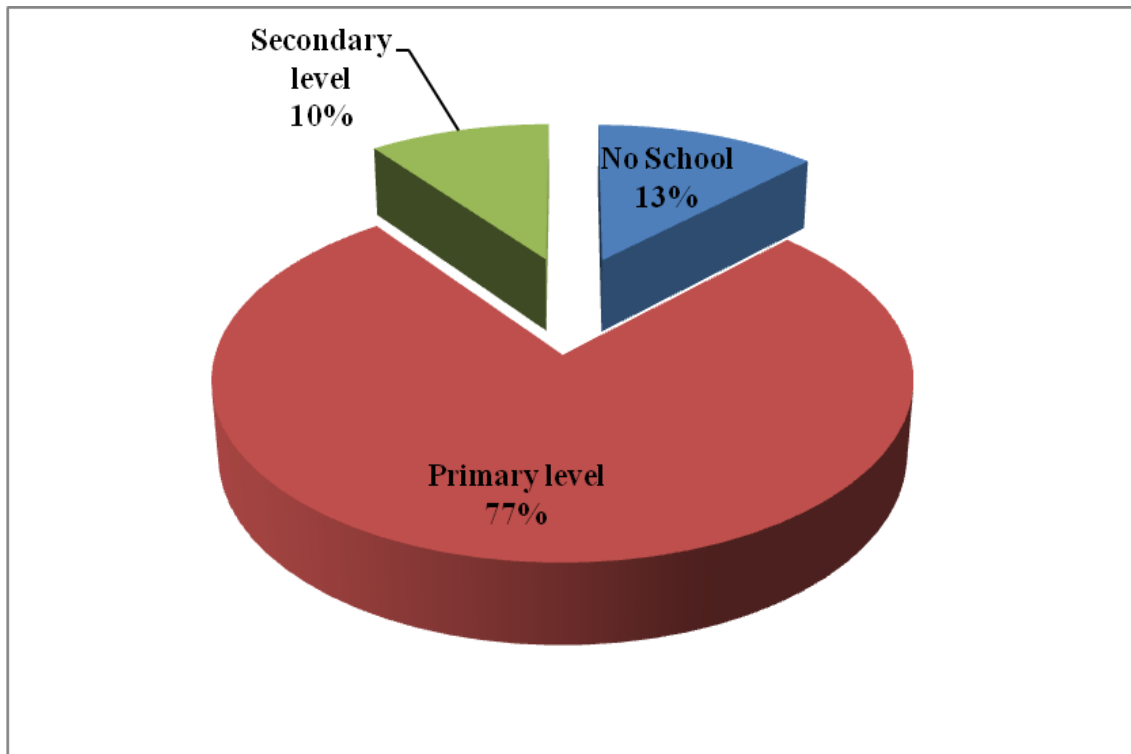
Source: Research findings (2015)

The results reveal that, the majority equals to 50 (56.8%) of the respondents fall in 4-6 household size. Also the study shows that the household with 1-3 size mostly are single parent families' especially female headed family.

4.2.3 Education level of Respondents

Education is a major key for human development, through educated people then environmental resources, water resources inclusive are managed and utilized sustainably and enhance low rate of degradation. Findings show that; 11 (12.5%) of respondents didn't attend school, 68 (77.3%) completed primary education, and 9 (10.2%) completed secondary education. More detail is presented in figure 4.2.

Figure 4.2: Distribution of Educational Level of the Respondents



Source: Research findings (2015)

The findings also reveal that; only 11 (13%) of respondents did not attend school, about 87% of studied population had attended school. This indicates that there is a higher rate of literacy in the study area which may lead to effectiveness of water resources management.

According to ECLAC (2006) the adult illiteracy increases the present and future socio economic vulnerability, and is a significant factor in the reproduction of such vulnerability through children, passing from generation to generation. Its effects can be seen throughout life. Jorgenson (2004) revealed that the overall effect of literacy rates on ecological footprints is positive while between zone difference are inconclusive. This implies that those who are educated have a great opportunity on ensuring equitable, economically sound and environmentally sustainable management of water resources.

4.2.4 Main livelihood Activities in Study Area

Livelihood activities refers to a set of economic activities involving self-employment and /or wage employment by using one's endowments (human and material) to generate adequate resources (cash and non-cash) for meeting the requirements of self and the

household, usually carried out repeatedly and as such become a way of life .Table 4.4 below shows the main livelihood activities in the study area.

Table 4.4 Main livelihood Activities in Study Area

Livelihood activities	Frequency	Percent
Agriculture (Maize, vegetables, tomatoes, paddy, beans, sunflower)	86	97.7
Small Business	1	1.1
Teacher	1	1.1
Total	88	100.0

Source: Research findings (2015)

The findings of this study reveals that; about 86(97.7%) of the respondents are engaged in agricultural activities as the main source of income whereby maize, vegetables, paddy, beans and sunflower are main crops; 1(1.1%) of the respondents is engaged in small businesses and 1(1.1%) of the respondents is the government employee.

The findings indicate that, majority of the respondents depend on agricultural activities as the main source of income to cover essential household needs. This is due to lack of alternative income generating activities.

Main occupation of the respondents

This study further indicates that; the majority of the respondents, 87(98.9%), are self-employed while; 1(1.1%) of the respondents is employed by the government. Figure 4.3 shows the distribution of the main occupation in the study area.

Figure 4.3: Main occupation of the respondents



Source: Research findings (2015)

The study finds that, the majority of local people in the study area are engaged in the self employment, especially agricultural activities as economic base. Furthermore, the study discovered that, the study area has potential factors for agricultural activities such as fertile land, reliable rainfall, permanent water source including rivers, and springs, access to market, and access to agricultural inputs.

4.2.5. The effects of human settlement and activities on water supply

This presents the findings that show the effects of human settlement and activities on water supply in the study area.

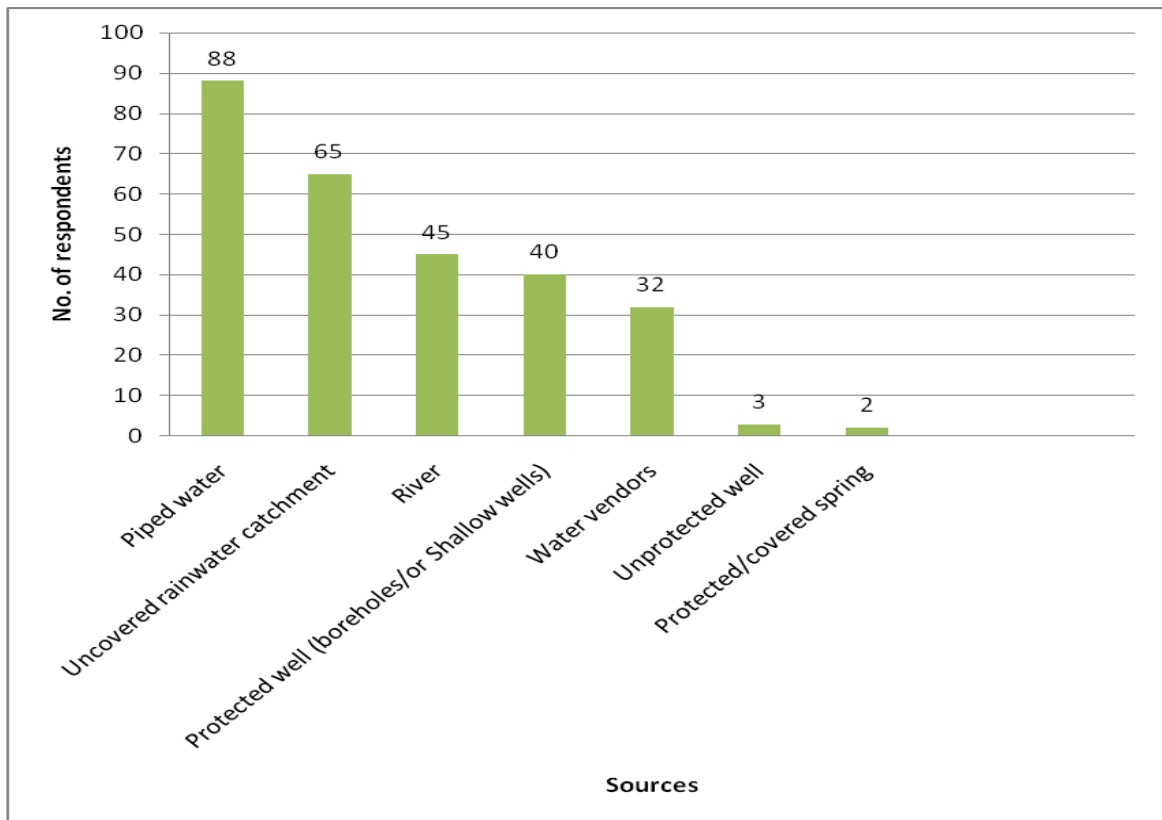
4.2.5.1: Summary of Major Findings from Household Survey

The main sources of drinking water used by households

The result shows that, there are various sources of drinking water used by the household in study area; drinking water sources in the study area include piped water; protected well (bore hole); protected/covered spring; unprotected well; river; uncovered rainwater catchment; and water vendors. Piped water accounted for large proportion of total drinking

water sources; a majority of the respondents 88(100%) have mentioned the use of piped water. However, households utilize other water sources for drinking purpose as alternative sources, 40(45.5%) of the respondents stated that they use water from protected well (bore holes and shallow ells); 2(2.3%) of the respondents mentioned protected/covered springs; 3(3.4%) of the respondents mentioned unprotected well; 45(51.1%) of the respondents mentioned surface sources (river); 65(73.9%) of the respondents mentioned uncovered rainwater catchment; and 32(36.4%) of the respondents mentioned water vendors. The figure 4.4 shows various sources of drinking water used by households in the study area.

Figure 4.4: Main sources of drinking water used by households



Source: Research findings (2015)

Based on household survey the result shows that, piped water is a major source of drinking water, since all respondents 88(100%) mentioned it, followed by uncovered rainwater catchment 65(73.9%); river 45 (51.1%); protected wells (bore hole and shallow wells) 40(45.5%); water vendors 32(36.4%); unprotected well 3(3.4%); and protected/covered spring 2(2.3%).

In this respect, previous Household Baseline Survey done by Ministry of Water (2000) in Tanzania mainland had shown that 28% of rural households in the year 2000 were using piped water.

Moreover, HBS recorded that 60% of household in rural areas were using protected well for drinking; also the report indicated that 17% of household in rural areas were using surface water for drinking. Therefore, the results have shown that percentage of household using piped water for drinking has increased compared to the results revealed by HBS (2000). Meanwhile, the percentage of household using protected well for drinking has decreased compared to the results revealed by HBS(2000). The findings from these two surveys show differences in respect of percentage of household using piped water in the rural areas. My study reveals that 88% of households are using piped water, but HBS (2000) had showed that only 28% of rural households in the year 2000 were using piped water.

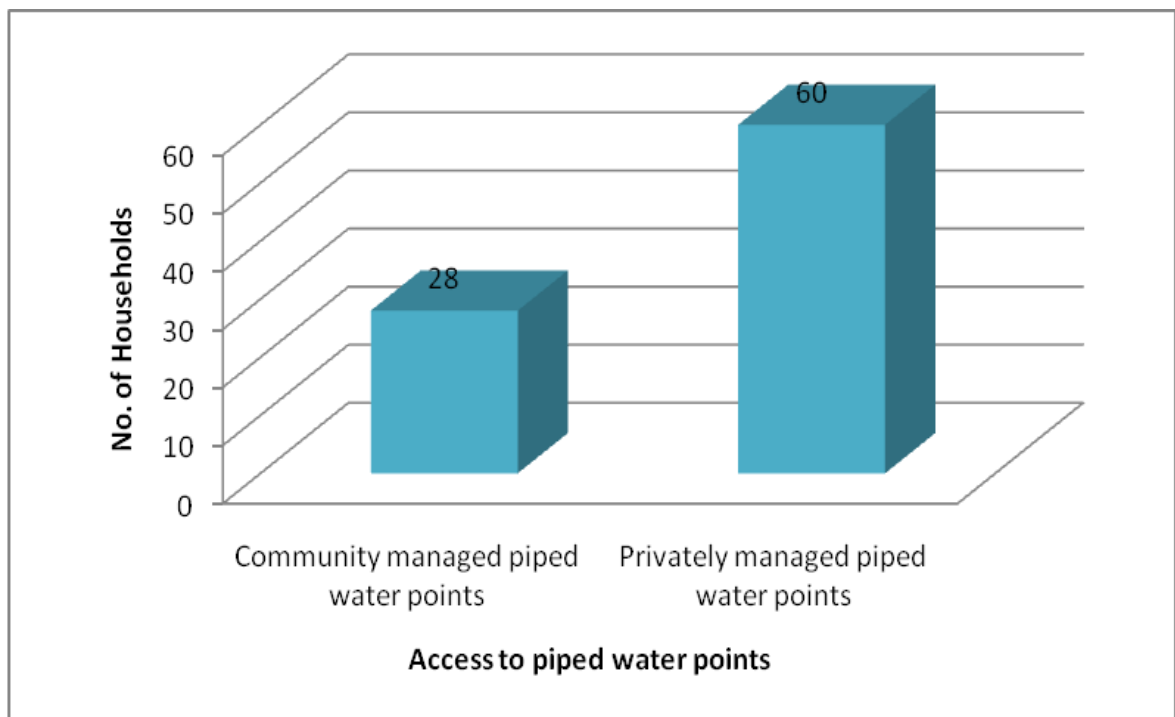
The implication of this comparison is that, currently there is an improvement on using piped water for household in the Tanzania rural areas despite the presence of various challenges. Additionally, the study shows that, even if uncovered rainwater harvesting is one of most water source that have been mentioned by respondents about 65(73.9%), meanwhile the study area has a favourable climatic condition (reliable rainfall pattern) characterized with long, heavy Masika rains that begins in mid-March and last until late May, while the short Vuli rains occur from November to January. The long-term average of annual precipitation in Mlali is 890 mm (Paavola, 2008). The mean annual temperature is 24⁰ Celsius (Chamshama, Mugasha, Ngegba, & Kimaro, 2006), but the communities around seem to be not interested in investing on rainwater harvesting system so as to solve water supply problem.

Worm and van Hattum (2006) argued that; the rainfall pattern over the year plays a key role in determining whether rainwater harvesting (RWH) can compete with other water supply systems. Tropical climates with short (one to four month) dry seasons and multiple high-intensity rainstorms provide the most suitable conditions for water harvesting. As a general rule, rainfall should be over 50 mm/month for at least half a year or 300 mm/year (unless other sources are extremely scarce) to make RWH environmentally feasible.

Access to drinking water from piped water points

Findings show that; 28 (32%) of the respondents access drinking water from piped water points managed by community; while 60 (68%) of the respondents from privately managed piped water points as indicated in figure 4.5.

Figure 4.5: Access to drinking water from piped water points



Source: Research findings (2015)

Figure 4.6: Community managed piped water point



Source: Research findings (2015)

Figure 4.7: Privately managed piped water point



Source: Research findings (2015)

The study reveals that; the majority of the respondents (68%) access drinking water from piped water points privately managed compare to piped water points managed by community. But the case is high in Mlali village because, since, it has 113 piped water points under private against 15 piped water points under the community; therefore it is easier for the entire households to access drinking water from private water points. While in Kipera village, there are 13 piped water points under the community against 3 piped water points under the private, therefore, the case is vice versa since, a large amount of households prefer to collect drinking water from piped water points managed by the community because they are evenly distributed in the respectively hamlets compare to piped water points under the private ownership that are few. Therefore, piped water points under private in Kipera village couldn't satisfy the household's water needs contrary to Mlali village whereby, piped water points under private are using mostly by many households because they are distributed in many areas in the respective village. Additionally, the study discovered differences in term of proper management of water points as indicated in **figure 4.6** and **figure 4.7** above. The study observes that community-based piped water points have dirty environment while privately managed piped water points have has clean environment. The study investigated more to get reasons for the disparity; some respondents were quoted as saying;

“Piped water point under the community is a public property such that water committee on behalf of village council is responsible to clean environment contrary to piped water points under private whereby it is handled by individuals.” Therefore, if water committees do not clean or emphasize the community to clean the environment then, surrounding areas of the community water points remain dirty”

The problem with water supply and delivery in the study area

Table 4.5 shows the existence of water supply problem in the study; findings show that 88(100%) of the respondents agreed that there is the presence of water supply problem.

Table 4.5 The problem with water supply and delivery in the study area

Response	Frequency	Percent
Yes	88	100.0

Source: Research findings (2015)

The study found that; every respondent in the study area is experiencing water supply problem, because the existing water sources and water infrastructures are shared by all entire community members. Consequently, if water taps flow then all household benefit but when water taps stop to flow then all households are affected equally. Therefore, there is an equal water supply services in the study depend upon the status of existing water sources as well as infrastructures. In this respect, Ministry of Water and Livestock Development (2002) reported that water supply is not satisfactory since the early 1970, despite significant investment in the water supply services.

The possible causes of the water supply problems in the study area

In this study, 25(28.4%) of the respondents mentioned increasing population as a cause of water supply problem while 63 (71.6%) of the respondents did not agreed ; 41(46.6%) of the respondents mentioned poor water infrastructures as a cause while 47 (53.4%) of the respondents did not agreed ; 57(68.8%) of the respondents mentioned Catchment degradation as a cause while 31 (31.2%) of the respondents did not agreed ; 63(71.6%) of the respondents mentioned development of agriculture practices as a cause while 25 (28.4%) of the respondents did not agreed; 2(2.3%) of the respondent mentioned unplanned settlement as a cause while 86 (97.7%) of the respondents did not agreed ; 24(27.3%) of the respondents mentioned climate change and variability as a cause while 64 (72.7%) of the respondents did not agreed ; and 13(14.8%) of the respondents mentioned other causes including; lack of commitment for village leaders and village water committees on water resources management while 75 (85.2%) of the respondents did not mention as it presented in table 4.6.

Table 4.6: Possible causes of water supply problem

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
Increasing population	25		63	
Poor water infrastructures	41		47	
Catchment degradation	57		31	
Development of agriculture practices	63		25	
Unplanned settlement	2		86	
Climate change and variability	24		64	
Other (specify)	13			75

Source: Research findings (2015)

The results from household survey analysis indicate that; development of agricultural practices and catchment degradation are major causes of water supply problem in the study area, since, a majority of the respondents 63(71.6%) and 57 (68.8%) pointed out the respective causes while unplanned settlement is mentioned by a minority of respondents 2(2.3%). The study found that the majority of households are smallholder farmers using poor agricultural inputs like hand hoes, machetes, axe and local seed varieties. They are practicing agricultural activities either around water sources (rivers and springs) or along catchment areas (steep slopes) aiming at seeking for wetted and fertile soils so that to improve crops productivity.

There are no infrastructures for irrigation schemes introduced in the respective villages. Poor agricultural practices are still going on in the upstream that is a source of piped water through gravity scheme. The situation is resulting into insufficient water supply in the downstream. Setting of bush fires during preparation of farm plots, and cultivation along the contour are among of poor farming practices going on in the upstream. Some respondents claimed that ongoing poor agricultural practices done by some villagers in the watershed area (upstream) affect water supply in their villages (downstream).

Poor agricultural practices affect surface water flow as well as spring discharge (Mvomero Water Department, 2014). Mwandosya (2008) urged that, agriculture is the main user of water claiming more than two thirds of the water withdraws from the Earth's rivers, lakes, and groundwater aquifers. This previous study insisted that as population and economies grow, water becomes an increasingly scarce and valuable resource. Mwandosya had witnessed the case of Lake Chad; the lake was about 25, 000 sq. km. in 1963. In 2007, the lake had shrunk to 1,850 sq.km. about 1/20th of its size in 1960s, mainly due to irrigation demands and partly due to climate change.

The consequences of water supply problems in the study area

In this study, 80 (90.9%) of the respondents said that slowing down of domestic and commercial activities is a severe problem, while 8 (9.1%) of the respondents said it is a minor problem; 73 (83%) of the respondents responded that too much time wasted in searching for water is a severe problem; 14(15.9%) of the respondents responded that too much time wastage for searching water is a minor problem, and 1(1.1%) of the respondents

has said that no time wastage for searching water; 71(80.7%) of the respondents responded that long queue in fetching water and quarreling are severe problems; 13(14.8%) of the respondents responded that it is a minor problem; 2(2.3%) of the respondents responded that there are no long queue and quarrels; and 2(2.3%) of the respondents e responded that they don't know if there are long queue and quarrels; 2 (2.3%) of the respondents said that children being late to or absent from school is a severe problem; 7(8%) of the respondents said that it is a minor problem; 75(85.2%) of the respondents said that it is not a problem; and 4(4.5%) of the respondents said that they don't know if water supply problem has caused children being late to or absent from school; 5(5.7%) of the respondents responded that increasing food price is a severe problem; 2(2.3%) of the respondents responded that it is a minor problem; 74(84.1%) of the respondents responded that it is not a problem; and 7 (8%) of the respondents responded that they don't know if water supply problem has effect on food prices; 58 (65.9%) of the respondents replied that the risk on drinking untreated water is a severe problem; 10 (11.4%) of the respondents replied that it is a minor problem; 11(12.5%) of the respondents replied that it is not a problem; 8(9.1%) of the respondents replied that they don't know; 72(81.8%) of the respondents pointed out that work load of woman is a severe problem; 10(11.4%) of the respondents pointed out that it is a minor problem; 5(5.7%) of the respondents pointed out that it is not a problem as shown in table 4.7.

Table 4.7: The consequences of water supply problem in the study area

Water issue	Severe problem	Minor problem	Not a problem	Don't know
Slowing down of domestic & commercial activities	80	8		
Too much time is wasted in search of water	73	14	1	
Long queues in fetching water, resulting in quarrels	71	13	2	2
Children usually are either late to or absent from school	2	7	75	4
Prices of food items increase due to shortage of water	5	2	74	7
Risk in drinking of untreated water from open wells or surface waters	58	10	11	8
Workload of women in the households becomes very heavy	73	10	5	
Other(specify)				

Source: Research findings (2015)

The results of household survey analysis indicate that; slowing down of domestic and commercial activities; too much time is wasted in search of water; workload of women in the households becomes very heavy; long queues in fetching water, resulting in quarrels; and risks in drinking of untreated water from open wells or surface waters are major consequences of water supply problem in the study area. Those consequences directly or indirectly have impact to the community livelihood it includes; lack of enough time to participate in alternative income generating activities; lack of enough time to handle family matters, and lack of enough time to be active member of community based organizations. However, these impacts differ from one household to another household.

Clarke (1988) suggested that increased scarcity of water (through drought or other access restrictions) reduce household capacity to combine water with other assets in order to produce income. Some respondents were quoted as saying;

“I wake up early in the morning everyday to seek water, I spend about 10 hours, and the situation affects my daily life, especially home matters”

“I failed even to establish alternative income activities because of water problem, I feel so sad”

“I and my family always are suffering from water-borne diseases like diarrhea because of using untreated drinking water from rivers”

Figure 4.8: Queues in fetching water at Mlali village



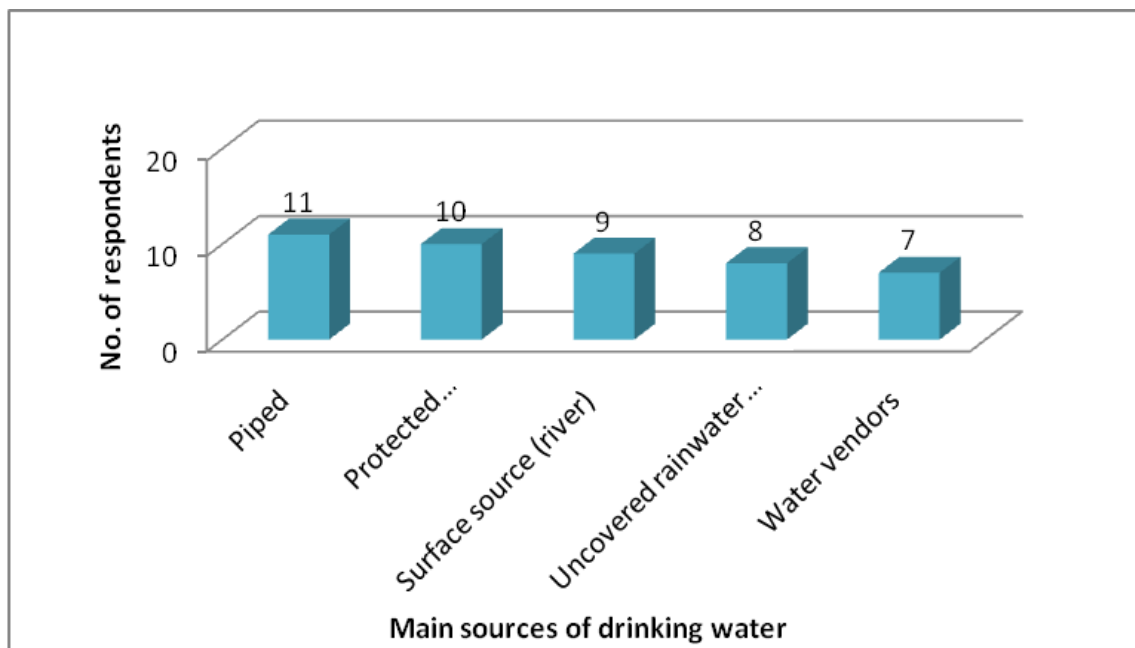
Source: Research findings (2015).

4.2.5.2: Summary of the Major Findings from Key Informants

The main sources of drinking water

Figure 4.9 shows the main sources of drinking water in the study area, the findings show that 11(91.7%) of the respondents mentioned piped water as a source of drinking water while 1(8.3%) of the respondents did not; 10(83.3%) of the respondents mentioned protected well (bore hole/shallow wells) while 2(16.7%) of the respondents did not; 9(75%) of the respondents mentioned surface source (river) as a source of drinking water while 3(25%) of the respondents did not; 8(66.7%) of the respondents mentioned uncovered rainwater catchment as a source of drinking water while 4(33.3%) of the respondents did not; and 7(58.3%) of the respondents mentioned water vendors as a source of drinking water while 5(41.7%) of the respondents did not mention.

Figure 4.9: Main sources of drinking water



Source: Research findings (2015)

The results from Key interview informants analysis indicates that; piped water is a major source of drinking water in the study area; in case of shortage of piped water, protected wells (bore hole and shallow wells) were mentioned as alternative sources of water used by the community in the study area whereby 9 operated public boreholes located in Mlali village while 11 operated public shallow wells located in Kipera village . Unreliability of

water supply due to degradation of water sources (springs) by illegal human activities like poor agricultural practices in water catchment areas was mentioned as one of the factors forcing people to go for protected well (bore hole) and other unprotected water sources in order to cope with water scarcity.

Figure 4.10: Rain water harvesting system at Mlali Heath Centre



Source: Research data (2015).

The management of piped water points

Table 4.8 shows access to drinking water from piped water points, the finding show that 8 (66.7%) of the respondents mentioned the piped water managed by community as a source of drinking water while 3 (25%) of the respondents mentioned piped water points managed by private individuals as a source of drinking water and 1(8.3%) of the respondent did not mention any source.

Table 4.8: The management of piped water points

Response	Frequency	Percent
Community	8	66.7
Private	3	25.0
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The result shows that; the piped water points managed by the community are the main source of water for households. The result is applicable at Kipera village since, there are 13 piped water points under the community as compared to 3 piped water points managed by privately, but in Mlali village the situation is verse versa such that majority of households are using piped water from water points managed by private owners due to a large amount of respective water points.

The study noted that leaders especially in ward and village levels are not aware about the existing water infrastructures in the respective villages. They failed to give out actual number of piped water points based on ownership.

Problems with water supply

Table 4.9 shows the existence of water supply problem in the study area, the findings show that 12(100%) of the respondents agreed that there is the presence of water supply problem.

Table 4.9: Water supply problem

Response	Frequency	Percent
Yes, problem	12	100.0

Source: Research findings (2015)

The study indicates that, water supply problem is a cross-cut issue, it implies that even leaders at village, and ward levels as well are familiar and affected directly or indirectly. However, the perception of the extent of the problem varies within leaders. Some respondents said that the problem is high while others said it is very high. Moreover, the study revealed efforts that have been undertaken by the government including; the formation of Water User Association (WUA) for Mlali and Kipera villages; rehabilitation of Water Network (intake, storage tanks, DPs) of which one storage water tank of 375,0000 litres rehabilitated at Mlali and 175,000 litres at Kipera village as well ; construction of other new pumping system infrastructures; drilling of new borehole of about 80m; and construction of pump house for installation of pump and motor into the borehole as stated by (District Water Department, 2014).

Figure 4.11: Rehabilitated water storage tank of 175,000litres at Kipera village



Source: Research data (2015)

Water supply problem occurrences

Table 4.10 shows the occurrence of water supply problem in the study area; 2(16.7%) of the respondents stated that water supply problem occurred between 1-3 years; 2(16.7%) of the respondents said it occurred between 4-7 years; 7(58.3%) of the respondents said it occurred between 8-10 years; and 1(8.3%) of the respondent did not know.

Table 4.10: Water supply problem occurrences

Problem occurrence	Frequency	Percent
1-3 years	2	16.7
4-7 years	2	16.7
8-10 years	7	58.3
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study shows that, water supply problem occurred over the past ten years. As according to the respondents the magnitude of the problem varies in some years, but for about the past ten years to date the problem persists in the respective villages.

Causes of water supply problem

Table 4.11 shows possible causes of water supply problem, 5(41.7%) of the respondents the increase of population as the major cause; 3(25%) of the respondents said that is a minor cause; and 4(33%) of the respondents said that is not a cause; 4(33.3%) of the respondents mentioned poor water infrastructures as a major cause; 6(50%) of the respondents said that is a minor cause; and 2(16.7%) of the respondents said that is not a cause; 12(100%) of the respondents said that catchment degradation is a major cause; 11(91.7%) of the respondents mentioned the development of agricultural practices as a major cause while 1(8.3%) of the respondent said that is a minor cause; 3(25%) of the respondents mentioned unplanned settlement as a major cause ; 2(16.7%) of the respondents mentioned it as a minor cause; and 4(33.3%) of the respondents said it is not a cause; and 3(25%) of the respondents pointed out that climate change is a major ; 5(41.7%) of the respondents pointed out that it is a minor cause; 2(16.7%) of the respondents pointed out that is not a cause; and 2(16.7%) of the respondents didn't know.

Table 4.11: Causes of water supply problem

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
Increasing population	5	3	4	
Poor water infrastructures	4	6	2	
Catchment degradation	12			
Development of agriculture practices	11	1		
Unplanned settlement	3	2	4	3
Climate change and climate variability	3	5	2	2
Other (specify)				

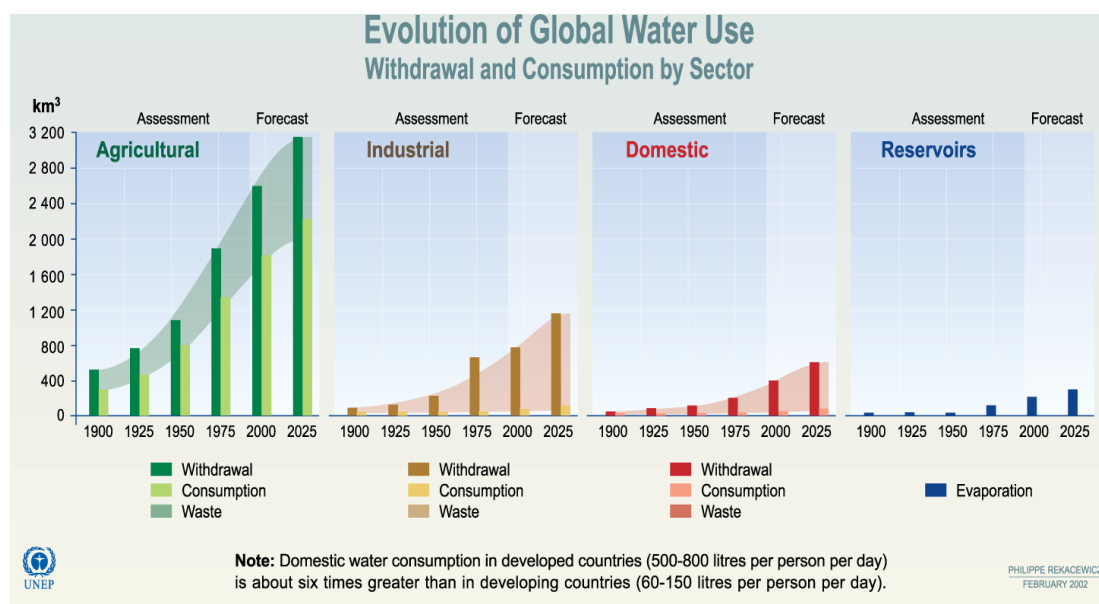
Source: Research findings (2015)

The result shows that, catchment degradation and development of agricultural practices are major source of water supply problem in the study area. The gravity water system (scheme) is one of piped water source in the study area (Interview with village leaders, 2014). Human activities like poor agricultural practices influence water catchment degradation create impact to the stream flow. In this respect, the previous study by Otuoma, et al., (2008) reported that watershed degradation affect rainfall distribution that directly affects stream flow.

In addition, increasing population was mentioned by 41.7% of the respondents as the other cause of water supply problem, this reality is supported by information documented by Mtinda (2006) who showed that Mlali gravity water scheme was built in 1970 and it had been saving about 7,000 people in the downstream (Mlali, Kipera and Melela Villages). But in this study changes have been observed, since; the number of people has increased and reached to about 10, 024 people. Therefore, the capacity of gravity water scheme to support sufficient water supply in the downstream has decreased. In this respect, the figure 4.12 below indicates global water withdrawal and consumption by sectors as assessed and predicted by UNEP from 1990 up to 2025. The assessment focused on four major users of water include; agricultural, industrial, domestic, and reservoirs sectors. Findings show that as agricultural sector develop then water withdraws, consumption and waste increase concurrently. This is because, globally agricultural sector consume more water than other sectors. Additional, agricultural production “consumes” more fresh water than any other human activity (Falkenmark, 1989). About 87 percent of the fresh water that is pumped worldwide is “consumed” (non recoverable) by agriculture (Postel, 1989).

This study and previous studies have shown similar results in such a way that as agriculture practices develop then water withdrawal, consumption, and waste increase concurrent and enhance insufficient water supply leading to water supply problem.

Figure 4.12: Global Water Withdrawals



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

The consequences of water supply problem in the study area

Table 4.12 shows the consequences of water supply problem in the study area, the findings show that 9(75%) of the respondents responded that slowing down of domestic and commercial activities are severe problems; while 2(16.7%) of the respondents responded that it is a minor problem; 6(50%) of the respondents said that time wastage in search of water is a severe problem; 4(33.3%) of the respondents said that is a minor problem; and 1(8.3%) of the respondent responded that it is not a problem; 5(41.7%) of the respondents mentioned long queues and quarrels as severe problems associated with water supply problem; 5(41.7%) of the respondents said that those are minor problems; 1(8.3%) of the respondents responded that is not a problem; 2(16.7%) of the respondents responded that children being either late to or absent from school is a severe problem while 9(75%) of the respondents said it is not a problem; 1(8.3%) of the respondents responded that increasing food prices due to shortage of water is a severe problem; 1(8.3%) of the respondents said that is a minor problem; and 9(75%) of the respondents responded that it is not a problem; 9(75%) of the respondents said that the risks in drinking untreated water from open wells or surface waters is a severe problem; 1(8.3%) of the respondents said that it is a minor problem; and 1(8.3%) of the respondents said that is not a problem; 9(75%) of the respondents said that the heavy workload of women in the households is a severe problem; 1(8.3%) of the respondents said that is a minor problem; and 1(8.3%) of the respondents said that is not a problem.

Table 4.12: The consequences of water supply problem in the study area

Water issue	Severe problem	Minor problem	Not a problem	Don't know
Slowing down of domestic & commercial activities	9	2		
Too much time is wasted in search of water	6	4	1	
Long queues in fetching water, resulting in quarrels	5	5	1	
Children usually are either late to or absent from school	2		9	
Prices of food items increase due to shortage of water	1	1	9	
Risk in drinking of untreated water from open wells or surface waters	9	1	1	
Workload of women in the households becomes very heavy	9	1	1	
Other(specify)				

Source: Research findings (2015)

The results reveal that, slowing down of domestic & commercial activities; risk in drinking of untreated water from open wells or surface waters; workload of women in the households become very heavy; too much time is wasted in search of water are major consequences of water supply problem in the study area. The findings is supported by previous studies; WWO (2010) reported that only 20% of the global population has access to running water and over 1 billion people do not have access to clean water. UN report (2009) disclosed that inadequate water affects the health of 1.2 billion people worldwide and contributes to the death of approximately 15 million children annually. Half of the population in developing countries is suffering from water-related diseases (WWO, 2010). UN report (2009) insisted that in developing countries; nearly 80% of diseases are linked to water, leading to 3 million early deaths.

Below is statement in the speech given out by UN Secretary General- Ban Ki-moon insisting on the impact of water supply problems as adopted from distilled demographics video (2010).

“There has been a widespread failure to recognize water’s vital role in providing food, energy, sanitation, disaster relief, environmental sustainability, and other benefits. This has left hundreds of millions of people suffering from poverty and ill health and exposed to the risks of water-related diseases.”

4.2.5.3. Findings from major two Focus Group Discussions

The main source of drinking water

Table 4.13 shows the main sources of drinking water in the study area, findings from two FGD shows that piped (water point) as main sources of drinking water.

Table 4.13: Main source of drinking water

Source of drinking water	Frequency	Percent
Piped	2	100.0

Source: Research findings (2015)

The results of two FGD show that; communities in the study area depend much on piped water as a source of drinking water in the households. The study shows that, although piped water supply is not reliable but at least serves the community than other sources that are not viable to all members of community.

The management of piped water point

Table 4.14 shows access to drinking water from piped water point, findings from one FGD shows that the piped water points privately owned are the main source of drinking water; while another FGD said that the piped water points managed by the community are the main sources for drinking water.

Table 4.14: The management of piped water points

Water points management	Frequency	Percent
Private	1	50.0
Community	1	50.0
Total	2	100.0

Source: Research findings (2015)

The results from the two FGD analyses show that; access to pipe water points differ from one village to another. The reality is that, the majority of household access piped water from water points that are managed by private owners in Mlali village because water points under private ownership are many while in Kipera village, the majority of the household access drinking water from water points managed by the community because of their availability in the area.

Water supply problem

Table 4.15 shows the existence of water supply problem in the study area, findings from two FDG show the presence of water supply problem.

Table 4.15: Water supply problem

Response	Frequency	Percent
Yes	2	100.0

Source: Research findings (2015)

Results of two FDG analyses indicate that; water supply problem persist in the study area. Some respondents were quoted as saying;

“Insufficient water supply is still the problem in their areas. Moreover, each household is affected by water supply problem.”

Water supply problem occurrence

Table 4.16 shows the occurrence of water supply problem in the study area, findings from two FDG show the existence of water supply problem over the past 10 years.

Table 4.16: Water supply problem occurrence

Occurrences	Frequency	Percent
8-10	2	100.0

Source: Research findings (2015)

The results from two FGD analyses discover that; water supply problem occurred between 8-10 years. Some respondents were quoted as saying;

“In some years the extent of the problem was high but in some years the extent of the problem was low.”

The respondents mentioned 2010, 2011, and 2012 years that experienced prolonged dry season leading to insufficient water supply in the respective villages. Respondents insisted that during those devastate years, the trend of water tap flow was affected, such that instead of 3-4 days a week, however water tap flow was once a week. The situation forced them to seek for another sources of water for drinking and other uses in the households.

Possible causes of water supply problem

Table 4.17 shows possible causes of water supply problem, findings from two FDG show that increasing population is not a cause; poor water infrastructure is minor cause; catchment degradation is major cause; development of agriculture practices is major cause; unplanned settlement is not a cause;

Table 4.17: Possible causes of water supply problem

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
Increasing population			2	
Poor water infrastructures		2		
Catchment degradation	2			
Development of agriculture practices	2			
Unplanned settlement			2	
Climate change and climate variability		2		
Other (specify)				

Source: Research findings (2015)

Results from the two FGD analysis show that; catchment degradation and development of agricultural practices are major causes of water supply problem in the study area. Other minor causes are poor water infrastructures and climate change. On poor water infrastructures, respondents claimed the cause being the existence of old water infrastructures that could not able to support the existing population. Respondents also complained that village leaders as well as water committee members are not serious about water resources management. Respondents sent their claim to village leaders as well as members of village water committees in both villages. Some respondents were quoted as saying;

“Village leaders are not there to work for local people or for us”

“Members of water committee never climb to gravity water scheme area to stop people who cause degradation of gravity scheme”

“Government leaders are not telling us the cause of water supply problem; we are still suffering the consequences because of water problem.”

The consequences of water supply problem in the study area

Table 4.18 shows the consequences of water supply problem in the study area, findings from two FGD show that, slowing down of domestic and commercial activities are severe problems; too much time is wasted in search of water, this is a severe problem; long queues in fetching water resulting in quarrel is a minor problem; children usually are either late to or absent from school is not a problem; increasing of food prices due to shortage of water in not a problem; risks in drinking untreated water from open wells or surface waters

is a severe problem; and heavy women workload in the households is also a severe problem.

Table 4.18: The consequences of water supply problem in the study area

Water issue	Severe problem	Minor problem	Not a problem	Don't know
Slowing down of domestic & commercial activities	2			
Too much time is wasted in search of water	2			
Long queues in fetching water, resulting in quarrels		2		
Children usually are either late to or absent from school			2	
Prices of food items increase due to shortage of water			2	
Risk in drinking of untreated water from open wells or surface waters	2			
Workload of women in the households becomes very heavy	2			
Other(specify)				

Source: Research findings (2015)

The results from the two FGD indicate that, slowing down of domestic & commercial activities; risk in drinking of untreated water from open wells or surface waters; workload of women in the households becoming very heavy; and too much time wasted in search of water are major consequences of water supply problem in the study area. Respondents stated that the problem of water supply is going into extreme. Respondents said that when, water supply is reliable, and providing enough water for domestic, and other uses, their lives would be a bite enjoyable, since water is a crucial aspect human development. SIDA (2004) reported that the outcomes of using water from unknown sources are generally health problem, which have economic impacts to the household, especially the rural and urban poor communities.

4.2.5.4: Summary of Discussion from Major Household Survey, Key Informant, and FGD findings

The major findings from household survey show that; piped water is main source of drinking water; accessibility to piped water points indicate that, 68% of the respondents depend on privately managed piped water points; 100% of the respondents stated that; the problem of water has persisted for over the past ten years in the study area; 71.6% and

68.8% of the respondents respectively mentioned the development of agricultural practices and catchment degradation as main causes of water supply problem and slowing down of domestic & commercial activities; risk in drinking of untreated water from open wells or surface waters; workload of women in the households becoming very heavy; and too much time wasted in search of water have been noted as major consequences associated with water supply problem in the study area. NAWAPO (2002) stated that; the social and economic circumstances prevailing today have made particular demands upon the country's water resources base and the environment, and its sustainability is threatened by human activities. Therefore, the study revealed that; human settlement and activities significantly affect water supply in the study area.

4.3 The effects of human settlement and activities on water distribution

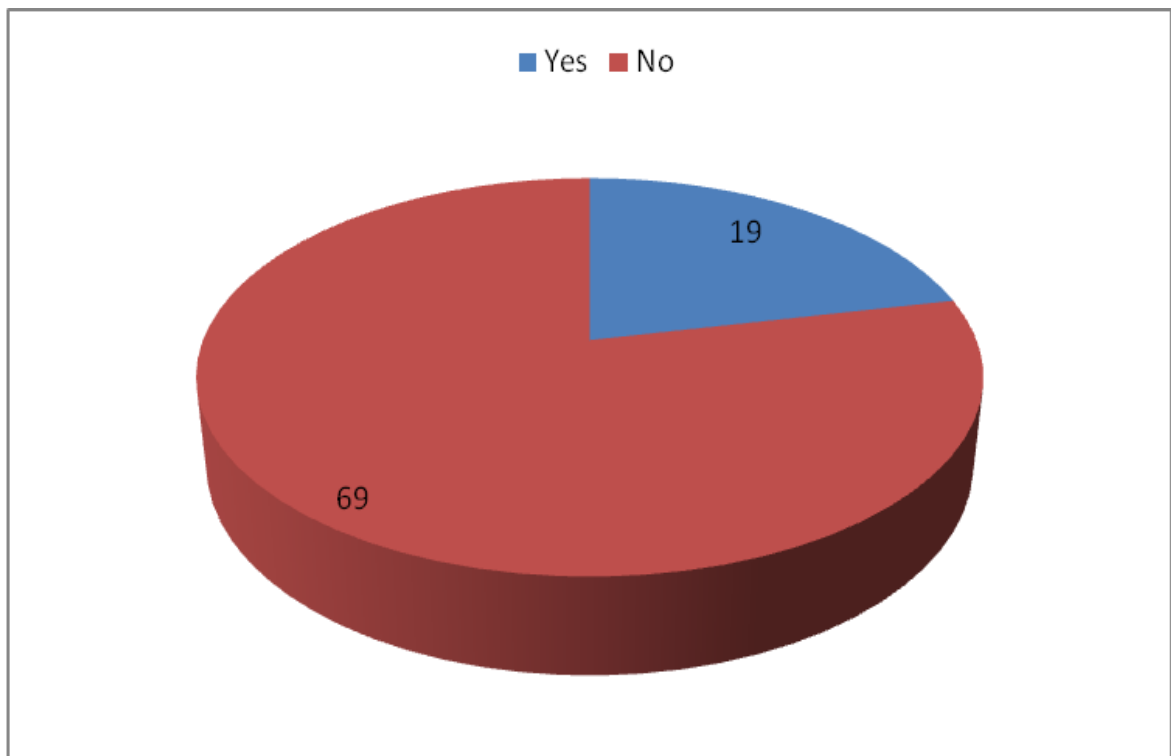
This presents the findings that show the effects of human settlement and activities on water distribution in the study area.

4.3.1: Summary of Major Findings from Household Survey

Households connected with pipe

With respect to respondents who are connected with the water pipe, findings show that 19(21.6%) of the respondents are connected with the pipe; while 69(78.4%) of the respondents are not connected as presented in figure 4.14.

Figure 4.14: Households connected with pipe



Source: Research findings (2015)

The study revealed that, (21.6%) of population in the study area has water pipes in their houses. Some respondents were quoted as saying “*connection costs and water bills are affordable.*” This result has also been shown by (HBS, 2000/1) that, 61.1% of rural households in Morogoro region are using improved (piped and protected) water sources as their drinking water. A comparison of the household connected with pipe between two studies show disparity; this study has showed relatively low percentage of household connected with pipe. Some respondents were quoted as saying.

“Initial costs for piped water connection are higher” while others said that *“water supply is not reliable; therefore, there is no need to have pipes in the house.”*

In this respect, previous studies by UN (2008) indicated that in 2006, 54% of the world’s population had a piped connection to their dwelling, plot, or yard, and 33% used other improved drinking water sources. The remaining 13% (884 million people) relied on unimproved sources. (WHO and UNICEF, 2006) indicated that in 2004, only 44% of people in the developing world had access to drinking water through a household

connection or a yard tap. There are huge disparities between regions: while access to drinking water through a household connection is as low as 16% in sub-Saharan Africa, 20% in Southern Asia, 21% in Oceania and 28% in South-eastern Asia, it is much higher in Eastern Asia (70%), Northern Africa (76%), Latin America and the Caribbean (80%) and Western Asia (81%). Respondents from households without pipe claimed that, they fail to fulfill their domestic activities, because they are required to fetch water from either private or community piped water points. Some respondents were quoted as saying;

“I fail to accomplish my daily routine; if I had a pipe in my home, I could do my daily work comfortably”

“Some neighbours who have pipes are not friendly, even if you are in hurry, they cannot give you a privilege.”

Also studies by WHO and UNICEF (2010) indicated that families which are not connected with water pipes to their premises usually assign women in the household to fetch water for household consumption. An enhanced access to safe drinking water provides the deprived, especially women, an opportunity to be in command of vital aspects of their livelihood and maximize their sense of confidence/self-esteem (Mukherjee and van Wijk, 2003).

Days a tap flowing water per week

Table 4.219 shows the number of days that a tap flows water per week based on households that are connected with pipes. Findings show that 12(13.6%) of the respondents mentioned 1-2 days; 7(8%) of the respondents mentioned 3-4 days and 69(78.4%) of the respondents could not say anything.

Table 4.19: Days a tap flowing water per week

Days	Frequency	Percent
1-2	12	13.6
3-4	7	8.0
None	69	78.4
Total	88	100.0

Source: Research findings (2015)

The study revealed that; 13.6% of the respondents responded that; at most 1-2 days per week water taps do flow, the respondents claimed that water taps flowing is not sufficient. When claims are channeled to village officials; they are not seriously addressed, some respondents were quoted as saying;

“We are paying water bills accordingly but water services are not hopeful.”

The claims by respondents show lack of commitment and integrity by the village officials.

Also the findings show the variation of continuity of water supply to the community members GHF, (2013) reported the variation from person to person and neighborhood to neighborhood based on user perception of the water supply. The study found that, even though water supply is not reliable; but it is at least fulfilling the need of community.

Distance walked to fetch water

Regarding the distance walk to collect water from the sources, findings show that 36(40.9%) of the sample population travel below as less than or equal to 50 metres; 23(26.1%) travel between 50-100 metres; 6(6.8%) travel between 101-200 metre; 4(4.5%) travel beyond 201 metre; and 19(21.6%) of the respondents could not tell anything as it indicated in table 4.20.

Table 4.20: Distance walked to fetch water

Distance	Frequency	Percent
<50m	36	40.9
50-100m	23	26.1
101-200m	6	6.8
>201m	4	4.5
None	19	21.6
Total	88	100.0

Source: Research findings (2015)

The results reveals that; 40.9% of the respondents travel a short distance such that less or equal to 50 meters to collect water; while 59.1% of the respondents travel beyond 50meters; the study finds that water sources especially piped water points are many and allocated close to community. Also the study shows that after every 10th houses there is a water point allocated especially in Mlali village where privately managed piped water points are huge, while in Kipera piped water points under the community are close to the community. Also the studies indicates that the minority who travel beyond 201 metres are

living away from water points. The Ministry of water (2002) reported that people, especially women and children, walk long distances to fetch water. This research shows an improvement on distance walk to fetch water since community members especially women and children walk a short distance to fetch water.

Time taken to fetch water

Regarding the time taken to fetch water, findings show that 28(31.8%) of the respondents spent as less than or equal to 60 minutes; 17(19.3%) of the respondents spent between 61-120 minutes; 9(10.2%) of the respondents spent between 121-180 minutes; 15 (17%) of the respondents spent beyond 181 minutes; and 19 (21.6%) of the respondents could not specify as it is indicated in table 4.21.

Table 4.21: Time taken to fetch water

Time	Frequency	Percent
<60min	28	31.8
61-120min	17	19.3
121-180min	9	10.2
>181min	15	17.0
None	19	21.6
Total	88	100.0

Source: Research findings (2015)

The results reveal that, majority of respondents (31.8%) spent as less than or equal to 60 minutes to fetch water currently based on those households that are not connected with pipe. The study indicates the correlation between distance walk to fetch water and time taken to fetch water. It shows that as distance shorten the time taken shorten whilst if distance walk is long then time taken long as well. In this respect, previous studies (HBS, 2000/1) have shown that 70.7% of households in Morogoro region who's nearest drinking water supply in the dry season are within 15 minutes. The respondents have stated costs gained through spending more time fetch for water include; fail to participate in alternative income generation activities. This findings is supported by (Tadesse et al, 2013) commented that the time spent due to multiple trips to collect water is so high in economic terms and contributes to lower productivity. Also (WHO and UNICEF, 2010) indicated that households members who spent more than 30 minutes to collect water usually fail to fulfill the household daily water consumption.

This study has proved the truth of these supportive arguments, because; the study discovered that the respondents who spent more time to fetch water have less economic opportunities than those who have spent less time to fetch water. Also this study has showed disparity with HBS (2000/1) findings; such as way that; this study has shown relative low percentage (31.8%) of households who spent a less than or equal to 60 minutes to fetch water. The study exposed that there is insufficient water supply in the study area.

Time spent to fetch water in the past ten years

Regarding the time taken to fetch water in the past, findings show that 66(75%%) of the respondents have spent as less than or equal to 60 minutes; 5(5.7%) of the respondents have spent between 61-120 minutes; 1(1.1%) of the respondents have spent between 121-180 minutes; 3 (3.4%) of the respondents have spent beyond 181 minutes; and 13 (14.8%) of the respondents were not concerned as indicated in table 4.22.

Table 4.22: Time spent to fetch water in the past ten years

Time	Frequency	Percent
<60 minutes	66	75.0
61-120 minutes	5	5.7
121-180 minutes	1	1.1
>181 minutes	3	3.4
None	13	14.8
Total	88	100.0

Source: Research findings (2015)

The results reveal that; majority of respondents (75%) spent as less than or equal to 60 minutes to fetch water in the past 10 years. The study reveals that more households spent a less than or equal to 60 minutes to fetch water over past ten years than current because, over past ten years entire population in the respective villages was relatively low of about 3500 population in the past ten years compare to about 10,024 population nowadays. The implication is that when populations increase, the demand for resources, especially water increase. This study is supported by (UNFPA, 1991 & RAS and NAS, 1992) as argued that as human population continues to expand, prosperity and the quality of life can be expected to decline because resources must be divided among more people. Also the study found that even if, piped water points are located nearby the community, the waiting time for fetching water is too long that hindering community participation in alternative income activities and enhance lower household income.

Number of buckets (20litres) of water needed by household per day

Table 4.23 shows the number of buckets (20litres) of water needed by households per day, findings show that; 9 (10.2%) of the respondents needed 1-3buckets per day; 46 (52.3%) of the respondents needed 4-7 buckets per day; 23 (26.1%) of the respondents needed 8-11 buckets per day; 5(5.7%) of the respondents needed 12-15 buckets per day; and 5(5.7%) of the respondents needed beyond 16 buckets per day.

Table 4.23: Number of buckets (20litres) of water needed by household per day

Number of buckets	Frequency	Percent
1-3	9	10.2
4-7	46	52.3
8-11	23	26.1
12-15	5	5.7
>16	5	5.7
Total	88	100.0

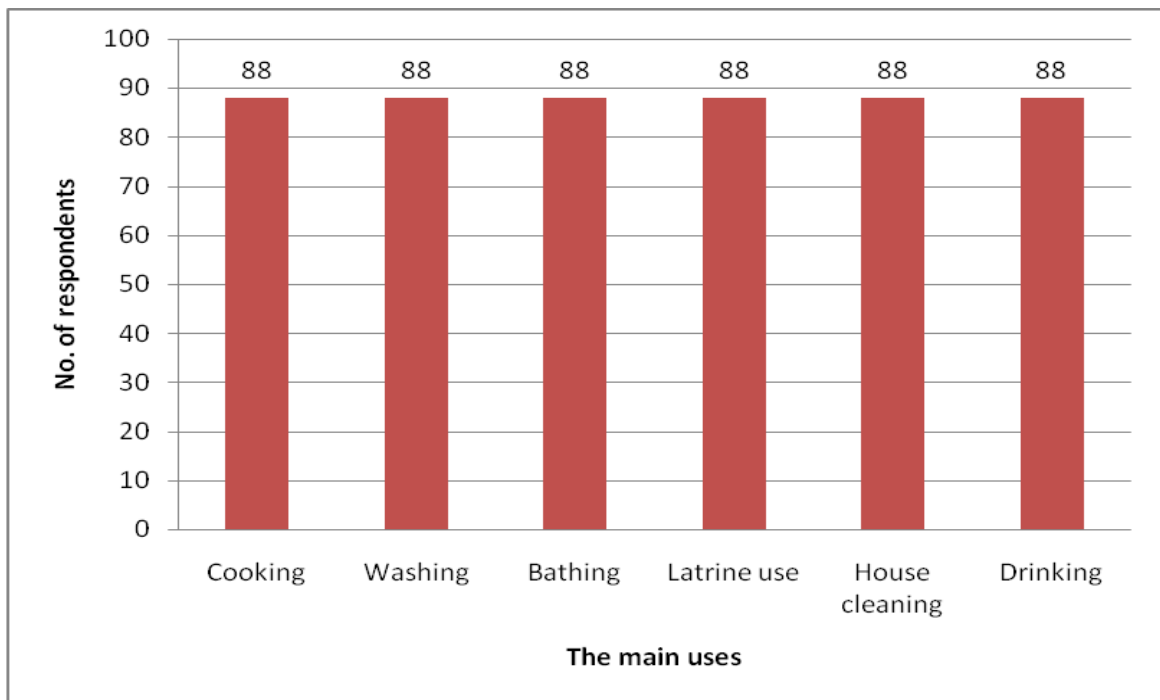
Source: Research findings (2015)

Results reveal that; majority (52.3%) of the respondents needed large amount (4-7 buckets) of water per day. The study found variation on water consumption per household per day. This study is supported by (Tadesse et al, 2013) as indicated that the average household water consumption pattern depends on the family size, the level of income, economic activity, the degree of engagement in productive activity and consumption behavior. The study reveals that the household size is correlated with water consumption. The findings of this study has shown that 50(56.8%) of the respondents posses 4-6 members of household as similar as report on Population and Housing Census (2012) report. Therefore, it implies that the higher number of household size the higher amount of water consumed per day.

The main uses of water at household

Regarding the main uses of water at household, findings show that, all respondents 88 (100%) use water for similar purposes as indicated in figure 4.15.

Figure 4.15: Main uses of water at household



Source: Research findings (2015)

The results reveal that, all respondents (100%) use water for cooking, washing, bathing, latrine use, house cleaning and drinking. However, the amounts of water consumed vary among households. This study is supported by Tadesse et al, (2013) who argued that the household level economic and productive activities determine the amount of water used per day for different purposes.

Water sufficient to meet household requirements

Table 4.24 shows the level of water sufficient to meet household requirements, findings show that, 19(21.6%) of the respondents responded that the amount of water supplied meet the household requirements; while 69(78.4%) of the respondents responded that, the requirements are not met.

Table 4.24: Water sufficient at household

Response	Frequency	Percent
Yes	19	21.6
No	69	78.4
Total	88	100.0

Source: Research findings (2015)

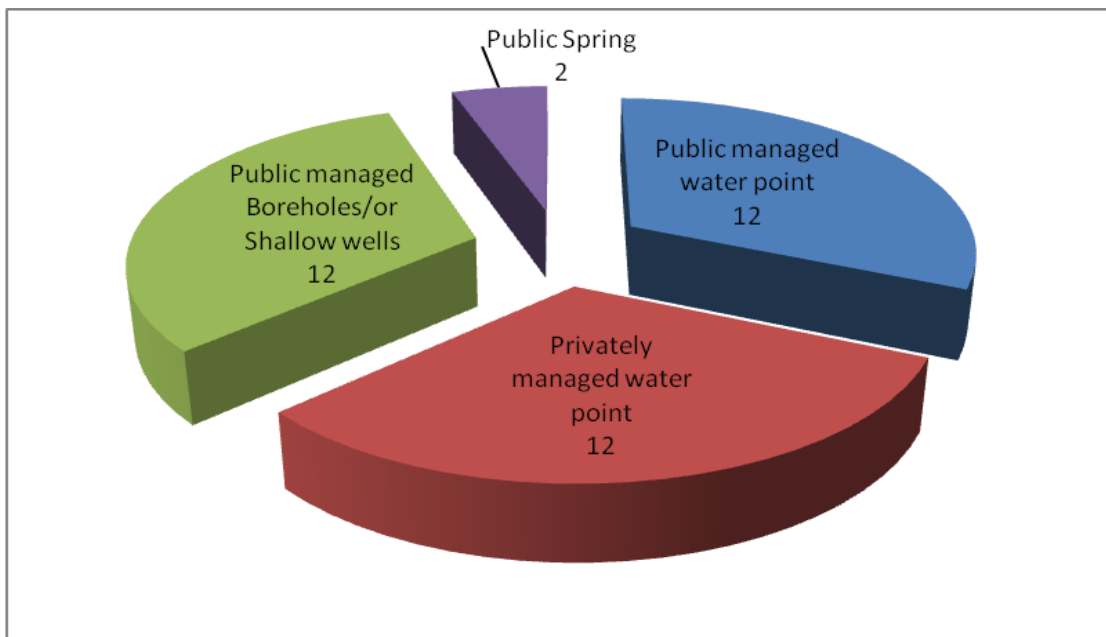
The results show that; 21.6% of the respondents who said that the supply of water meet the household requirements are connected with pipes in their houses while 69(78.4%) of the respondents who said that the supply of water does not meet the household requirements are not connected with pipes in their houses. According to UNEP (1999) report it shows that, domestic water consumption in developed countries (50-800litres per person per day) is about six times more than in developing countries (60-150 litres per person per day). In this study, 69(78.4%) of the respondents claimed that the water supply does not meet the household requirements. This is because, the average amount of water gained by per person per is about 1 bucket (20litres) which is below the standard of human water consumption per day as given by UNEP (1999). Also the study found that, majority of respondents do not have water storage containers, such that they depend on direct tap water flowing which is not reliable.

4.3.2: Summary of Major Findings from Key Informants session

The main water collection points

Regarding the main water collection points, findings show that, 2(4%) of the respondents pointed out public managed spring as water collection point; 12(32%) of the respondents mentioned public managed bore hole/or shallow wells as water collection point; 12(32%) of the respondents mentioned privately managed water points as water collection point; and 12(32%) of the respondents as mentioned public managed water points as water collection point as indicated in figure 4.16.

Figure 4.16: Main water collection points



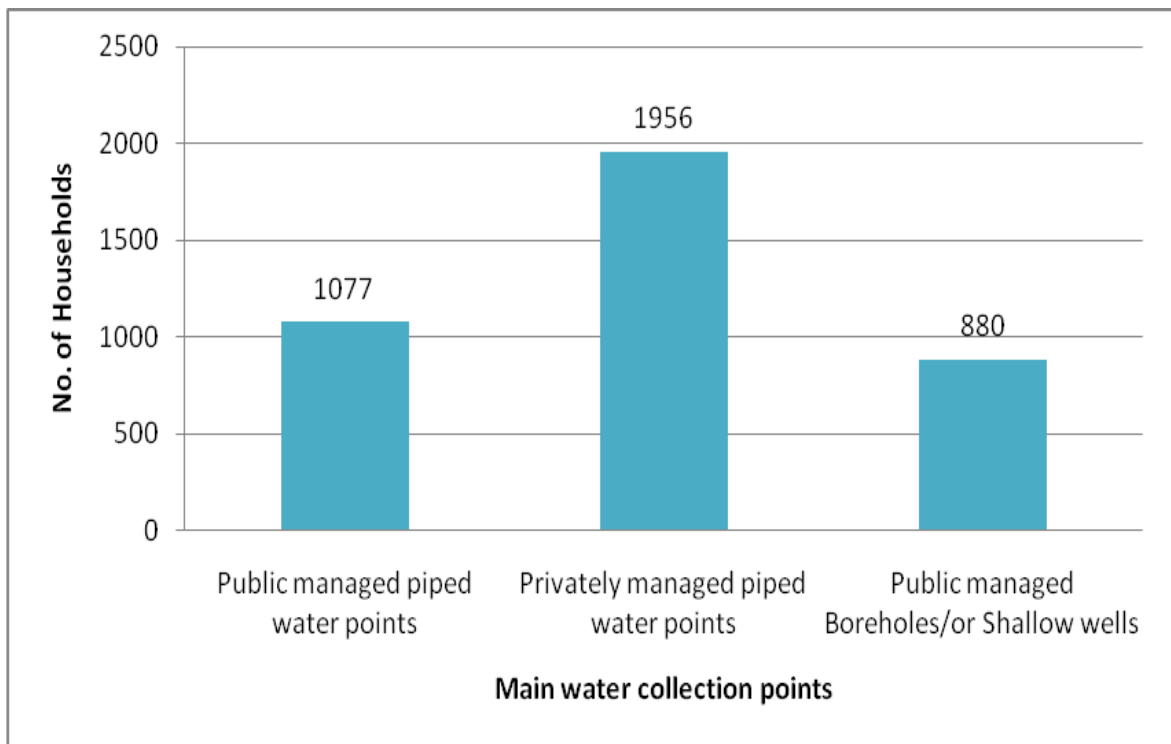
Source: Research findings (2015)

Results reveal that, public managed boreholes/or shallow wells, public managed piped water points, and privately managed piped water points are common water collection points which are well known and coordinated well by both village and district leaders. Also the study reveals that, the public managed spring as water collection point is only known by district leaders, this implies that, there is parallel coordination between village and district leaders on spring management. This situation might cause irresponsibility to village leaders on management of spring and end result will be degradation of the existing spring in the study area.

Relationships between households and water collection points

Regarding the relationship between households and the main water collection points in the study area, findings show that, 1956 (73.37%) of total households collect water from privately managed piped water points; 1077(40.39%) of total households collect water from public managed piped water points; and 880(33%) of total households collect water from public managed boreholes/or shallow wells as indicated in figure 4.17.

Figure 4.17: Relationship between households and water collection points



Source: Research findings (2015)

The study reveal that; privately managed piped water points are the main water collection points in the study area followed by public managed piped water points and public managed borehole. According to the respondents (73.37%) of total household in the study area collect water from privately managed water points. Despite, the study area posses other water collection points like public managed springs, rivers, and uncovered rainwater harvesting systems, however, the number of households benefited is not yet known. Additionally, one household can collect water from any source depending on season, affordability, and accessibility.

Experience on water shortage distribution

Table 4.25 shows experience on water shortage distribution, findings show that all respondents 12(100%) stated 6-10 years experience on water shortage in the study area.

Table 4.25: Experience on water shortage distribution

Experience	Frequency	Percent
6-10 years	12	100.0

Source: Research findings (2015)

The results reveal that, the study area experienced the shortage of water distribution shortage in between 6-10 years. The respondents show differences in term of magnitude of the water distribution shortage. Some said that, water distribution shortage occur throughout the year while other said that, some months have good water distribution. The study shows correlation between water distribution at collection points including; privately managed piped water points and community managed piped water points and water supply from the sources include; gravity scheme and pumping scheme. For the fact that; if the quantity of water is depleted due to different factors including development of agricultural practices, catchment degradation or climate variability then water distribution at water points is affected. .

4.3.3: Summary of Major Findings from Focus Group Discussion session

Table 4.26 shows the main water collection points in the study area, findings from two FGD show that the public water points, private water points, and borehole are used as collection points.

Table 4.26: Main water collection points

Water collection points	Frequency	Percent
Public water point	2	100
Private water point	2	100
Borehole	2	100

Source: Research findings (2015)

Results from two FGD indicate that, despite, having other water points, the public managed water points, privately managed water points are also used as collection points, and public boreholes are used as collection points.

Experience on water distribution shortage

Table 4.27 shows experience on water distribution shortage in the study area, findings from two FGD show that the area has had 6-10 years experience on water shortage

Table 4.27: Experience on water distribution shortage

Experience	Frequency	Percent
5-10 years	2	100.0

Source: Research findings (2015)

The study reveals that, the study area had experienced water supply shortage in between 6-10 years. Moreover, the respondents didn't recall years with high level of water supply shortage as well years with low level of water distribution shortage. Furthermore, the study shows that the study area is experiencing shortage of water supply.

The daily routine at household level

Table 4.28 shows daily activities in the household with respect to fetching water in the study area; findings from two FGD indicates that, majority of members of the community especially women are used to wake up at 5-6 am to prepare tea/or pourage for other members of household, at 6-7 am they go to fetch water. , where they spend about 1-7hours, then they come back to prepare lunch for the family members, from 1-2 pm, they go back to fetch water, they come back to prepare dinner f from 5-9 pm after which they go for a sleep.

Table 4.28: The daily routine at household level

Activities	Hours						
	5-6 am	6-7 am	7am-1pm	1-2 pm	2-5pm	5-9pm	9pm-5am
Wake up							
Preparation of tea/pou rage							
Fetching of water							
Preparation of lunch							
Fetching of water							
Preparation of dinner							
Sleeping							

Source: Research findings (2015)

The study shows that, water shortage affect the daily activities at household level, since members of household especially women spent more time during the day for fetching water Also the study reveals that the situation was worse during the dry season, unlike the

rain season because, the gravity scheme is full of water and enhance reliability of water supply. Time spent for fetching water depend upon household size as well as distance from water sources. Large household sizes consume a large amount of water compared to small household size. Meanwhile household allocated far from water sources require to spend more fetching water compare to household that are situated nearby water sources.

4.3.4: Summary of Discussion of Household Survey, Key Informant, and FGD findings

The major findings from Household Survey have shown that; 21.6% of the respondents are connected with pipe; while 78.4% of the respondents are not connected with pipe; 13.6% of the respondents claimed that water tap are flowing between 1-2 days per week; 40.9% of the respondents travel a short distance to collect water; 31.8% of respondents spent as less than or equal to 60 minutes to fetch water especially those from household which are not connected with pipe; 75% of respondents spent as less than or equal to 60 minutes to fetch water in the past 10 years; 52.3% of the respondents needed a large amount of 4-7 buckets of water of (20litres) per day, moreover, the amount of water used depended up on household size and economic activities; all respondents use water for cooking, washing, bathing, latrine use, house cleaning, and drinking purposes; 21.6% of the respondents said that the water supply meet household requirements while; 78.45% of the respondents said that water supply does not meet household requirements, this disparity is caused by the presence and of pipes in some household and the absence of pipes in the in the others. ;

The major findings from Key Informant have shown that; public managed borehole, public managed piped water points, and privately managed piped water points are common water collection points coordinated by village, ward and district leaders, however, 4% of the respondents mentioned the public spring as water collection point, but the study shows parallel understanding and coordination between the village and district with respect to management and utilization of public spring; 73.37% of total households depend on privately managed piped water points; 40.39% of the total households depend on public managed piped water points; 33% of the total household depend on public managed borehole; and the study area is experiencing water distribution shortage happened between 6-10 years a go as per the results of key informant and FGD analysis. In general, the study

comments that; human settlement and activities significantly affect water distribution in the study area.

4.4 The effects of human settlement and activities on water quality

This presents the findings that show the effects of human settlement and activities on water quality in the study area.

4.4. 1: Summary of Major Findings from Household Survey

Opinion on the drinking water

Table 4.29 shows an opinion on the quality of drinking water in the study area. Findings show that; 55(62.5%) of the respondents said that the water quality is good; 11(12.5%) of the respondents said that water has salty taste; 7(8%) of the respondents said that water is not colorless, it has some colours; 6(6.8%) of the respondents said that water has bad odour; and 9(10.2%) of the respondents said that water has some particles inside.

Table 4.29: Opinion on the drinking water quality

Opinion	Frequency	Percent
Good	55	62.5
Salty	11	12.5
Coloured	7	8.0
Bad odour	6	6.8
Has some particles inside	9	10.2
Total	88	100.0

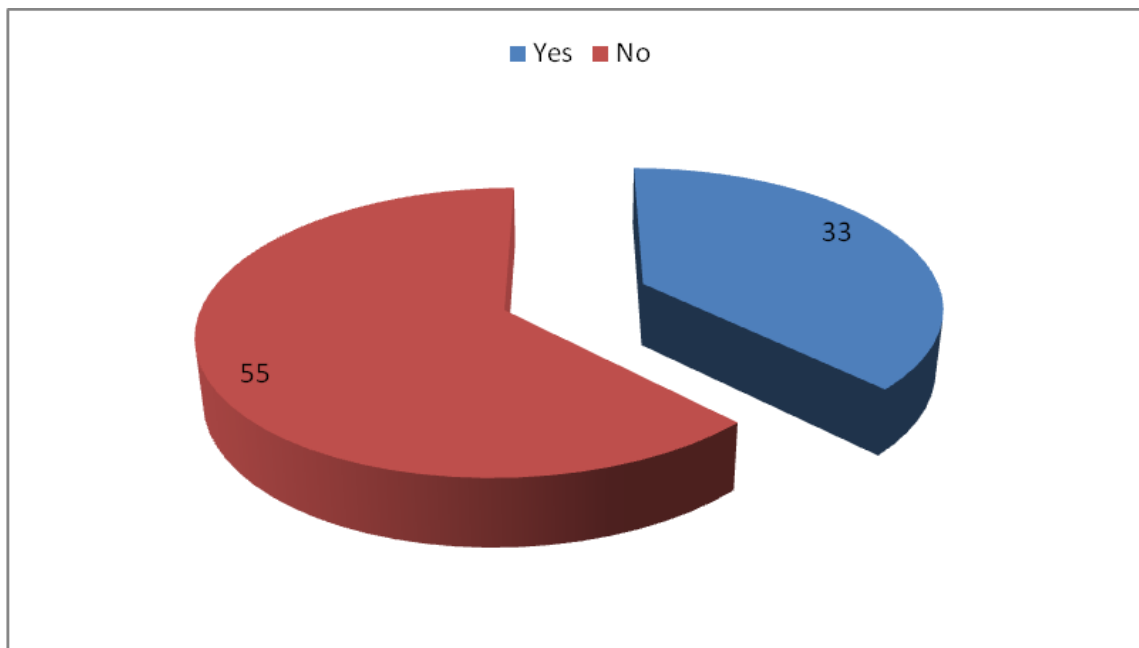
Source: Research findings (2015)

The study found that water quality is still good in the study area, since majority of respondents (62.5%) declared that the water in the area has a good quality (37.5%) of the informants said that the water quality has been changing over time.

Water quality change over time

Regarding quality, taste or appearance change overtime, findings show that 33(37.5%) of the respondents said yes; while 55(62.5%) of the respondents marked no as presented in figure 4.18.

Figure 4.18: Water quality change over time



Source: Research findings (2015)

The study discovered that; the water quality has not changed over time, since majority of respondents (62.5%) said so (37.5%) of respondents said no. Also the study revealed that the respondents differ on water quality change concept. The study reveals that, the minority of the respondents agreed that the water quality change based on physical characteristics of water such that changing of colour, odor, and taste. Meybeck et al (1996) stated that the quality of water may be described in terms of the concentration and state (dissolved or particulate) of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. Therefore, it is not realistic to confirm water quality change based upon change of physical characteristics only.

Factors that influence the change of physical characteristics of water

Table 4.30 shows factors that influence the change of physical characteristics of water in the study area, findings show that, 1(1.1%) of the respondents mentioned the type of rocks; 2(2.3%) of the respondents mentioned increasing population; 13(14.8%) of the respondents mentioned agricultural activities; 7(8%) of the respondents mentioned chemicals from farm (pesticides); 1(1.1%) of the respondents mentioned surface runoff; 4(4.5%) of the respondents mentioned poor infrastructures (dirty water storage tanks);

1(1.1%) of the respondents mentioned catchment degradation; 4(4.5%) of the respondents mentioned that pumped water from underground has salty taste; while 55 (62.5%) of the respondents disagreed.

Table 4.30: Factors that influence the change of physical characteristics of water

Factors	Frequency	Percent
Type of rocks	1	1.1
Increase population	2	2.3
Agriculture activities	13	14.8
Chemicals from farm (pesticides)	7	8.0
Surface runoff	1	1.1
Poor infrastructures (Dirty water storage tanks)	4	4.5
Catchment degradation	1	1.1
Pumped water from underground has salty taste	4	4.5
None	55	62.5
Total	88	100.0

Source: Research findings (2015)

Results show that; agricultural activities are the main cause of changing the water physical characteristics in the study area. In this respect, previous studies (Meybeck et al, 1996) urged that water quality is affected by a wide range of natural and human influences. The effects of human activities on water quality are both widespread and varied in the degree to which they disrupt the ecosystem and/or restrict water use. A given example of pollution from diffuse sources, such as agricultural run-off, is particularly difficult to control. UNEP (2010) reported that the vast extent of agricultural activities around the world contributes significantly to both economic productivity and water-pollutant loads; N, P in the ground water have increased since 1970s. Ignazi (1993) showed that, intensive cultivation and growing concentration of “factory” livestock or aquaculture operations have also long been known to produce large non-point source contributions of pollutants to surface and ground water pollution.

A comparison of domestic, industrial, and agricultural source of pollution from the coastal zone of Mediterranean countries found that agriculture was leading source of phosphorus compounds and sediment (UNEP, 1996a). FAO (1996) disclosed that beyond nitrate contamination, agricultural activities are also linked to the salinization of surface water,

eutrophication (excess nutrients), pesticides in runoff, and altered erosion and sedimentation patterns. Also the study found that poor infrastructures (dirty water storage tanks) and pumping from underground water system contribute water quality change. Furthermore, the study found that apart from existing gravity scheme, also pumping scheme is being use as a source of piped water in-spite of having salty taste as claimed by some respondents. The construction of pumping scheme is ongoing project under the World Bank Rural Water Supply Project that aims to improve water supply in Mlali and Kipera villages (District Water Department, 2014). Figure 4.19- 4.20 shows water network through pumping scheme at Mlali and Kipera villages.

Figure 4.19: Storage water tank at Gudugudu hamlet in Mlali village (left) and Community water point (right) .



Figure 4.20: Constructed pumping scheme house

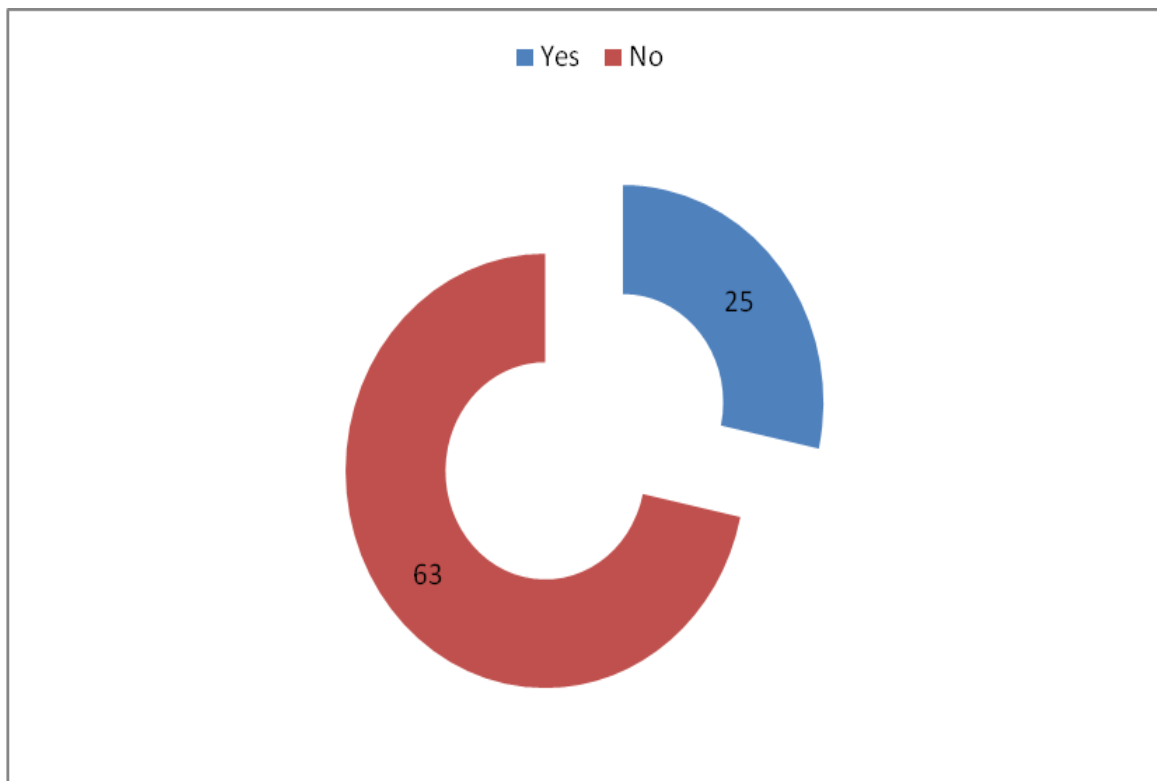


Source: Research findings (2015)

Household water treatment

Figure 4.22 shows the number of households that treat water to make it safe to drink in the study area, findings show that; 25(28.4%) of the respondents do treat water ; while 63(71.6%) of the respondents do not treat water.

Figure 4.21: Households water treatment



Source: Research findings (2015)

The study indicates that; only (28.4%) of sample population treated water to make it safe to drink. In this respect, previous studies have shown the important of water treatment. WHO (2005) commented that unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrhea disease annually, causing more than 1.5 million deaths, mostly among children under 5 years of age. Sobsey (2002) argued that, treating water at the household level is more effective than conventional improvements in water supplies in ensuring the microbiological quality of drinking water at the point of consumption. Clasen (2006a) found that household-based interventions were about twice as effective in preventing diarrhoeal disease (47%) than improved wells, boreholes, and communal stand pipes (27%). Furthermore, the study revealed that, the households that treat water to make it safe to drink, have experienced less water borne diseases infections compared to non water treatment households.

Water treatment methods

Table 4.31 shows water treatment methods in the study area; findings show that, 20(22.7%) of the respondents have mentioned boiling; 5(5.7%) of the respondents have mentioned water guards; while 63(71.6%) of the respondents haven't used any methods.

Table 4.31: Water treatment methods

Methods	Frequency	Percent
Boiling water	20	22.7
Water guard	5	5.7
None	63	71.6
Total	88	100.0

Source: Research findings (2015)

The study shows that; 22.7% of the respondents desire boiling water method to make drinking water safe than water guard method. The respondents gave reasons of using most boiling water method including; convenience and human healthily friendly. The respondents who use water guard for water treatment, they said that the method is easy since, no time consumed.

Monthly costs for safe drinking

Table 4.32 shows the cost to make safe water for drinking per month in the study area; findings show that, 3(3.4%) of the respondents spent Tshs 3000; 13(14.85) of the respondents spent between Tshs 3100-10,000; 9(10.2%) of the respondents spent between Tshs 11,000-30,000; while 63 (71.6%) of the respondents t did not spend any costs.

Table 4.32: Monthly costs for safe drinking water

Costs	Frequency	Percent
3000	3	3.4
3100-10000	13	14.8
11000-30000	9	10.2
None	63	71.6
Total	88	100.0

Source: Research findings (2015)

The study reveals that, the costs incurred to make safe water for drinking at the household depend on household size and desired method. The large household size required to spend more cost so to make safe water. Also the study found that firewood is the most source of

energy used to boil water so that to make it safe. For boiling water costs, the respondents calculated the costs for firewood collection through time spent to and fro the field. Some respondents were quoted saying:

“I collect 2 bundles of firewood from the field every week; if I buy it, will cost me about Tshs 10,000 per month.”

if I use the time spent on firewood for income generating activities, I could earn about Tshs 20,000 per month.”

For water guard costs, the respondents said that it costs about Tshs 3000 per month.

Reasons for not treating water

Table 4.33 shows the reasons for not treating drinking water in the study area; findings show that; 13(14.85%) of the respondents responded that, it is time consuming; 48(54.5%) of the respondents it costs 2(2.3%) of the respondents just trust the water from the original sources; while 25 (28.4%) of the respondents treated their water before using it for other important activities.

Table 4.33: Reasons for not treating water

Reasons	Frequency	Percent
Time consuming	13	14.8
Costs conscious	48	54.5
Entrust water from the original sources	2	2.3
None	25	28.4
Total	88	100.0

Source: Research findings (2015)

The study found that; majority of the respondents (54.5%) pointed out the costs as the main reason for not treating water for drinking. Costs reason is supported by previous studies. Thevos, et al (2000) reported that lack of money as one of the reasons that they did not intend to purchase chlorine to purify their water in Zambia.

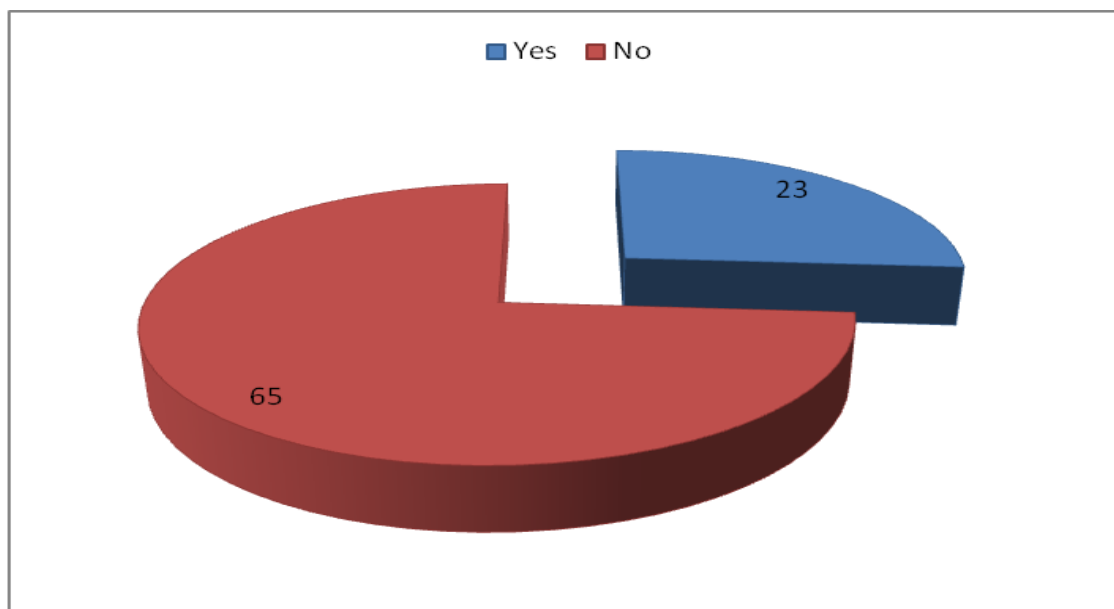
McLennan (2000a) reported the main reasons given for no longer boiling water were “cannot buy enough fuel,” “no stove,” and “no appropriate pots in the Dominican Republic. Also, time consuming was one of the reason mentioned by the respondents (14.8%).

This is also supported by (McLennan, 1998, 2000b and Halvorson, 2004) report that not having sufficient time as well as not enough time to boil water every day was reasons given by respondents in Dominican Republic and Pakistan respectively.

The government efforts taken to minimize water quality problem

Figure 4.22 shows the government efforts taken to minimize water quality problems in the study area; my findings show that; 23(26.1%) of the respondents agreed that the government have taken efforts to minimize water quality problem; while 65(73.9%) of the respondents did not agreed.

Figure 4.22: Government efforts taken to minimize water quality problem



Source: Research findings (2015)

The study shows that; a minority of the respondents (26.1%) are aware about the government efforts to minimize water quality problem. Moreover, the study indicates that the minority have rights to information since; they participated in community development activities including various village general meetings.

According to Local Government Act (District Authorities) No. 7 of 1982 section 141 state that; a village general assembly has given supreme authority on all development matters in the respective village even to organize village general assembly so that to make policy related to village affairs.

Efforts undertaken by the government to make safe water

Table 4.34 shows the effort undertaken by the government in the study area; findings show that; 2(2.3%) of the respondents mentioned introduction of water treatment methods to the community; 2(2.3%) of the respondents mentioned capacity building on water management through meeting at hamlet level; 9(10.2%) of the respondents have mentioned water treatment in storage tank by using chlorine; 9(10.2%) of the respondents have mentioned cleaning water storage tanks; 1(1.1%) of the respondents has mentioned repair water infrastructures; while 65 (73.9%) of the respondents haven't mentioned any efforts.

Table 4.34: Efforts undertaken by the government to make safe water

Efforts	Frequency	Percent
Introducing water treatment ways	2	2.3
Capacity building on water management through meeting at hamlet level	2	2.3
Water treatment in storage tank by using chlorine	9	10.2
Cleaning water storage tanks	9	10.2
Repair water infrastructures	1	1.1
None	65	73.9
Total	88	100.0

Source: Research findings (20150

The study found that; water treatment in storage tank by using chlorine and cleaning water storage tanks are the main efforts undertaken by the government so as to minimize water quality problems in the study area. In this respect, previous study has shown the importance of treat water by using chlorine. Gordon et al (1987) indicated that chlorination was first used to disinfect public water supplies in the early 1900s, and helped drastically reduce waterborne diseases in cities in Europe and the United States. The impact of chlorine in reducing diarrhoeal diseases has been documented by Arnold & Colford, (2007).

Reasons for not knowing the government efforts

Table 4.35 shows the reasons for not knowing the efforts undertaken by the government to minimize water quality problems in the study area; findings show that; 52(59.1%) of

respondents responded that they are not informed; 13(14.85%) of the respondents responded that they are not aware; while 23(26.1%) of the respondents are informed.

Table 4.35: Reasons for not knowing the government efforts

	Frequency	Percent
Not informed	52	59.1
Not aware	13	14.8
None	23	26.1
Total	88	100.0

Source: Research findings (2015)

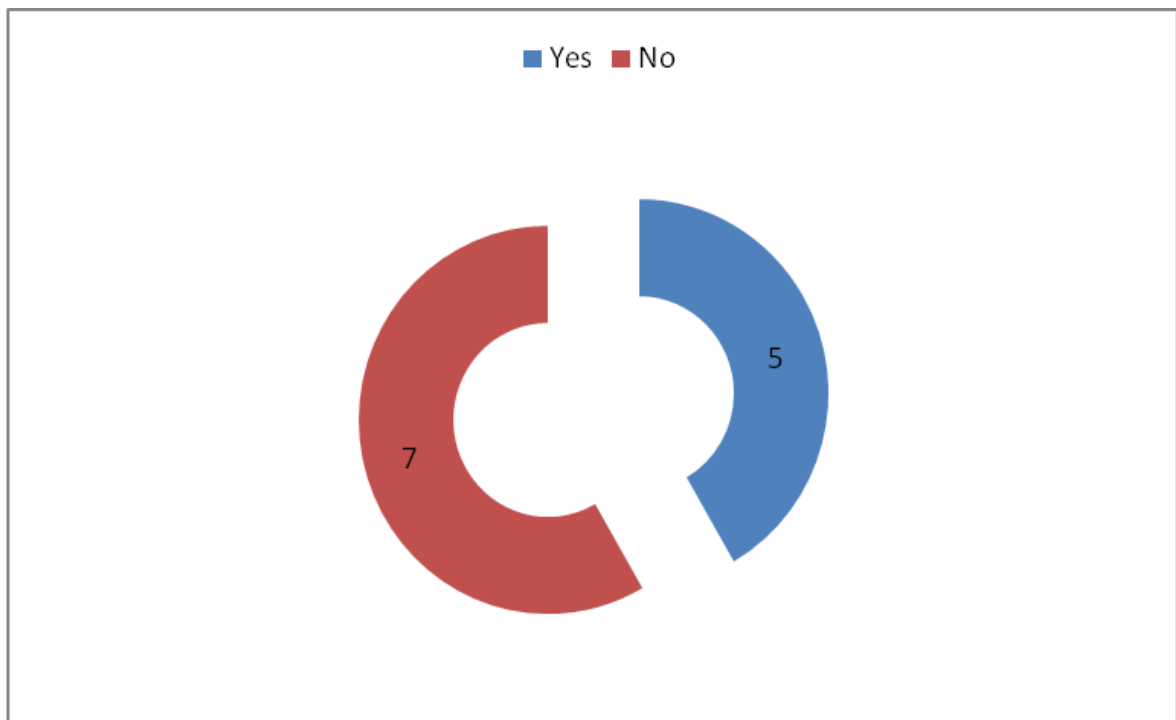
The study shows that, majority of the respondents (59.1%) are not informed about an efforts undertaken by the government to minimize water quality problems in the study area because, they are far from community development activities such that they are not often attending the village general meetings or meeting at hamlet level. Also the study revealed that the respondents who unaware for government efforts, they were absence in the study area for quite sometimes. In addition, they are less participating in community development activities.

4.4.2: Summary of Major Findings from Key Informants

Experience on change of water quality

Figure 4.23 shows the experience on change of water quality over the past 10 years in the study area, findings show that; 5(41.7%) of the respondents agreed the change of water quality; while 7(58.3%) of the respondents did not agree.

Figure 4.23: Experience on change of water quality



Source: Research findings (2015)

The study found that, a majority of the respondents (58.3%) have no idea about change of water quality in the respective villages. Despite the numerous water quality survey done by responsible authorities like Mvomero District Council under Water Department and Wami/Ruvu Water Basin Board in different years however, some villages as well ward leaders particularly in Mlali and Kipera had no information about these findings. For instance, water quality survey done by Wami/Ruvu Water Basin in 2012/2013 in Ruvu River only found the minimal river flow due to lack of dilution; in addition, the Ngerengere sites below Morogoro town all have very poor water quality compared to the rest of the basin. Mgeta River at Mgeta has the best water quality, followed by Morogoro River at Morogoro. Unlikely, the survey results were not shared to local community within the basin. Therefore, the respective leaders lack basic knowledge of water quality context. In this respect, previous the study by UNEP (2010) reported that a key to understanding water quality challenges and solutions is collecting, storing, analyzing, and sharing water quality data. Without adequate data, serious water quality challenges are unlikely to be identified and managed adequately to protect human and ecosystem health.

Possible causes of water quality problems

Table 4.36 shows possible causes of water quality problems in the study area, findings show that; 2(16.7%) of the respondents mentioned poor solid waste disposal as a major cause; 5(41.7%) of the respondents mentioned pesticides as a major cause; 5(41.7%) of the respondents mentioned inorganic fertilizers as a major cause; 4(33.3%) of the respondents mentioned washing clothes nearby by water sources as a major cause; and 3(25%) of the respondents mentioned poor toilet sanitation as a major cause.

Table 4.36: Possible causes of water quality problems

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
Poor solid waste disposal	2	2	1	7
Using of pesticides	5	7		
Using of inorganic fertilizers	5	7		
Washing clothes nearby water sources	4	1	7	
Poor toilet sanitation/ or hygiene	3	2	7	
Other (specify)				

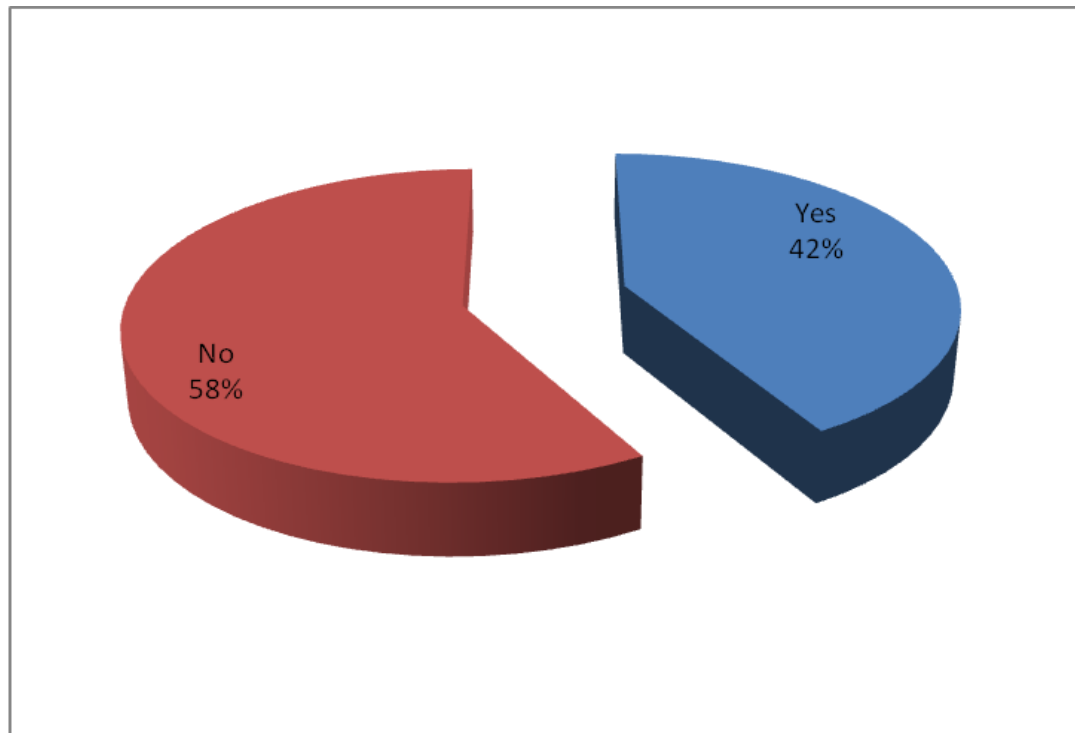
Source: Research findings (2015)

The result shows that (41.7%) of the respondents experienced change on water quality over the past 10 years in the study area, however, the study found the major causes of water quality problems including; the use of pesticides, and inorganic fertilizers. This result is supported by FAO (1996) that runoff of nutrients, especially phosphorus, lead to eutrophication causing taste and odor in public water supply, also runoff of pesticides leads to contamination of surface water and biota. With respect to poor toilet sanitation, previous studies by UNICEF and WHO (2008) indicated that 2.5 billion people live without improved sanitation. Over 70 percent of these people, or 1.8 billion people who lack sanitation, live in Asia. The amount of fecal coliform bacteria (associated with fecal matter) detected in Asia's rivers is 50 times the WHO guidelines, indicating a high level of dangerous microbial contaminants (UNEP, 2000).

Diseases outbreak related to poor water quality

Figure 4.24 shows diseases outbreak related to poor water quality, findings show that, 5(42%) of the respondents agreed; while 7(58%) of the respondents did not agree.

Figure 4.24: Diseases outbreak related to poor water quality



Source: Research findings (2015)

The study reveals that; few respondents (42%) agreed that diseases outbreak related to poor water quality in the study area. This percentage is correlated with percentage of the respondents who experienced the change of water quality over the past ten years in the study area. Therefore, the respondents who agreed on change of water quality also agreed on diseases outbreak relating to poor water quality.

List of diseases occurred

Table 4.37 shows the list of diseases occurred in the study area, findings show that, 1(8.3%) of the respondents mentioned the abdomen fever; 3(25%) of the respondents mentioned diarrhea; 1(8.3%) of the respondent mentioned cholera; while 7(58.3%) of the respondents did not mention any.

Table 4.37: List of diseases occurred

Diseases	Frequency	Percent
Abdomen fever	1	8.3
Diarrhea	3	25.0
Cholera	1	8.3
None	7	58.3
Total	12	100.0

Source: Research findings (2015)

The study found that, diarrhea is a common water borne disease occurred in the study area; for the reason that, the majority (25%) of the respondents mentioned diarrhea. In this respect, the previous study by UNICEF (2008) indicated diarrheal diseases as the most water borne disease worldwide. Other diseases include; cholera and typhoid that remain a serious problem in many regions of the world.

Age group affected most by water borne diseases

Table 4.38 shows the age group affected mostly by water borne diseases; finding shows that, 3(25%) of the respondents mentioned 0-5 years; 1(8.3%) of the respondent mentioned 6-14 years; 1(8.3%) of the respondent mentioned 15-49 years; while 7(58.3%) of the respondents did not mention any.

Table 4.38: Age group mostly affected by water borne diseases

Age group	Frequency	Percent
0-5 years	3	25.0
6-14 years	1	8.3
15-49 years	1	8.3
None	7	58.3
Total	12	100.0

Source: Research findings (2015)

The result indicates that, 0-5 years age group is mostly affected by water borne diseases in the study area. This result is supported by WHO (2002) reported that worldwide, waterborne diseases are among the leading killers of children under five years old and more people die from unsafe water annually than from all forms of violence, including war. Also this study found the efforts undertaken by village, ward and district levels concerning minimize water quality problems in the study area.

The efforts undertaken include formulation of Water User Association (WUA) that aims to control and monitor of all water sources; create community awareness on using safe water; and public water supply treatment by using chlorine. Water User Association namely Mlaki is made up with water committee members from Mlali and Kipera villages. The roles of WUA are governing by the constitution and by-laws that act as administrative tools so that to ensure all matters related to water resources management in both villages are handled well. Despite the importance of by-laws on ensuring sustainable water resources management, however, the study found a draft of village water by-laws that approved by village general assembly in the respective villages; in spite of draft of by-laws being sent to district level, but are not yet declared as Act demand (Village Leaders, 2014). Furthermore, by-laws to be enforced should be declared at the district level through full council (councilors general meeting) as stipulated in Local Government (District Authorities) Act No. 7 of 1982 section 118 (1) (d).

4.4.3: Summary of Major findings from two FGD

Experience on change of water quality

Table 4.39 shows experience on change of water quality, findings from two FGD agreed on change of water quality.

Table 4.39: Experience on change of water quality

Response	Frequency	Percent
Yes	2	100.0

Source: Research findings (2015)

The results of analysis from two FGD have shown change of water quality in the study area. The members of community have experienced change of water quality.

Possible causes of water quality problems

Regarding possible causes of water quality problems, the findings from two FGD have shown that, 2(100%) of FDG mentioned the use of pesticides as a major cause; 2(100%) of FDG mentioned the use of inorganic fertilizers as a major cause; 2(100%) of FGD mentioned poor solid waste disposal as a minor cause; 2(100%) of FGD mentioned washing clothes nearby water sources as a minor cause; and 2(100%) of FGD mentioned poor toilet sanitation as a minor cause as presented in table 4.40.

Table 4.40: Possible causes of water quality problems

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
Poor solid waste disposal		2		
Using of pesticides	2			
Using of inorganic fertilizers	2			
Washing clothes nearby water sources		2		
Poor toilet sanitation/ or hygiene		2		
Other (specify)				

Source: Research findings (2015)

The results of analysis from two FGD have shown that; the use of pesticides and inorganic fertilizers are major causes of water quality problem in the study area. Other minor cause include; poor solid waste disposal as a minor cause; washing clothes nearby water sources; and poor toilet sanitation.

Also the study found that farmers are using pesticides and inorganic fertilizers for aim of increasing crops yield. Also the study found that; the behaviour of washing clothes nearby water sources occurs during dry season when the respective villages face insufficient water supply. The majority of residents in the study area use pit latrine with poor sanitation facilities. Therefore, the area is subjected to waterborne diseases outbreak during rainy season.

Diseases outbreak related to poor water quality

Regarding diseases outbreak related to poor water quality, findings from two FGD have show that; 2(100%) of FGD agreed that the diseases outbreak is related to poor water quality as shown in table 4.41.

Table 4.41: Diseases outbreak related to poor water quality

Response	Frequency	Percent
Yes	2	100.0

Source: Research findings (2015)

The results of analysis from two FGD have shown that; the study area is experienced with diseases outbreak related to poor water quality. However, FGD didn't give out diseases outbreak record because outbreaks occur individually.

List of diseases occurred

Table 4.42 shows list of diseases occurred in the study area, findings from two FGD have shown that; 1(50%) of FGD has pointed out typhoid; while 1(50%) of FGD has pointed out diarrhea.

Table 4.42: List of diseases occurred

Diseases	Frequency	Percent
Typhoid	1	50.0
Diarrhea	1	50.0
Total	2	100.0

Source: Research findings (2015)

The results of analysis from two FGD have shown that; typhoid and diarrhea are the main diseases related to poor water quality occur most in the study area. The two FGD have shown variation because of rate of disease outbreak.

Age group affected most

Table 4.43 shows age group affected most by water quality problem in the study area, findings from two FGD have shown that; 1(50%) of FGD has responded 0-5 years; while 1(50%) of FGD has responded 6-14 years.

Table 4.43: Age group affected most

	Frequency	Percent
0-5 years	1	50.0
6-14 years	1	50.0
Total	2	100.0

Source: Research findings (2015)

The results of analysis from two FGD have shown that; 0-5 years and 6-14 years are age groups that affected most by water quality problems in the study area. The two FGD have shown variation because of extent of impacted age group with respective diseases.

4.4.4: Summary of Discussion from Major Household Survey, Key Informant, and FGD findings

The major findings from Household Survey show that; there is no significant water quality change over the past 10 years in the study area, for the reason that; majority of respondents (62.5%) said that the water is good; while 37.5% of the respondents said that the water quality has changed; slight water quality change is caused by poor agricultural activities in

the study area; 28.4% of sample population have treated water to make it safe for drinking; 22.7% of the respondents are in favor of boiling water method to make drinking water safe than using the water guard method. The study found that; costs incurred to make safe water for drinking at the households depends on household size and method used. 54.5% of the respondents have pointed out costs as main reason for not treating water for drinking; 26.1% of the respondents are aware about the government efforts undertaken to minimize water quality problems.

The study found that; water treatment in storage tanks by using chlorine and cleaning water storage tanks are the main efforts undertaken by the government so as to minimize water quality problems in the study area; 59.1% of the respondents are not informed about the efforts undertaken by the government to minimize water quality problems because they are far from community development activities. In spite of slight water quality problem in the study area, however, the study discovered diseases outbreak related to poor water quality in the study area including; diarrhea, cholera, skin diseases and abdomen fever.

The findings from Key Informant show that; 41.7% of the respondents did not agreed of the water quality change over the past 10 years, however; 25% of the respondents mentioned diarrhea as the most water borne disease; 0-5 years and 6-14 years aged groups are the most affected by waterborne diseases in the study area. In general, the study comments that; human settlement and activities have insignificantly affected water quality in the study area. Since, the study did not handle scientific evidences on water quality status from recognized institutions. Moreover, there are no water quality survey results documented with respect to Ngerengere upstream sub catchment where the study area is located.

4.5: The effectiveness of fees system on water resources management

4.5.1: Summary of Major Findings from Household Survey

Water bill per month in the household

Table 4.44 shows the water bill per month in the household, findings show that 19(21.6%) of the respondents pay between Tshs 1000-10,000 per month as water bill; while 69(78.4%) of the respondents do not pay water bill.

Table 4.44: Water bill per month in the household

Water bill	Frequency	Percent
1000-10000	19	21.6
None	69	78.4
Total	88	100.0

Source: Research findings (2015)

The study found that, few respondents (21.6%) who pay water bill are connected with water taps in their houses while (78.4%) of the respondents do not pay monthly water bill because, they are not connected with water taps in their houses. Also the study shows that, water meters are not established in the study area. Therefore, water committees that are responsible to collect water bill are using assumption approach which is improper tariffs collection techniques. Moreover, household with large size are required to pay more water bill per month under the assumption that they more water as compared to the rest. The importance of metering indicated by EPA (2013) documented that, water meters, both at the source and the service connection, are very important for all aspects of the water supply operations and make accurate water auditing possible; water meters make it possible to charge customers based upon the quantities of water that the customers consume; water meters record usage and make billing fair for all customers; water meters can encourage conservation by making customers aware of their usage as well as help detect leaks and establish accountability.

Costs incurred per one bucket (20litres) of water

Regarding water costs incurred by those who do not have water taps in their houses, the findings show that, 50(56.8%) of the respondents incur a less than or equal to Tshs 500 for one bucket (20litres) of water; 4(4.5%) of the respondents incur between Tshs 510-1000; while 34(38.6%) of the respondents do not incur any costs as presented in table 4.45.

Table 4.45: Costs incurred per one bucket (20litres) of water

Costs	Frequency	Percent
<500	50	56.8
510-1000	4	4.5
None	34	38.6
Total	88	100.0

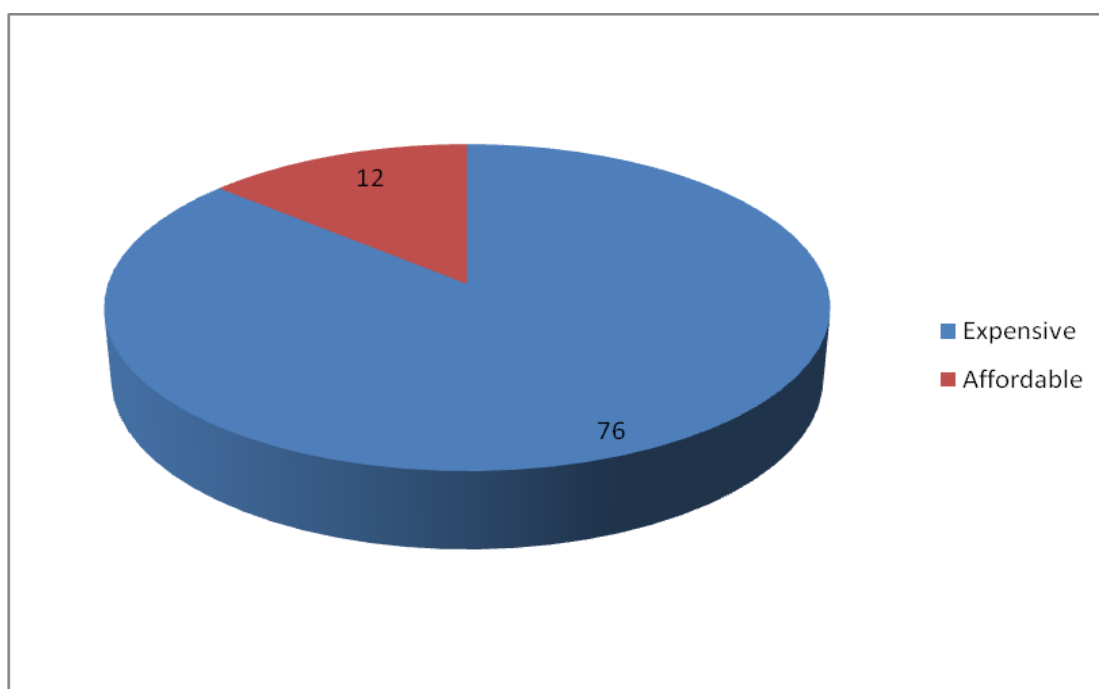
Source: Research findings (2015)

The study found that, majority (56.8%) of the respondents incur less than or equal to Tshs 500 to buy water for one bucket (20litres) outside their houses. Also the study found that, the respondents buy water from the water vendors and the circumstance normally occur during extreme dry season between July – October. The main uses of water are cooking and drinking while other uses depend on other water sources.

Opinion on expensiveness of water service prices

Figure 4.25 shows opinion on expensiveness of water service prices (water services affordability), findings show that; 76(86.4%) of the respondents said it is expensive while 12(13.6%) of the respondents said it is affordable.

Figure 4.26: Opinion on water service prices



Source: Research findings (2015)

The study reveals that, majority of the respondents (86.4%) mentioned about the expensiveness of water service prices in the study area. Besides, the study found that, socio-economic activities of the household are key factors that determined the water services affordability. Although, majority of the respondents depend on agriculture as source of income, there are others who grow crops and sell them at their local markets so as to increase household income. In this respect, the study by OECD (2003) found that; the share of water charges in household expenditures is inversely related to income.

However, the difference in the affordability ratio between the highest and lowest income household varies considerably from country to country. The study reveals that, few respondents (13.6%) afford the water service prices.

Number of buckets of water utilized by household per day before the introduction of water fees

Table 4.46 shows the number of buckets of water utilized by household per day before the introduction of water fees, findings show that; 30(34.1%) of the respondents utilized 3-6 buckets per day; 41(46.6%) of the respondents utilized 7-11 buckets per day; 11(12.5%) of the respondents utilized 12-15 buckets per day and 6(6.8%) of the respondents utilized above 16 buckets per day.

Table 4.46: Number of buckets of water utilized by households per day before the introduction of water fees

Buckets	Frequency	Percent
3-6	30	34.1
7-11	41	46.6
12-15	11	12.5
>16	6	6.8
Total	88	100.0

Source: Research findings (2015)

The study found that; majority of the respondents (46.6%) utilized 7-11 buckets (20litres) of water per day. The amount of buckets utilized depends on household size and socio-economic activities. The study reveals that; the large household sizes utilized more buckets of water per day.

Number of buckets (20litre) of water utilized by household per day after the introduction of water fees

Table 4.47 shows the number of buckets of water utilized by household per day after the introduction of water fees, findings show that; 68(77.3%) of the respondents utilized 1-3 buckets per day; 16(18.2%) of the respondents utilized 4-7 buckets of water per day; and 4(4.5%) of the respondents utilized 8-12 buckets of water per day.

Table 4.47: Number of buckets of water utilized by household per day after the introduction of water fees

	Frequency	Percent
1-3	68	77.3
4-7	16	18.2
8-12	4	4.5
Total	88	100.0

Source: Research findings (2015)

The study found that, majority of the respondents (77.3%) utilized 1-3 buckets (20litres) of water per day after introduction of water fees compare the previous situation whereby (46.6%) of the respondents utilized 7-11 buckets of water per day. Number of buckets of water utilized by household per day has decreased due to introduction of water fees in the study area. The study shows the relationship between water utilization and water fees. In reality, the introduction of water fees in the study area contributes to the reduction of buckets of water utilized by household per day. The effectiveness of water fees on water resources management is supported by previous studies. Ayoo and Horbulyk (2008) argued that the tariff setting plays a crucial role in the management of water services. Hoekstra (1998) and Rogers et al (2002) indicated that prices increases can impact the development of more efficient technology, and the sustainable use of natural resources.

4.5.2: Summary of Major Findings from Key Informant

Involvement in setting of water fees

Table 4.48 shows the involvement of respondents in setting up water fees, findings show that, 11(91.7%) of the respondents have been involved; while 1(8.3%) of the respondent haven't been involved.

Table 4.48: Involvement in setting of water fees

Response	Frequency	Percent
Yes	11	91.7
No	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study finds that, the majority of the respondents (91.7%) are involved in setting of water fees in the study area, because they are directly working with local community. The respondents including village and ward leaders as well as district water engineer; while (8.3%) of respondents is not directly working with local government. This result is supported by Local Government Act No. 7 of 1982 section 118 (e) and (f) which disclosed general functions and duties of local government authorities as stated that, to consider, regulate and co-ordinate development plans, projects and programmes of villages and township authorities within its area of jurisdiction, so as to ensure the more beneficial development and mobilization of productive forces in the village and township authorities and their application towards; regulation and monitoring the collection and utilization of revenue of village councils and township authorities.

Water fees payment

Table 4.49 shows water fees payment in the study area, findings show that; 11(91.7%) of the respondents mentioned less or equal than Tshs 20 per water bucket of (20litre); while 1(8.3%) of the respondents did not mention any.

Table 4.49: Water fees payment

Water fees	Frequency	Percent
<Tshs 20	11	91.7
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study revealed that, the majority of the respondents (91.7%) are involved in setting of water fees in the study area. Those respondents including; village, ward, and district leaders, who are responsible to make sure that water fees are setting in the respective villages.

Water fees collection responsibility

Table 4.50 shows the responsibility to collect water fees in the study area, findings show that, 10(83.3. %) of the respondents are responsible to collect water fees; while 2(16.7%) of the respondents aren't responsible.

Table 4.50: Water fees collection responsibility

Response	Frequency	Percent
Yes	10	83.3
No	2	16.7
Total	12	100.0

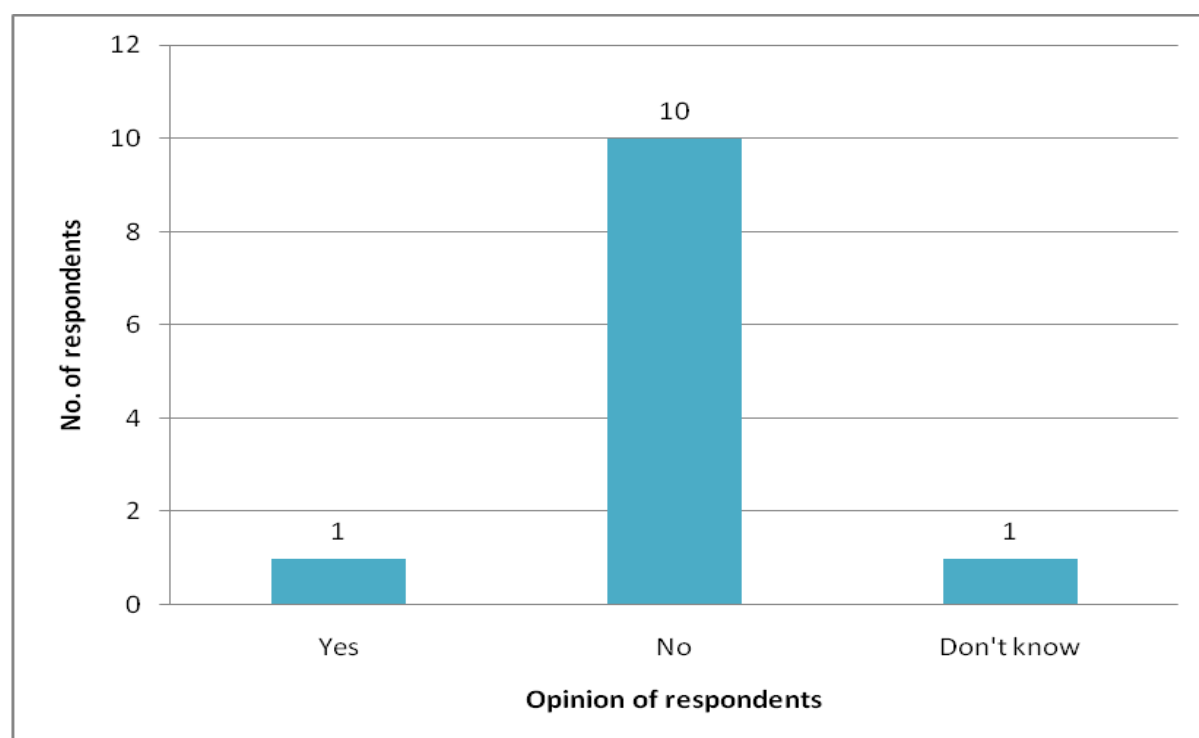
Source: Research findings (2015)

The study found that, the majority of the respondents (83.3%) are daily working in the study area including village and ward leaders; while few respondents (16.7%) are not daily working in the study area, these include; district water engineer and the officer from Wami/Ruvu Water Basin.

Opinion on affordability in paying water fees

The figure 4.27 shows opinion on affordability to pay water fees in the study area for members of the community; findings show that; 1(8.3%) of the respondent agreed; 10(83.3%) of the respondents disagreed; and 1(8.3%) of the respondent didn't have an idea.

Figure 4.26: Opinion on affordability in paying water fees



Source: Research findings (2015)

The study found that, the majority of the respondents (83.3%) disagreed on the communities affordability to pay water fees. Some respondents were quoted as saying; *“Almost all members of the community have low income, therefore, they will not able to pay for water fees accordingly.”*

Effectiveness of water fees on water resources management

Table 4.51 shows effectiveness of water fees on water resources management in the study area, findings show that; 11(91.7%) of the respondents have agreed; while 1(8.3%) of the respondents didn't know.

Table 4.51: Effectiveness of water fees on water resources management

Response	Frequency	Percent
Yes	11	91.7
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study found that, the majority of the respondents (91.7%) agreed that water fees regulate water uses and enhance water resources management.

4.5.3: Summary of Major findings from two FGD

Establishment of water fees

Table 4.52 shows community awareness on establishment of water fees in the study area.

Table 4.52: Establishment of water fees

Response	Frequency	Percent
Yes	2	100.0

Source: Research findings (2015)

The study found that; the majority of community members understood that water fees has been established in the study area. It reflects that, members of community are absolutely involved in the community development activities in the study area.

Amount of water service fees

Table 4.53 shows the amount of water service fees in the study area; findings from two FGD have shown that; less than or equal to Tshs 20 per bucket (20litre) of water should be paid.

Table 4.53: Amount of water service fees

Water service fees	Frequency	Percent
<Tshs20	2	100.0

Source: Research findings (2015)

The study found that, the majority of the community members are aware on the amount of water fees that should be paid. Also the study reveals that; members of the community are involved during the setting of water fees. Therefore, there is transparency in the study area.

Water fees collection responsibility

Table 4.54 shows the responsible organ to collect water service fees in the study; findings from two FGD have shown that; village water committees are responsible to collect water fees.

Table 4.54: Water service fees collection responsibility

Responsible	Frequency	Percent
Village Water Committees	2	100.0

Source: Research findings (2015)

The study result shows that, the majority of the community members are aware on the organs responsible to collect water fees in the study area. This evidence shows transparency in the study area.

Level of the community on water fees payment

Table 4.55 shows the level of the community on water fees payment in the study area; findings from FGD show that, the communities members do not afford to pay water fees in the study area.

Table 4.55: Level of the community on water fees payment

Response	Frequency	Percent
No	2	100.0

Source: Research findings (2015)

The study found that, the majority of members of the community do not afford to pay water fees in the study area. Some respondents were quoted as saying;

“We are poor; we cannot afford to pay water fees.”

“We have large household sizes, which consume a large amount of water per day; therefore, this will make us not being able to fulfill the demand of water per day.”

In the study area, the majority of the residents are living under the poverty line. The study by (Below et al, 2010) showed that the average total income per household per year in Mlali ward is Tshs 881, 731, and the average annual per capita income is Tshs 262, 662. The related study by World Bank (2010) found that, in Sub-Saharan Africa, about 388 million of people living on less than US\$ 81.25 a day. Regarding to annual per capita income of Tshs 262,662 equal to Tshs 719.62 per day per household in the study area, therefore, it is difficult to fulfill water demand per average household size of about 4 members per day. Because, in developing countries water consumption is 60-150 litres per person per day as reported by UNEP (1999), thus; about Tshs 500 require per day to fulfill household water demand. The situation is leading into less amount of water consumed by person per day because of low income of household in the study area.

Effectiveness of water fees on water resources management

Table 4.56 shows effectiveness of water fees on water resources management in the study area, findings from two FGD show that; 50% of the community members agreed that water fees has effect on water resources management; while 50% of the community members didn't know if water fees has effect on water resources management.

Table 4.56: Effectiveness of water fees on water resources management

Response	Frequency	Percent
Yes	1	50.0
Don't know	1	50.0
Total	2	100.0

Source: Research findings (2015)

The study found that, since, the concept is technical therefore; there is an ambiguity on understanding among the community members. Those community members, who have agreed on the concept, focus on repair and maintenance of water infrastructures by using collected water fees.

4.5.4: Summary of Discussion from Household Survey, Key Informant, and FGD Findings

The findings from household survey show that; 21.6% of the respondents pay water bill, this involve those who have water tap in their houses ; also the study shows that; despite having piped water supply hr, water meters have not yet been established in the study area; the majority of the respondents (56.8%) incur less than or equal to Tshs 500 to buy water for one bucket of (20litre) outside their houses; 86.4% of the respondents agreed on expensiveness of water service prices; 46.6% of the respondents utilized 7-11 buckets (20litre) of water per day before introduction of water service fees; 77.3% of the respondents utilized 1-3 buckets of water per day after introduction of water service fees; therefore, number of bucket of water utilized by household per day has decreased due to introduction of water fees; findings from Key Informant show that; village, ward and district leaders are involved in setting of water fees in the study area; village and ward leaders are responsible to collect water fees; 83.3% of the respondents have disagreed that the community is afford to pay water fees; village and ward leaders agreed that water fees contribute to water resources management; findings from two FGD have shown that; members of the community are aware about the establishment of water fees; members of the community are aware about the amount of water fees to be paid (>Tshs 20 per bucket of 20litre); members of the community are aware about the organ that is responsible for collection of water fees that is village water committees; members of the community do afford to pay water fees; members of the community differ on their understanding about the role of water fees on water resources management.

Consequently, the study reveals that; water fees significantly contribute to water resources management in the study area, because, the study reveals the decrease of number buckets per household after the introduction of water fees in the study area.

4.6: Stakeholders involvement in planning for water resources management

This presents the findings that show; stakeholders involvement in planning for water resources management in the study area.

4.6.1: Major findings from Household Survey

The community awareness in water resources management

Table 4.57 shows the community awareness in water resources management, findings show that, 32(36.4%) of the respondents are aware about water resources management; while 56(63.6%) of the respondents aren't aware about water resources management.

Table 4.57: The community awareness in water resources management

Response	Frequency	Percent
Yes	32	36.4
No	56	63.6
Total	88	100.0

Source: Research findings (2015)

The study result shows that, the majority of the respondents (63.6%) are not aware about water resources management. Furthermore, the study reveals that, there are no frequent awareness campaigns in water resources management since, a majority of the respondents claimed that they lack awareness in water resources management because; the responsible authorities do not conduct frequency awareness campaign concern water resources management.

Also the study discovered that, those respondents who aware about water resources management are either living nearby the community based water points or have connected with pipe in their houses.

Level of understanding of water resources management

Table 4.58 shows the meaning of water resources management according to the respondents who are aware about it, findings show that; 21(23.9%) of the respondents mentioned avoiding illegal human activities surrounding water sources; 6(6.8%) of the respondents mentioned cleaning of water sources; 5(5.7%) of the respondents mentioned planting trees surround water sources; while 56(63.6%) of the respondents are not aware.

Table 4.58: Level of understanding of water resources management

Aspects	Frequency	Percent
Avoiding illegal human activities surrounding water sources	21	23.9
Cleaning of water sources	6	6.8
Planting trees surround water sources	5	5.7
None	56	63.6
Total	88	100.0

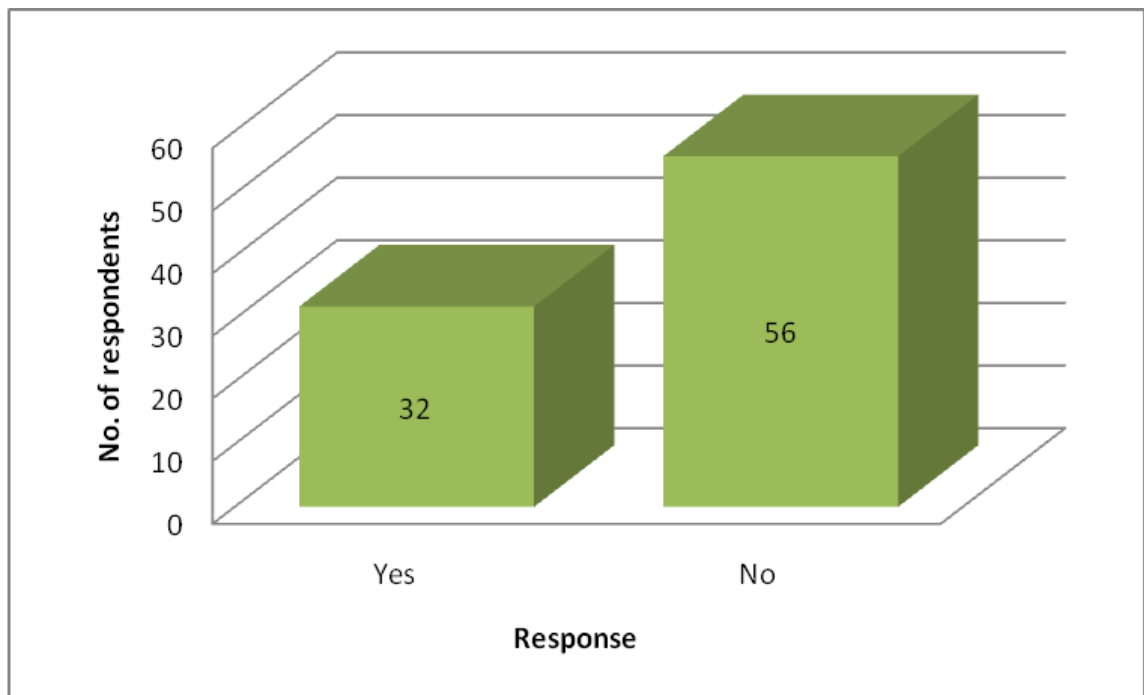
Source: Research findings (2015)

The study result shows that, the respondents (36.4%) who are aware about water resources management understood well the meaning of the concept. For the reason that, they managed to mention various terms related to water resources management. 23.9% of the respondents mentioned the avoidance of illegal human activities surrounding water sources as the meaning of water resources management.

The community participation in water resources management

Figure 4.27 shows the community participation in water resources management in the study area, the findings show that; 32(36.4%) of the respondents do participate in water resources management; while, 56(63.6%) of the respondents don't participate in water resources management.

Figure 4.27: Community participation in water resources management



Source: Research findings (2015)

The study found that; the majority of the respondents (63.6%) don't participate in water resources management in the study area. Also the study revealed the presence of correlation between low participation of the community and lack of awareness on water resources management. Furthermore, the respondents who lack awareness on water resources management don't participate in water resources management.

Ways undertaken by the community in water resources management

Table 4.59 shows ways undertaken by the community in water resources management in the study area, the findings show that; 9(10.2%) of the respondents have planted trees surrounding water sources; 16(18.2%) of the respondents have cleaned water sources; 7(8%) of the respondents have protected water sources against illegal human activities; while 56(63.6%) of the respondents could not take any way

Table 4.59: Ways undertaken by the community in water resources management

Ways	Frequency	Percent
Planting trees surrounding water sources	9	10.2
Cleaning water sources	16	18.2
Protecting water sources against illegal human activities	7	8.0
None	56	63.6
Total	88	100.0

Source: Research findings (2015)

The study shows that, the respondents who participate in water resources management used different ways to manage water resources in the study area. 19.3% of the respondents cleaned water sources.

Reasons for not participating in water resources management

Table 4.60 shows reasons for not participating in water resources management in the study area, findings show that; 32(36.4%) of the respondents are not informed; 22(25%) of the respondents were poor participants; 1(1.1%) of the respondents had little time; 1(1.1%) of the respondents lacked commitment; while 32(36.4%) of the respondents did participate in water resources management.

Table 4.60: Reasons for not participating in water resources management

Reasons	Frequency	Percent
Not informed	32	36.4
Poor participation	22	25.0
Little time	1	1.1
Lack of commitment	1	1.1
None	32	36.4
Total	88	100.0

Source: Research findings (2015)

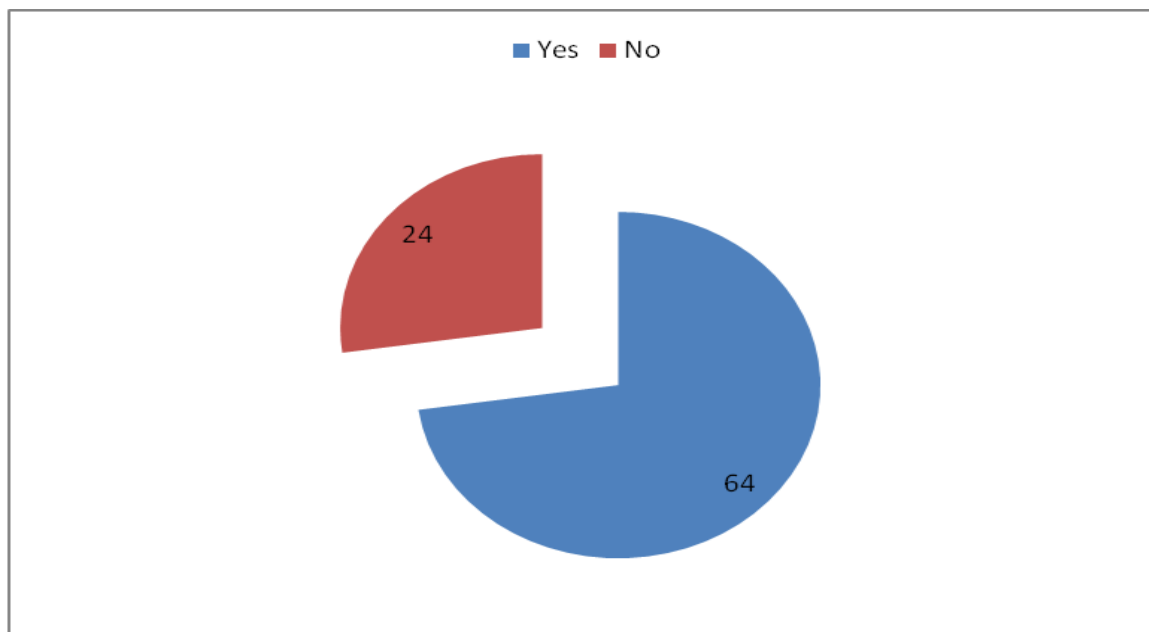
The study found that, 36.4% of the respondents were not informed by village leaders to participate in water resources management. The related result shown by Mtinda (2006) indicates that; lack of community participation in project planning was due to lack of information from their leaders and the approaches used by the water providers when implementing water projects. In this study, the respondents said that, they were informed by neither village leaders nor water committees to participate in water resources

management. Moreover, since, water resources management is a voluntary task; therefore, majorities in the local community are not shown interest to participate.

The Community participation in setting of water services fees

Figure 4.29 shows the community participation in setting of water fees in the study area, findings show that; 64(72.7%) of the respondents participated in setting of water services fees in the study area; while 24(27.3%) of the respondents did not participate.

Figure 4.38: Community participation in setting of water services fees



Source: Research findings (2015)

The study reveals that, the majority of the respondents (72.7%) participated in setting of water services fees in the study area. Also the study find out that, the higher level of the community participation happened because, the agenda was about monetary, therefore, the community members were interested to know if setting water fees is affordable or not. The setting of water fees was done through the community meetings at hamlet level.

The venue of the meeting was at water points managed by the community in the respective hamlets. The water services fee set was Tshs 20 per bucket (20litre) and worked at the community based water points.

Involvement in setting water service fees

Table 4.61 shows reasons for not involved in setting water service fees in the study area, findings show that; 20(22.7%) of the respondents were not informed; 3(3.4%) of the respondents had little time; 1(1.1%) of the respondents were absent; while 64 (72.7%) of the respondents were involved.

Table 4.61: Reasons for lack of involvement in the setting of water services fees

Reasons	Frequency	Percent
Not informed	20	22.7
Little time	3	3.4
Absence	1	1.1
None	64	72.7
Total	88	100.0

Source: Research findings (2015)

The study found that, 22.7% of the respondents were not involved in setting water services fees because they were not informed by village leaders. Also the study discovered that; in spite of not being informed by village leaders, some members of the community have no tendency of attending for community activities include meetings. In general, village leaders are give out information to members of the community concerning upcoming meeting with disclosed agenda, but some members do respond positively while others ignore. Local Government Act No.7 of 1982 section 103 (2) and (3) insist that; there shall be held an ordinary meeting of the village assembly at least once in every three months. Moreover, the village council may, if it considers it necessary or desirable for any reason so to do, convene an extraordinary meeting of the village assembly to discuss and decide upon any matter of extraordinary public importance. Therefore, full community participation in development activities resulting to equal benefits sharing and enhances positive social change. If a few members of the community making decision for the majority, it might lead to unsustainability of community development activities.

This fact is supported by Ong'or (2005) indicated that; the participation of stakeholders in decision making process and therefore governance of water resources is a critical strategy in ensuring the sustainability of watersheds in the provision of resources. It can also help in the operational process of the new water sector strategy by governments.

4.6.2: Major findings from Key Informant

Level of community awareness in water resources management

Table 4.62 shows the level of community awareness in water resources management in the study area, findings show that; 1(8.3%) of the respondents responded that the community has high level; 2(16.7%) of the respondents responded that the community has medium level; and 9(75%) of the respondents responded that the community has low level.

Table 4.62: Level of community awareness in water resources management

Level	Frequency	Percent
High	1	8.3
Medium	2	16.7
Low	9	75.0
Total	12	100.0

Source: Research findings (2015)

The study found that, the majority of the respondents (75%) have low level of awareness in water resources management. Based on findings from household, the survey shows that; information asymmetry is a major reasons leading to low level of community awareness in water resources management in the study area. Furthermore, the study reveals that; majority of members of the community do attend village meetings as well participate in voluntary community development activities. In this respect, studies by, Narayan (1995) argued that; communities need to be given greater opportunity to manage and decide on issues like water supply projects. Tadesse (2013) insist that; community participation enables the beneficiaries to influence the development and management of projects rather than merely receiving a share of project benefits.

Local partner's involvement in water resources management

Table 4.63 shows local partners involvement in water resources management in the study area, findings show that, 12(100%) of the respondents agreed that the local partners are involved in water resources management.

Table 4.63: Local partners involvement in water resources management

Response	Frequency	Percent
Yes	12	100.0

Source: Research findings (2015)

The study reveals that, water resources management in the study area is supported by local partners such as MOROWASA, WAMI/RUVU water Basin, EWACO, and WUA; all are working together with District and Village Councils. The roles of local partners include; to ensure all water sources are protected for mainly in economically, water services and other consumption; empowering village and water leaders on sustainable water resources management and sanitation; empowering local community on sustainable water resources management and sanitation; support construction of water infrastructures; and support rehabilitation of water infrastructures. Furthermore, the presences of local partners significantly contribute to water resources management in the study area.

4.6.3: Summary of Discussion from Major findings of Household Survey and Key Informants

The findings from Household Survey show that; 63.6% of the respondents are not aware about water resources management; 36.4% of the respondents are aware about water resources management and understood well the related terms used in water resources management; 19.3% of the respondents manage water resources through cleaning water sources; 63.6% of the respondents do not participate in water resources management; 36.4% of the respondents were not informed by village leaders to participate in water resources management; 72.7% of the respondents participated in setting of water service fees; 22.7% of the respondents were not involved in setting water service fees because they were not informed by village leaders.

The findings from Key Informant show that; 75% of the respondents declared that, level of community awareness in water resources management is still low; water resources management is supported by local partners that play role on empowering village and water leaders on sustainable water resources management and sanitation; empowering local community on sustainable water resources management and sanitation; support construction of water infrastructures; and support rehabilitation of water infrastructures. Therefore, the study reveals that; local community involvement in planning for water resources management is poor, since, majority of the respondents do not participate in water resources management activities, while; village, ward, district leaders, and local partner's involvement in planning for water resources management is good.

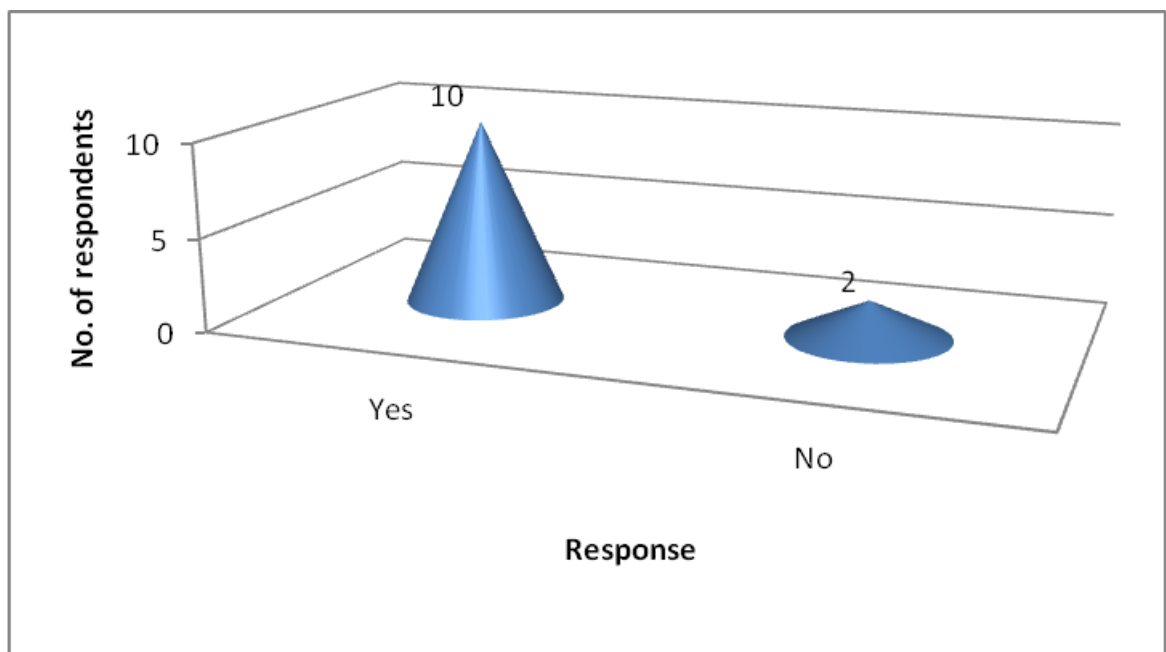
4.7: Capacity of local institutions on water resources management

4.7.1: Major findings from Key Informants

Experience on water use conflicts over the past 10 years

Figure 4.30 shows experience on water use conflicts over the past 10 years in the study area, findings show that; 10(83.3%) of the respondents agreed that there has been an occurrence of water use conflicts; while 2(16.7%) of the respondents did not agree on the occurrence of water use conflicts.

Figure 4.29: Experience on water use conflicts over the past 10 Years



Source: Research findings (2015)

The study found that, majority of the respondents (83.3%) agreed on the occurrence of water use conflicts for over the past 10 years in the study area. Based on the respondents, the main cause of water use conflict is water scarce. The conflicts occur between farmers and livestock keepers but sometimes occur between farmers and farmers over the question of land. Moreover, different conflicts resolution approaches undertaken include; the implementation of water supply project, formation and implementation of WUA, Water use conflict resolution meetings, and Users made a schedule on water use. Also the study revealed existence of village water committees in the study area.

The water committees are responsible; to coordinate water use conflicts resolution meetings; to oversee and ensure sufficient water services; to collect water service fees; to disseminate education to the community on efficient use of water; and to oversee water infrastructures. Additionally, the respondents said that, water use conflicts occur rarely in the study area. The study finds out that; the majority of water committee members are inactive, because, they are new in the respective positions; therefore, they have low capacity on water resources management. Besides, they are not empowered on matters related to water resources management.

In this respect, the study by it was found that VWSCs were, by and large, successful in achieving the goals of transparency, participation, inclusion and ownership. (Katz 1998). Village committees can enhance demand based approaches by bringing decision-making down to the village level where users can decide, among other things, the type of technology, location of the facility, level and hours of service, tariff charges and how they should be used.

Establishment of village water funds

Table 4.64 shows establishment of village water funds in the study area, findings show that; 11(91.7%) of the respondents agreed on establishment of village water funds; while 1(8.3%) of the respondents did not know.

Table 4.64: Establishment of village water funds

Response	Frequency	Percent
Yes	11	91.7
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study reveals that, village water funds were established in the study area. The aim of water fund is to support water resources management initiatives such as repair and maintenance of water infrastructures, protection of water sources, and motivation for water committee members. WHO (2010) has shown the achievement of village water fund in Zambia, whereby; lives of more than 75,000 people in 326 communities and 14 schools in rural districts of Western Province improved. Improving water and sanitation has a

substantial impact on the health of community members, reducing the number of deaths caused by diarrheal diseases by 65%. According to the respondents, the village water funds are managed by village water committees. With respect to the strength of village water funds on water resources management, the respondents haven't shown the achievement of established village water funds, for the reason that, for the time being there is no money collected and deposited into the water fund. Therefore, fund will be operated after water service fees payment begin, additionally, water service fees is only source of water fund.

Existence of village water by-laws

Table 4.65 shows the existence of village water by-law in the study area, findings show that; 11(91.7%) of the respondents agreed on the existence of village water by-law; while 1(8.3%) of the respondents were not aware.

Table 4.65: Existence of village water by-laws

Response	Frequency	Percent
Yes	11	91.7
Don't know	1	8.3
Total	12	100.0

Source: Research findings (2015)

The study found that, leaders at district, ward, and village levels are accountable for facilitation of formulation of village water by-law in the study area. Also the study discovered that, formulated by-laws are still at draft stage, therefore, they could not operate in the respective villages until they will be declared by full council at district level as stipulated by Local Government Act, 1982. The respondents at ward and village levels said that the process of by-laws declaration is stuck at district level, whereby district legislative officer and district water engineers are responsible.

Existence of village water use plan

Table 4.66 shows the existence of village water use plan in the study area, findings show that; 2(16.7%) of the respondents agreed on the existence of village water use plan; while 10(83.3%) of the respondents did not know.

Table 4.66: Existence of village water use plan

Response	Frequency	Percent
Yes	2	16.7
Don't know	10	83.3
Total	12	100.0

Source: Research findings (2015)

The study found that, village water use plan was formulated in the past but, currently it does work in the village. Since, majority of the respondents (83.3%) don't know if the village water use plan exists. Also the study reveals that the village water use plan was formulated by few authorized people in the community. Moreover, it was not passed through the proper channel in the villages so that to be approved by majority in the village council as well as Village General Assembly. Water use plan play crucial role on water resources management. The importance of water use plan showed by WHO (2005) such that to ensure drinking-water through good water supply practice.

4.7.2: Summary of Discussion from Major Findings of Key Informant

The major findings of Key Informant show that; majority of the respondents (83.3%) agreed on the occurrence of water use conflicts over the past 10 years in the study area; the main cause of water use conflict is water scarce.

The conflicts occur between farmers and livestock keepers but sometimes occur between farmers and farmers over the question of land village water funds established in the study area, aim to support water resources management initiatives such as repair and maintenance of water infrastructures, protection of water sources, and motivation for members of water committees; village water by-laws formulated and approved at village level, it is still waiting to be declared at district level; village water use plan is formulated in the past but, it does not exist in the village. Since, majority of the respondents (83.3%) don't know if their village posses water use plan.

4.8: Policy Issues in Water Resources Management

Policy is a principle or protocol to guide decisions and achieve rational outcome (Anderson, 2005). Policy is the basic principle by which a government is guided in its daily activities.

Issues related to water resources management are addressed in National Water Policy (2002). The objective of the policy for Water Resources Management is to develop a comprehensive framework for promoting the optimal, sustainable, and equitable development and use of water resources for the benefit of all Tanzanians, based on a clear set of guiding principles. In this study, some Policy implications are reflected.

4.8.1: Water Resources Allocation, Use, and Socio-Economic Considerations

Water as a common use resource

Policy promotes fair and equal procedures in access to and allocation of water resources so that all social and economic activities are able to maximize their capacities. The research findings show that; piped water is a major source of drinking water, since all respondents 88(100%) from household survey have mentioned; majority of the respondents (68%) access drinking water from piped water points managed by the private compare to piped water points managed by community; 21.6% of the respondents are connected with pipe; while 78.4% of the respondents are not connected with pipe; 13.6% of the respondents claimed that water tap flowing 1-2 days per week; 40.9% of the respondents travel a short distance to collect water; 31.8% of respondents spend as less than or equal to 60 minutes to fetch water currently based on those household that are not connected with pipe; 75% of respondents spend as less than or equal to 60 minutes to fetch water in the past 10 years; 52.3% of the respondents needed a large amount of buckets 4-7 buckets per day. however, issues of distance and time taken to fetch water are not prioritized.

Coordination and collaboration

Policy encourage effective collaboration and coordination mechanism among sectors at all levels. However, the study found parallel coordination with respect to awareness on National Water Policy among leaders at ward and village levels.

Table 4.67 shows the respondents awareness on National Water Policy, findings show that; 4(33.3%) of the respondents are aware about National Water Policy; while; 8(66.7%) of the respondents are not aware.

Table 4.67: Awareness on National Water Policy

Response	Frequency	Percent
Yes	4	33.3
No	8	66.7
Total	12	100.0

Source: Research findings (2015)

The study revealed that, even leaders at village and ward levels are not aware about National Water Policy (2002). A majority respondents (66.7%) at village and ward levels claimed that, there are no facilitation on awareness of National Water Policy done in their respective areas. Therefore, the study failed to prove whether, policy objective with respect to coordination and collaboration is achieved in the study area. The respondents said that, the government officials at the respective ministry are responsible to disseminate National Water Policy awareness to the leaders at district, ward, and village levels but, not yet done so far. In general, it seems that, there is parallel coordination between National and Local level with respect to water resources management.

Participation

Policy advocates community participation in decision-making, planning, management, and implementation of water resources management and development. The study found that; 63.6% of the respondents from household survey are not aware about water resources management; while only 36.4% of the respondents are aware about water resources management and understood well the related terms used in water resources management; 36.4% of the respondents were not informed by village leaders to participate in water resources management; 22.7% of the respondents were not involved in setting water service fees because they were not informed by village leaders. The findings from Key Informant show that; 75% of the respondents declared that the level of community awareness in water resources management is low. In general, the study observed that, there is no full participation of the community in water resources management and development.

Water quality management and pollution control

Policy promotes water resources with an acceptable quality. The study found that; there is no frequent water quality monitoring and assessment undertaken by recognized institutions in Ngerengere upstream sub catchment where the study area is located. Therefore, it was difficult to comment change of water quality over the past 10 years in the study area.

Because, the recognized institution do not produce scientific evidences on water quality status so that to prove hypothesis.

Water resources planning and development

Policy advocates sustainable plans and development of water resources. The study found that; village water use plan is formulated in the past but, it does not exist in the respective villages. Since, majority of the respondents (83.3%) do not know if village water use plan exist. Furthermore, formulated water plan was not considered integrate multi-sectoral approach.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter presents the summary, conclusion, recommendations, and policy implications based on findings of the study. It further points out recommendation for further research.

5.2 Summary

This study focused at assessing the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services in Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region. The study was guided by six main aspects such as to assess the effects of human settlement and activities on water supply; to assess the effects of human settlement and activities on water distribution; to assess the effects of human settlement and activities on water quality; to assess the capacity of local institutions on water resources management; to assess the effectiveness of fees system on water resources management; and to assess the stakeholders involvement on planning water resources management in Mlali ward.

In this study, various literatures on the effects of human settlements and activities on water resources were reviewed. The study was conducted using cross-sectional design where a total number of respondents interviewed from household survey were 88 (n=88) in both villages; they were instrumental in the provision of quantitative data. Two focus group discussions (FGD) were conducted, whereby 16 community members (men and women) participated. Participants pertaining to key informant (KI) interview were selected from village council leaders, ward leaders, and district leaders. Key informant interviews were conducted that 12 participants were involved.

The 12 key informants provided qualitative data aiming at understanding the impact of human settlement and activities on water resources management; the information collected was used to supplement the information gathered from the communities.

The study revealed that: The area is predominated by agricultural activities as the main source of income whereby maize, vegetables, paddy, beans, and sunflower are main crops; while few individuals are engaged in small business and government employment. The area is characterized with household size of 4-6 members with growth rate of 4.2. Also the findings show the impacts of human settlements and activities affect on water resources; also the findings show the role of Integrated Water Resources Management Approach.

The effects include: water supply leading to slowing down of domestic & commercial activities; risk in drinking of untreated water from open wells or surface waters; workload of women in the households becomes very heavy; too much time is wasted in search of water. Water distribution affects daily activities at households such that more time spent by individuals to collect water from water points. Water quality problem is not discovered by the study because the recognized institutions did not produce scientific evidence to prove the truth. Even though, the respondents mentioned water-borne diseases outbreak in the study area.

The roles of IWRM approach focus on: the capacity of local institutions on water resources management: efforts undertaken to solve water use conflicts including, implement water supply project, formation of WUA, water use conflict resolution meetings, and user made a schedule on water use; facilitate formulation of village water funds aim to support water resources management initiatives such as repair and maintenance of water infrastructures, protection of water sources, and motivation for water committee members, although funds not yet raised because, water fees collection not yet started until accomplishment of on-going water supply project in the respective villages; facilitate formation of village water by-laws so that to enhance protection of water sources in the respective villages, however, by-laws are not yet operational since, they are not declared by full council at the district council.

The effectiveness of fees system on water resources management: village water committees are responsible to collect water fees; socio-economic activities of the households are key factors that determined the water services affordability, thus the few households afford water services prices, findings show that before introduction of water fees services then households utilized 7-11 buckets (20litres) of water per day while after

introduction of water fees then households utilized 1-3 buckets (20litres) of water per day, majority of the respondents agreed that water fees regulate water uses and enhance water resources management. Moreover, water meters are not established in the study area. Therefore, water committees that are responsible to collect water bill are using assumption approach which is improper tariffs collection techniques. Additionally, household with large size assumed to use more water, therefore, required paying more water bill per month;

The Stakeholders involvement on planning water resources management: majority of the people are not aware about water resources management since, there are no frequent awareness campaigns in water resources management done by responsible authorities in the respective villages as well as lack of proper information dissemination; majority of people don't participate in water resources management because, of low awareness; a few people who participate in water resources management used different ways; majority of the people participate in setting of water service fees since, it is very sensitive agenda; a few people are not involved in setting water service fees because, they are not involved by village leaders; majority of people have low level of awareness in water resources management due to unreliable information dissemination.

5.3 Conclusions

Water resources management has become an important issue due to anthropogenic effects by agricultural activities, catchment degradation, and increasing population. Prosperity and the quality of life in the study area are affected by impacts of human settlement and activities on water resources. Consequences of these effects include; slowing down of domestic & commercial activities; risk in drinking of untreated water from open wells or surface waters; workload of women in the households becomes very heavy; too much time is wasted in search of water. Despite the presence of IWRM approach and its components such as Integrating Planning (Coordination), Governance (Equity) and Economics (Efficiency) however, it is not well rooted at village level (local community) in Tanzania. Some components of IWRM approach have formulated in the study area but, little efforts undertaken on enhancing. Therefore, the roles of IWRM approach on ensuring equitable, economically sound, and environmentally sustainable management of water resources and

provision of water services in the study area are not much determined. National Water Policy (2002) addressed issues related to water resources management but, the policy is not well publicized at village and ward levels.

5.4 Recommendations

Based on the findings of this study some recommendations can be made:

- i. The government should emphasize the followings; rain water harvesting system all over the country; this alternative course will ensure availability of water for various uses; community on water treatment before use especially for drinking. The feasible water treatment methods should be encouraged.
- ii. The government should increase community-based piped water points if necessary in order to reduce scrambling during water fetching. Moreover, respective piped water points should be well managed.
- iii. The government should consider frequently training on sustainable agricultural practices and other socio-economic activities to the community so that to minimize the impacts of poor agricultural practices on water resources and other related resources.
- iv. Village councils should enforce village water by-laws accordingly in order to protect water sources meanwhile respective leaders at all levels should be accountable for water resources management effectively.
- v. The government should take immediate actions to minimize the consequences of water supply problems especially in rural areas so that to improve prosperity and quality of life of rural communities.
- vi. Responsible authorities should set costs for piped water connection considering level of household income especially in rural areas; this could enable majority to connect piped water in their houses.
- vii. The government should facilitate training on proper water use to the community especially in rural areas so that to ensure availability of water sustainably in line with emphasize using of water storage containers.

- viii. Responsible authorities should share water quality survey report with local community especially local leaders. Therefore, to make them aware about water quality status in their respective areas.
- ix. The government should disseminate good sanitation techniques to the community in order to minimize water-borne diseases outbreak.
- x. Responsible authorities should install water meters so that to make efficient water tariffs collection.
- xi. The government should intervene on water fees setting such that it is uniform all over the country thus making it affordable for everyone.
- xii. The government should insist integrating planning should at local community level. Additionally, in every local community development planning then water resources management should be promoted.
- xiii. Local development partners should insist support to local community especially on water resources management as well as water infrastructures development.
- xiv. Local leaders should be empowered on sustainable water resources management.
- xv. Village water by-laws should be declared by full council as soon as possible in order to be enforced so that to protect water sources.
- xvi. Responsible authorities should facilitate formulation of village water use plans according to the laws so as to ensure sustainable water use.
- xvii. The government should institutionalize IWRM approach effectively in order to ensure sustainable water resources management.
- xviii. The government should conduct awareness on National Water Policy (2002) to the local community; in order to make local community especially local leaders aware on issues addressed in the policy and therefore, in-cooperate during implementation of community development activities in their areas.
- xix. There is need to conduct more studies so as to assess the magnitude of the effects of human settlement and activities on water resources in line with the roles of Integrated Water Resources Management (IWRM) Approach at village (local community) level in Tanzania.

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APPENDICES

APPENDIX I: Community questionnaire for research – (Quantitative approach-household survey)

Aim: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks.

Household Questionnaire (Questionnaire for Water Consumers)

Respondent Number:

A: Background Information

1. Area of residence.

Division.....Ward.....Village.....

2. Sex of respondent: Tick (✓) where is appropriate male() female()

3. Age of respondent..... Years old.

4. Respondent's education level: Tick (✓) where is appropriate.

No school () Primary level () Secondary level () College and above (. .), others (specify).....

5. Marital Status: Tick (✓) where is appropriate

Married () Single () Divorced/Separated () widowed ()

6. What is your household size? (How many are you in your household?):

1 () 2 () 3 () 4 () 5 () 6 () 7 () 8 () 9 +

7. Main occupation of the respondent, employed () Self-employed ()

none ()Specify the occupation ()

Peasant () Fishermen () Business () others (specify).....

8. What are main livelihood activities in these

B: Water supply

9. What is the main source of drinking water used by household?

Tick (✓) where is appropriate;

- Piped ()
- Protected well ()
- Protected/covered spring ()
- Unprotected well ()
- Unprotected spring ()
- Surface source

(Lake/dam/river/stream/pond) ()

- Covered rainwater catchment ()
- Uncovered rainwater catchment ()
- Tanker truck ()
- Bottled water ()
- Other (please specify).....

10. Where is the source/who manages it?

- Into own house ()
- Into own yard/plot ()
- Into neighbor's house/yard/plot ()
- Water point managed by community ()
- Water point managed by private ()
- company/individual ()

11. Do you think there are problems with water supply and delivery in your area?

() Yes, problems () No, no problems () Don't Know

12. What will you say about the following issues of water supply in your area? Tick (✓) as appropriate in the table below: Severe problem, Minor problem, Not a problem and Don't know, in the table below.

Water issue	Severe problem	Minor problem	Not a problem	Don't know
(1) Slowing down of domestic & commercial activities				
(2) Too much time is wasted in search of water				
(3) Long queues in fetching water, resulting in quarrels				
(4) Children usually are either late to or absent from school				
(5) Prices of food items increase due to shortage of water				
(6) Risk in drinking of untreated water from open wells or surface waters				
(7) Workload of women in the households becomes very heavy				
(8) Other(specify)				

13. What do you think are the possible causes of the water problems in your area? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
(1)Increasing population				
(2) Poor water infrastructures				
(3)Catchment degradation				
(4)Development of agriculture practices				
(5)Unplanned settlement				
(6)Climate change				
(7)Other (specify)				

14. What are socio-economic impacts associated with shortage of water distribution?

.....

.....

.....

.....

.....

15. What do you think can be done to improve water distribution in your area?

.....

.....

.....

.....

.....

D: Water distribution

16. Do you have pipe connected to your home? (1) Yes (2) No
17. If yes, how many days does your tap flow in a week? (1) 1-2 (2) 3-4 (3) 5-7
18. If not, how far (in metres or kilometres) does it take you to walk to where you draw / fetch water? (1) < 50 m (2) 50 - 100 m (3) 100 -200 m (4) over 200m
19. How long does it take you to fetch water from the main drinking water source (to go, wait, collect water and return)?..... minutes
20. How long does take you to fetch water from the main drinking water source over past ten years?.....minutes.
21. On the average, how many buckets (20litres) of water do you need for your household per day? (1)1 (2) 2 (3) 3 (4) 4 (5) 5 (6) 6 (7) 7 (8) 8 (9) 9 +
22. What are main uses of water at your household?.....
23. Is the water you fetch sufficient to meet your household requirements?(1)Yes (2) No

E: Water quality

24. What will you say about the quality of the water that you drink?

Good () Salty () Coloured () bad odour () Has some particles inside ()

Others () Specify.....

25. Do you think the quality (for example, taste, and appearance) of household water sources have changed over time? Yes () No ()

26. If yes, mention the factors that influence the change of water quality

- 1)
- 2)
- 3)
- 4)
- 5)

27. Do you treat your water in any way to make it safer to drink? Yes() No()
28. If yes, what do you usually do to the water to make it safer to drink?.....
29. How much does it costs to make safe water for drinking?.....Tshs/Month
30. Do you know any actions that have been taken by the government to minimize water quality problem? Yes () No ()

If yes, mention:

- 1)
- 2)
- 3)
- 4)
- 5)

F: Water service fees

32. If you have pipe connected to your home, how much do you pay (on average) as water bill per month? TShs
33. If you buy water outside your house, how much do you pay (on average) for one bucket (20 litres) of water? TShs
34. Do you think water service price is expensive or affordable to you?
- Expensive () Affordable () Don't Know ()
35. How many buckets of water does your household per day before introduction of water fees?
36. How many buckets of water does your household use per day after introduction of water fees?

G: Stakeholders involvement in planning for water resources management

37. Have you heard about water resources management?

Yes () No ()

38. If you have heard about it, what does it mean?

.....
.....

Have you participated/involved in implementation of water resources management initiatives?

Yes () No ()

39. If yes, mention the activities/initiatives that you have participated/involved regarding to water resources management.

- 1).....
- 2).....
- 3).....
- 4).....
- 5).....

41. Have been involved in setting of water services fee?

Yes () No ()

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME

APPENDIX II: Key Informant Interview checklist for village leaders, and ward leaders (Qualitative approach).

AIM: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks

A: BACKGROUND INFORMATION

1. Area of residence.

Division.....Ward.....Village.....

2. Sex of respondent: Tick (✓) where is appropriate male () female ()

3. Age of respondent..... Years old.

(Below__20) (20__30) (30__40) (40__50) (50__60) (60____ above)

4. Respondent's education level: Tick (✓) where is appropriate.

No school () Primary level () Secondary level () College above () other specify.....

5. Main occupation of the respondent.....

6. What are your main activities

.....

.....

7. What are the main activities of your office?

8. Is there any need of having coordination between your office and other institutions? Yes..... No..... If yes, explain why.....

.....

.....

9. Is there any coordination between your office and any other sectors/institutions of the government? Yes () No ()

10. If yes, how is the coordination? EffectiveIneffective.....
11. What issues do you coordinate?

B: Water supply

12. What is the main source of drinking water used by household?

Tick (✓) where is appropriate;

- ☐ Piped ()
- ☐ Protected well ()
- ☐ Protected/covered spring ()
- ☐ Unprotected well ()
- ☐ Unprotected spring ()
- ☐ Surface source

(Lake/dam/river/stream/pond) ()

- ☐ Covered rainwater catchment ()
- ☐ Uncovered rainwater catchment ()
- ☐ Tanker truck ()
- ☐ Bottled water ()
- ☐ Other (please specify).....

13. Where is the source/who manages it?

- Into own house ()
- Into own yard/plot ()
- Into neighbours' house/yard/plot ()
- Water point managed by community ()
- Water point managed by private ()
- company/individual ()

14. Do you think there are problems with water supply and delivery in your area?

(1)Yes, problems (2) No, no problems (3) Don't Know

15. If so, when?.....years.

16. What will you say about the following issues of water supply in your area? Tick (✓) as appropriate in the columns under: Severe problem, Minor problem, Not a problem and Don't know, in the table below.

Water issue	Severe problem	Minor problem	Not a problem	Don't know
(1) Slowing down of domestic & commercial activities				
(2) Too much time is wasted in search of water				
(3) Long queues in fetching water, resulting in quarrels				
(4) Children usually are either late to or absent from school				
(5) Prices of food items increase due to shortage of water				
(6) Risk in drinking of untreated water from open wells or surface waters				
(7) Workload of women in the households becomes very heavy				
(8) Other(specify)				

17. What do you think are the possible causes of the water problems in your area? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
(1) Increasing population				
(2) Poor water infrastructures				
(3) Catchment degradation				
(4) Development of agriculture practices				

(5)Unplanned settlement				
(6)Climate change				
(7)Other (specify)				

18. Have you taken efforts to minimize the water problem in your area? Yes() No()

19. If yes, List the efforts:

- a)
- b)
- c)
- d)

C: Water distribution

20. Where does community collect water?

Tick (✓) where is appropriate; Public water point () Private water point ()
Borehole () Dam () Spring () River () Shallow well ()

21. How many households collect water from those sources?

- a) Public water point: () households
- b) Private water point: () households
- c) Borehole: () households
- d) Dam: () households
- e) Spring: () households
- f) Shallow well: () households

22. Have the residents ever experienced water shortage distribution? If so, when?.....years.

D: Water quality

23. Have you experienced change of water quality over past 10 years? Yes()No()

24. If yes, what efforts have you taken to minimize the water quality problem?.....

25. What are some of the factors that you think may be affecting the safety or quality of drinking water in your community? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
(1) Poor solid waste disposal				
(2) Using of pesticides				
(3) Using of inorganic fertilizers				
(4) Washing clothes nearby water sources				
(5) Other (specify)				

26. Are there any diseases outbreak related to poor water quality occurred? Yes() No()
27. If yes, List diseases occurred:.....
28. Which age group affected most? Tick where is appropriate
- a) Age: 0-5 years ()
 - b) Age: 6-14 years ()
 - c) Age: 15-49 years ()
 - d) Age: 50- above ()

E: Capacity of local institutions on water resources management

29. Have you participated on any trainings relating to water resources management? Yes() No()
30. If yes, mention:.....
31. Have you experienced water use conflicts over time? Yes() No()
32. If yes, how did you resolve it?.....
33. Do you have village water committee? Yes() No()

34. What are roles of water committee:
- 1)
 - 2)
 - 3)
 - 4)
 - 5)
35. Have you established water funds? Yes() No()
36. Who is responsible to manage fund?.....
37. How does fund work for water resources management?.....
38. Do you know any policy which addresses the water resources management issues? Yes() No()
- If yes, mention it.....
39. Mention the issues stipulated in that policy
-
-Do you
formulate water by-law? Yes() No()
40. If yes, how does it impact water resources management?.....
41. Have you office initiate on formulation of village water use plan? Yes()
No()
42. If yes, explain how it works upon water resources
management:.....

F: Water fees system

43. Do you set water fees system? Yes() No()
- If yes, how much do community pay (on the average) for one bucket (20 litres) of water? Tshs.....
44. Do communities afford water fees? Yes() No()

G: The stakeholders involvement on planning of water resources management

45. Is the community aware about water resources management? Yes () No ()
46. How do you disseminate the information about water resources management to the community?
.....
47. What initiatives taken by community with respect to water resources management?
a)
b)
c)
d)
e)
48. Do community involved during setting of water services fees? Yes()
No()
49. Do you have local partners involve in water resources management?
Yes() No()
50. If yes, mention:
1)
2)
3)
4)
5)
51. What are roles of local partners with respect to water resources management?.....

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME

APPENDIX III: Key Informant Interview checklist for Village Water Committees members (Qualitative approach).

AIM: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, Tanzania as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks

A: BACKGROUND INFORMATION

1. Area of residence.

Division.....Village.....Ward.....

2. Sex of respondent: Tick (✓) where is appropriate male () female ()

3. Age of respondent..... Years old.(Below__20) (20__30) (30__40) (40__50)
(50__60) (60____ above)

4. Respondent's education level: Tick (✓) where is appropriate.

No school () Primary level () Secondary level () College above () other
specify.....

5. Main occupation of the respondent.....

6. What are your main activities

.....

.....

B: Water supply

7. What is the main source of drinking water used by household?

Tick (✓) where is appropriate;

- Piped ()
- Protected well ()
- Protected/covered spring ()
- Unprotected well ()
- Unprotected spring ()

- Surface source
(Lake/dam/river/stream/pond) ()
- Covered rainwater catchment ()
- Uncovered rainwater catchment ()
- Tanker truck ()
- Bottled water ()
- Other (please specify).....

8. Where is the source/who manages it?

- Into own house ()
- Into own yard/plot ()
- Into neighbours' house/yard/plot ()
- Water point managed by community ()
- Water point managed by private ()
- company/individual ()

9. Do you think there are problems with water supply and delivery in your area?

(1)Yes, problems (2) No, no problems (3) Don't Know

10. If so, when?.....years.

11. What will you say about the following issues of water supply in your area? Tick (√) as appropriate in the columns under: Severe problem, Minor problem, Not a problem and Don't know, in the table below.

Water issue	Severe problem	Minor problem	Not a problem	Don't know
(1) Slowing down of domestic & commercial activities				
(2) Too much time is wasted in search of water				
(3) Long queues in fetching water, resulting in quarrels				
(4) Children usually are either late to or absent from school				
(5) Prices of food items increase due to shortage of water				
(6) Risk in drinking of untreated water from open wells or surface waters				
(7) Workload of women in the households becomes very heavy				
(8) Other(specify)				

12. What do you think are the possible causes of the water problems in your area? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
(1) Increasing population				
(2) Poor water infrastructures				
(3) Catchment degradation				
(4) Development of agriculture practices				
(5) Unplanned settlement				
(6) Climate change				
(7) Other (specify)				

13. Have you taken efforts to minimize the water problem in your area? Yes () No ()

14. If yes, List the efforts:

- e)
 f)
 g)
 h)

C: Water distribution

15. Where does community collect water?

Tick (✓) where is appropriate;

Public water point () Private water point () Borehole () Dam ()

Spring () River () Shallow well ()

16. How many households collect water from those sources?

- a)Public water point: () households
- b)Private water point: () households
- c) Borehole: () households
- d)Dam: () households
- e)Spring: () households
- f) Shallow well: () households

17. What are the main uses of water? Tick where is appropriate

- a) Domestic ().....litres
- b) Agriculture ().....litres
- c) Livestock ().....litres
- d) Other (specify).....litres

18. Have the residents ever experienced water shortages?

If so, when?.....years.

D: Water quality

19. Have you experienced changes in water quality over the past 10 years? Yes()

No ()

20. If yes, what efforts have been taken by village water committee to minimize the problem?.....

21. What are the factors that you think may be affecting the safety or quality of drinking water in your community? Tick (✓) as appropriate in the table below: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
(1)Poor solid waste disposal				
(2) Using of pesticides				
(3) Using of inorganic fertilizers				
(4)Washing clothes nearby water sources				
(5)Other (specify)				

22. Are there any diseases outbreak related to poor water quality occurred?
Yes() No()
23. If yes, List diseases outbreak occurred:.....
24. Which age group affected most? Tick where is appropriate
- e) Age: 0-5 years ()
 - f) Age: 6-14 years ()
 - g) Age: 15-49 years ()
 - h) Age: 50- above ()

E: Capacity of local institutions on water resources management

25. Have you participated on any trainings relating to water resources management?
Yes () No ()
26. If yes, mention:.....
27. Have you experienced water use conflicts over time? Yes () No ()
28. If yes, how did you resolve it?.....
29. What are roles of village water committee:
- a)
 - b)
 - c)
 - d)
 - e)
30. Have you established water funds? Yes () No ()
31. Who is responsible to manage fund?.....
32. How does fund work for water resources management?.....
33. Do you know any policy which addresses the water resources management issues?
Yes () No ()
34. If yes, mention it.....
35. Mention the issues stipulated in that policy:
.....
.....

36. Do you have water by-law? Yes () No ()

37. If yes, how does it impact water resources management?.....

F: Water fees system

38. Do you responsible to collect water fees ? Yes () No ()

If yes, how much do community pay (on the average) for one bucket (20 litres) of water? Tshs.....

39. Is water fees help on ensuring water resources management? Yes ()No ()

40. If no, give reasons:.....

G: The stakeholders involvement on planning of water resources management

41. What initiatives taken by village water committee with respect to water resources management?

a).....

b).....

c).....

d).....

e).....

42. Do village water committee involved during setting of water services fees? Yes()
No ()

43. Do village water committee has mandate to enforce village water by-law? Yes ()
No ()

44. Do village water committee involved during formulation of village water use plan?
Yes () No ()

45. If yes, explain how it works upon water resources management:.....

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME

APPENDIX IV: Key Informant Interview checklist for District Engineer (Qualitative approach).

AIM: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, Tanzania as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks

A: BACKGROUND INFORMATION

1. Area of residence.
Region.....District.....
2. Sex of respondent: Tick (✓) where is appropriate male () female ()
3. Age of respondent..... Years old.(Below__20) (20__30) (30__40) (40__50) (50__60) (60____ above)
4. Respondent's education level: Tick (✓) where is appropriate.
No school () Primary level () Secondary level () College above () other specify.....
5. Main occupation of the respondent.....
6. What are your main activities
.....
.....
7. What are the main activities of your office?
8. Is there any need of having coordination between your office and other institutions?
Yes..... No..... If yes, explain why.....
.....
.....

9. Is there any coordination between your office and any other sectors/institutions of the government? Yes.... No.....

10. If yes, how is the coordination? Effective ... Ineffective...

What issues do you coordinate?

B: Water supply

11. What is the main source of drinking water used by households in Kipera and Mlali villages?

Tick (✓) where is appropriate;

- ☐ Piped ()
- ☐ Protected well ()
- ☐ Protected/covered spring ()
- ☐ Unprotected well ()
- ☐ Unprotected spring ()
- ☐ Surface source

(Lake/dam/river/stream/pond) ()

- ☐ Covered rainwater catchment ()
- ☐ Uncovered rainwater catchment ()
- ☐ Tanker truck ()
- ☐ Bottled water ()
- ☐ Other (please specify).....

12. Where is the source/who manages it?

- ☐ Into own house ()
- ☐ Into own yard/plot ()
- ☐ Into neighbours' house/yard/plot ()
- ☐ Water point managed by community ()
- ☐ Water point managed by private ()
- ☐ company/individual ()

13. Do you think there are problems with water supply and delivery in Kipera and Mlali villages? (1)Yes, problems (2) No, no problems (3) Don't Know

14. If so, when?.....years.

15. What will you say about the following issues of water supply in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Severe problem, Minor problem, Not a problem and Don't know, in the table below.

Water issue	Severe problem	Minor problem	Not a problem	Don't know
(1) Slowing down of domestic & commercial activities				
(2) Too much time is wasted in search of water				
(3) Long queues in fetching water, resulting in quarrels				
(4) Children usually are either late to or absent from school				
(5) Prices of food items increase due to shortage of water				
(6) Risk in drinking of untreated water from open wells or surface waters				
(7) Workload of women in the households becomes very heavy				
(8) Other(specify)				

16. What do you think are the possible causes of the water problems in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
(1)Increasing population				
(2) Poor water infrastructures				
(3)Catchment degradation				
(4)Development of agriculture practices				
(5)Unplanned settlement				
(6)Climate change				
(7)Other (specify)				

17. Have you taken efforts to minimize the water problem in Kipera and Mlali? Yes() No ()

18. If yes, List the efforts:

- a).....
- b).....
- c).....
- d).....

C: Water distribution

19. Where do communities in Kipera and Mlali villages collect water?

Tick (✓) where is appropriate; Public water point () Private water point ()
Borehole () Dam () Spring () River () Shallow well ()

20. How many households collect water from those sources?

- a)Public water point: () households
- b)Private water point: () households
- c) Borehole: () households
- d)Dam: () households
- e)Spring: () households
- f) Shallow well: () households

21. Have the residents ever experienced water shortage distribution? If so, when?.....years.

D: Water quality

22. Have your office tested water quality in Kipera and Mlali? Yes () No ()

23. How long does your office take to test water quality? After every.....years.

24. Have you experienced change of water quality over past 10 years? Yes () No ()

25. If yes, what efforts have you taken to minimize the water quality problem?.....

26. What are some of the factors that you think may be affecting the safety or quality of drinking water in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
(1) Poor solid waste disposal				
(2) Using of pesticides				
(3) Using of inorganic fertilizers				
(4) Washing clothes nearby water sources				
(5) Poor toilet sanitation/ or hygiene				
(6) Other (specify)				

27. Are there any diseases outbreak related to poor water quality occurred in Kipera and Mlali village over past 10 years? Yes () No ()

28. If yes, List diseases occurred:.....

29. Which age group affected most? Tick where is appropriate

a) Age: 0-5 years ()

b) Age: 6-14 years ()

c) Age: 15-49 years ()

d) Age: 50- above ()

E: Capacity of local institutions on water resources management

30. Have you used Integrated Water Resources Management approach on ensuring sustainable water resources management? Yes () No ()
31. Have you experienced water use conflicts over past 10 years in Kipera and Mlali villages? Yes () No ()
32. If yes, how did you resolve it?.....
33. Are there village water committees in Kipera and Mlali villages? Yes () No ()
34. If yes, are they active with regards to water resources management?.....
35. Have your facilitate establishment of water funds in Kipera and Mlali Villages? Yes () No ()
36. If yes, what is the current status of the funds? In term of amount of money collected:.....Tshs.
37. Is fund ensuring sustainable water resources management? Yes () No ()
38. If yes, explain:.....
39. Does water policy address the water resources management issues effectively? Yes () No ()
If yes, mention it.....
40. Have your office facilitate formulation of water by-law in Kipera and Mlali villages? Yes () No ()
41. If yes, how does it impact water resources management?.....
42. Have you office support on formulation of village water use plan? Yes ()No ()
43. If yes, explain how it works upon water resources management:.....

F: Water fees system

44. Does your office facilitate setting of water fees system in Kipera and Mlali villages? Yes () No ()
45. If yes, how much do community pay (on the average) for one bucket (20 litres) of water? Tshs.....

46. Do communities afford water fees? Yes () No ()

G: The stakeholders involvement on planning of water resources management

47. What level of community awareness on water resources management? (1) High (2) Medium (3) Low

48. How does your office disseminate the information about water resources management to the communities in Kipera and Mlali villages?

.....

49. What initiatives already taken by community with respect to water resources management?

- a)
- b)
- c)
- d)
- e)

50. Do community involved during setting of water services fees? Yes () No ()

51. Does your office collaborate with local partners in water resources management? Yes () No ()

52. If yes, mention:

- a)
- b)
- c)
- d)
- e)

53. What are roles of local partners with respect to water resources management?.....

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME

APPENDIX V: Key Informant Interview checklist for Wami/Ruvu river basin leader(s) (Qualitative approach).

AIM: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, Tanzania as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks

A: BACKGROUND INFORMATION

1. Area of residence.
Region.....District.....
2. Sex of respondent: Tick (✓) where is appropriate male () female ()
3. Age of respondent..... Years old.(Below__20) (20__30) (30__40) (40__50) (50__60) (60____ above)
4. Respondent's education level: Tick (✓) where is appropriate.
No school () Primary level () Secondary level () College above () other specify.....
5. Main occupation of the respondent.....
6. What are your main activities
.....
.....
7. What are the main activities of your office?
8. Is there any need of having coordination between your office and other institutions? Yes..... No..... If yes, explain why.....
.....
.....
9. Is there any coordination between your office and any other sectors/institutions of the government? Yes.... No.....

10. If yes, how is the coordination? Effective ... Ineffective...

What issues do you coordinate?

B: Water supply

11. What is the main source of drinking water used by households in Kipera and Mlali villages?

Tick (✓) where is appropriate;

- ☐ Piped ()
- ☐ Protected well ()
- ☐ Protected/covered spring ()
- ☐ Unprotected well ()
- ☐ Unprotected spring ()
- ☐ Surface source

(Lake/dam/river/stream/pond) ()

- ☐ Covered rainwater catchment ()
- ☐ Uncovered rainwater catchment ()
- ☐ Tanker truck ()
- ☐ Bottled water ()
- ☐ Other (please specify).....

12. Where is the source/who manages it?

- ☐ Into own house ()
- ☐ Into own yard/plot ()
- ☐ Into neighbours' house/yard/plot ()
- ☐ Water point managed by community ()
- ☐ Water point managed by private ()
- ☐ company/individual ()

13. Do you think there are problems with water supply and delivery in Kipera and Mlali villages? (1)Yes, problems (2) No, no problems (3) Don't Know

14. If so, when?.....years.

15. What will you say about the following issues of water supply in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Severe problem, Minor problem, Not a problem and Don't know, in the table below.

Water issue	Severe problem	Minor problem	Not a problem	Don't know
(1) Slowing down of domestic & commercial activities				
(2) Too much time is wasted in search of water				
(3) Long queues in fetching water, resulting in quarrels				
(4) Children usually are either late to or absent from school				
(5) Prices of food items increase due to shortage of water				
(6) Risk in drinking of untreated water from open wells or surface waters				
(7) Workload of women in the households becomes very heavy				
(8) Other(specify)				

16. What do you think are the possible causes of the water problems in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water problems	Major cause	Minor cause	Not a cause	Don't know
(1)Increasing population				
(2) Poor water infrastructures				
(3)Catchment degradation				
(4)Development of agriculture practices				
(5)Unplanned settlement				
(6)Climate change				
(7)Other (specify)				

17. Have you taken efforts to minimize the water problem in Kipera and Mlali? Yes () No ()

18. If yes, List the efforts:

- a)
- b)
- c)
- d)

C: Water distribution

19. Where do communities in Kipera and Mlali villages collect water?

Tick (✓) where is appropriate; Public water point () Private water point ()
Borehole () Dam () Spring () River () Shallow well ()

20. How many households collect water from those sources?

- a) Public water point: () households
- b) Private water point: () households
- c) Borehole: () households
- d) Dam: () households
- e) Spring: () households
- f)Shallow well: () households

- g) Have the residents ever experienced water shortage distribution? If so, when?.....years.

D: Water quality

21. Have your office tested water quality in Kipera and Mlali? Yes () No ()
22. How long does your office take to test water quality? after every.....years.
23. Have you experienced change of water quality over past 10 years? Yes () No ()
24. If yes, what efforts have you taken to minimize the water quality problem?.....
25. What are some of the factors that you think may be affecting the safety or quality of drinking water in Kipera and Mlali villages? Tick (✓) as appropriate in the columns under: Major cause, Minor cause, Not a cause and Don't know in the table below.

Causes of water quality problems	Major cause	Minor cause	Not a cause	Don't know
(1) Poor solid waste disposal				
(2) Using of pesticides				
(3) Using of inorganic fertilizers				
(4) Washing clothes nearby water sources				
(5) Poor toilet sanitation/ or hygiene				
(6) Other (specify)				

26. Are there any diseases outbreak related to poor water quality occurred in Kipera and Mlali village over past 10 years? Yes () No ()
27. If yes, List diseases occurred:.....
28. Which age group affected most? Tick where is appropriate
- a) Age: 0-5 years ()
- b) Age: 6-14 years ()
- c) Age: 15-49 years ()
- d) Age: 50- above ()

E: Capacity of local institutions on water resources management

29. Have you used Integrated Water Resources Management approach on ensuring sustainable water resources management? Yes () No ()
30. Have you experienced water use conflicts over past 10 years in Kipera and Mlali villages? Yes () No ()
31. If yes, how did you resolve it?.....
32. Are there village water committees in Kipera and Mlali villages? Yes () No ()
33. If yes, are they active with regards to water resources management?.....
34. Have your facilitate establishment of water funds in Kipera and Mlali Villages? Yes () No ()
35. If yes, what is the current status of the funds? In term of amount of money collected:.....Tshs.
36. Is fund ensuring sustainable water resources management? Yes () No ()
37. If yes, explain:.....
38. Does water policy address the water resources management issues effectively? Yes () No ()
- If yes, mention it.....
39. Have your office facilitate formulation of water by-law in Kipera and Mlali villages? Yes () No ()
40. If yes, how does it impact water resources management?.....
41. Have you office support on formulation of village water use plan? Yes ()No ()
42. If yes, explain how it works upon water resources management:.....

F: Water fees system

43. Does your office facilitate setting of water fees system in Kipera and Mlali villages? Yes () No ()
44. If yes, how much do community pay (on the average) for one bucket (20 litres) of water? Tshs.....
45. Do communities afford water fees? Yes () No ()

G: The stakeholders involvement on planning of water resources management

46. What level of community awareness on water resources management? (1) High (2) Medium (3) Low

47. How does your office disseminate the information about water resources management to the communities in Kipera and Mlali villages

.....

What initiatives already taken by community with respect to water resources management?

- a)
- b)
- c)
- d)
- e)

48. Do community involved during setting of water services fees? Yes () No ()

49. If yes, is it pay fees accordingly?.....

50. Does your office collaborate with local partners in water resources management? Yes () No ()

51. If yes, list them:

- a)
- b)
- c)
- d)
- e)

52. What are roles of local partners with respect to water resources management?.....

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME

APPENDIX VI: Focus group questionnaire-(Qualitative approach)

Aim: To assess the magnitude of the impacts of human settlements and activities on water resources in line with the role of Integrated Water Resources Management Approach on ensuring equitable, economically sound and environmentally sustainable management of water resources and provision of water services using Kipera and Mlali villages in Mlali Ward, in Mvomero District in Morogoro Region, Tanzania as a case study. I beg you to share with me various issues related to this study. The information provided is confidential and will serve research purposes only not otherwise. Thanks.

Focus Group Discussion will involve 16 villagers whereby 8 villagers will be obtained from each village.

A: Background Information

1. Area of residence:

District.....Ward.....village

2. Characteristics of Focus Group Discussion members (age, education, and occupation).

B: Water supply

3. What are the main sources of water supply in the village?
4. Who own those water sources?
5. Did you experience any shortage of water supply over past 10 years? Yes () No ()
6. If yes, what are the main causes?
7. Have you experienced water use conflicts? Yes () No ()
8. If yes, what are social impacts?.....

C: Water distribution

9. How many water points own by public?
10. How many water points own by private?
11. Did you experience insufficient distribution of water over past 10 years? Yes? Yes () No ()

12. If no, what the main causes?

13. Do your daily activities affected by insufficient distribution of water? Yes () No ()

14. To what extent, explain:.....

D: Water quality

15. Do you experience change of water quality over past 10 years? Yes () No ()

16. If yes, what are the main changes? (1) Colour (2) Odour (3) Taste (4) Other (specify)

17. What are the main factors contribute on changing of water quality?.....

18. Does change of water quality affect your social life? Yes () No ()

19. If yes, to what extent: explain:.....

E: Capacity of local institutions on water resources management

20. Do you have village water committee? Yes () No ()

21. Do you know the functions of this committee? Yes () No ()

22. If yes, mention:.....

23. Do you think that the committee is strong with regards to water resources management? Yes () No ()

24. If no, explain why?.....

25. Give suggestion to improve the performance of the committee:.....

F: water fees system

26. Does water fees system established in your village? Yes () No ()

27. Have community involved during a setting of water fees? Yes () No ()

28. How much per bucket (20 litres) of water? Tshs.....

29. Is community affording water fees? Yes () No ()

30. Do water fees help on water resource management? Yes () No ()

31. If yes, explain:.....

G: The stakeholders involvement on planning of water resources management

32. Have you participated in planning of water resources management? Yes () No ()
33. If yes, at what stage of planning have you participated?
34. Does planning ensuring water resources management? Yes () No ()
35. If no, what are limitations?.....
36. Are they any local partner for water resources management in your village? Yes () No ()
37. If yes, list:.....
38. Are they contributing on water resources management? Yes () No ()

END

THANK YOU FOR YOUR ASSISTANCE AND VALUABLE TIME