FACTORS INFLUENCING MANAGEMENT OF WATER RESOURCES IN ATHI RIVER BASIN PROJECT, LARI SUB COUNTY, KIAMBU COUNTY, KENYA

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DECLARATION

This research project report is my original work and has not been submitted for award of degree in any other university.

Signature……. Date……

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L50/79982/2015

This research project report has been submitted for examination with my approval as university supervisor.

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DEDICATION

This Research project report is dedicated to my beloved family, especially my brother John Koigi, my father, John Kigunda and mother Rahab Thira for their unrelenting support and cheerful engagement.

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ABBREVIATIONS AND ACRONYMS

AWSB	Athi Water Service Board
ASAL	Arid and Semi-Arid Lands
EIA	Environmental Impact assessments
EMCA	Environment Management and Coordination Act
FAO	Food and Agriculture Organization
GoK	Government of Kenya
GWP-TAC	Global Water Partnership-Technical Advisory Committee
INBO	International Network of Basin Organizations
IRBM	Integrated River Basin Management
IRP	International Resource Panel
IWRM	Integrated Water Resource Management
MOU	Memorandum of Understanding
NEMA	National Environmental Management Authority
NWRMS	National Water Resource Management Strategy
RoK	Republic of Kenya
SCMP	Sub-catchment Management Plan
UN	United Nations
WDC	Water Development Cycle
WRMA	Water Resources Management Authority
WRUA	Water Resource Users Associations
WUA	Water Users Associations

ABSTRACT

There is wide spread scarcity of water because demand exceeds the supply of water. This scarcity is mainly attributed to increasing population and climate change. The water scarcity is severe in arid and semi-arid areas with human settlements. Severe water shortage has led to conflicts among communities. In Kenya, there is a need to manage water resources in order to have effective and sustainable water use. In Kenya water is managed by Water Resource Management Authority and management activities are implemented by the Water Resource Users Association. The purpose of this study was to assess factors which influence management of water resources in Athi River Basin in Lari Sub County in Kiambu County. The objectives of the study were to: assess Stakeholders involvement in water resources management in Lari Sub County, assess factors influencing training of water users on water resource management in Lari Sub County, assess water conservation strategies used in Lari Sub County; and assess agro-chemicals influencing water quality in Lari Sub County. The target population was 1227 and included Water Resource User Associations members from Lari Sub County, the executive committee and the officials of the Water Resource Management Authority in Kiambu County. A sample size of 175 respondents was used in the study. Descriptive survey research design was used in the study and Information was collected through questionnaire and interview schedules. In the field section, using simple sampling method, information was collected from members. Results indicated that there was a positive and significant relationship between the variable of management of water resources, assess Stakeholders involvement, participation in training, water conservation strategies used and assess agro-chemicals influencing water quality. The data was analyzed using the Statistical Package for Social Sciences version 22 and data was presented using Tables. The key findings on stakeholder involvement showed that the majority of respondents were male aged between 35 years to 45 years who were mainly self-employed. It was further noted that most of community projects were being managed by elected members of Water Resource User Association. Water conservation strategies used was weak in the majority of members, improved by the introduction of a Stakeholders operator. The report emphasizes the need for participation in training; an aim found not to be entirely unrealistic. Simplicity in management structures is recommended. Flat-rate contributions and a punitive bond are highlighted as important elements of the Stakeholders operator's contract. There is currently an absence of regulation at the member's level. The ongoing use of alternative sources is found to undermine cost recovery, but also highlights the priority given by users to water softness. Most respondents also stated not attending trainings that were held in the group and the few that attended the training stated that they found training on use of technology more useful. The findings on the third objective showed that most group members had boreholes and others harvested rain water for irrigation. However, it was noted that a small percentage did not engage in any water conservation measures. The findings on the third objective showed that Di-Ammonium Phosphate was the commonly used fertilizer for planting food crops and the list used fertilizer was Calcium Ammonium Nitrate which is used for dressing. It was further noted that few farmers practiced organic farming. Most farmers also used protective clothing when applying pesticides. The findings were used to indicate the factors that eventually affect water quantity and quality, the information will be useful to the Ministry of Water, Agriculture, Local not for profit organizations and Community Based Organizations.

CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Water is one of the most important natural resource that affects the ecosystem and general human being. At the same time, water resources are under considerable pressure as a result of change in hydrologic regime due climate change, Increased human population and economic changes which have great consequences for people and the environment. (WWAP, 2015). Water scarcity affects most parts of Asia and Africa such as India, China and most parts of Africa. In these populations more than fourth of a population are water stressed and most of these people live in water basins. The most water stressed region is the middle east with 1200 cubic meters of water per person.

In Sub-Saharan Africa, human welfare and economic development depend on the wise use of water. Basins within arid and semi-arid areas such as the Sahel are experiencing water physical water stress and will not be able implement water conservation measures (Donkor et al, 1997). Basins in these areas (including much of the Sahel stretching from West to East Africa and a belt of land stretching from Angola to northern Botswana and Zimbabwe, reaching into southern Mozambique and northern South Africa) are also more likely to be exposed to adverse environmental risks resulting from irrigation expansion. Since environmental flow rules implemented in the authors' modeling are seldom legislated or enforced in reality, the sustainability of aquatic environments would likely be undermined. In the case of irrigation pumps (both motor and treadle), which rely heavily on groundwater, the environmental risks include overdraft of existing water resources. Presently, many people in urban and rural areas have no access to safe drinking water and sanitation services. Many of the poor in rural areas have limited and unreliable access to water for even subsistence farming. The poor often pay the most for water services, suffer the most in terms of health and economic opportunity. Their lack of overall access is at the heart of poverty trap and it is they who are most affected by increasing water degradation and scarcity. Combined with these factors, rising population and increasing the pressure on already scarce water resources. In this context, water has become a commodity of strategic importance in most African countries, because of increasing demands and rising costs coupled with diminishing supplies of water (Barker,1996).

The importance of water resources for sustainable development for African countries has been recognized at the highest level of the African Heads of States through the Sharm el-Sheikh declarations calling for the equitable and sustainable use, and promotion of integrated management and development, of national and shared water resources in Africa. Integrated Water Resources Management (IWRM) was adopted since the adoption of the Africa Water Vision 2025 and the Johannesburg Declaration on Sustainable Development (2002), which called for the preparation and implementation of IWRM plans. The crucial role of water resources for socio-economic development in Africa led to the creation of African Ministers' Council on Water (AMCOW) as the African voice and leadership on water and sanitation in Africa with the key objective of mobilizing countries, regional institutions and partners to address in a sustainable and coherence way the water challenges in Africa (Ansa Asare OD,1996).

Water-resources management issues have become so pressing that the World Economic Forum named water as one of its top challenges two years in a row, in 2013 and 2014. Within this changing physical and socio-economic landscape, water practices of the past are no longer adequate. Countries cannot grow sustainably, or strengthen their resilience to climate change, without smart water management that takes into account decreasing water availability and quality, and the need for deliberative allocation based on social, environmental, and economic needs. Due to this there is need for integrated water resource management. For example, there is much needed cooperation between the Nile river basin region covering several sub basin countries which are Ethiopia, Sudan and Egypt. These three countries over the last few years have been engaging in Trans boundary cooperation in water resource management.

In Kenya, there are different basins with several regions sharing the same basin and Athi River is in this category. Athi River is approximately 591 Km long and is the second longest river in Kenya after the Tana. The Athi Catchment Area (ACA) is 37,750 km2 and is home to a population of approximately 9.79 million (Kenya National Census, 2009) with a high economic potential in terms of agriculture, industrial zones and tourism. The Athi River emanates from the Ngong Hills, while its main tributary, the Nairobi River has its sources at the Kikuyu Escarpment. The other main tributaries include the Ndarugu, Thiririka, Thwake and Tsavo Rivers (WRMA, 2015).

Administratively, the drainage basin covers: Nairobi, Makueni, TaitaTaveta, Kwale, Mombasa, Kiambu, Machakos, Kajiado, Kilifi, Kitui and Nyandarua counties. Its major cities and towns are Nairobi (the capital city), Mombasa (the second largest city), Kiambu, Kajiado, Machakos, Malindi, and Kilifi. (WRMA, 2015) Other upcoming cities include Konza, Machakos, Tatu and Diani. The water resources and environment have been degraded by human activities such as industrial development, farming, informal settlements, deforestation, solid waste disposal and wetland and riparian encroachment. Pollution of Athi River is on the rise and has negatively impacted the downstream communities for whom the River is a lifeline (IRC, 2000).

It is against this background that this study aimed to assess the influence of WRUAS strategies on water resource management in Athi River Basin, Lari sub county Kiambu County, Kenya. It investigated various strategies of water resources management such as Management of community water resources, training of the water resource users, water conservation measure and use of agro chemicals. Environmental elements such as; climate (dry and wet seasons), landscape and water bodies (rivers, boreholes, dams, and springs); and events like droughts, were used during the study.

1.2 Statement of the problem

Lari Sub County catchment area is located in wet and cold climatic conditions with some few areas being semi-arid for example Kirenga, Kambaa, Githirioni and Nyambari. The major economic activity in the region is subsistence farming which is not favored by the weather which is mostly dry currently due to changing global weather such as prolonged droughts. The main sources of water for the region comes from rivers, springs and wetlands found within the span of the region, with the rivers forming tributaries of Athi River. Water scarcity in the region has become a big issue and is escalated by the long dry spells that are experienced in ephemeral tributaries which span the region and includes Bathi and Kambaa rivers. The area is highly heterogeneous hence it experiences variable surface water runoff especially in Bathi tributary which can be explained by the infrequent flash floods and very little percolation due to the geology of the area some of the issues which aggravate the problem are catchment degradation as a result of tree-felling in forest and reserve areas, encroachment and cultivation of wetlands. These activities cause destruction of surface cover resulting in increased surface run-off and soil

erosion. Eroded soils are carried by the surface run-off and deposited in rivers, lakes and dams, resulting in reduced storage capacity (Mwangi ,2011).

At the community level, water resources conservation activities are implemented by Water Resource User associations. As a result of the prior water related concerns associated with Lari, hasty measures are necessary to correct the current status of water catchment areas in the area. Training of Water Resource User Associations on water conservation, adequate financing of the Water Resource User Associations, merging of small Water Resource User Association and knowledge on environment are areas that need closer attention in order to correct the water catchment conservation inefficiencies in Lari Sub County.

Several studies have been conducted in order to determine the conflicts between different Water Resource Users Associations who share the same resources as well as how water resource regulations are received by the Water Resource User Associations but each WRUA in Kenya is required to have a Sub catchment management plan, which aims at managing water resources especially during long term droughts, which has not yet been researched on its effectiveness in water resource management during the dry seasons.

In this study the focus was on factors influencing management of water resources in Athi river basin project, Lari Sub County.

1.3 Purpose of the study

The purpose of the study was to assess factors influencing management of water resources in Athi River Basin Project, Lari Sub County, Kiambu County, Kenya.

1.4 Objectives of the study

The objectives of the study were:

1) To assess Stakeholders involvement in Water Resource Management in Athi River Basin, Lari Sub County, Kiambu County, Kenya.
2) To assess influence of training of Water Users on water resource management in Athi River Basin, Lari Sub County, Kiambu County, Kenya.
3) To assess water conservation strategies used in Water resource management in Athi River Basin, Lari Sub County Kiambu County.

4) To assess Fertilizers and pesticides which influence Water resource management in Athi River Basin, Lari Sub County, Kiambu County.

1.5 Research questions

The research questions of the study are:

1. How does Stakeholders involvement influence management of water resources in Athi River Basin, Lari Sub County, Kiambu County, Kenya?
2. Which Training of the water users factors influence water resource management in Athi River Basin, Lari Sub County, Kiambu County, Kenya?
3. Which Water conservation strategies are used that influence water resource management in Athi River Basin, Lari Sub County, Kiambu County, Kenya?
4. Which fertilizers and pesticides influence Water quality in Athi River Basin, Lari Sub County, Kiambu County, Kenya?

1.6 Significance of the study

The study is important to various stakeholders including the government, the local communities, as well as the county governments. The study contributed to the existing body of knowledge on the effectiveness of different strategies being used by the local community to manage their water resources effectively. The recommendations for future study would be to rule out the retrogressive practices by government and the local communities that has led to overuse and poor maintenance of water resources. The study would enable policy makers and law enforcers to formulate and implement rules and regulations for use and management of these water resources.

1.7 Basic assumptions of the Study

That the individuals who are in the water resource associations represents the large number of people who use the rivers directly and are most affected by poor water resource management at the local level.

1.8 Limitations of the study

The study conducted in Lari Sub County Kiambu County, Kenya and these results cannot be shared in other parts since factors differ according to regions.

The study focused on farmers and other direct beneficiaries of the rivers but, the other population that has to travel and still fetch the water from the same rivers will not be included in the study.

1.9 Delimitation of the study

The study was conducted in Athi River Basin, Lari Sub County**.** Lari Sub County is located in the upper Kiambu West which is part of Kiambu County**.** It is adjacent to the Kikuyu Escarpment Forest, which is part of the southern Aberdare Range and covers 37,600 ha (KENVO 2008). The climate is classified as warm temperate, summer dry with warm summers (Koeppen-Geiger Csb) (Kottek, et al. 2006) with an average annual temperature of 14.2 °C, the annual precipitation is at 1395 mm. In 1985 the Bathi River dam, north of Kimende, was constructed to supply the area with tap water. It is managed by the Athi Water Service Board (AWSB).

1.10 Definitions of Significant Terms Used in the Study

In this section terms are elaborated in the context of the topic of the study.

Agricultural chemicals	Are agricultural compounds that are applied directly to or on plants for one or more of the purposes .Agricultural chemicals range from herbicides to plant growth regulators.
Effective Management of water resources	This includes all activities that promote sustainable use of water resources.
River basin	Is the land that water flows across or under on its way to a river.
Sub Catchment Area	Refers to the area of land whose topography and drainage system directs water to a single water resource
Training of water users	This is the process of passing knowledge from one experienced person to another.
Water catchment areas	This is where rain water or water runoff is collected by the natural land scape.
Water conservation	These are all measures put in place to increase water supply in a certain area
Water resources	Refers to freshwater in lakes, rivers and existing ground water
Water resource management	Is the process of planning, developing, distributing and maintaining the optimum use of water resource such as a river, lake or a wet land.
Water resource user's association	Is a collection of users of different water resources such as farmers, fish farmers, local industries who bring together their financials, technical, physical materials and labor for the functioning and maintenance of water resources .
Water sustainability Strategies	A plan of action aimed at achieving the overall aim in this case utilizing water resources and making sure there is adequate water for future generations, carried out by all the stakeholders of any given water resource.

1.11 Organization of the study

Chapter one contains introduction to the study and it includes background of the study, problem statement, significance of the study and definition of terms.

Chapter two contains literature review of the study and includes, Theoretical Framework, Conceptual Framework, and related variables of management of water resources.

Chapter three contains Research methodology of study and includes research design, target population, sample size and sampling procedures, data collection instruments, data collection procedures, data analysis techniques, ethical considerations and operationalization of variables.

Chapter four consists of data analysis, presentation and interpretation of data.

Chapter five contains summary of findings, discussion, conclusions, and recommendations.

CHARTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents Literature review of the study. It includes Empirical Framework which consist of overview of water resource management, operation and management of the water resource user associations and water catchment areas in Kenya. The literature review was drawn from various materials that are similar or closely resemble the area of study. The Chapter also includes: Theoretical Review, Conceptual Review and a Knowledge gap.

2.2 Management of water resources

As pointed out by Tshmanga (2010) Water resources are sources of water that are useful or potentially useful to humans and the surrounding ecosystems. They include both ground and surface water resources such as rivers, wells, springs, dams and lakes. According to him, the way these resources are used for human and environmental activities such as agriculture, industry, household, recreation and environment; the rules and practices surrounding their protection, conservation, governance and participation, aiming at enhancing their relative value, is referred to as water resource management. Djordjevic (1993) explained that water resources management comprises all organized activities and planning regarding water resources development, conservation, protection and control from water adverse effects. Water resources management includes aspects such as water uses (inherent values, domestic needs, food security, energy supply, transportation and recreation), conservation, assessment, protection, participation and governance.

This implies that management of water resources consists in matching water supply and water demand, and reducing environmental damage caused by water, or to waters and the bodies of water. According to Hirji et al. (2002), water resources management deals with a number of issues which include: irrigation management; the process of water resources law, policy and strategy formulation; groundwater management; catchment protection; management of wetlands; flood management; and rural and urban water supply management. Water resources management uses hydraulic and other structures, complex water resources systems and measures to influence water demand, use, conservation and protection.

In Southeast Asia and the Himalayas, as elsewhere, land and water resource management issues are most pronounced in areas of marginal production systems, and directly connected to poverty reduction efforts. Climate change is likely to exacerbate existing challenges within these sectors in unexpected ways. The Asia-Pacific region is one of the most rapidly urbanizing regions in the world, with urban populations growing at 2.3% per annum compared to the global average of 2%. Currently, there are 10 mega-cities in the region (cities with 10 million or more residents). This will increase to 15 by 2025, leading to significant increased demand for water resources. In addition, water quality is threatened by land-use changes that degrade ecosystems, point source pollution from industrial and domestic waste, and non-point source pollution from organic and inorganic chemicals (Howitt,2015).

There are many challenges facing water management in South Africa. This is mainly due to inadequate rainfall, hence mismanagement of water resources due to political breakdowns and racial groups also contribute to the problem. Some of the other challenges may include: limited physical resources, a long cycle of inadequate rainfall, a rapid growing population, and stagnant economies. Complex challenges such as these, dictate a critical need to manage and conserve water resources properly. The current trends in South Africa indicate that, water problems will continue becoming more and more complex, conflicting or interfering with other developmental sectors such as: agriculture, mining and energy, industry, transportation and communications and with social sectors including education, environment, health, rural and regional development (Anderson,2005)

Ethiopia is one of the poorest countries although the River Nile passes through the country. Despite this the country is blessed with adequate water resources but, the country suffers from drought, famine, water related preventable diseases. According to World Bank(2000) the estimated freshwater per capita of Ethiopia is 1711 cubic meters. On the contrary, the percentage of population that have improved water sources is only 24%. The problem of water resource management (and ensuing drought and famine) is multidimensional. Perhaps it is possible to categorize the problems in two major groups: institutional and natural. The institutional aspect of the problem encompasses primarily governance related factors such as, budgetary, planning, implementation, monitoring and evaluation, and sustainability issues. The natural dimension of

the problem stems from the variability in the availability of water resources with respect to space and time.

Kenya's people are, according to the United Nations, one of the most struggling populations in the world. With a population of approximately 36.6 million and an annual population growth of approximately 2.6%, the country's poverty index has also continued to rise steadily. Water scarcity in Kenya has been an issue for decades, as only a small percentage of the country's land is optimal for agriculture, and the year-round climate is predominantly arid. In Kenya, there are five drainage basins which contain of six catchment areas namely Lake Victoria north, Lake Victoria south, Athi, Ewaso nyiro, Riftvalley and Tana (figure 1). The Kenya's natural water resources do not provide an equitable delivery of water to the various regions of the country and the country's water basins do not reach an equitable area of the country. This leaves most of the population without any fresh water. Rapid urbanization has also pushed poor urban dwellers to the slums, where there is no water or sanitation, and overcrowding exacerbates the already hazardous health conditions.

Kenya's water politics are also unique, as there has been a divide between areas that have been privatized and sectors where investors have been discouraged from developing. At a time when water privatization is seen as a negative in developing countries because of the high costs that are passed along to the impoverished, lack of development here means a lack of piping, sanitation or tanker service. Water pathogens are a huge health problem in Kenya, as the people have been left unprotected against sporadic epidemics such as cholera and parasitic worms. The rate of exposure is extremely high because the water is not only contaminated at the basins and pumps where water is collected but the containers are almost always "found," second-hand objects, often previously used for oil, fertilizer or wastes (UNEP,2012). Kenya currently is facing drought; this means that there are inadequate water conservation measures put in place. Drought is a subtle, natural hazard that is a normal part of the climate of virtually all regions of the world. Drought is considered by many to be the most complex but least understood of all natural hazards affecting more people than any other. There are different types of droughts highlighted below;

Meteorological Drought; This type of drought is measured solely on the amount or degree of dryness as compared to the usual or average and the duration of the dryness. Hence the duration and the amount of dryness are the major characteristics of this type of drought.

Agricultural drought; Agricultural drought refers to precipitations shortages, differences between actual and potential evapotranspiration and soil deficits. Drought affects agriculture activities first because the moisture in the soil is usually the first to get depleted due to high temperatures and also the wind.

Hydrological drought; Some characteristics of this type of drought include decreased water in water reservoirs such as dams and rivers or any other water resources. Most of the times this type of affect a wide range of activities such as electricity production as well as large scale agriculture and in general environmental and social impacts. This type of drought may be due to prolonged lack of rainfall that leads to decreased levels in dams, rivers and ground water. This means a whole country could experience drought if this type of drought was to occur.

Kenya is one of the countries that are usually affected by drought simply because there are few preparedness measures put in place. For example, each year Kenya receives rainfall to an extent where flooding is experienced but a few months later there is cases of droughts simply because there are no rain harvesting systems put in place (NDMA,2015).

As noted by Djordjevic (1993) the complex intricacy of water resources management depends on both, the water demand and the water supply. Therefore, water resources management is a dynamic process of devising alternative sequences or activities that will optimize the achievement of the objectives related to water resources. As noted by Ioulia et al. (2008), in our days' water has become one of the most important raw materials, energy carrier and environmental factors in the society, the limited availability of which may considerably hinder the socioeconomic development of many regions. The carefully planned management of water resources is therefore, an indispensable requirement. As explained by Hirji et al. (2002), there already exists an international consensus on the principle of sound water resources management. This has been demonstrated through international actions that go back to the „Water and Sanitation Decade" (1980-90), following the Mar del Plata Conference and the resulting action

plan of 1977 which led to the emergence of Inter-Secretariat Group on Water Resources of 1990 under the Administrative Co-ordination Council of the UN. Capacity-building in the water sector became the theme of the UNDP-IHE Conference in Deft in 1991.This was quickly followed by the ICWE in Dublin in 1991.Three basic elements of capacity building were identified: the creation of an enabling environment with appropriate policy framework; institutional development, including community participation; and human resources development and strengthening of managerial systems. The Dublin Principles called for placing greater emphasis on integrated, cross sectorial water management, addressing water quantity and quality, and environmental considerations in water management. They also advocated for linking land-use management as an integral part of sustainable water management and using river basins as management units (as it is with WRUAs in Kenya).

Further, the principles put emphasis on recognition of water as an economic good, promoting cost-effective intervention, supporting participatory efforts to manage water resources and focusing on actions to improve the lives of people and the quality of their environment. They also stressed adopting positive policies to address women's needs, empower women and incorporating mechanisms for conflict resolution (Ibid).

The ICWE called for innovative approaches to the assessment, development and management of freshwater resources, and provided policy guidance for the UNCED in Rio de Janeiro, Brazil, in June 1992 which highlighted the need for water sector reforms throughout the world. The Dublin statement reaffirmed that it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price, and went on to assert a number of principles. The first is that water must be managed in a holistic way, taking into account interaction among users and environmental impacts. The second principal is that water should be valued as an economic good and managed as a resource necessary to meet basic human rights. Thirdly, institutional arrangements must be reformed so that stakeholders are fully involved with all aspects of policy formulation and implementation. Water management must be devolved to the lowest appropriate level and the roles for NGOs, the private sector and community groups must be enhanced. Lastly, women must play a central part in the provision, management and care of the resource (Turral, 1998).

2.2.1 Water Catchment Areas in Kenya

In Kenya, there are five drainage basins which contain six catchment areas namely Lake Victoria South, Athi, Tana, Ewaso Nyiro, Lake Victoria North and Riftvalley (NEMA, 2011). (Appendix 5)

2.2.1.1 Lari Sub County Sub Catchments area

Lari Sub County is located in the upper Kiambu West which is part of Kiambu County. It is adjacent to the Kikuyu Escarpment Forest, which is part of the southern Aberdare Range and covers 37,600 ha (KENVO 2008). The climate is classified as warm temperate, summer dry with warm summers (Koeppen-Geiger Csb) (Kottek, et al. 2006) with an average annual temperature of 14,2 °C, the annual precipitation is at 1395 mm. In 1985 the Bathi River dam, north of Kimende, was constructed to supply the area with tap water. It is managed by the Athi Water Service (AWS).

2.2.2 Operation of Users of water resources associations

WRUA is an association of water users, riparian land owners and other stakeholders who use the water resource in one way or the other and are either voluntary or officially engaged in management, conservation of water resources in their region of residence (WRMA, 2007). WRUAS are voluntary membership organizations that are formed to protect and manage the water resource such as a river that they share in common. These are individuals or organizations who utilize water for social economic or recreational purposes. These are new organizations that are increasingly gaining popularity around the world and are recognized for solving some of the problems arising related to water resource management such as poor land and water resource practices, lack of compliance to the regulations put in place by either local government or national government, lack of proper monitoring and poor awareness.

Water resource management authority (WRMA) identifies different areas in the sub catchments areas as Alarm, Alert or Satisfactory (WRMA, 2007). In places classified as Alarm, WRMA requires the water resource users to form WRUAS. Then research is carried out on the available water resources such as boreholes, rivers, pans or ponds. After all the data is collected the WRUAS are tasked with maintaining and managing these water resources. The main objectives or functions of WRUAS include: To Manage the water catchments; to manage the resources

properly; to increase the availability of water resources; to increase the usage of the water for the economic and social improvements; to develop sustainable and responsive institutions. (WRMA, 2007).

2.2.3 Management of the Water Resource User Associations

Water Resource Management Authority (WRMA) is a parastatal that was formed under the Water Act and started its operations in 2005.WRMA is the lead agency in the management of water resources in Kenya. As the lead agency, WRMA has a vital role manage and regulate and equally distribute the national water resources to all users. WRMA is therefore responsible for the formation of the Water Resource User Associations all over Kenya. The main aim of forming the Water Resource Associations is to put in place a forum where activities to conserve and utilize local water resources are discussed and implemented according to the law for everyone to benefit. This means that every stakeholder gets a chance to manage and utilize their local water resources in a fair way.

Below is the organizational structure of WRUA:

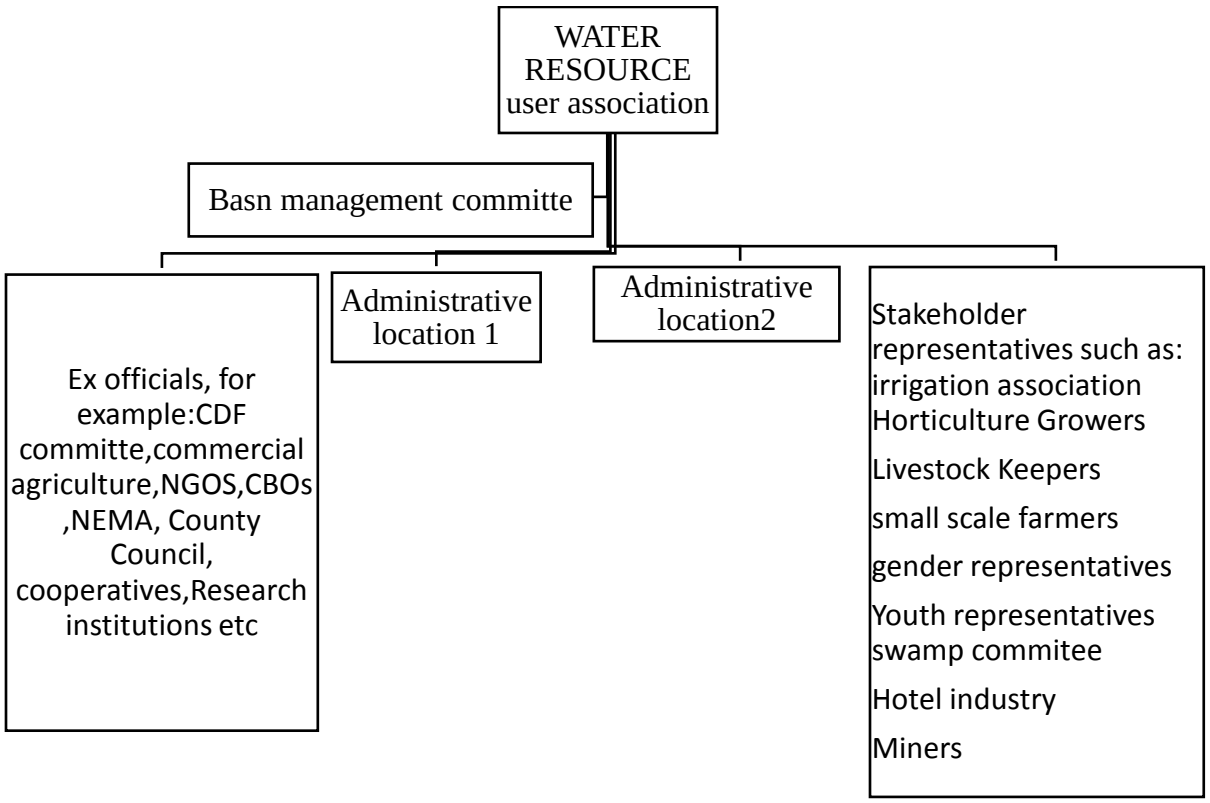

Figure 1: Organizational structure of the WRUA

2.2.4 Formation of Sub Catchment Management Plan

After the formation of the WRUAS each of these group is required to come up with a sub catchment management plan (SCMP). A SCMP is a document outlines a way of common water resource management such as water conservation strategies. It shows different stakeholders roles and their level of involvement. It identifies different problems, Priorities and opportunities or strategies to be carried out by WRUAS in water resource management. The main objective of the plan is to prevent deterioration of the status of water resources and prevent any further damage to water resources in order to maintain the balance of the ecosystem and preserve the ecosystems that utilize them. This plan has strategies to protect the water resources. These strategies include: eliminate eucalyptus trees from river banks; to establish tree nurseries, and tree planting calendars that will help boost forest cover; riparian demarcation and growing vegetable cover; land and water conservation; rehabilitation of degraded hills and wetlands; environmental education and extension, to each member of the society; encourage water harvesting in households and also encourage gender equality (WRMA, 2007).

2.2.5 Water quality in Kenya

With a population of about 42 million Kenyans 37% of Kenyans still rely on unimproved water sources such as ponds, shallow wells and rivers, while 70% of Kenyans use unimproved sanitation solutions. This translates into more than 17.3 million people using unimproved water sources and 32.7 million people using unimproved sanitation facilities (Water org,2007). These challenges are especially evident in the rural areas and the urban slums. Only 9 out of 55 public water services providers in Kenya provide continuous water supply, leaving people to find their own ways of searching for appropriate solutions to these basic needs. Under these circumstances the poor particularly women and girls spend a significant amount of time travelling some distance to collect water.

2.2.6 Water sector regulations in Kenya

The Kenya water act (Gok, 2002), provides for decentralization of powers from national level to regional and local level. This act led to formation of the water resource management authority which was given the mandate to manage the water resources around the country. This authority was decentralized to regional levels so per each catchment area there exist the WRMA.WRMA designed different approaches towards managing the water resources including formation of the

WRUAS. This way the power to manage water resources was left for the local people. The water services Trust Fund (WSTF) was established under the Water Act (2002) to assist in financing water projects in underserved communities. The WSTF set up financing opportunities for rural water supplies, and initiated other programs for urban areas more specifically for peri urban areas.

2.3 Explanation of relationships of variables in the Conceptual Framework

The main variables are reviewed below:

2.3.1 Stakeholders involvement in Water Resource Management

Over the past few years there has been a lot of conflicts as a result of the water resources usage and participation of all the stakeholders is difficult and complex. WRUAS are founded on the principle of inclusion where different users on board provide an effective platform for improved resource management practices, stakeholder negotiations, conflict prevention and management.
These WRUAS comprises of stakeholders with different objectives and may range from farmers, groups or organizations using the same water resources for their own gain including entertainment, irrigation and simply drinking water or household consumption. (FAO, 2006)

WRUAS bring together different users and getting them to participate may pose a challenge. Apart from attending meetings, Participation requires significant engagement in decision making and acting on the activities laid out in the plan (SCMP). Active participation of these stakeholders is seen as an important strategy towards solving possible conflicts on water use. For this to be realized, some reconditions such as thorough stakeholder analysis and accountable representation of distinctive members should be fulfilled. Were, Roy& Swallow (2006) clearly indicates the general manner in which user participation and dialogues should be conducted. Public participation in decision making should be unanimously approved and representatives of the local members should be involved in formulation of major plans or strategies.

2.3.2 Training of Water Users

The main use of putting in place water resource users' associations is to allow or give a platform where every stakeholder can participate in making decisions in regards to their water resources. A successful association is one that has clearly and thoroughly though out plan of work and put

in place the interest of the stakeholders and allows for participation of its members. As a requirement, members of the WRUA should undergo trainings on water resource management. The quality and frequency of the trainings may determine the effectiveness of water resource management by a particular WRUA. Some of the type of training needed included; effective way of carrying out irrigation, water conservation strategies and water policies in Kenya.

2.3.3 Water Conservation Strategies

Water conservation is the process of reducing surface flow of water by increasing infiltration over a prolonged time. The major water conservation strategies include: cultural measure such as tillage, terracing, building gabions rain harvesting measure. Most households in this location also use different rain water harvesting methods such as using guttering systems in roofs, digging canals that tap water in gardens and also digging small dams. (Ngigi,2009)

2.3.4 Use of Fertilizers and Pesticides

Majority of residents of Lari practice agriculture as the main source of livelihood, with the area dominated by subsistence farming. Tea farming is practiced largely by residents of the eastern part of Lari. This area includes Kagwe, Kagaa, Gatamaiyu and Matimbei areas. Crops grown for sale include vegetables such as cabbage, coriander, spinach and kale (Sukuma wiki). Vegetable farming in the constituency is largely favored by the large amounts of rainfall received throughout the year and the continuous cold seasons. Many farmers in the area rear dairy cows. While the milk is produced mainly for home consumption, the surplus is sold, usually to dairy cooperatives that have local offices in Lari (FAO,2010). Due to the areas' major agricultural activities, farmers in the area use Pesticides and inorganic fertilizers for their farming. This means that during rainy season most of the runoff water end up in the water bodies carrying with it these chemicals. The agricultural chemicals are the major pollutants in these area and over time the water quality decreased considerably. Overtime the WRUAS came up with measures to reduce pollution through chemical contaminants and most farmers are adopting organic farming.

2.4 Theoretical Framework

This section highlights different theories which are relevant to the study.

2.4.1 Absolute conservation theory

This theory suggests conserving the natural resources by stopping their use. This means that if the natural resources such as water, air, soil are not used at all then their quality and quantity is not affected at all. However, this theory is impractical since we depend on the natural resources to survive such as water air and soil, however it could apply to those natural resources that are being rare due to human interference such as diamonds gold etc.(Urmela,2012). This relates to the third objective (Water conservation measures) where the study was investigating different ways used to conserve the water such as not using a river that is drying up for a certain period of time.

2.4.2 Relative conservation theory

This approach considers use and conservation of natural resources. It is practical in such a way it advocates for proper utilization of natural resources. For example, if you cut one tree plant ten more for future use. The quality and quantity of natural resources are regenerated for future use. (Urmela,2012). This theory relates to the third objective of water conservation where the study was investigating how the communities or water users are improving the quality and quantity of water resources.

2.4.3 Mick Jagger Theory of Drought management

Drought is a Natural calamity which no one has control over but drought can be managed in such a way that even when there is drought there is enough water. This theory states that if a country or region put in place water management strategies such as rain harvesting and building reservoirs then in times of drought there can be adequate water even to supply the driest parts of the country (Harou, 2015). This theory related to the topic of the study which is investigating measures put in place to manage water resources in order to avoid droughts in future.

2.5 Conceptual Framework

The Conceptual Framework can be defined as a visual or written product, one that explains, either graphically or in narrative form, the main things to be studied-key factors, concepts, or variables and the presumed relationships among them (Miles and Huberman,1994). In this study three entities which are interrelated were developed. Any factors that lead to changes in these

three entities will have an impact on effective water resource management. In Figure 2 below the variables have been grouped into three broad categories: i) the independent variable such as stakeholder's participation in water resource management, training of water users, water conservation strategies used and Fertilizers and Pesticides used. ii) The moderating variables such as government policies and intervening variable such as climate change. iii) the dependent variables which determine management of water resources such as improved health, adequate and quality water for household and community use.

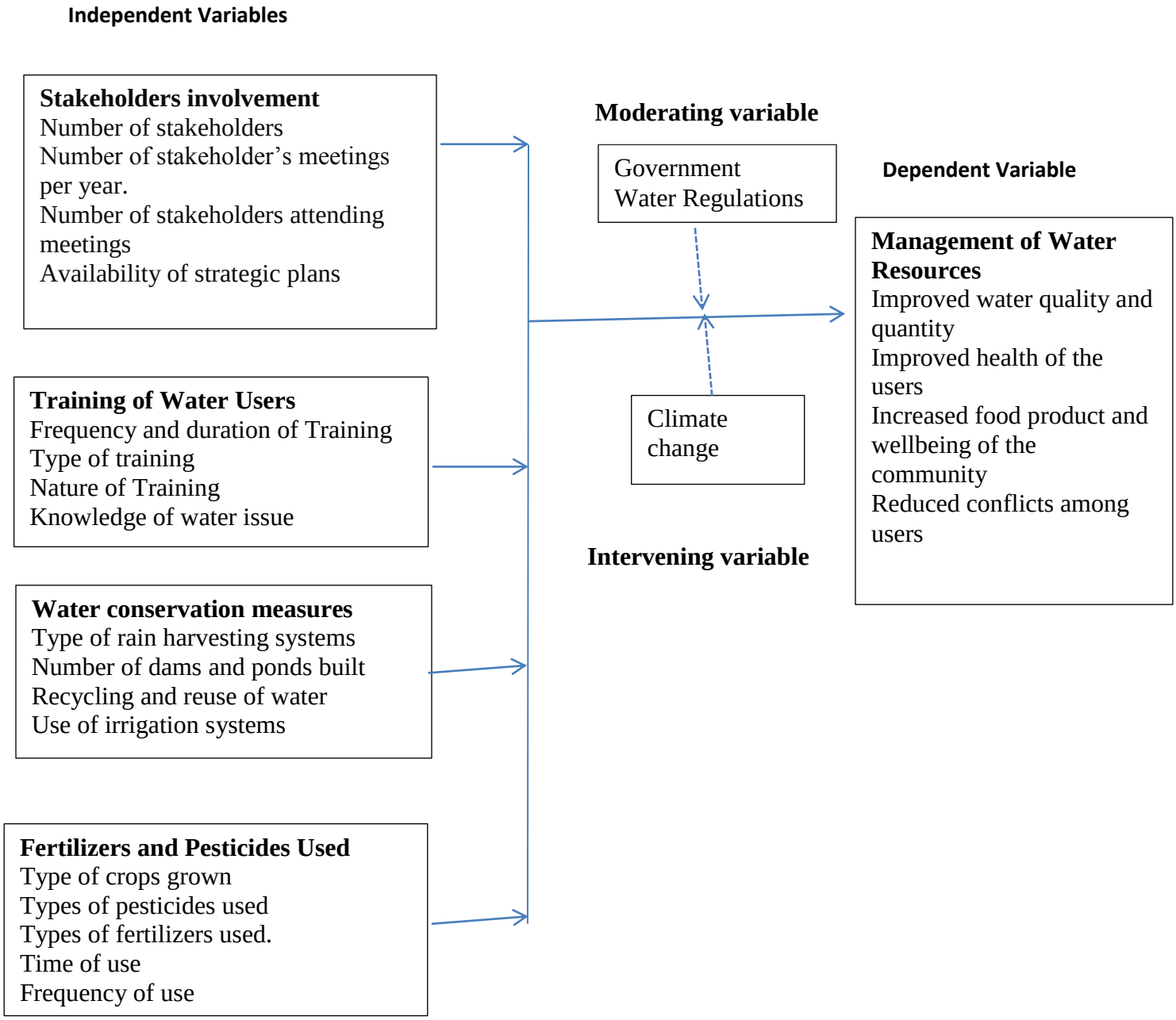

Figure 2: Conceptual Framework

2.6 Knowledge Gaps

From the literature reviewed it is clear that the formation of WRUAS is new and the plans developed by WRUAS (Sub Catchment Management Plans) are new concepts. These plans highlight different strategies used to manage the water resources in different parts of the country. Limited research has been done in order to determine the effectiveness of water management strategies at local level. There is a need for more research and information on management of water resources, water conservation strategies and agro chemicals used in Lari Sub County, Kiambu County Kenya. This can help improve the quality of water and the life of the people in the area of study.

2.7 Summary of literature review

This chapter highlights literature already knows on water resource management around the world in Africa and Kenya. The chapter also includes the conceptual framework that highlights the relationship between Dependent variable (Water resource management) and independent variables (Stakeholder participation, Training of water users, Water conservation measures and Agrochemicals used).

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents Research methodology which includes research design, Target population, sample size and sampling procedures, data collection tools, data collection procedures, data analysis techniques, Ethical considerations and operationalization of variables.

3.2 Research design

A research design is a plan that is used to answer the research questions (Orodho,2003). This study used the descriptive survey research design because it provides high level of general capability in representing a large population. The research design is used because of its low cost and convenience in data collection. Furthermore, the research design provides is reliable hence, avoids the researcher's biasness.

3.3 Target population

Small populations can form samples and studied as distinct cases (Orodho, 2003). The choice of the target population was guided by the topic of the study which is influences of water resource user association's strategies on water resource management in Athi River Basin, Bathi sub catchment area in Lari Sub County. The target population of the study comprised of the registered members of the 6 Water Resource User Associations from the whole of Lari Sub County. The other target population comprised of 3 top officials of Water Resource Management Authority in Kiambu County who helped to form the Water Resource User Associations. The total number of members of the WRUAS in the location was 1,227 and included maximum of 4 officials in each WRUA (WRMA, 2007).

Table 3.1 Target population

Category	Target population	Percentage
WRUA members	1200	96
Executive committee	24	3
WRMA officials	3	1
Total	**1227**	**100**

3.4 Sample size and sampling procedures

A Sample is a small part of the large pollution that is considered to be a representative of the large population (Cooper, 2003). During research, since the size of the WRUAS in terms of membership is different, a random selection process was used, where the probabilities of each cluster being included in the sample is proportional to the size of the cluster. The main sampling units of the survey were the WRUA members and the executive committee who were picked randomly. The WRMA officials were purposely sampled for the study while each member of the sample population was assigned a number from the Table of random numbers and picked randomly. Using Yamane, (1967) equation the sample size obtained from the target population is given below:

$n = N/1+N(e)^2$ =1227/1+1227 (0.07) ²

Where: e is the precision (0.07) =1227/1+1227(0.0049)

N is the target population =1227/7.0123

n is the sample size **n=175**

Table 3.2 Sample size

Category	Sample size	Percentage
WRUA members	166	86
Executive committee	6	10
WRMA officials	3	4
Total	**175**	**100**

3.5 Data collection instrument

Survey research can use several methods to collect data (Cooper and Schindler, 2003). In this study, data was collected from the respondents through a personally administered structured

questionnaire. The respondents were the members of the Athi River Sub Catchments area WRUAS. Interview schedules were also being used and were administered to the Water Resource Management Authority as well as the Water Resource Users Associations executive members.

3.5.1 Pilot testing of the instruments

The term 'pilot study refers to mini version of a full-scale study and is also called 'feasibility' study, as well as the specific pre-testing of a particular research instrument such as a questionnaire or interview schedule. The purpose of pilot testing is to discover errors or problems with the data collection instrument. Pilot testing was done by collecting data from 10 members of Water Resource User Association in neighboring Limuru Sub County. Then the questionnaires were checked if the respondents answered the questions properly and how well they understood.

3.5.2 Validity of the instrument

Instrument validity means the meaningfulness, accuracy and technical soundness of the research instrument (Mugenda and Mugenda, 1999). It is the extent to which an instrument measures what it is intended to measure. To this effect questionnaire or interview guide are said to be valid when they actually measure the intended parameters. To enhance the instrument validity, the researcher instruments were appraised by the supervisor to provide expert opinion and evaluate the applicability and appropriateness of the content, clarity and adequacy of the instruments from a research perspective. A pilot test of the instruments was also conducted among 5 randomly selected respondents that were not from area of study in order to ensure validity in the content of each research instrument.

3.5.3 Reliability of the instrument

Reliability of the instrument refers to the degree to which the instrument is able to produce the same results after repeated trials according to Mugenda and Mugenda, (2003). The researcher employed the split half test method in order to test reliability of the research instrument. The process of obtaining split-half reliability is begun by splitting in half all items of a test that are intended to probe the same area of knowledge in order to form two sets of items. The entire test is administered to a group of individuals, the total score for each set is computed, and finally the

split-half reliability is obtained by determining the correlation between the two total set scores. The data collected form the pilot study was entered into Statistical Package for Social Sciences (Version 22). Sample items from domain of indicators were split into equal halves and analyzed through spearman Brown Prophecy Formula using the Statistical Package for Social Sciences. According to Mugenda and Mugenda (2000) an instrument that yields a reliability coefficient above 0.8 is consistent and reliable. If the computation gives coefficient of 0.8 the research instrument was considered reliable.

3.6 Data collection procedures

Data of the study was obtained by visiting sampled respondents from different WRUAS and schedule a meeting in which the questionaries' were distributed. The interviews were conducted on the agreed dates and the proceedings were recorded. The questionnaires were distributed to the sampled households with the aid of a research assistant, and the completed questionnaires were collected later on agreed date. This was helpful in increasing the questionnaire return rate and in reducing the chances of delay. Instructions were carefully explained to the respondents during the issuing of the questionnaires and they also assured that the information given would be treated confidentially and used only for the purpose of the study. The completed questionnaires were checked for completeness and appropriateness of the responses.

3.7 Data analysis techniques

Data analysis techniques are the processes of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making (Orodho,2003). Data collected during the study were analyzed using the Statistical Package for Social Sciences version 22. The items in questionnaires were identified and assigned a variable name and also assign values. Descriptive statistics were used to measure frequency. The responses were used to compute descriptive analyses which were presented using Tables and statistics such as mean in order to draw interpretations, comparisons, and summaries.

3.8 Ethical considerations

The study addressed the ethical issues through use of an introductory letter (Appendix 1) which explained the purpose of the study. It was also used to ensure that the researcher obtained the

consent and voluntary participation of the respondents and the right to know the purpose of the study and how the process were conducted. A letter from NACOSTI was used. It ensured that the respondents gave their information voluntarily and that the respondent had the right to know the purpose of the study and right to confidentiality and anonymity. The works of authors were quoted and referred to by use of citations and references. The principle of objectivity was adhered to during the entire search process including the design, data collection, analysis, and interpretation of data.

3.9 Operational definition of the variables

The Table 3.3 shows the variables of the study, how they were measured and data analysis techniques which were used.

Table 3.3 Operationalization of variables

Objectives	Variables Independent	Indicators	Measurement scale	Tools of analysis	Type of data analysis
To assess Stakeholders participation in water resource Management in Athi River Basin, Lari Sub County, Kiambu County, Kenya.	Stakeholders participation in water resource management	Number of stakeholders Number of stakeholder's meetings per year. Number of stakeholders attending meetings Availability of strategic plans	Nominal Ratio	Percentage Mean	Descriptive
To assess factors influencing training of Water Users in Athi River Basin, Lari Sub County, Kiambu County, Kenya.	Training of water users	Education level Gender Experience Frequency and duration of training Type of training Nature of training Knowledge of water issue	Ordinal Ratio	Percentage	Descriptive
To water conservation strategies in Athi River Basin, Lari Sub County Kiambu County.	Water conservation measures	Type of rain harvesting systems Built dams and ponds Recycling and reuse of water Change in irrigation patterns	Ordinal Ratio	Percentage	Descriptive
To assess Agro-chemicals influencing Water Quality in Athi River Basin, Lari Sub County, Kiambu County	Fertilizers and Pesticides	Type of crops grown Types of pesticides used Types of fertilizers used When the fertilizers are used Frequency of use	Ordinal Ratio	Percentage	Descriptive
	Dependent Management of water resources	Reduced conflicts among the water resource users Improved quality and quantity of the water resources	Ratio	Percentage	Descriptive

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

The chapter focuses on the data analysis, presentation and interpretation of data collected in the study using descriptive statistics. Conclusions and recommendations were3 made from analyzed data.

4.2 Questionnaires return rate

From the data collected, out of the 175 questionnaires administered, 150 of them were filled and returned. This response rate is considered very good for making conclusions of the study. Mugenda and Mugenda (2003) observed that a 50% response rate is adequate, 60% is good while 70% is rated very well. The recorded high response rate can be attributed to the data collection procedures, where the researcher pre-notified the key informants of the intended survey, also the researcher utilized a self-administered questionnaire where the respondents completed and these were picked shortly after.

4.3 Socio-Demographic Information

The study sought to establish information on various aspects of respondents' background such as gender, age, level of education, economic status, residential, time of being a resident and marital status. This information aimed at testing the appropriateness of the respondent in answering the questions regarding factors influencing management of water resources in Athi river basin project, Lari Sub County, Kiambu County, Kenya.

4.3.1: Gender of Respondents

The results are given in Table 4.1

Table 4.1: Gender of the Respondents

Gender	Frequency	Percentage
Male	91	60.7
Female	59	39.3
Total	**150**	**100**

The study found out that the majority of the respondents were male with 60.7% while 39.3% were female, the finding shows that there was not much disparity in data collection, both gender opinion was all represented fairly.

4.3.2: Age of Respondents

Table 4.2 shows the age of the respondents.

Table 4.2: Age of Respondents

Years	Frequency	Percentage
18-34	36	24.0
35-45	53	35.3
46-54	37	24.7
Over 55 years	24	16.0
Total	**150**	**100**

The findings show that most (35.3%) of the respondents indicated that they were between the ages of 31-40 years while 24.7% were between 41-50 years and 24% were between 19-30 years while only 16% were above 50 years old. These findings imply that those persons aged 35-45 years formed majority of opinion leaders in the WRUAS followed by 46-54 years.

4.3.3: Level of Education of the Respondents

The level of education is shown in Table 4.3

Table 4.3: Level of Education of the Respondents

Years	Frequency	Percentage
Primary level	13	8.7
Secondary	44	29.3
Diploma	32	21.3
Bachelor	30	20.0
Master degree	10	6.7
Others	21	14.0
Total	**150**	**100**

Table 4.3 shows that majority (29.3%) of the respondents had secondary level of education, 21.3% had diploma level, 20% had bachelor degree level, 14% others or had never attended school, while 8.7% had primary level. Therefore, it can be noted that majority of the respondents had attained the basic education and thus would provide valid and consistent information.

4.3.4: Economic status of the Respondents

Table 4.4 shows the economic status of the respondents.

Table 4.4: Economic Status of the Respondents

Economic status	Frequency	Percentage
Employed	26	17.3
Unemployed	50	33.3
Self-employed	59	39.4
Retired	15	1.0
Total	**150**	**100**

The findings in show that, 39.4% were self-employed, 33% were unemployed, 17.3% were employed in the formal sector which majorities of them were in teaching profession while only 1% of the respondents were retired from their jobs. Therefore, the majority of the respondents worked in the informal sector as they struggle to get their daily meal. Considering that the main economic activity in the area is farming it was therefore noted that the majority of respondents were farmers in their farms.

4.4 Information about WRUA membership

This section deals membership of the WRUA. This sought to establish information such as the respondents' length of membership in the WRUA, the extent to which they participated in the association's activities, their objectives in joining the WRUA as well as whether or not the WRUA had achieved its objectives or not. When did you join the WRUA?

4.4.1 Duration of membership in the WRUA

The study sought to establish for how long the household respondents had been members of the WRUA. This information was useful in determining the extent to which they had an understanding of the performance of the WRUA. The summary of this information is summarized in Table 4.5

Table 4.5 Duration of Membership in WRUA

Membership	Frequency	Percentage
1 to 3years	51	34
Above 4	99	66
Total	**150**	**100**

Table 4.5 shows that 34% of the respondents had joined the WRUA between 1 and 3 years ago, all the rest, or a combined proportion of 66% of all household respondents had been members for 4 years or more. This suggests that a majority of those participants in the study were conversant with the activities of the WRUA, and could therefore provide reliable information on the goings on in the association.

4.4.2 Participation in the activities of the WRUA

The respondents in the study were asked to state whether or not they participated actively in the activities of the WRUA, as the extent to which they were involved in the matters of the WRUA significantly influences the overall performance of the association. These findings are presented show that all the participants, 100%, participated actively in WRUA activities. This implies that they were keen on the day-to-day matters affecting and involving the association, and therefore could influence the extent to which the WRUA achieved its objectives.

4.4.3 Roles in the WRUA

Members of WRUAs are expected to play a role in the associations' activities, and the respondents were requested to state some of the findings, which are summarized in Table 4.6.

Table 4.6 Members' roles in WRUA

Roles	Frequency	Percentage
Regulating water access	63	42
Planting tress	42	28
Management responsibilities	45	30
Total	**150**	**100**

The study shows that most of the householders who participated in the study were either committee members or just ordinary members. On the other hand, 63 (42%) of the respondents were involved in regulating water access, while Others were involved in tree planting 42(28%) and holding management responsibilities (30%%). From these findings, it is seen that members of households were actively involved in WRUA activities, and therefore influence the effectiveness of the WRUA in accomplishing its mandate. None of the respondents who participated in the study indicated that they did not participate actively.

4.4.4 Expectations in joining the WRUA

To establish why the members had joined the WRUA, the researcher asked the respondents to indicate what their expectations were in joining the WRUA. The participants in the study stated

various reasons that influenced their choice to join the WRUA, the findings are summarized in Table 4.8.

Table 4.8. Expectations in joining WRUA

Expectations	Frequency	Percentage
Water conservation	42	28.0
Promotion of equitable	37	25.0
Clean water	30	20.0
Developing	23	15.0
Implementation	18	12.0
Total	150	100

Among the different expectations expressed by the respondents, the most common one was the expectation for better water conservation, as this was identified by 42 (28%) of the respondents, followed by the expectations for promotion of equitable access to water in the ENNCA area, which was identified by 37 (25%) of the participants in the study. Others stated that they had joined the WRUA with the expectation of participating in developing the WRUA 30(20%), or in order to get enough clean water for all in the area 23(15%). Few members of the households in the study had joined just to participate in the implementation of WRUA activities18 (12%). These findings show that the members of the WRUA have so much confidence in the ability of the WRUA to enable them have better conservation of water as well as to promote more equitable access to water in the ENNCA area.

4.4.5 Achievement of the expectations

Having indicated what their expectations were in joining the WRUA, the respondents were asked to state whether these expectations had been realized or not. Summary of the findings are presented in Table 4.9.

Table 4.9 Have the expectations been met.

Met expectations	Frequency	Percentage
Expectation met	65	43.3
Expectation not met	35	23.3
Partially met	40	32.7
Total	**150**	**100**

The findings show that (43 %) of the respondents felt that their expectations in joining the WRUA had been met, with (23.3%) suggesting that these had not. A smaller proportion of (32.7%) of the respondents stated that these expectations had been partially achieved. This implies that the WRUA has been significantly effective in achieving most of the objectives that it was expected to.

4.5 Stakeholders involvement

This section deals with objective one of the study; To assess how does Stakeholders involvement influence management of water resources in Athi River Basin, Lari Sub County, Kiambu County, Kenya, Kenya. And also seeking the opinion of the respondents. The findings are represented in Table 4.10.

Table 4.10: Stakeholders of community project

Stakeholders	Frequency	Percentage
An elected leader	65	43.3
Headman	35	23.3
Politician	1	0.7
Committee	49	32.7
Total	**150**	**100**

Table 4.10 shows that most of the local projects were being managed by an elected leader with 43.3% of the respondent indicating it, 32.7% of the respondents indicated that they were being managed by a committee while 23.3% indicated that they were being managed by headman but only 0.7% indicated politician. This implies that most of the water resource user associations are headed by an elected member of the group and there is very little interference with any political leader.

4.6: Rate at which stakeholders respond to the needs

Having shown different stakeholders involved, it was further investigated the response of stakeholders to members needs and it was found out that in most cases stakeholders do not respond to the needs. The summary of the findings are given in Table 4.11

Table 4.11 Rate at which Stakeholders respond to the need

Response to needs	Frequency	Percentage
Yes	70	47.0
No	80	53.0
Total	**150**	**100**

When the respondents were asked whether the Stakeholders of the project responds adequately whenever concerns were raised, 60% of the responded indicated No while 40% yes. This implies that most of the times the stakeholders do not respond to the needs of the community but sometimes the stakeholders respond to the needs.

4.7: Stakeholders factors influencing sustainability of community development projects

The results of stakeholders factors influencing sustainability of community development projects are shown in Table 4.12

Table 4.12: Stakeholders factors influencing sustainability of community projects

	S.D		disagree		Moderately agree		Agree		Strongly agree		Mean	S.D
	F	%	F	%	F	%	F	%	F	%		
Managing people, their opinions and the changes they requests are important in community development projects for sustainability	-	-	-	-	6	4	78	52	66	44	4.40	0.567
Stakeholders knowledge and skills are important factor in projects in enhancing sustainability	-	-	-	-	7	4.7	100	66.7	43	28.6	4.24	0.526
Planning establishes the objectives and the purpose of the project	-	-	-	-	24	16	92	61.3	34	22.7	4.066	0.620
Organizational structure helps in the division of activities into manageable units where everyone knows who is to do what and who is responsible. It removes confusion and conflict in the projects or any work.	-	-	6	4	52	34.7	72	48.7	20	13.3	3.706	0.746
Documenting lessons learnt and best practices in weekly or monthly bases is part of the plan and is important in monitoring and evaluation	-	-	8	5.3	52	34.7	73	48.7	17	11.3	3.660	0.749
and experience (Project managers have adequate task familiarity) in management	12	8	22	14.7	44	29.3	60	40	12	8	3.253	1.06

F= frequency

When respondents were asked to rate the Stakeholders factors influencing sustainability of the community development project, 52% of the respondents agree that managing people, their opinions and the changes they requests are important in community development projects for sustainability with 4.4 mean average, 66.7% agree that Stakeholders knowledge and skills are important factor in projects in enhancing sustainability with 4.24 mean average, 61.3% agree that planning establishes the objectives and the purpose of the project with 4.07 mean average, 48.7% agree that organizational structure helps in the division of activities into manageable units where everyone knows who is to do what and who is responsible. It removes confusion and conflict in the projects or any work with 3.7 mean average and 48.7% agree that documenting lessons learnt and best practices in weekly or monthly bases is part of the plan and is important in monitoring and evaluation with a mean average of 3.6 while 29.3% of the respondents moderately agree that project managers have adequate and experience (task familiarity) in management with a mean average of 3.25.

4.8 Training factors

This section deals with objective three of the study; To determine how training influence the sustainability of community development projects in Lari Sub County, Kiambu County, Kenya. It seeks whether the respondent has ever participated in any training and how they benefit from such training. And also seeking the opinion of the respondents in a five point Likert scale of 1(strongly disagree), 2 (disagree), 3 (moderately agree), 4 (agree) and 5(strongly agree).

Table 4.13: Respondent participation in training

Participation in training	Frequency	Percentage
Yes	49	33.0
No	101	67.0
Total	**150**	**100**

When the respondents were asked if they have ever attended any training, 67% of them indicated No while 33% indicated yes. The findings implies that most of the members of the WRUA did not attend the trainings being carried out.

4.9: Benefits of training

Results on benefits of training are shown in Table 4.14.

Table 4.14: Benefit of Training

Benefit of training	Frequency	Percentage
Importance of the project	33	22.0
How project can be properly used to better lives of local	50	33.4
How to take care of the project equipment	47	31.3
more about the project	20	13.3
Total	**150**	**100**

Findings show that, 33.4% of the respondents indicate that the benefit got from training was how project can be properly used to better lives of local, 31.3% was how to take care of the project, 22% importance of the project and 13.3% gained more knowledge about the project. From the findings if was discovered that most of the members of the WRUAS preferred trainings on how projects can be properly used to better their lives.

The Table 4:15 shows what type of training most members received and attended most**.**

Table 4.15: Training factors

	S.D		**disagree**		**Moderately agree**		**agree**		**Strongly agree**		**Mean**	**S.D**
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
Through training local community were able to efficiently service the project in case of breakdown of the machines used	3	2	15	10	64	42.7	57	38	11	7.3	3.386	0.841
The community were trained in modern technology to help to curb poor management and accountability of the project when implementation agencies pull out	5	3.3	18	15.3	56	37.3	64	42.3	7	4.7	3.333	0.872
Training greatly influenced the perception of local community towards the project	15	10	20	13.3	42	28	62	41.3	11	7.4	3.226	1.09
Local community were well mobilize and trained to achieved ownership of the project when implementation agencies pull out	13	8.7	46	30.7	65	43.3	26	17.3	-	-	2.693	0.858

F= Frequency

From Table 4.15 show that the majority of the respondents moderately agree with the statements concerning training, with 42.7% moderately agree that through training local community were able to efficiently service the project in case of breakdown of the machines used with 3.38 mean average, 37.3% that the community were trained in modern technology to help to curb poor management and accountability of the project when implementation agencies pull out with 3.33 mean average and 41.3% that training greatly influenced the perception of local community towards the project with a mean of 3.22 while 43.3% agree that local community were well mobilize and trained to achieved ownership of the project when implementation agencies pull out with a mean of 2.693. This implies that the community found training on modern technology useful and they were able to service and take care of projects in case of breakdown.

4.10 Water conservation measures

The study intended to investigate whether various water conservation measures at the household level had an effect on the performance of the WRUA, and the respondents were asked various questions related to the extent to which they agreed with these. The findings are summarized in the Table 4.16

Table 4.16: Water conservation techniques

Techniques	Frequency	Percentage
Rain harvesting system	21	13.9
Use of a bore hole	80	53.3
Practice irrigation	41	27.3
Recycle water	8	5.5
Total	**150**	**100**

The respondents who agreed that they harvesting rain water were 13.9% while 53.3% of them indicated that they use bore holes, 27.3% practiced irrigation while 5.5% indicated that they recycle water. This implies that the stakeholders' participation was critical in the implementation of the community projects in the county through reduction of operations costs, improving the efficiency of the project and increasing the longevity of the projects.

4.11 Use of fertilizers and pesticides

4.11.1 Awareness on pesticides use

The findings of awareness on pesticides use are shown in Table 4.17

Table 4.17: Awareness on pesticides use

Pesticides awareness	Frequency	Percentage
Yes	103	69.0
No	47	31.0
Total	**150**	**100**

The findings show that most of the respondents were aware of the pesticides with 69% with very few respondents of 31% that had no idea on pesticides awareness. This implies that most of the respondents did not receive any information or awareness on how to use pesticides.

4.11.2 Type of crops do you grow

Most of communities in this areas produce food crops such as vegetables and cereals while few of them grew cash crops such as tea. The findings were summarized in Table 4.18 below.

Table 4.18: Types of crops grown

Crops grown	Frequency	Percentage
Food crop	81	54.0
Cash crop	30	20.0
Plantation crop	24	16.0
horticulture crop	15	10.0
Total	**150**	**100**

The 54% of the respondent who agreed that they have participated in food crop plantation, 20% had participated in cash crop plantation with 16% response in plantation crop and a minimum

response of 10 % in horticulture crop. This shows that the respondents had participated in both cash crop and food crop but most of the respondent had practiced food crop.

4.11.3 Training on use of pesticides

It is common in these parts of Kenya that most farmers are not trained on how to use pesticides and any precaution to take while using them. The findings were summarized in Table 4.19 below.

Table 4. 19: Training on use of pesticides by Farmers

Pesticides use	Frequency	Percentage
Yes	73	49.0
No	77	51.0
Total	**150**	**100**

According to the finding use of the pesticides seemingly was not a common thing among the participants with 51% saying that they had not use pesticides with only 49% saying yes they have used pesticides.

4.11.4. Protective clothing when spraying the pesticides

Findings on the use of protective clothing while spraying pesticides are shown in Table 4.20

Table 4.20: Farmers wearing protective clothing when spraying pesticides

	Frequency	Percentage
Yes	132	88.0
No	18	12.0
Total	**150**	**100**

Clothing while spraying the pesticides being a major requirement in farm safety many respondents of 132 that represent 88% of the total respondent said that they wear protective cloths, only 18 respondents% among a total of 150 respondents that represent 12% said no. This implies that most of the respondents used protective clothing while applying pesticides.

4.11.5 Use fertilizers

The findings on fertilizer use are shown in Table 4.21

Table 4.21: Use of fertilizers

	Frequency	Percentage
Yes	103	69.0
No	47	31.0
Total	**150**	**100**

The findings show that use of fertilizers was common among many respondents with 69% of them saying that they used fertilizer, only a few that represents 31% said that they have not used fertilizer. This implies that the majority of respondents use fertilizer on their food crops.

4.11.6 Type of fertilizer

The findings on type of fertilizers used is shown in Table 4.22

Table 4.22 Types of fertilizers used

Types of fertilizers used	Frequency	Percentage
DAP	32	37.0
CAN	56	9.0
UREA	18	12.0
17-17	13	20.0
23-23	16	11.0
others	15	10.0
Total	**150**	**100**

According to the finding various fertilizes were used by the respondent but the most used fertilizer but the members were DAP with 37%, followed closely with 17-17 that had 20%, other fertilizers that were used by the respondents did not achieve even 15% of the total percentage

each. So the two were commonly used. This implies that the respondents use DAP for planting crops and CAN for top dressing.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings of study, discussions, conclusions and recommendations. The chapter contains areas for further research.

5.2 Summary of findings

The majority of the respondents were male (60.7%) aged between 35 years to 45 years. Most of these Respondents had secondary school level of education (29.3%) and were self-employed (34.9%).

The findings on stakeholder involvement showed that most of local projects were being managed by elected leaders with (43.3%). The analysis further showed that in most cases (53%) the stakeholders responded to the needs of the community members that were raised. The respondents agreed that managing people, their opinions and the changes they request are important in community development projects for sustainability.

The findings on training factors showed that majority of participants did not participate in most trainings carried out (67%).And some of the respondents stated that the most useful training to them was how projects can be used to improve the lives of the members (33. 4%). The analysis showed that the community was trained on the use of technology in their projects.

The findings on water conservation measures showed that majority (53.3%) of the respondents used boreholes as a water for irrigation and drinking and 27.3% depended on rain water harvesting. However, 5.5% of the respondents indicated that they do not use any form of water conservation measures.

The findings on Pesticides use showed that 51% of the respondents were not trained on use of pesticides while 49% stated that they were trained on use of pesticides. Most respondents stated that they use pesticides (69%), and the most used fertilizer used was DAP (37%) used for planting food crops. The least used fertilizer is the CAN which is used for dressing.

In general, it was found that most members of the Athi river basin project have confidence in the ability of the Athi river basin project to enable them have better conservation of water as well as to promote more equitable access to water. The most common reason identified for joining the Athi river basin project was the expectation for better water conservation (28% of the respondents), followed by the expectations for promotion of equitable access (25%) of the participants in the study. Others stated that they had joined the Athi river basin project with the expectation of participating in developing the Athi river basin project (20%).74% of the respondents felt that Athi river basin project had been significantly effective in achieving most of the objectives that the Athi river basin project was expected to.

It was established that the legal status of the Athi river basin project affects its operations, which implies that the legal status can have a significant effect on its performance within the catchment area. Those who strongly agreed or agreed that the legal status of their affects its performance was 49% and 40% respectively. This has an effect on the level of members' understanding of the regulations governing Athi river basin project, familiarity with the SCMP, equity in enforcement of rules and the adherence to water sector regulations. This implies that the management of Athi river basin project should always fast-track the registration process of the Athi river basin project so that it can attain full legal status as set out in the WRMA rules governing the activities and operations of the Athi river basin project. The effect of the technical capacity of the Athi river basin project was assessed based on various technical aspects related to the management of Athi river basin project to determine whether these affected performances of Athi river basin project, and to what extent.

5.3 Discussion of Findings

The discussion of the findings in this study are based on the outputs from the analyses of the data obtained from the study. The study aimed at establishing factors which influence management of water resources in Athi river basin project, Lari Sub County, Kiambu County. Most of the respondents were male who were middle age this meant women were not mostly involved in the groups and had little influence on water resource management. It was found that there is a significant relationship between water regulation performances of Athi river basin project. This follows the regulatory mechanisms set out in the Article 10 of the Athi river basin project (2002) rules, which require that a Athi river basin project is to be considered for registration if it is legally registered as an Association under the Societies Act, or as a Trust or Company under their respective Acts) and if has a constitution which is consistent with collaborative management of the water resources of a particular resource and which promotes public participation (inclusive), conflict mitigation, gender main-streaming and environmental sustainability. This also agrees with the requirements set out by the Global Water Partnership, (2000) that calls for an Integrated Water Resources Management, which is a process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Significantly different priorities and visions of the future and have competing interests in the water resources which are contained in a complex hydrological system.

From the findings it was found out that most members of the WRUA did not attend the trainings. Trainings are very important for community development as this relates agrees with Ostrom (2005). It was also noted that it is very important for these groups to be trained on how to use current technology for water resource management.

Water conservations measures were not popular as discovered in the findings. Few members had rain water harvesting system. With water conservations measures it would ensure availability of water even during drought seasons and these measures can increase food production all-round the year. This agrees with Harou (2015) study that with proper drought management and water conservation strategies there was increase in food production.

It was also found that there is a significant relationship between the technical capacity of Athi river basin project and their performance in water resource conservation. This relates to the findings by Bititci (2000), to the effect that a system of assessing performance enables the performance management process to function effectively and efficiently. This also agrees with the observation by Were, Roy, and Swallow (2008) whereby they explain that the extent of public participation in all decision-making processes must be unanimously approved, and that representatives of local elected officials, communities and all users concerned must participate in the formulation of master plans for water development and management, priority action plans and projects with the help of specialists from the administration and specialized consulting firms.

5.4 Conclusions of the Study

The following conclusions were drawn from the findings:

Athi river basin project are important establishments in conservation of water resources and ecosystems management. These associations are a central component in the evolution of the framework that defines how water is managed at the river basin or strategic levels, and their performance is greatly influenced by water sector regulations.

Water resource users' associations provide an opportunity for the involvement of stakeholders and beneficiaries in the corporate management of water resources and resolution of water related conflicts, promotion of water conservation practices as well as in promoting catchment conservation measures to improve water quantities and quality.

On their performance in the catchment area, the technical capacity Athi river basin project affects their performance. This because it is evident that Athi river basin project have the potentialities to harness stakeholder participation towards addressing prevalent concerns in water resource management, including low levels of awareness, poor land and water use practices, low levels of compliance with regulations, proper monitoring mechanisms and water resource conservation.

5.5 Recommendations of the Study

The following recommendations were made:

1) The role of the Athi river basin project has continued to gain increasing importance at the catchment level. It is important therefore to conduct water resource management practices throughout the basin
2) Women should be directly involved in the water resource management strategies since they are also affected directly by water issues.
3) Members of the Water resource user's associations should be encouraged to attend all the trainings offered and also should suggest what type of trainings they would find useful.
4) Water resources management is faced by challenges such as scarcity leading to conflicts, which have a direct impact on the livelihoods and socio-economic activities of people living within different catchment areas.
5) Measures of addressing the water conservation, abstraction, equitable distribution need to be contextualized so as to ensure greater effectiveness of the decentralized strategy of the water resource management through local associations.
6) There is need for training of the WRUA Members on different ways of rain harvesting as a way to conserve water resources.

5.6 Areas for further studies

The following areas for further studies were identified

i) Similar studies done in other regions on the same study
ii) Research on need for training of farmers on maintenance of water in order to conserve water for the whole community.
iii) Further research can be done to assess the extent of use or organic manure on crop production.
iv) Further research on women attendance and involvement in stakeholders meetings and decision making.

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APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION

25th March, 2017

Beth Wanjiku Koigi
Po Box 8063,
Nairobi,

Dear Respondent,

RE: COLLECTION OF DATA

I am a student of Masters of Arts degree in Project Planning and Management in the University of Nairobi. As part of the requirement for the award of the degree, I am required to undertake a research study on factors influencing management of water resources in Athi River Basin Lari Sub County. I therefore request your assistance in completing the questionnaire hereby attached. Kindly answer all the questions correctly.

The research results were used for academic purposes only and were treated with confidentiality. Your cooperation was appreciated.

Yours Faithfully,

Beth Wanjiku Koigi.
L50/79982/2015

APPENDIX 2: QUESTIONNAIRES FOR THE WRUA MEMBERS

Instructions

Please Tick in the relevant boxes and fill in the appropriate spaces

Date of Interview……

A. HOUSEHOLD CHARACTERISTICS

1. What is your gender?

Male ☐ Female ☐

2. What is your age in years?

Below 18 ☐ 18 to 34 ☐ 35 to 45 ☐ 46 to 54 ☐ 55& above ☐

3. What is your highest level of education?

Primary ☐ Secondary ☐ College/university ☐ No formal education ☐

Others please specify…….

4. Give your marital status.

Married ☐ Divorced ☐ Widow/widower ☐ Single ☐

5. What is your main occupation?.....

6. Household composition

Category	**Number**
Children 0-14 years	
Youths 15-17 years	
Adult 18 years and above	
Total Household Members	

B) WRUA INFORMATION

7. Is the WRUA group registered?

Yes ☐ No ☐

If Yes, what is it registered as?.....

8. When did you join the WRUA?……

9. A) Do you participate actively in the activities of the WRUA in your area?

Yes ☐ No ☐

B) If yes, please state some of your roles in the WRUA

……

……

……

C) If No, why don't you participate actively

……

……

10. A) What were your expectations in joining the WRUA?

……

……

B) Have they been met?

Yes ☐ No ☐

SECTION C. Assessing how Stakeholders involvement in Water Resource Management in Athi River Basin, Lari Sub County, Kiambu County, Kenya

1. The following are some statements about Stakeholders involvement (Planning, Organisational structure and Staffing). Please tick your corresponding responses as either true or false.

Statements	Strongly agree	Agree	Strongly disagree	Disagree
Stakeholders knowledge and skills are important factor in Water Resource Management				
Managing people, their opinions and the changes they requests are important in Water Resource Management				
Planning establishes the objectives and the purpose of the project				
Documenting lessons learnt and best practices in weekly or monthly bases is part of the plan and is important in monitoring and evaluation				
Organizational structure helps in the division of activities into manageable units where everyone knows who is to do what and who is responsible. It removes confusion and conflict in the projects or any work.				
The Stakeholders are involved in the recruitment exercise of staffs.				

SECTION D: Determining how Training of Water Users on water resource management in Athi River Basin, Lari Sub County, Kiambu County, Kenya.

Gender Male ( ) Female ( )

1. According to you does your level of education influence how the project is administered

Yes ( ) No ( )

Give one reason for choosing Yes or No above……

2. How many members of the committee have qualification in the following levels?

Degree ( )

Diploma ( )

Secondary ( )

Class Eight ( )

Others (specify)

3. Have you received any training in Water Users on water resource management?

   YES ( ) NO ( )

If so, give duration of training……..

4. What two major areas of your Water Users on water resource management did you cover which relate to your roles in the current project?

Who organized for the training?

Please give the reasons for your answer……

5. Name two methods used during the training ……..
6. How do you get information about the projects?

SECTION E: Determining how Water conservation strategies are used in Athi River Basin, Lari Sub County, Kiambu County, Kenya?

Statements	Strongly agree	Agree	Strongly disagree	Disagree
Rain harvesting system				
Use of a bore hole				
practice irrigation				
recycle water				

SECTION F: Determining how fertilizers and pesticides influence Water quality in Athi River Basin, Lari Sub County, Kiambu County

a) Do you have awareness on pesticides?

Yes ☐ No ☐

b) What type of crops do you grow?

……..

a) Do you use Agro Chemicals?

Yes ☐ No ☐

If Yes Indicate the main uses of pesticides in your area……

b) Have you received any training on use of pesticides?

Yes ☐ No ☐

e) Do you wear protective clothing when spraying the pesticides?

Yes ☐ No ☐

f) How often do you spray your crops or animals?

……..

g) How long to you wait to sell or eat the crops after spraying?

……

h) How do you dispose the pesticides after use?

……

i) What Type of pesticide do you use and on what?

Type of Pesticide		**Crops**	**Livestock**
DuduThrin			
Hotline			
Bestox			
Halothrin			
Planton			
Oshothion			
Triatix			

j) Do you use fertilizers?

Yes ☐ No ☐

If yes, when do you use the fertilizers?

……

k) What type of fertilizer do you use?

Type of fertilizer	
DAP	
C A N	
UREA	
17-17	
23-23	
Others	

If others, please explain……

……..

l) Do you use Manure?

Yes ☐ No ☐

If yes when do you use manure?

……

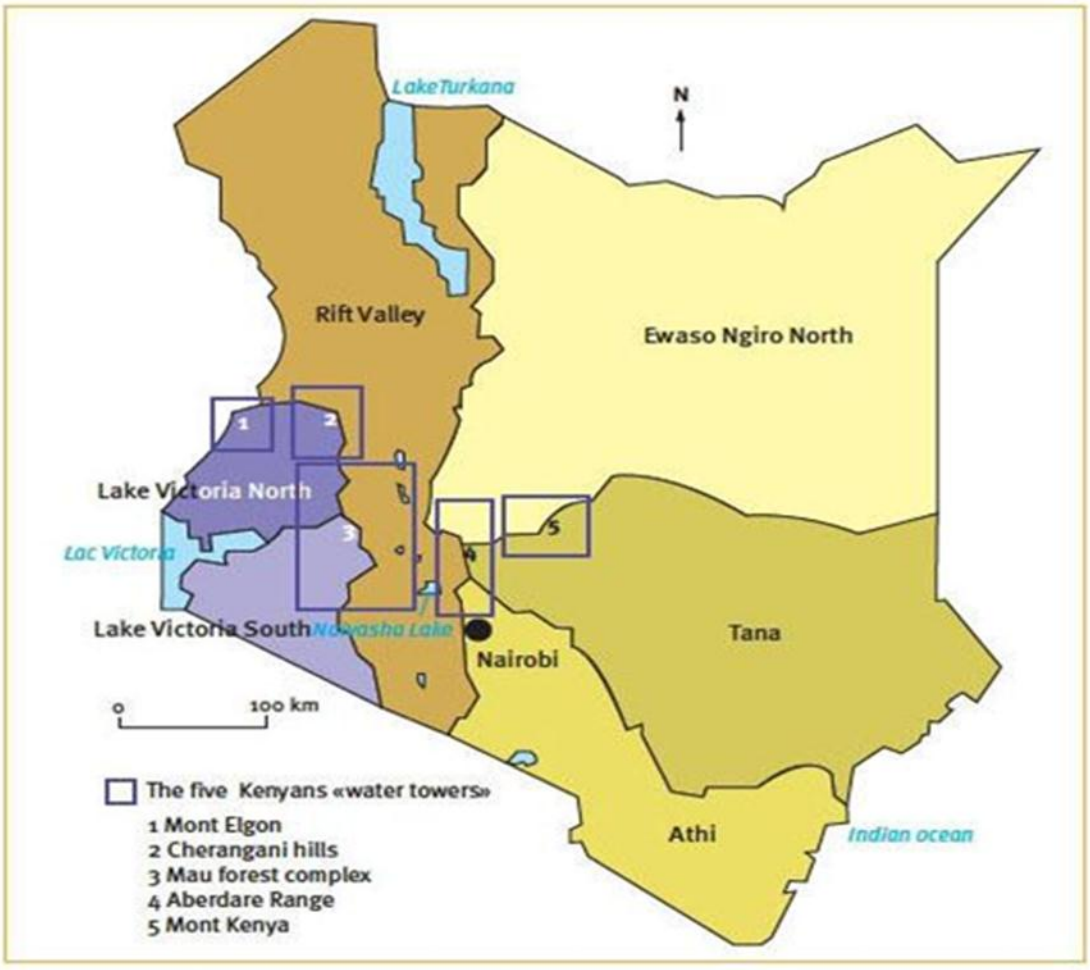
APPENDIX 3: INTERVIEW SCHEDULE FOR EXECUTIVE COMMITTEE MEMBERS AND WRMA OFFICIALS.

1. What are your main goals in addressing water resource management?
2. What are your roles in the water resource management?
3. What are the different strategies that you are implementing to manage your water resources?
4. Do the Stakeholders participate in Water resource management?
5. What are the factors influencing training of the water users in water resource management?
6. What water conservation strategies influence the water supply in water resource management?
7. What are the Fertilizers and Pesticides used that affect the water quality?
8. To what extent has the national and local government assisted in water resource management in bathi area?
9. How do you describe the performance of WRUAS in management of water resources?
10. What are some of the challenges faced by WRUAS in water resource management?
11. What are the future planned strategies to be employed by the WRUA in water resource management?

APPENDIX 4: CATEGORIES OF PESTICIDES USED.

Category	**Pesticide**
Pyrethroid	Duduthrin
	Hotline
	Bestox
	Halothrin
Organophosphates	Planton
	Oshothion
Herbicides	Score
	Robust
	Rinagan
Fungicides	Broad Hactare
	Seed plus
	Funguran
Carbamates	Senin

APPENDIX 5: WATER CATCHMENT AREAS IN KENYA



APPENDIX 6: PLAGIARISM REPORT