

**DETERMINANTS OF SUSTAINABILITY OF COMMUNITY WATER
PROJECTS IN KIENI EAST DISTRICT, NYERI COUNTY**

BY

MWANGI MARY WANJIRU

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DECLARATION

This is my original work and has not been presented for award of a degree in the University of Nairobi or any other university.

Signature.....

Date.....

Mwangi Mary Wanjiru

L50/65482/2013

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

Signature.....

Date.....

Professor Timothy Maitho

Department of Public Health, Pharmacology and Toxicology

University of Nairobi

DEDICATION

This research project is dedicated to my siblings Richard and Florence for their encouragement and moral support during the study period. Further dedication goes to my dear mum Murugi, for her prayers, support and encouragement.

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ABBREVIATIONS AND ACRONYMS

ASAL	Arid and Semi-arid areas
C.B.O's	Community Based Organisations
CCAT	Community Coalition Action Theory
IIED	International Institute for Environment and Development
MDGs	Millennium Development Goals
NGO's	Non-Governmental Organisations
O and M	Operations and Maintenances
OECD	Organisation for Economic Cooperation and Development
PLA	Participatory Learning and Action
PRA	Participation Rural Appraisal
RRA	Rapid Rural Appraisal
SPSS	Statistical Package for Social Science
U.N	United Nations
UNICEF	United Nations Children's Fund
W.H.O	World Health Organization

ABSTRACT

Access to safe and sufficient water is essential for the sustenance of human well being and is a basic human need. Meeting basic human needs is an equity requirement. Statistics reveal that about 17 millions Kenyans, 43% of the population, do not access to safe drinking water. In quest to meeting the United Nations Millennium Development Goal of halving the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015, the Government of Kenya and other development agencies have partnered with the community with a common goal of enhancing access to safe and adequate water supply. Despite the numerous projects in Kieni East District, water scarcity has remained a big issue in this area. In this regard, the study purposed to investigate the determinants of sustainability of community water projects in the area with a focus on water resources conservation practices, project management strategies, community participation and community training and education. However, there is limited information on this subject as limited studies' have been carried out in Kieni East District of Nyeri County. The study targeted a population size of 10,443 household consumers, 72 executive committees' members of the community managed water projects and two Government Water Officers. Descriptive survey design was employed to gather information from a sample size of 250 respondents. Representative sample units were selected using purposive sampling technique and Cochran formulae. Questionnaires and interview guide were used to collect data from the sampled stakeholders. Raw data was organized, edited, coded and analysed for descriptive and inferential statistics using computer software, Statistical Package for Social Sciences and presented using frequency distribution, percentages and tables. With regards to water resources conservation practices, study findings established a high participation level of 80% in conserving the water resources with 63% indicating storage reservoirs as water conservation measures and 4% indicating fencing to protect the water sources. Findings also established a positive and significant correlation between the level of water conservation practices and water sources reliability after obtaining a Pearson correlation coefficient of 0.426 at 0.01 significance interval. Study findings also established that community members' participation level in conception, design and implementation of the water projects was rated good at 70%. More findings established that the source of funding the water projects through community contributions and Government or donors funding was at 83% and 17% respectively. A majority of 88% community members' indicated that they were responsible for operations and maintenances of their water projects and were committed to making regular contributions. Findings also established that 80% community organizations had clear goals and objectives and were guided in their activities and development plans while clear definition of functional responsibilities of committee members was rated at 75%. Technical knowledge and skills of the project operator was rated at 62%. With regards to community training and education, findings established community trainings on operations and maintenances at 83% with 79% members receiving between 1 – 5 trainings. Technical skills were however found lacking among community members for the community only funded water projects. It is recommended that sensitization among community members on water resources conservation practices should be carried out to enhance reliability of the water sources. The study also recommends community participation during project's conception, design and implementation. It is also recommended that project management strategies should be integrated in the water project's long term plans in order to enhance long term benefits as well as community training and education in order to build adequate capacity among committee members. The study findings will benefit the Government, water project financiers and water users in realizing long term goals of new and existing water projects.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Project sustainability is defined in various ways by scholars around the world. The American Heritage defines project sustainability as keeping in existence or maintaining. Project sustainability is the ability of a system of any kind to endure and be healthy over the long term. Sustainability is also defined as the ability of an organization to develop a strategy of growth and development that continues to function indefinitely. This study will adopt the definition of sustainability as the process of ensuring an adaptive prevention system and sustainable infrastructure and interventions that can be integrated into ongoing operations to benefit diverse stakeholders (Johnson et al, 2004). Project sustainability entails the management of resources in a manner that ensures benefits for both current and future generations. Sustainability measures how the growth, maintenance, or degradation of a resource or set of resources affects a population's ability to sustain itself. A resource can either be natural or manmade and includes knowledge, technical, financial and other social systems.

Sustainability of a water supply system is the maintenances of an acceptable level of services throughout the design life of the water supply system. After the project completion, responsibility for management and ownership is given to the community. It has been identified that some projects become noticeably unsuccessful, even without any technical failures, while others have achieved their targets without much difficulties. Identification of underlying causes for performance of community water supply projects is important for sustainable management of existing projects and new development projects.

Statistics around the world reveal that our fresh water supply is practically non-existent. Nearly 97% of the world's water is salty or otherwise undrinkable while another 2% is locked in ice caps and glaciers, (World bank, 2010). The fact that only 1% of the earth's water is available for all of humanity needs such as agriculture, industrial and household needs brings to our attention that conservation of water requires our full attention if we hope to sustain our water projects.

In some parts of the world like Australia, rainfall is much less frequent than is needed to make up for water consumption. This situation accounts for the amount of salt increasing in the underground water tables, turning regions into deserts. The problem of water scarcity is local as well as global in nature due to the fact that resources of water on earth

are limited and are reducing every year. This is partly as a result of the effects of global warming thereby causing unpredictable rainfall patterns and drought. Some parts of the world experience rainfall throughout the year while other parts suffer the consequences of drought. Widespread dry spells are observed over much of Europe, Asia, Canada, Western and Southern Africa and Eastern Australia.

The seventh Millennium Development Goal (MDG) is to increase the proportion of the world's population that access to safe drinking water and basic sanitation (United Nations, 2010). Whilst the international community has made this advancement towards this goal over the past decade, progress in rural areas is lagging relative to urban areas (United Nations, 2011). Worldwide, 80% of the people who have limited access to drinking water supplies live in the rural areas (United Nations, 2010).

Northern Africa and Sub-Saharan Africa have made different levels of progress towards the Millennium Development Goal on water. North Africa has 92% coverage and is on track to meet its 94% target before 2015. However, Sub-Saharan Africa experiences a contrasting case with 40% of the 783 million people without access to an improved source of drinking water from the region. On the other hand, Sub-Saharan Africa is far from meeting the United Nations Millennium Development Goal on water with just 61% water coverage against a target of 75% set for the region, (U.N, 2010). An analysis of data from 35 countries in Sub-Saharan Africa shows significant differences between the poorest and richest population in both rural and urban areas. Over 90% of the richest group's in urban areas use improved water sources and over 60% have piped water on premises. In rural areas, piped-in water is non-existent in the poorest 40% of households and less than half of the population use some form of improved source of water.

Statistics shows that out of a population of about 40 million people in Kenya, about 17 million (43%) do not have access to clean water (World Bank, 2010). For decades, water scarcity has been a major issue in Kenya, caused mainly by years of recurrent droughts, poor management of water supply, contamination of the available water, and a sharp increase in water demand resulting from relatively high population growth. In most areas, the shortage of water in Kenya has been amplified by the government's lack of investment in water, especially in rural areas. Most of the urban poor Kenyans only have access to polluted water, which greatly contributes to cholera epidemics and multiple diseases that affect health and livelihoods. Despite the critical shortage of clean water in Kenya's urban slums, there also is a large rural to urban discrepancy in access to clean water in Kenya.

According to the World Bank (2010), slightly less than half of the rural population has access to water, as opposed to the urban population where 85% have access to safe drinking water. Due to continued population growth, it has been estimated that by the year 2025, Kenya's per capita water availability will be 235 cubic meters per year, about two-thirds less than the current 650 cubic meters.

Developing water supply systems for dispersed rural communities especially in semi-arid areas, such as Kieni East District, is an increasing challenge due to the need to meet multiple sustainability criteria. To date, actions taken by the Government and donors have not been able to meet this challenge in semi-arid areas in most developing regions in Kenya. Factors that increase the likelihood of sustaining a project relate to project design and implementation, the host organization and the broader community.

Water is an essential commodity required for daily human sustenance, economic and social developments in life. Lack of water in a region contributes to retarded economic and social development. Water scarcity is as a result of inadequate supply in quantity and poor quality. This scenario is mostly observed in arid and semi-arid areas where rainfall is relatively low compared to the world's mean annual precipitation and maintenance of the existing water supply systems is poor. While the demand for water is increasing due to the rapid population growth, increased agricultural needs and industrial revolution, water resources are continuously getting depleted. This calls for concerted efforts to conserve the scarce commodity and ensure continued sustenance to the current generation as well as the future generation's needs.

Kenya is generally a dry country with over 75% of its area being classified as semi arid and only around 20% being viable for agriculture. Kieni East District whose annual precipitation is less than 500mm is classified as a semi-arid region. The Government of Kenya and other development partners such as UNICEF has initiated water projects to alleviate water scarcity in semi-arid regions in Kenya. Kieni East District located in Nyeri County in the Central part of Kenya has been a target for development of community water projects by the Government and Non-Government organizations. Development of water projects with an aim of mitigating water scarcity in the ASALs regions is a major step towards poverty alleviation in the rural areas. The impacts of such projects may however not last long if proper planning for sustainability of the facilities is not observed.

Various factors may contribute to the difficulty in developing sustainable rural water supply systems. In rural areas that are subject to hydrologic variability, reliable water supply systems may require more energy intensive infrastructures such as groundwater sources which can add to technical and financial difficulties facing the communities. Rural communities are likely to be less capable of achieving economies of scale in water supply and treatment. Households may as well lack the technical capacity needed to operate and maintain water systems.

In light of these challenges, it is important to understand the dynamics of access to water as well as management of water projects in rural areas to ensure sustainability. The primary goal of this study is to offer a framework for sustainable community water supply developments and explore how it can be applied in semi-arid regions in Kenya. To achieve this, the research will examine the conservation of water sources in Kieni East District, the level of community participation in water projects, the management strategies and systems of water projects as well as the influence of community education and training.

1.2 Statement of the Problem

Inadequate access to clean water supply has been cited as one of the biggest problems faced by many societies and the whole world in the 21st century. Some say water is life and it is therefore a basic necessity to every living thing. A target of halving the proportion of the population without sustainable access to safe drinking water and basic sanitation by the year 2015 is one of the United Nations Millennium Development Goal's. Kieni East District, hereby classified as an arid region within Nyeri County, faces perennial drought and limited water resources. This region receives an annual precipitation of between 550mm – 950mm. This has triggered the Government and the non-Government Organizations (NGO's) to assisting the communities living in these regions access to safe and reliable water. However, there is lack of sustainability of these water projects as demonstrated by serious shortages of water during the dry season. There is therefore a need to find out why there are numerous water projects while the problem of water shortage persists.

Studies conducted by scholars and authors such as Binder (2008) , Narayan (1995), Wakeman (1995), Wijk-Sijbesma (1995), Paul (1987), Yacoob and Walker (1991), McCommon, Warner and Yohalem (1990), Nikkhah and Redzuan (2009), Dungumaro and Madulu (2003), Livingstone and McPherson (1993), and Sahlin (1998) agree to the definition, indicators and measures of sustainability as commitments to meet service

expectations and needs of communities in the long-term. Sustainability is viewed as the management of resources in a manner that ensures benefits for both current and future generations. The studies also indicate the importance of community participation and proper project organization management skills for successful development projects. The findings of the studies indicate that proactive involvement of beneficiaries influences development and management of projects and that effective community participation is concerned with willingness and capacity of the target community and beneficiaries to take charge and determine the nature of the project. The studies further indicate that community participation is low in developing countries. However, there is gap in terms of studies already done locally to investigate the determinants of sustainability of community water projects in Kenya. There is also limited information on this subject as limited studies' have been carried out in Kieni East District on sustainability of community water projects. This indicates a local knowledge gap on water projects' sustainability issues. Therefore, this study intended to investigate the determinants of sustainability of community water projects in Kenya, with a focus on Kieni East District in Nyeri County.

1.3 Purpose of the study

The purpose of this research was to carry out an in depth study of the determinants of sustainability of community water projects in Kieni East District of Nyeri County.

1.4 Objectives of the study

The study was guided by the following objectives:

1. To establish the influence of Water Resources Conservation Practices on sustainability of Community Water Projects in Kieni East District.
2. To assess the influence of Project Management strategies on sustainability of Community Water Projects in Kieni East District.
3. To establish the influence of Community Participation on sustainability of Community Water Projects in Kieni East District.
4. To establish the influence of Community Education and Training on sustainability of Community Water Projects in Kieni East District.

1.5 Research questions

The study was intended to answer the following questions:

1. To what extent does conservation of water resources practices influence sustainability of Community Water Projects in Kieni East District?

2. To what extent do Project Management strategies influence sustainability of Community Water Projects in Kieni East District?
3. To what extent does Community Participation influence sustainability of Community Water Projects in Kieni East District?
4. To what extent does Community education and training influence sustainability of Community Water Projects in Kieni East District?

1.6 Significance of the study

The main aim of conducting this study was to explore the determinants of sustainability of community water projects. Analysis of datasets in Kieni East District indicated that just 50% of the implemented water projects are functional. Improving long term functionality of water supply projects ensures continuous provision of a service that is fundamental to improved health, reduced burden of carrying water for long distances and improved livelihoods. The findings and recommendations of the study will provide practical solutions to water project stakeholders' in ensuring continuity of the projects for long term benefits. Findings will specifically benefit the Government, water resources users and the community towards enhancing sustainability of existing and new water projects during implementation and post implementation phases. It also provides a basis for future researchers who are interested in this area of study. The study redefines the pre-requisites of enhancing sustainability of the water projects and contributes in achieving the Millennium Development Goal of halving the proportion of people without access to safe water by the year 2015.

1.7 Basic assumptions of the study

It was assumed that respondents would be available and that they would provide information concerning their water projects willingly and honestly. It was also assumed that respondents were familiar with kikuyu dialects. It was also assumed that the data provided by the respondents was correct and accurate and that the study would be completed successfully within the scheduled timeframe.

1.8 Limitation of the study

This study was limited within a specified time schedule and budget since the researcher was self-sponsored. Language barrier was another limiting factor whereby respondents were handicapped to the questionnaires interpretations due to the high illiteracy level in

the region. This was however countered by training the research assistants who could best understand the language of their choice.

Uncooperative committee members' of the water projects was also a big challenge due to suspicion on the motives of the research study. Working closely with community leaders and volunteers as well as making the respondents understand that the research was solely for academic purpose helped to mitigate these challenges.

1.9 Delimitation of the study

The study was confined to community water projects in Kieni East District of Nyeri County only. The selected stakeholders included household consumer's heads, management committee members of the projects and key Government Water Officers. This area was selected because it is classified as a water scarce region characterised by perennial drought and low annual precipitation and the fact that it was a targeted region for water development projects by the Government and development partners whereas the problem of water scarcity was persistent. This region therefore possesses the characteristics that the researcher wanted.

1.10 Definitions of significant terms

Community Education and trainings	Enhancement of skills and knowledge of water project team and community members.
Community participation	Refers to the involvement of community members throughout the project life cycle in decision making processes and activities during needs assessment, project design and implementation and post implementation.
Government Policies	These are the laws and procedures formulated by Government to guide the design and implementation of water
Participatory learning and action	It is a practical, adaptive research strategy that enables diverse groups and individuals to learn, work and act together in a co-operative manner.

Project management strategies	Refers to the methodologies and approaches employed by the Government and development partners in initiation, designing, implementation, monitoring and evaluation of water projects.
Sustainability of water projects	Refers to the management of water resources projects in a manner that ensures benefits for both current and future generations.
Water conservation practices	Refers to policies, strategies and activities to manage fresh water as a sustainable resource to protect the water environment and to meet current and future human demand
Water scarcity	Refers to a situation when water availability in a country or in a region is below 1000m ³ /person/year.

1.11 Organization of the study

Chapter one provides background information on water situation in various parts of the world, the problem statement, purpose of study, research objectives and the research questions that the study was seeking to answer, significance of the study, limitations and delimitations of study. Chapter two provides literature reviewed on the concept of sustainability of water projects, empirical literature on the determinants of sustainability of community water projects, theoretical framework, conceptual framework and the knowledge gap identified. Chapter three outlines the research methodology that the study employed, the target population, the sample and sampling techniques adapted, data collection techniques, data analysis methods and ethical considerations. Chapter four provides the results of the data analysis, presentation and interpretation according to the four variables of the study. Chapter five provides a summary of the findings, discussion, conclusions of the study, recommendations of the study and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides background information on water projects' situation in selected countries, literature on independent and dependent variables of the study, theoretical framework, conceptual framework, the knowledge gap and a summary of the literature reviewed.

2.2 Water projects in Bangladesh

Sustainable water management in Bangladesh is critically important due to the low lying topography and high poverty index. A large proportion of the rural poor depend on natural sources in the flood plains and hilly watersheds for their livelihood. Their main subsistence activities include fishing and harvesting of wetland plants. However the management of water resources involves a centralized heavy engineering approach to control floods and install irrigation systems. This underscores other uses of water such as domestic use, sanitation, fisheries and navigation resulting into undermined lives and livelihoods of the rural poor.

Construction of irrigation systems has depleted the natural water bodies, thereby denying the subsistence and small scale farmers the opportunity to food production. Access to water resources is unequal between the poor and the rich. In an attempt to promote equity, sustainable water management and environmental preservation, integration of multi objective planning and decision making, maintenance of ecosystems and protection of livelihoods, public participation and ecosystem-based local management constructs have been adopted by water management in Bangladesh (Golam and Chowdhury, 2010).

2.3 Water projects in African countries

According to International Institute for Environment and Development (IIED) report by Skinner (2009), up to US dollars 360 millions spent on building boreholes and wells was wasted as a result of poor maintenance of water supply points. An estimated number of 50,000 water supply points are non functional across Africa. The report further indicates that only one third of water points constructed by NGO's in Senegal are working while 58% in Ghana are beyond repair. This is attributed to the fact that the Government and other development agencies do not consult local people on long term sustainability constructs such as operations and maintenance and financial management after termination

of external financial support. The culture of constructing water points and then walking away without proper assessment on post implementation maintenance procedures is highly criticized.

Skinner (2009) indicates that badly constructed, poorly maintained and unprotected shallow wells, was the scenario in Katine location in North East Uganda in 2007. AMREF developed sustainability strategies in Katine location of training local communities on operations and maintenances of new water points which has since been adopted in the other sub counties in Uganda. In an attempt to mitigate such scenarios, water and sanitation committees are set up to monitor newly implemented boreholes and are charged with the responsibility of consulting trained hand-pump mechanics if one breaks down. The committees also meet regularly with village health teams to discuss needs and the idea is that everyone who uses the boreholes and wells is bound to make financial contributions to their long-term upkeep.

2.4 Water projects in Kenya

According to the Government of Kenya, water scarcity in the country has been an issue for decades, as only a small percentage of the country receives adequate rainfall. Kenya's natural water resources do not provide an adequate 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 adequate fresh water. Rapid urbanization has also pushed poor urban dwellers to the slums, where there is no water. Kenya's water politics has brought about a divide between urban and rural areas in water services. Rural areas of Kenya are left without water while the urban areas hardly get enough. The Kenyan Government can hardly afford to develop water solutions because of the strained budget.

Women and children spend up to one-third of their day fetching water in the hot sun from the nearest fresh water source due to water shortage, (World Bank, 2010). This backbreaking work leaves roughly half of the country's inhabitants vulnerable to serious danger. Water pathogens are a huge health problem in Kenya, as the people have been left unprotected against epidemics such as cholera and parasitic worms.

A number of organizations have picked up the slack of Kenya's Government by providing water solutions through construction of community managed water projects. Most of the ASAL areas in Kenya have been a target by development agencies in construction of

community managed water projects. Through community participation and cost sharing strategies, communal water points such as water pans, boreholes, wells and protected springs have been implemented by developers. Kieni East District has got 24 community water projects spread across Gakawa, Thegu, Narumoro, Kabaru and Kiamathaga locations. The population distribution according to the 2009 national population census is as presented in Table 3.1.

Table 2.1: Population Distribution in Kieni East District

	Male	Female	Total	Households	Area in Sq. Km.	Density
Naromoru	10,723	10,810	21,533	6,620	133.2	161.7
Kiamathaga	6,130	5,813	11,943	3,356	110.1	108.5
Kabaru	11,263	10,821	22,084	6,205	203.6	108.5
Thegu	7,598	7,021	14,619	4,734	118.7	123.1
Gakawa	13,283	13,038	26,321	8,097	251.5	104.6
Total	48,997	47,503	96,500	29,012	817.1	118.1

2.5 Sustainability of Water Projects

Habtamu (2012) in his study on factors affecting the sustainability of rural water supply systems in Mecha-Woreda, Amhara region, Ethiopia, defines sustainability as the functionality of a water point over a long period of time. The determinants of sustainability of community water supply systems are categorized into pre implementation factors and post implementation factors. Pre-implementation factors includes community participation, technology selection, site selection, demand responsiveness, construction quality, population and training while post-implementation factors are technical support, community satisfaction, institutional and financial management, training and willingness to sustain the water project (Gebrehiwot, 2006).

Sustainability is a measure of how the growth, maintenance, or degradation of a resource or set of resources affects a population's ability to sustain itself. A resource can be natural

or man-made and includes knowledge, technical, financial and other social systems. Sustainability is as a result of processes, investments, technologies and systems as they affect resources available to a population over time. Such processes include policy reform, investments made by donors, Government or other groups and technologies. The extent of local participation in ownership of a process, investment decision, technology development and system is seen to be crucial to sustainability.

According to Narayan (1995), Ochelle (2012), Wakeman (1995) and Wijk-Sijbesma (1995) key indicators of sustainability have the following components. First, reliability of the systems which implies that in community based systems, there has to be availability of spare parts and local skills to operate and maintain facilities to ensure that the system remains functional. Secondly, the sources of water have to be reliable and this may be guaranteed by water resources conservation. Thirdly, local institutional capacity with an autonomous management structure is an important component of sustainability. Management of the projects should have the flexibility to implement any necessary remedial measures. Cost sharing for operation and management should be considered as users in the community need to contribute resources to make the project sustainable. Resources required for operation and management should be within the capacity of the community to provide. Interagency collaboration between communities, Governments, Non-governmental organizations, the private sector, research institutions is required both in planning and implementation of community water based projects.

According to the United Nations Economic and Social Council, Commission on Sustainable Development (2005) in promoting and facilitating sustainable water development and management, it is paramount to promote social stability and adaptability to environmental change, raise awareness and to build human and institutional capacity, provide access to safe water supply and protect the quality of surface and groundwater and aquatic ecosystems and strengthen the enabling role of Governments to enact and enforce water legislation at local water management capacities. IFAD (2009) considers the essential dimensions in sustainability of projects as institutional sustainability, household and community resilience to anticipate and adapt to change through clear decision-making processes, collaboration and management of resources internal and external to the community and environmental sustainability.

Sustainability rate of rural water supply systems increases as a result of communities owning and managing their schemes, existence of management organization at the village

level, protection of the water point, communities cost recovery for operation and maintenance, technology type and availability of their spare parts and recognition of women.

2.6 Water Resources Conservation Practices and Sustainability of Water Projects

Water conservation encompasses the policies, strategies and activities to manage fresh water as a sustainable resource to protect the water environment and to meet current and future human demand. Demand is increasing every year for water while resources are becoming more and more limited. Since many individuals are unaware that this issue needs attention, it is up to more informed and proactive individuals and companies to take up the responsibility. A 40 percent increase is expected in water demand over the period of next two decades (World Bank, 2010). The increase in water demand is a contribution of various factors including the growing population, increased agricultural needs and industrial use of water and electricity production. The increased demand in water combined with the pollution of water has had many adverse effects on the environment, growth and economy of many countries.

In parts of the world where rainwater is available, major problems are still prevalent because of a lack of proper systems to clean the water. Pollutants like oil, sediments, and agricultural chemicals make the percentage of usable water practically non-existent. Methods of water conservation must be implemented in these areas if our planet is to continue to sustain itself.

The United Nations (2010) has predicted that by the next two decades there will be 17 percent increase in demand of water compared to resources available. The unpleasant fact is that most people remain careless and do not recognize the importance of water conservation. Huge campaigns are conducted every year by many Government Organizations and Non Government Organizations to spread awareness of the importance of water conservation. As citizens of this planet, it is our individual responsibility to take an active role in water conservation. The simple tasks we perform every day like gardening, tending to laundry, washing are opportunities for us to make a difference.

Water scarcity causes enormous problems for population and the society at large such as insufficient production of food leading to hunger and poverty in such regions. The population growth in such regions exceeds the capability for sustainable use of water resources. This results into retarded economic growth as a consequence of restrictions on

water uses in industries, urban and tourism development. Water resources in regions experiencing water scarcity are subjected to degradation in quantity and quality adding to water shortage crisis. Poor quality water is contaminated and has been cited as a direct cause of water borne diseases such as cholera, dysentery leading to increased poverty index. Water conflicts among local communities or countries' sharing a limited resource is also a common scenario. In this regard, preserving natural ecosystems in view of conserving the water resources is critical to enhancing sustainability of water for domestic and industrial uses. This contributes to poverty alleviation and hunger as a result of increased food production and industrialization. Purdum (2002) noted that water managers and developers ought to incorporate comprehensive planning and resource development into an allocation system in order to prevent waste, ensure certainty to existing users, protect the natural environment and provide for future users.

Developed countries where water scarcity was a problem have been able to cope with the challenge through development of organizational and institutional solutions, water technologies and management skills that have allowed for appropriate water for domestic use, food production and industrial purposes. Finding a balanced equilibrium on water demand and supply in regions experiencing water scarcity through the use of modern technologies and management tools and adaptable to the local culture, environment and institutions is currently the biggest challenge.

The concept of water conservation maximises the availability of surface water for human uses. Planning and management initiatives provide water for domestic, industrial and food production. Water scarcity is a consequence of inadequate quantity of water and poor water quality. This is as a result of two categorical causes' namely natural and manmade causes. Natural causes are results of arid and semi-arid climates or drought whereas man made causes are results of desertification and water management due to human activities. Drought is a natural but temporary imbalance of water availability consisting of a persistent lower than average precipitation of uncertain frequency, duration and severity of unpredictable or difficult to predict occurrence resulting in diminished water resources and reduced carrying capacity of the ecosystem.

2.7 Project Management strategies and Sustainability of Water Projects

Management is a social process entailing responsibility for the effective and economic planning and regulations of the operations of an enterprise in fulfilment of a given purpose or task. Management entails coordination of all resources through the process of planning,

organizing, directing and controlling to achieve set objectives. Project management is the application of a collection of tools and technique to direct the use of diverse resources towards the accomplishment of a unique, complex, one-time task within time, cost, and quality constraints.

Effective operation and maintenance (O and M) of rural water supply systems is critical for sustainability of the water projects. The community management of rural water supply systems on operations and maintenance is not successful, if financing resources are not available and frequent supports not provided (Binder, 2008). Budgeting sufficient funding for community water supply systems is important for ensuring sustainability and proper maintenance.

Community water projects are owned, operated and maintained by the user group. It is a requirement that once a project is implemented and functional, a well-trained team of staff is constituted to ensure good maintenance standards. Financial management is of essence in mobilisation of funds and resources for maintenance and operations activities. A management committee team constituted by the beneficiary community is mandated to providing effective leadership through decision making in all management activities. It is through effective management of resources, human capital in water projects that successful implementation and sustainability of water projects after implementation exit can be achieved.

Financial feasibility during project planning is critical to ensuring project sustenance without continued external support. Projects should therefore include long term benefits during planning. The benefit model plan ought to make a projection of the operations and maintenance costs, recurrent regular incomes as well as development costs for capital investments.

Rural water supply is characterized by point sources such as hand pumps, springs, wells, and small scale piped systems. Operation of rural water facilities is ensured by community or private operators. Where population density is above 400 people per km² the rural approach becomes unviable and hence an urban approach becomes necessary. Most of the rural water services systems are still not sustainable because of inadequate operation by community leading to breakdown of facilities and low access rate, poor water quality and increased disputes. The situation is severe in ASAL areas where disparities in water supply distribution patterns are glaring (National water policy, 2012).

Establishment of a strong community organization to continue the operations of the project efficiently and effectively after the end of the external funding is critical. Such community organizations provide leadership through creating transparency and accountability of the projects benefits. Post implementation management should therefore adopt an assets based approach whereby beneficiaries pay for the services.

2.8 Community Education, Training and sustainability of water projects

Staff training or expertise building in a range of matters, including strategic planning skills, knowledge of needs assessment and logic model construction, leadership skills and financial management is important to project sustainability (Johnson et al., 2004). Fagen (2009) observes that projects that included staff preparation and training, especially training in creative and flexible problem solving, had greater sustainability than projects that did not. Chances of sustainability increase where staff and other stakeholders feel that they or their clients can benefit from the project.

The National Academy of Sciences (1997) observes that competent operating personnel are important to the sustained, safe operation of small water systems. It is therefore necessary that good operator training is carried out to ensure improved small water systems. Without adequately trained personnel, even a well-financed and organized system with the most advanced technology and regular compliance visits will fail to deliver.

Mengesha, et al (2003) in their study on sustainability of drinking water supply projects in Rural of North Gondar, Ethiopia recommend that building adequate skills and capacity to maintain water sources is an essential factor to ensuring sustainability of the water system. Training educates and creates awareness among the community members giving them an opportunity to participate in the development process. It builds and creates technical capacity of staff in the management of finances, data, reporting, contracts as well as operations and maintenances of projects after implementation exit.

It is imperative that community members should be trained on subjects such as operations and maintenance, record keeping, tariff setting, financial management and conflict resolution to build capacity at local level. Trainings on operations and maintenances build technical skills at community level to operate and repair the water projects infrastructures. This promotes long term functionality of the water projects since the trained personnel are fairly efficient and reliable. On the other hand, financial resources are required to support

and pay maintenances cost of the water projects. The various sources of maintenances charges include community contributions, sale of water and Government subsidy. It is in this regard that training community members on financial management is critical to guaranteed transparency and accountability of the revenue and expenses. Community members ought to be trained on the importance of being the key players in maintaining their projects. Conflict among community members over sharing of the limited water resources, procurement, financial management and corruption have also been observed in the community managed water projects. It is therefore important that committee members and the entire community is trained on the various conflict resolution strategies such as arbitration, negotiation, mediation to build capacity at the local level.

Community training and education builds institutional capacity at the local level of the community organizations with regards to realizing long term benefits. Pre implementation training and post implementation community trainings therefore, ought to be integrated in the water projects work plans. The definition and indicators of community education and trainings includes adequate technical skills and ability by community members to operate and manage their water projects and relevance and adequacy of the trainings towards long term sustainability.

2.9 Community Participation and Sustainability of Water Projects

Involving the users in the planning, implementation, operation, protection and maintenance of water supply systems meaningfully is the key to sustainability. Community members' contributions may take the form of money, labor, material, equipment, or participation in project-related decision-making and meetings (Davis and Lyer, 2002).

Research studies have found that community support for a project, as manifested in the cooperation of community bodies such as community organizations and Government agencies with the project implementers is a major predictor of its sustainability. Savaya and Waysman (1998) stressed the importance of strengthening the sense of ownership among those who benefit from the project in the community to increase their motivation to sustain it. A strong sense of local ownership and genuine participation in design, project implementation and monitoring and evaluation by both men and women are critical to successful implementation and sustainable benefits (OECD, 2002).

According to Narayan (1995), Ochelle (2012), McCommon, Warner and Yohalem (1990) and Wright (1997) key indicators of community participation include community participation in decision-making, community contribution towards maintenances, community representation and responsibility and informed choice. It is therefore necessary for all aspects related to project development and implementation to be based on community preferences. More so, communities need to willingly contribute to the development and operation of the project. Those responsible for managing community water projects should represent the diversity within the community and be elected democratically. The community ought to have the authority to make decisions relating to the project on behalf of the users.

Project designs ought to be made based on local demands. This requires participation by stakeholders in project identification, design process and implementation. To ensure participation of the community at every stage of the project, participatory approaches such as PRA, PLA and RRA should be applied. A good participatory design responds to the aspirations and demands of a population by taking into consideration all marginalized populations composed of the children, women and the disabled.

Community participation can be realized through recruitment and engagement of community bodies in the project development process from conceptualization, to design, implementation and closure. The identified indicators of community participation includes level of participation in project conception, design, implementation and maintenances, stakeholders' representation in management committees leadership, gender balance in committee management and willingness to make contributions towards operations and maintenances.

2.10 Government policies and Sustainability of Water Projects

Scheirer (2005) advanced political support as a factor promoting project sustainability. Given the power and perseverance of institutional routines it is viewed as important to adapt projects to the policies and regulations of the relevant government bodies (Sarriot, 2004).

Projects are implemented within a wider policy environment. Government policies can have significant impact on the sustainability of development programs or projects. The policy framework should be analyzed and taken into account during project design. Projects which comply with Partner or Government policies have much better prospects

for sustainability as they are more likely to have high-level political and institutional support both during implementation and beyond.

According to the United Nations Economic and Social Council, Economic Commission for Africa (2005), appropriate regulatory frameworks and institutions at national level to oversee water and sanitation services provision are essential to operational national policies, protect property rights, and generate equitable returns on private investments through efficient tariff structures and levels, service standards and expansion targets.

United Nations Economic and Social Council, Economic Commission for Africa (2005) observes that there has to be specific measures that allow close oversight of water and sanitation management, general health and environmental protection by applying service standards and penalties for default. The Government has to come up with equitable rules to ensure fair competition in subcontracting and procurement procedures and tax liability and systems. There has to be social policy measures aimed at protecting the rights of vulnerable groups of consumers, such as tariff adjustment rules, Government subsidy policies, disconnection procedures for delayed or unpaid water bills and dispute resolution mechanisms.

2.11 Theoretical Framework

This study was guided by two underlying theories supporting community involvement in the implementation and management of community based projects. The two supporting theories included the citizen participation theory and Community Coalition Action theory (CCAT).

2.11.1 Citizen Participation Theory

Citizen participation is a process which provides individuals with an opportunity to influence public decisions and has long been a component of the democratic decision making process. The history of public participation can be traced in ancient Greece and colonial England when Government processes and procedures were designed to facilitate external participation. Citizen participation was institutionalized in the mid 1960's. Citizen participation theory states that participation is a desired and necessary part of all community development activities. Spiegel (1968) advanced that citizen participation process can meaningfully tie programmes to people by enhancing ownership.

Citizen participation in programme implementation was earlier practiced in Platos Republic. Plato's concept of freedom of speech, assembly, voting and equal representation

have evolved through the years to form basic pillars upon which the United States was established. Citizen Participation is the essence of democracy. The town assembly in America was unique because all of the citizens in the community got together to decide on issues. The growth of states both numerically and economically later made it increasingly difficult for every citizen to actively participate in all community decisions and programmes. This led into use of representatives either directly or in form of community groups (Christen and Robinson, 1980).

In spite of the fact that direct citizen participation has declined, ample opportunities exist in most communities for citizens to get involved in their community's destiny. Volunteer groups function as links between individuals and larger societal structures. Involvement of the community in programs implementation helps promote dignity and self-sufficiency within the individual which helps to tap the energies and resources of individual citizen within the community and also provides a source of special insight, information, knowledge and experience which contribute to soundness of community solutions. Community involvement helps advance its projects, plans, actions and leadership. It also helps reduce the cost for personnel needed to carry out many of the duties associated with the community actions without which, scores of worthwhile projects would never be achieved in many communities.

According to this theory, majority of the community members are reluctant to participate in implementation of projects when they don't have enough information to act responsibly. They will only act in community activities if they understand the issue and the tied benefits. The high value placed on education in any society sometimes cause people with low education achievement to feel sidelined from participating in any community activity. Citizen participation in community betterment organizations and projects does not usually occur by chance alone but it is bound by participants' acceptable principles such as visible positive benefits, better knowledge and group comforts.

Much from this theory can be adopted in implementation of community managed water projects through involving beneficiaries in projects implementation processes. Participatory approach in all phases of planning and decision-making will lead to better decisions. Involvement of community beneficiaries enhances project ownership and sustainability.

2.11.2 Community Coalition Action Theory (CCAT)

This study was also guided by the Community Coalition Action Theory (CCAT) by Butterfoss and Kegler (2002). The researcher considered it appropriate in investigating the determinants of sustainability of community water projects. Community Coalition Action Theory (CCAT) focus on several important factors that affect a community coalition's ability to conduct its core functions of creating collaborative capacity, building community capacity and fostering change at the local level and is thus an important framework for building and evaluating coalitions. The theory builds on a number of existing models and frameworks which includes the Community Organization and Development Model, the Framework for Partnerships for Community Development, the Framework of Organization Viability, the Community Coalition Model, the Health Promotion and Community Development Model, the Typology of Community Organization and Community Building and the Model of Community Health Governance.

This theory models the progression of community coalitions from formation to institutionalization and includes a cyclical feedback mechanism in response to new issues and changes in community context. It takes into account the various factors which impact on community coalitions, such as the community's social and political climate, history, and values.

The CCAT begins in the Formation stage, where the lead agency builds a collaboration to respond to a particular community need or mandate. The lead agency identifies and recruits the coalition membership and leaders are selected to develop the coalition's operations and processes and structures. Operations and processes are the coalition's mechanisms for communication among staff and members, decision-making and conflict management. Structures are the formal rules and procedures that facilitate the coalition's activities. These components make synergy within the coalition more likely.

With members and systems in place, the coalition then goes through the maintenance stage, which involves the pooling of resources to maintain its activities, the engagement of members and effective planning strategies. Finally, community coalitions move into the institutionalization stage, in which successful coalition strategies, such as community policies, practices, and other activities can facilitate community change outcomes. Community change outcomes can increase community capacity to respond to its own needs and create health and social outcomes such as reductions in mortality and progress towards social goals. The community coalition may institutionalize its activities within the

community to build community capacity. Throughout this process, coalitions may return to earlier stages as a means of responding to changes in the coalition or community. The community context can affect the coalition at any stage.

The CCAT introduces several important coalition characteristics such as leadership, membership and structure that affect a community coalition's ability to foster changes in the community. The theory highlights the idea that a coalition's strategies can create community capacity outcomes as well as health and social outcomes.

2.12 Significance of theoretical frameworks.

Community Coalition Action Theory (CCAT) models the progression of community coalitions from formation through implementation to institutionalization. At the formation phase, community members form coalitions best known as Community Based Organizations with common goals and objectives of promoting water accessibility. It is at this stage that conception of water projects is made as well as preparation and approval of bylaws to guide the governance and leadership of the community organization. Implementation phase entails preparation of water projects' design and construction of the water infrastructures to deliver the objectives. It is best achieved through the community coalitions who participate in making informed decision on the project technology to adapt and in making contributions towards implementation in form of cash, materials and labor. The institutionalization phase involves maintaining the endeavor through proper management and operations to ensure long term benefits.

The CCAT model proposes fourteen constructs. The constructs are based on the stages of development from coalition formation, maintenance and institutionalization. The twelve factors in the model include leadership, decision-making, communication, conflict resolution, benefits and costs, organizational climate, staffing, capacity building, member profile, recruitment pattern, organizational structure and community capacity. Member participation, satisfaction, and quality of action plan measures coalition effectiveness (Butterfoss and Kegler, 2002).

These constructs provide a framework and a set of guidelines in ensuring project sustainability from conceptualization through implementation and post implementation. It is imperative that community participation and enhanced community capacity through training, leadership skills and excellent management skills should be integrated in the long term sustainability action plan of community water projects. The proposed constructs by

the citizen participation theory and Community Coalition Action Theory calls for active community involvement in the project phases, adequate skills, guided leadership and management. Much of these two theories can be adopted in implementation of community managed water projects through involving beneficiaries in projects implementation processes.

2.13 Conceptual framework

According to Mugenda and Mugenda (2003) a conceptual framework is a hypothesized model that identifies the concepts under study and their relationships. It presents in a diagrammatic form the way the researcher has conceptualized the relationship between the independent and dependent variables. The independent variables are arranged on the left while the dependent variable is on the right of the diagram in Figure 1.

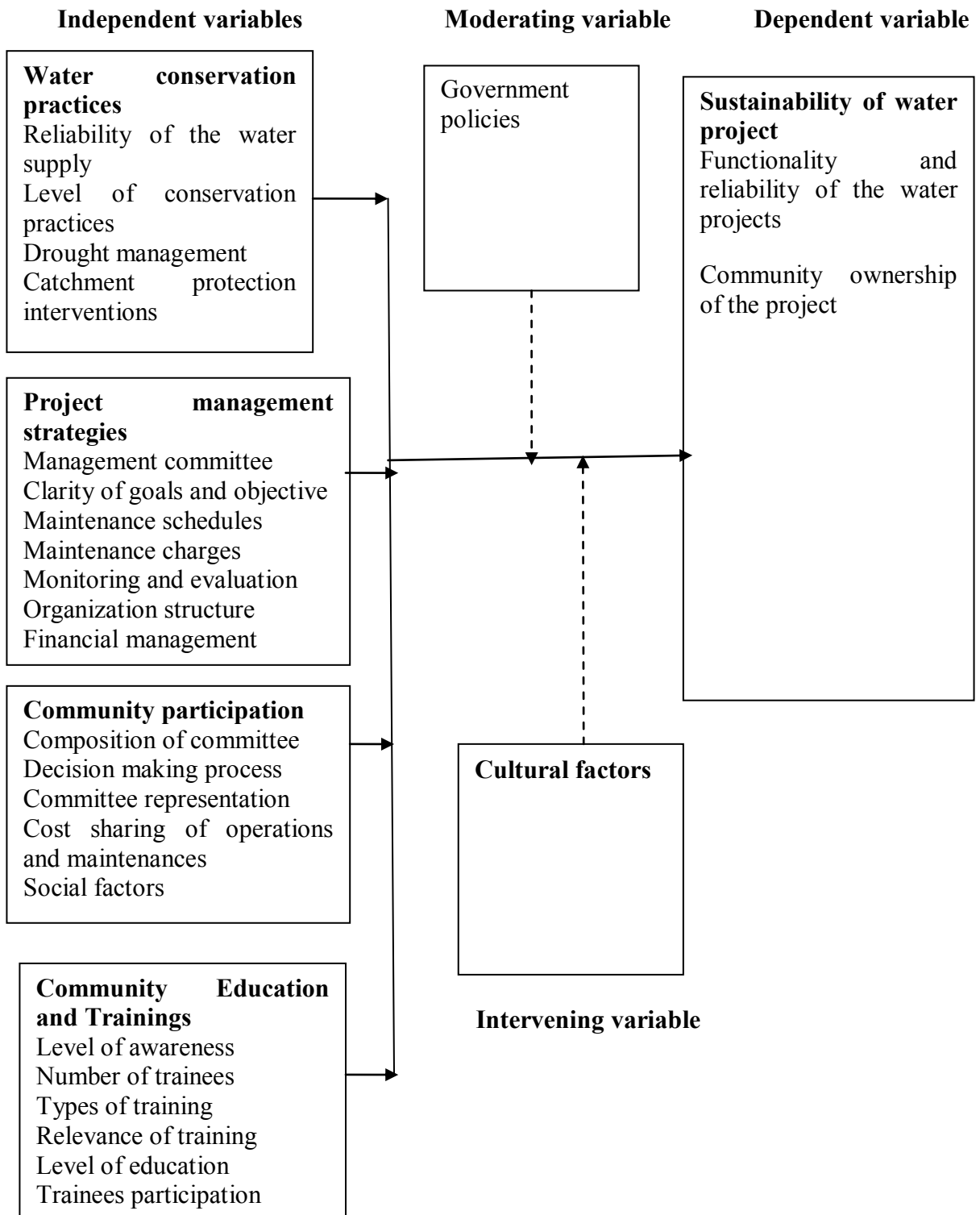


Figure 1: Conceptual Framework

The independent variables for this study are water conservation practices, project management strategies, Community education and training and community participation while the dependent variable of the study is sustainability of Community water projects. The study aimed at investigating how the independent variables determined the dependent variable. The other variables are the Government policies and cultural factors.

2.14 Knowledge gap

This chapter has given literature reviewed from existing secondary sources according to the variables of the research, theoretical frameworks and the conceptual framework which formed a basis of the study. In the literature reviewed many studies have highlighted on the influence of community participation, institutional capacity building, and project management practices.

The Project management strategies indicators identified are financial management, organizational planning, strategic planning, willingness of community members to sustain their projects through contributions towards operations and maintenances, skilled water operators and leadership. It was also indicated that application of project management strategies such as strong constitution, strategic planning and effective financial management is below average in the community managed water projects.

Community participation involves capabilities and willingness of communities to take charge, influence and determine the nature of project during its life cycle to ensure long lasting impacts. The identified indicators in the literature review of community participation are community participation in decision making, community contribution, representation, responsibility, social factors and informed choice. It has also shown that the level of involvement of communities in water projects activities is still low in most developing countries especially in rural areas.

Human capacity development is important through specialized training and education of project managers, staff, community members and the whole project team. The identified indicators for community training and education include level of awareness, types of training, relevance of training and number of trainees. Lack of community education is one of the factors which could lead to breakdown and non-sustainability of water supply projects.

The aim of conserving water resources is to ensure adequate quantity and satisfactory quality supply to the community. Water resources are classified according to water sources

such as groundwater, surface water and rainwater. The identified indicators for water conservation practices included water quality, conservation intervention measures, and types of catchment protection interventions and level of water sources reliability. Limited water resources conservation could lead to non-sustainability of water resources. It has been indicated and observed that while water resources conservation level is still low among rural communities, it greatly determines the reliability and sustainability of water projects.

The literature reviewed shows there is knowledge gap of studies done locally to investigate the determinants of sustainability of community managed water projects in Nyeri County. This indicates that there is a local knowledge gap on water projects' sustainability issues in Kenya. Therefore, the research was done in order to investigate the determinants of sustainability of community water projects in Kieni East District, Nyeri County.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the Research methodology that was employed to the study. It describes the research design adapted, target population, the sampling design and size, data collection methods and procedures, validity and reliability of the instruments, pilot study, data analysis techniques and ethical considerations in the study.

3.2 Research Design

A descriptive survey research design was employed to the study since the unit of analysis selected was all the community water projects in Kieni East District in Nyeri County. This design involves describing the characteristic, attitudes, possible behavior and values of a particular phenomenon and therefore the researcher considered it most appropriate in examining the determinants of sustainability of community water projects. This design is most preferred when conducting research study to a large population since it allows generalization of results of the research sample to the larger target population. The researcher formulated the study objectives; designed data collection instruments, selected an appropriate sample size and collected data using questionnaires and an interview guide.

3.3 Target Population

The target population of the study was the committee members of the community water projects in Kieni East District, the household water consumers and the Government Water Officers. Kieni East District has got twenty four (24) water management committees spread across the twenty four water projects. Each of the water management committees are made up of executive leaders consisting of the chairman, treasurer and secretary. An estimated total population of 10,443 household consumers' spread across the five locations, namely; Naromoru, Kabaru, Kiamathaga, Thage and Gakawa are served by the communal water projects. The target population units of the research study consisted of; 10,443 household consumers', 72 water management committee members and two Government Water Officers.

3.4 Sampling and sampling procedures

Sampling is the process by which a relatively small number of individual, object or event is selected and analyzed in order to find out something about the entire population from which it was selected. A sample is a small proportion of targeted population selected using some systematic format. Due to the nature of the study, the researcher adopted Cochran (1963) formula to calculate the sample size of household consumers' respondents and purposive sampling technique in order to select two committee members' respondents from each of the 24 water projects' as well as the two key informants from the Ministry of Water and Irrigation.

The sample size of household consumers at 7% level of significance was obtained as presented below:

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

Whereby n is the sample size

N is the target population (no of household consumers) =10,443

e is the level of significance = 0.07

$$n = \frac{10,443}{[1 + 10,443 * 0.07^2]} = 200 \text{ household consumers}$$

Through purposive sampling, a sample of 48 executive committee members and two key informants were selected. A sample size of 200 household consumers was also obtained using Cochran formulae. Stratified proportional sampling technique, was used to obtain a sample of household consumers' from each of the five locations who were then selected through simple random sampling technique as presented in Tables 3.1 and 3.2.

Table 3.1 Proportionate sampling of household consumers in Kieni East District

Location	No of Household consumers	Sample size
Naromoru	1358	26
Kiamathaga	2174	42
Kabaru	2160	40
Thegu	1280	24
Gakawa	3561	68
Total	10,443	200

The composition of the total sample size of stakeholders is presented in Table 3.2

Table 3.2 Sampling frame of stakeholders

Target group	Population size	Total sample size
CBO committee members	72	48
Key informants	2	2
Household consumers	10,443	200
Total	10,517	250

3.5 Data collection methods

The Researcher developed the data collection instruments. Questionnaires and interview guides instruments were used to gather information for the study. Questionnaires collected data from the executive members of the water management committees and household consumers while an interview guide gathered information from the key Government Officers. Questionnaires contained closed-ended questions and a few open ended questions. The closed ended questions contained a list of possible alternatives from which respondents were required to select the answer that best described their situation. Semi-structured interview was employed to collect information from key informants. Both the questionnaire and interview guide were divided into sections which provided information on demographic characteristics, water resources conservation practices, community training and education, project management strategies and community participation.

3.6 Validity of research instruments

Frankel and Wallen (2008) define validity as the appropriateness, correctness and meaningfulness of the inferences selected on research results. It is the degree to which results obtained from analysis of the data actually represent the phenomenon under study. The question of validity is raised in the context of the form of the test, the purpose of the test and the target population. The researcher concentrated on content validity. Mugenda and Mugenda (2003) define content validity as a measure of the degree to which data collected using a certain instrument represent a specific domain of indicators or content of a particular subject. The researcher assessed content validity by consulting research experts including the supervisor, professional experts and peers to ensure that the instrument measured what it was intended to measure.

3.7 Reliability of research instruments

Reliability is the degree to which a test consistently measures whatever it measures (Gay, 1987). It is the ability to consistently yield the same results when repeated measurements are taken under the same conditions. Reliability was assessed using the split half technique and questionnaires administered to a small group of respondents. The questionnaire items were assigned arbitrary scores and data entered into computer software for Statistical Package for Social Sciences. Data was analysed using Spearman Brown prophecy formula and a correlation coefficient of 0.87 was obtained indicating that the instruments had internal consistency. This method is most preferred to other techniques such as test retest and equivalent forms since it eliminates chance error due to differing test conditions (Mugenda and Mugenda, 2003).

3.7.1 Pilot study

Pilot testing is a smaller version of a large study that is conducted in order to prepare for the study and also provide a basis for the design (Orodho, 2004). It involves pre testing of the instruments to assess their validity and reliability. Pilot testing was conducted to a small group of water committee members and consumers to test the reliability of the research instruments. The researcher carried out the study in Gatune water project within Kiamathaga location of Kieni East District to a sample of 20 respondents, approximately 8% of the total sample size. According to Mugenda and Mugenda (2003), a pilot size of between 1% and 10% is considered appropriate. Piloting helped the researcher in reviewing and adjusting the research instruments appropriately. The research instruments were reviewed and revised objectively with the help of peers and professional experts

3.7.2 Split half test

The researcher employed the split half technique to test reliability of the research instruments. Data collected from the pilot study was entered into computer software Statistical Package for Social Sciences. Sample items from domain of indicators were split into equal halves and analysed through Spearman Brown prophecy formula using computer software Statistical Package for Social sciences. The researcher considered the instruments appropriate for data collection after obtaining a correlation coefficient of 0.87 from the analysis test score. According to Mugenda and Mugenda (2003) an instrument that yields a reliability coefficient of above 0.8 is reasonably consistent and therefore acceptable for data collection and analysis.

3.8 Data collection procedure

The researcher sought permission from the local administration of Kieni East District to conduct the study in the area. After getting informed consent, the researcher recruited two research assistants to assist in data collection. The research assistants were trained on the research objectives and guided on techniques of administering the questionnaires and the interview guide. Two different questionnaires were administered to water management committee members and the water consumers while interviews were conducted to key informants face to face.

3.9 Data Analysis techniques

Data analysis refers to systemic organization and synthesis of research data and testing of hypothesis in order to gain information pertinent to a given research question. The researcher scrutinized the returned questionnaires for completeness and consistent answers. This step entailed closed checking of the questionnaire items in order to identify the ones which had been left blank or incomplete and the legibility and any items wrongly responded to. Data was then coded to reduce the number of responses to classes and then classified according to the items in the questionnaire parts.

Descriptive statistics, correlations and content analysis were used to analyse the raw data. Closed questions were analysed using the Statistical Package for Social Sciences version 18.0 by first coding the responses for analysis. Raw data was then entered into SPSS computer software and analysed for descriptive and inferential statistics such as the percentages, means and correlations. Data was analysed for Pearson correlations to determine the degree of linear dependence between the independent and dependent

variables. The value of Pearson product moment coefficients ranges between -1 and +1 for negative correlations and positive correlations. This technique is preferred since it is efficient and gives straight formal analysis. Content analysis technique was applied to analyse qualitative data by identifying patterns and themes. After data analysis, the results were presented in tabulation.

3.10 Ethical considerations

The researcher endeavoured to upholding ethical issues while administering the research instruments. Informed consent was sought from respondents and concerned authority before collecting data and participation was for the willing respondents only. All information from respondents was also kept confidential and private. The study findings were also presented without manipulation in favour or interests of the outcomes.

3.11 Operational definition of variables

The measurement of variables in this research was undertaken as shown in Table 3.3.

Table 3.3 Operational definition of variables

Objectives	Variables	Indicators	Measurement	Measurement scale	Tools of analysis	Type of analysis
To establish the influence of water resources conservation practices on sustainability of community water projects Kieni East district	Water resources conservation practices	Water supply adequacy	Level of adequacy	Interval	Means, percentages	Descriptive
		Types of water resources conservation interventions	Percentages of water resources conservation interventions	Interval	Means, percentages	Descriptive Content analysis
		Level of water conservation practices	Percentage of CBO's practicing water conservation.	Ratio Interval	Means, percentages	Descriptive
		Level of water sources reliability.	Reliability level	Ratio Interval	Means, percentages	Descriptive Correlation
To assess the influence of project management strategies on sustainability of community water projects in Kieni East District	Project management strategies	Clarity of project goals and objectives	Degree of clarity	Nominal	Means, percentages	Descriptive
		Composition of management committee	Ratio of management committee	Interval	Means, percentages	Descriptive Content analysis
		Knowledge and skills of project team	Level of education	Ordinal	Means, percentages	Descriptive
		Organization structure of management committee	Level of clarity of functions, responsibilities and lines of authority	Nominal	Means, percentages	Descriptive
		Financial management	Cost sharing ratio towards implementation operations and maintenances of water projects	Ordinal	Means, percentages	Descriptive Content analysis

To establish the influence of community participation on sustainability of community water projects in Kieni East District	Community participation	Committee representation	Ratio of stakeholders' in committee representation	Nominal	Means, percentages	Descriptive
		Decision making process	Number of community members involved during project conception, design and implementation.	Ordinal	Means, percentages	Descriptive
		Women representation in management committees	Percentage of women in management committees	Ordinal	Means, percentages	Descriptive
		Level of Community contribution	Ratio of community contributors Relationship of contributions and decision making	Nominal	Means, percentages	Descriptive Correlations
		Social factors	Ratio of age groups participants Ratio of gender in committee representation	Nominal	Means, percentages	Descriptive Content analysis
To establish the influence of community Education and trainings on sustainability of community water projects in Kieni East district	Community Education and trainings	level of knowledge	Average number of trainings received	Interval	Means, percentages	Descriptive
		Relevance of training	Degree of training relevance to water management	Ordinal	Means, percentages	Descriptive Content analysis
		Level of awareness	Number of community member trained	Interval	Means, percentages	Descriptive

		Level of trainees participation in operations and maintenances	Extent of trainees participation in Operations and maintenance	Ordinal	Means, percentages	Descriptive Content analysis
	Dependent Sustainability of water projects	Community ownership of the project Functionality and reliability of the water project	Number of stakeholders in the water project Adequacy level of water supply	Interval Ordinal	Means, percentages Means, percentages	Descriptive Content analysis Descriptive Correlations Content analysis

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter provides data analysis, presentation and interpretation. Raw data was analyzed according to the objectives of the study and variables of sustainability of community water projects for descriptive statistics and correlations using computer software Statistical Package for Social Sciences version 18.0. The variables included water resources conservation practices, community education and training, project management strategies and community participation. Data was presented in frequency distribution, percentages, cross tabulations, narratives and interpreted according to the four objectives of the study.

4.2 Questionnaire return rate

A total sample of 250 respondents, who consisted of 200 water consumers, 48 water management committees and two Government Water Officers, were selected. The response rate of the selected stakeholders was therefore 100%. The return rate of the questionnaires administered to the consumers' of the water projects was as presented in Table 4.1:

Table 4.1: Questionnaires return rate for consumers of the water projects

Location	Frequency	Percentage
Naromoru	26	13
Kiamathaga	42	21
Kabaru	40	20
Thegu	24	12
Gakawa	68	34
Total	200	100

The return rate of the questionnaires administered to the executive water committee members was 100%. A sample of two committee members was successfully selected from each of the 24 water projects' as planned. Two key Water Government Officers from the Ministry of Water and Irrigation, namely the area District Water Officer and the Community Development Officer, were also selected and interviewed.

4.3 Demographic characteristics of the respondents

The demographic characteristics of respondents on gender and age distribution, education level and type of family are presented in Tables 4.2 to 4.4.

Table 4.2: Gender and Age of consumers' respondents

Age	Male	Female	Percentage
Below 20 years	0	1	1
21-30 years	13	4	8
31-40 years	60	32	46
41-50 years	38	17	28
Above 50 years	28	7	17
Percentage	69	31	100

Among the consumers' respondents, 1% was aged below 20 years, 8% were aged between 21-30 years, 46% were aged between 31- 40 years, and 28% were aged between 41-50 years while 17% were aged above 50 years. This indicated that the most dominant age group in this community was between the ages of 31 to 50 years. Most of the respondents were males at 69% since they are the household heads of the family units.

Table 4.3: Education level of committee members' respondents

Education level	Frequency	Percentage
Primary level	11	23
Secondary level	35	73
University level	2	4
Total	48	100

Among the committee members' respondents, 23% had attained primary school education and 73% had attained secondary school education while 4% had attained university education. These indicate high literacy level among management committee members as well as the entire community who are able to make informed decisions concerning water project's management and operations.

Table 4.4: Type of family of respondents

Type of family	Frequency	Percentage
Male headed	161	80
Female headed	35	18
Child headed	4	2
Total	200	100

Among the consumers' respondents, 80% indicated that their families were male headed, while 18% indicated that their families were headed by a female and only 2% were headed by a child. Statistics show that most of the households' were headed by males which indicate that men had maintained their key productive role in the family units of heading their families.

4.4 Influence of water resources conservation practices on sustainability of community water projects

The study aimed at establishing the influence of water resources conservation practices on sustainability of community water projects. The indicators of the study variable included the level of water conservation practices, types of conservation interventions practiced, extent of water reliability and adequacy of water supplied. The results of the opinions of respondents on the study indicators are presented in Tables 4.5 to 4.8.

Table 4.5: Level of water conservation practices

Response	Frequency	Percentage
Yes	161	80
No	39	20
Total	200	100

In responding to the level of water conservation practices among the consumers' respondents, 80% indicated that their CBO's practiced water resources conservation. This indicates a high participation level in conserving water which directly contributes to long term sustainability and functionality.

Table 4.6: Types of water conservation practices

	Planting of trees	Storage reservoirs	water harvesting	Fencing of water sources	Percentage
Surface water	6	19	5	2	67
Ground water	1	11	1	0	27
Rainwater	0	0	3	0	6
Percentage	14	63	19	4	100

With regards to the types of water conservation interventions, 14% committee members' respondents indicated planting trees, 63% indicated storage reservoirs in conserving surface and ground water, 19% indicated water harvesting, while only 4% indicated fencing around the water sources. None of the committee members indicated practicing water pricing as a water conservation intervention. The two Government Officers indicated water pricing through metering of consumer points to minimize wastage and planting of trees as some of the best water conservation practices that community organizations could adopt.

Table 4.7: Extent of water reliability

Water conservation interventions	Reliability percentage			
	Great extent	Moderate extent	Low extent	Totals
Planting of trees	0	10	4	14
Storage reservoirs	31	29	2	62
water harvesting	10	6	2	18
Fencing of water sources	0	2	2	4
Total	41	47	10	100

Among community members who consented to practicing water resources conservation, 41% indicated that it influenced reliability of their water sources to a great extent while 47% indicated an influence of moderate extent.

Table 4.8: Relationship between water conservation practices and extent of water sources reliability

Pearson correlation coefficient

		Extent of water sources reliability	level of water catchment protection
Extent of water sources reliability	Pearson Correlation	1	0.426(**)
	Sig. (2-tailed)		0.000
level of water catchment protection	Pearson Correlation	0.426	1
	Sig. (2-tailed)	0.000	
	N	200	200

NB- Correlation is significant at the 0.01 level (2-tailed).

The study sought to establish the degree of relationship between the level of water conservation practices and the extent of water sources reliability. A positive and significant Pearson correlation coefficient of 0.426 was obtained at 0.01 significance interval indicating positive correlation between the level of water conservation practices and the extent of water sources reliability. The Water Government Officers interviewed indicated that Community organizations which practiced adequate water conservation interventions such as storage reservoirs, roof water harvesting and fencing around water sources had more reliable water sources in quality and quantity than those who sparingly practiced.

4.5 Influence of community participation on sustainability of community water projects

The study sought to establish the influence of community participation on sustainability of community water projects. The indicators of the study variables included level of participation in project conception, design and implementation, women representation in water management committees, level of community participation in operations and maintenances, stakeholders' representations in management committees and gender representations in project committees. The results of the opinions of respondents on the study indicators are presented in Tables 4.9 to 4.15.

Table 4.9: Level of community participation in conception, design and implementation

Level of participation	Frequency	Percentage
Poor	38	19
Good	139	70
Excellent	23	11
Total	200	100

In responding to the level of community members' participation in conception, design and implementation of the water projects, only 19% community members' respondents indicated poor participation level, while 70% indicated good participation and 11% indicated excellent participation. It was confirmed from the two Government Officers that community members and water committee members were fairly active during conception, design and implementation. Community members were the project initiators' through the community organization groups and most of the times prepared the project conception proposals. They were also actively involved in deciding on the most appropriate technology in project design stage and participated in data collection of the projects as well. Members were also actively involved in implementation activities of the project. It was further indicated that community members participated in various ways during implementation of the water projects with some contributing cash towards financing implementation while others making contributions of construction materials such as sand, ballast, building stones and timber. They also contributed to providing unskilled and skilled labor during construction.

Table 4.10: Women representation in water management committees

Women representation	Frequency	Percentage
Poor	30	15
Fair	135	68
Good	35	17
Total	200	100

In responding to the level of women representation in water management committees among the consumers' respondents, only 15% indicated poor women representation level, while 68% indicated a fair representation level and 17% indicated a good representation level. One of the Government Officer's interviewed indicated that the treasurer's position in the executive committee positions' was a special reserve for women members. This

shows that the community members were gender sensitive and honored the gender equity rule of 30% gender representation in leadership positions

Table 4.11: Level of community participation in operations and maintenances’

Response	Frequency	Percentage
Yes	176	88
No	24	12
Total	200	100

With regards to the level of community participation in operations and maintenances activities of water project, 88% were of a yes opinion while a meager 12% were of a negative opinion. The interviewed Community Development Officer indicated that some community organizations had programmed regular operations and maintenance schedules and responsibilities of maintaining the water facilities while some other community organizations made contributions in cash, materials and free labour to repair and maintain their water projects.

Table 4.12: Stakeholders’ representation in the management committee structures

Stakeholders’ representation	Frequency	Percentage
Good	12	25
Fair	28	58
Poor	8	17
Total	48	100

In responding to the level of the stakeholders’ representation in the management committees’ structures, only 25% indicated good representation level, while 58% indicated fair representation level and 17% indicated poor representation level. The stakeholders included the domestic water consumers, farmers, public institutions and land owners who were indicated to be fairly represented in the management committees.

Table 4.13: Gender representation in committee membership

Respondents	Frequency	Percentage
Male	33	69
Female	15	31
Total	48	100

With regards to gender representation in committee membership, 69% respondents were males, while 31% were females. Results indicate a fairly good gender balance in committee representation of the water projects of 30% representation from either gender which guarantees a fair representation of opinions on gender issues in the water projects. The gender issues influencing water projects are the technological adoptions, participation in operations and maintenances and gender roles in conception, design and construction activities.

Table 4.14: Influence of community contributions on decision making

Response	Frequency	Percentage
Great extent	17	36
Moderate extent	27	56
Low extent	4	8
Total	48	100

The study sought to establish the extent to which community contributions influenced key decision making in implementation and operations issues of the water projects. Among the committee members interviewed, 36% indicated an influence of great extent in decision making while 56% indicated an influence of moderate extent and only 8% indicated an influence of low extent. . This indicates that community contributions greatly influenced the decision making process. Contributions either at the implementation level or towards operations and maintenances increases a sense of ownership of the assets and consequently elevates the desire to making informed choice towards long term sustainability.

Table 4.15: Relationship between community contributions and decision making

Pearson correlation coefficient

	Community contributions	Extent of influence of community contributions on decision making
Community Pearson Correlation	1	0.385(**)
Sig. (2-tailed)		0.007
N	48	48

NB- Correlation is significant at the 0.01 level (2-tailed).

The study sought to establish the relationship between contributions made by the community and their extent of influence in decision making. Findings obtained a Pearson correlation coefficient of 0.385 at 1% significant interval. Results established that community contributions were 38.5% significant towards influencing decision making.

4.6 Influence of project management strategies on sustainability of community water projects

The study sought to establish the influence of project management strategies on sustainability of community water projects. The indicators of the study variable included sources of funding for the water projects, level of community contributions towards operations and maintenances, functionality of the organization structure, rating for application of standard management tools, level of knowledge and skills of the project operators and frequency of project review meetings. The results of the opinions of consumers' respondents and committee members' respondents on the indicators are presented in Tables 4.16 to 4.22.

Table 4.16: Source of funding for water projects

Source of funding	Frequency	Percentage
Community contribution	166	83
Government/Donor	34	17
Total	200	100

With regards to sources of funding of the water projects, 83% consumers' respondents indicated that the main source of funding their water projects was from community contributions while 17% respondents indicated that either the Government or Donors were the main financiers of their water projects. The two Government Officers indicated that all community water projects were partly or fully funded by the community. It was indicated that in the Government and donor funded water projects, the community made a contribution of 15% or 25% share of the total amount required while donors or the Government made 85% or 75% contribution respectively of the total amount. If no external donation was available, the community made the 100% contribution of their water project. The main source of funding implementation of communal assets is a key factor to influencing a sense of ownership towards long term sustainability.

Table 4.17: Level of community contributions towards operations and maintenances

Responses	Frequency	Percentage
Yes	176	88
No	24	12
Total	200	100

With regards to establishing the level of community contributions towards operations and maintenances of the water projects, 88% consumers' respondents indicated that they made contributions towards operations and maintenances while 12% indicated that they were not committed to making regular contributions towards operations and maintenances. Committee members' respondents of the water projects indicated that community members made regular contributions towards operations and maintenances. The District Water Officer indicated that all water consumers made contributions towards operations and maintenances. However this varied among the various Community Based Organizations (CBO's). It was indicated that in some Community organizations, household consumers were committed to making regular equal monthly contributions while in some others, members made contributions only when there occurred a technical breakdown. Availability of funds for operations and maintenances determines the level of functionality and reliability of the water projects.

Table 4.18: Clarity of project goals and objectives

Responses	Frequency	Percentage
Clear	159	80
Not clear	41	20
Total	200	100

With regards to clarity of project goals and objectives, 80% community respondents indicated that their project goals and objectives were clear while 20% indicated they were not clear. This indicates that most of the water project's CBO's were guided by project goals and activities in their plans, activities and developments.

Table 4.19: Functional responsibilities of committee members

Response	Frequency	Percentage
Yes	36	75
No	12	25
Total	48	100

In responding to the definition of functional responsibilities of committee members, 75% respondents indicated that management committee functions and responsibilities were properly defined while 25% indicated that functions and responsibilities were not defined. Data collected from the Government Officers confirmed that most of the Community Based Organization's were guided by functional by laws in the management and operations of the water projects. This however varied among the various Community Based Organizations. The informants further indicated that several other Community organizations of the water projects did not have functional by laws and only prepared standby laws to mitigate the prevailing challenges. It was however indicated that the community's constitution could not differentiate the leadership and management functions after establishing that committee members who are functionally the water projects leaders were also the project managers and water operators.

Table 4.20: Rating for application of standard management tools

Application of management tools	Frequency	Percentage
Poor	8	17
Fair	39	81
Good	1	2
Total	48	100

With regards to application of standard management tools among committee members, 17% respondents indicated a poor opinion while 81% indicated a fair opinion and only one respondent indicated a good opinion.

Table 4.21: Knowledge and skills of the project operator

Response	Frequency	Percentage
Yes	30	62
No	18	38
Total	48	100

With regards to the level of technical knowledge and skills of the project operator, 62% committee members' respondents indicated that the project operators were knowledgeable and skilled while 38% indicated that project operators were not adequately skilled. Findings from the interviews established that qualified water operators were hired on casual basis to attend to an emergency while the hardly qualified committee members were charged with the responsibility of water operations.

Table 4.22: Frequency of progress review meetings

Review meetings	Frequency	Percentage
Monthly	44	92
Quarterly	4	8
Total	48	100

In responding to the frequency of committee meetings, 92% committee respondents indicated holding review meetings on monthly basis while 8% indicated holding review meetings on quarterly basis. This indicates satisfactory committee meetings which are good communication tools while making critical decisions on management and operations issues.

4.7 Influence of community trainings and education on sustainability of community water projects

The study sought to establish the influence of community training and education on sustainability of community water projects. The indicators of the study variable included the number of trainings, relevance of trainings to operations and management, level of trainees' participation in project operations and rating of trainers' technical skills. The opinions of consumers' respondents, committee members are presented in Tables 4.23 to 4.27.

Table 4.23: Trainings on operations and management of water projects

Responses	Frequency	Percentage
Yes	166	83
No	34	17
Total	200	100

In responding to the level of community training on operations and maintenances, 83% consumers' respondents indicated that they had received some training on operations and

management of water projects while 17% indicated they had not received any training. The Community Development Officer indicated that community members in most of the community water projects had been trained on operations only to enable them participate actively in running their projects.

Table 4.24: Number of trainings on operations and maintenances

Response	Frequency	Percentage
None	34	17
1-5	158	79
6-10	8	4
Total	200	100

Among the community water consumers' who had received training, 79% respondents indicated receiving between 1 to 5 training sessions while only 4% indicated attending between 6 to 10 trainings. The District Water Officer indicated that most community members had attended only one training session on operations after completion of the project while the Community Development Officer indicated that adequate community trainings were carried out for the Government and donor funded water projects.

Table 4.25: Relevance of trainings to management of water projects

Relevance of trainings	Frequency	Percentage
Very relevant	23	48
Fairly relevant	25	52
Irrelevant	0	0
Total	48	100

In responding to the relevance of community trainings to management of the water projects, 48% committee respondents indicated that the trainings were very relevant while 52% indicated that they were fairly relevant and none indicated that the trainings were irrelevant. The two Government Officers interviewed, indicated that much of the training conducted were highly relevant but inadequate and skewed on operations and maintenances only. It is a necessity that trainings on operations and maintenances, financial management, record keeping, procurement and conflict resolutions are conducted to ensure long term benefits of the projects

Table 4.26: Level of trainees' participation in project activities

Response	Frequency	Percentage
Yes	139	70
No	61	30
Total	200	100

While establishing the level of trainees' participation in project activities, 70% consumers' respondents indicated that trained members actively participated in project operations and maintenances activities while 30% indicated that trainees' were not active participants in project activities.

Table 4.27: Rating of trainers technical skills

Trainers skills	Frequency	Percentage
Poor	1	2
Fairly good	45	94
Excellent	2	4
Total	48	100

In responding to the level of trainers' technical skills among committee members, 2% indicated poor technical skills of the trainers while a majority of 94% and 4% indicated fairly good skills and excellent skills respectively. Findings from key informants confirmed that the trainers were from the Ministry of Water and Irrigation and were qualified Community Development Officers.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION,
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introductions

Chapter five presents a summary of the findings, discussion, conclusions, recommendations of the study and suggestions for further studies. The purpose of the study was to investigate the determinants of sustainability of community water projects in Kieni East District of Nyeri County.

5.2 Summary of findings of the study

The findings of the study are summarized and presented according to the four variables of study namely; water resources conservation practices, community participation, project management strategies and community education and training.

5.2.1 Water resources conservation practices

The study findings established a high participation level by community members' organizations of 80% in conserving the water resources. Findings also found out that water resources conservation interventions varied among the community organization with 63% indicating storage reservoirs as water conservation measures and 4% indicating fencing to protect the water sources. Findings also established that no group practiced water pricing as a water conservation option. The study also established a positive and significant correlation between the level of water conservation practices and the extent of water sources reliability after obtaining a Pearson correlation coefficient of 0.426 at 0.01 significance interval. It was further established that community organizations which practiced adequate water conservation interventions such as storage reservoirs, roof water harvesting and fencing around water sources had more reliable water sources in quality and quantity than those who sparingly practiced.

5.2.2 Community participation

Study findings established that community members' participation level in conception, design and implementation of the water projects was 70% and 11% indicating good participation and excellent participation levels. Further findings indicated that community members and water committee members were fairly active during conception, design and implementation phases of the project cycle. Community members were the project initiators' through the community organizations' groups and most of the times prepared

the project conception proposals. They were also actively involved in deciding on the most appropriate technology in project design stage and would as well participate in data collection of the project. Further findings established that members were actively involved in implementation activities of the project. It was indicated that community members made cash contributions towards implementation while some others contributed in providing locally available construction materials such as sand, ballast, building stones and timber. They also contributed in providing unskilled and skilled human labor during construction. Findings also established a high level of community members' participation in operations and maintenances, with 88% indicating active participation. More findings indicated that community members contributed in cash, materials and provision of labor towards operations and maintenances. The study findings show that women representation in water management committees was satisfactorily good, with respondents indicating fair and good representation levels at 68% and 17% respectively. Findings also established that the treasurer's position in the executive committee membership was a special reserve for women. Findings also established a fairly good stakeholder's representation in the water management committees with 25% and 58% indicating good and fair representation levels respectively. Further findings also established fair gender balance and representation in water management committees at 69% and 31% for men and women respectively. With regards to the extent of influence of community contributions upon key decisions of the project, the study findings established an influence of great extent and moderate extent at 36% and 56% respectively.

5.2.3 Project management strategies

Study findings show that the main source of funding of the water projects was from community contributions as indicated by 83% respondents and only 17% indicated Government or donors funding. More findings established that community managed water projects were either fully funded by the community or partly funded by both the community and external financier at a ratio of 1:4. A majority of 88% community members' indicated that they were responsible for operations and maintenances of their water projects and were committed to making regular contributions. Study findings also show that 80% community organizations had clear goals and objectives and were guided in their activities and development plans. Study findings indicate clear definition of functional responsibilities of committee members at 75%. It was further shown that the CBO's constitution could not differentiate the leadership and management functions after

establishing that committee members who were functionally the water projects leaders were also the project managers and operators.

Further findings show that committee members rated the application of standard management tools such as work plans at 81% and 2% for fair and good applications levels respectively. Technical knowledge and skills of the project operator was rated at 62%. Data from the two key informants established that qualified water operators were hired on casual basis only when there was a breakdown while the hardly qualified committee members were charged with the responsibility of water operations. With regards to the frequency of committee meetings 92% CBO's indicated holding meetings on a monthly basis to discuss operations and management issues of the project.

5.2.4 Community education and training

Study findings show community trainings on operations and maintenances at 83% with 79% receiving between 1 – 5 trainings. However, further information from key informants' revealed skewed trainings on water operations only. Further findings show that technical skills were lacking among community members for the community only funded water projects. With regards to the relevance of training on operations and management of water projects, 48% and 52% indicated that they were very relevant and fairly relevant respectively. Further information show that as much as the trainings were relevant, they were inadequate and skewed on water operations only. Trainees' participation in project activities was rated at 70%. Study findings also show satisfactory technical skills among the trainers with 94% indicating fairly good skills. Further information collected from key informants revealed that trainers were from the Ministry of Water and Irrigation and were qualified Community Development Officers.

5.3 Discussion of findings

A discussion of the findings is given according to the four variables of the study;

5.3.1 Water resources conservation practices in water projects

The concept of water conservation maximises on the availability of surface water for human uses. Planning and management initiatives provide water for domestic, industrial and food production. Water scarcity is a consequence of inadequate quantity of water and poor water quality. This is as a result of two categorical causes' namely natural and manmade causes. Natural causes are results of arid and semi-arid climates whereas man made causes are results of desertification and water management due to human activities.

Drought is a natural but temporary imbalance of water availability consisting of a persistent lower than average precipitation of uncertain frequency, duration and severity of unpredictable or difficult to predict occurrence resulting in diminished water resources and reduced carrying capacity of the ecosystem. Conserving the limited water resources increases the production capacity thereby guaranteeing the implemented water projects long term reliability and functionality.

The study established an average participation level by community organizations in conserving the water resources at 80% (Table 4.5). McLyor (2000) observed that the prime reason why the water resources are being destroyed was because majority of people were passive observers of environmental degradation. The various conservation interventions practiced vary among the community groups with a majority of 63% indicating storage reservoirs and others indicating water harvesting, planting of trees and catchment protection through fencing around water sources (Table 4.6). This indicates a local knowledge gap on the importance and rationale of conserving the limited resource. Findings also established low awareness level among community organizations on the various feasible water conservation interventions namely water pricing, catchment protection and water harvesting. This indicates a need to creating awareness among the community members through sensitization programme on the importance of conserving the limited water resources as well as introducing the various feasible practices of water conservation. It is in this regard that sensitization programs and awareness creation among community water organizations should be conducted. The two Government Officers indicated water pricing interventions through metering of consumer points to minimize wastage, and planting of trees as some of the best water conservation practices.

The study also established a positive and significant correlation between the level of water conservation practices and the extent of water sources reliability after obtaining a Pearson correlation coefficient of 0.426 at 0.01 significance interval (Table 4.8). It was further established that community organizations which practiced adequate water conservation interventions such as storage reservoirs, roof water harvesting and fencing around water sources had more reliable water sources in quality and quantity than those who sparingly practiced (Table 4.7). Conservation of water maximises the availability of surface water for human uses by practically improving water adequacy and satisfactory quality which promotes sustainability of the water projects. Findings agree with past research observations by Cosgrove and Rijsberman (2000) that advanced application of Dublin convention principle of participatory approach in water resources conservation.

5.3.2 Community participation in water projects

Narayan (1994) advanced that beneficiary participation is the single most important factor contributing to project effectiveness. Without participation, it has been claimed that systems are unlikely to be sustainable even with the availability of spare parts and qualified technicians. Community participation in water projects may take different forms such as initial expression for water demand, selection of appropriate technology and siting, provision of labour and local materials, contributions of cash to the project cost and selection of management committees and water tariff (Harvey and Reed, 2006). Community participation is a tool for improving the efficiency of a project because it is believed to enhance project acceptance and ownership. Kumar (2002) advanced that participation is a key instrument in creating self reliant and empowered communities by stimulating local mechanism for collective action and decision making. Participation is a powerful tool in addressing to marginalization and inequity. It is aimed at increasing the sense of ownership over the water supply within community members. The top –down service delivery by the Government and NGO’s normally leaves a legacy of dependency in beneficiary community on external support.

The study established community participation in conception, design and implementation phases of water projects at 70% (Table 4.9). Participation entailed representation of opinions in decision making processes in conception and design phases and making contributions in cash, materials and labor during implementation. The study also established 88% of community participation in operations and maintenances of the water project after implementation (Table 4.11). Participation entailed contributions in cash, materials and labor. Opinions of community members during conception and design influenced the choice of water infrastructures for implementation. Being the end users, they are more willing to maintain a project of their interest which enhances long life. This is in agreement with findings by Davis and Lyer (2002) who established that community members’ contributions may take the form of money, labor, material, equipment, or participation in project-related decision-making.

The study also found out that women were fairly represented in water management committee at 31% (Table 4.13). This indicates compliance with the gender equity principle of 30% either gender representation. It guarantees a fair and equal participation by both men and women in decision making processes, implementation, operations and maintenances. It was also established that stakeholders’ were fairly represented in the

water management committees at 58% (Table 4.12). These findings concurs with past findings by OECD (2002) who established that a strong sense of local ownership and genuine participation in design, project implementation and monitoring and evaluation by both men and women are critical to successful implementation and sustainable benefits.

Findings also established a positive relationship between community contributions and the extent of influence of the contributions on decision making after obtaining a Pearson correlation coefficient of 0.385 at 0.01 significance intervals (Table 4.15). Research findings concurs with past findings by Narayan (1995), Ochelle (2012), McCommon, Warner and Yohalem (1990) and Wright (1997) who indicate that participation is characterized by community contribution, control, representation in management, responsibility to operate and maintain, participation in decision making process. The rationale of community participation is to promote control and ownership of the water projects by the beneficiaries which is a key factor to ensuring sustainability. It is therefore necessary for all aspects related to project development and implementation to be based on community preferences. More so, communities need to contribute willingly to the development and operation of the project. Those responsible for managing community water projects should represent the diversity within the community and be elected democratically. The community ought to have the authority to make decisions relating to the project on behalf of the users.

To promote community participation, there is need to develop by laws and local constitution for each of the community organization to aid and guide community members in financial management of their contributions, proper selection of committee members, gender and stakeholders' representation and development of an organization structure. The community organizations also need to seek registration with Government bodies such as Water Resources Users Association to enhance management.

5.3.3 Project management strategies in water projects

Findings established that the main source of funding of the community managed water projects was community contributions at 83% (Table 4.16). This mainly funded design and implementation of the water projects. A few of the Government and donor funded projects were also funded partly by the beneficiary community. The source of project funding determines the extent of ownership of the water projects after completion of implementation, which is a key factor to sustainability. Community members are more inclined to protecting assets they had funded to ensure maximum benefits. The study also

established that majority of beneficiaries had embraced the responsibility of operations and maintenances as reflected by the high percentage of the consumers at 88% who consented to making regular contributions towards operations and maintenances (Table 4.17). This ensures optimum functionality of the project as a result of proper maintenances which guarantees the project a long life. These findings are in agreement with recommendations made by Binder (2008) who observes that community management of rural water supply systems on operations and maintenance is not successful, if financing resources are not available and frequent supports are not provided.

It was also found out that 80% of the community members understood clearly their projects' goals and objectives which are critical to providing direction and guiding the community members in their activities and development plans (Table 4.18). Lacking clear project goals and objectives may shorten the life of the projects. This is in agreement with observations made by Gido (2009) who pointed out that it is essential for every member of the project team to clearly understand the goals and objectives of the water projects at every stage of the project implementation.

On the other hand, findings established definition of responsibilities and lines of authority of the water committees at 75% (Table 4.19). The water operators' level of technical skills in operations and maintenances of the project was rated 62% (Table 4.21). It was also established that use of standard management tools such as work plans and monitoring and evaluation tools was fair at 81% (Table 4.20). Application of standard management tools ensures that projects are implemented within the constraints of time and budget and as expected. While meetings are good communication tools on deliberations of management and operations issues and enhancement of transparency and accountability, the frequency of community meetings to report project review was found inadequate. This is contrary to the recommendations given by Rico (2009) and Ochelle (2012) who observes that communication within a team influence the fate of most components of team management and their interdependencies.

Establishment of a strong community organization to continue the operations of the project efficiently and effectively after the end of the external funding is critical. Such community organizations provide leadership through creating transparency and accountability of the projects benefits. Post implementation management should therefore adopt an assets based approach whereby beneficiaries pay for the services.

5.3.4 Community education and training in water projects

Study findings established that 83% community members had been trained on operation of their water projects (Table 4.23). This indicates that most water consumers were knowledgeable and skilled on operations of the water infrastructures. This is in agreement with observations by Campos (2008) who recommends training on issues like operations and maintenance to empower communities manage their water projects thereby promoting sustainability. Lack of community education is one of the factors which could lead to breakdown and non sustainability of water supply projects in developing countries (Ademiluyi and Odugbesan, 2008)

52% indicated that the trainings conducted were fairly relevant to management and operations of the water projects (Table 4.25). The skewed trainings however indicates inadequate knowledge and skills among community members who are not adequately trained on maintenances, financial management, conflict resolution, record keeping and tariff setting which are critical to ensuring sustainability of the projects. This is contrary to observations made by Johnson et al, (2004) who argues that staff training or expertise building in a range of matters including strategic planning skills, knowledge of needs assessment, leadership skills and financial management is important to project sustainability. Fagen (2009) observes that projects that included staff preparation and training, especially training in creative and flexible problem solving, had greater sustainability than projects that did not. Chances of sustainability increase where staff and other stakeholders feel that they or their clients can benefit from the project.

It was found out that trainees' participation in project activities was above average at 70% (Table 4.26). This indicates satisfactorily good participation by trained community members in operations and maintenances activities. Study findings also established fairly good technical skills among the trainers at 94% (Table 4.27). This concurs with observations by the National Academy of Sciences (1997) who recommends competent operating personnel to the sustained, safe operations of small water systems. It is therefore necessary that good operator training is carried out to ensure improved small water systems. Without adequately trained personnel, even a well-financed and organized system with the most advanced technology and regular compliance visits will fail to deliver.

5.4 Conclusions of the study

The following conclusions were made from the study:

1. It was concluded from the study findings that water resources conservation practices have a role to play in sustainability of water projects. The study established that the level of water conservation and the types of water conservation interventions have a direct influence on reliability and adequacy of the water sources. The study also found out that community organizations hardly recognized the rationale of conserving the limited water resources and that information on the various feasible water conservation interventions was lacking among the community members.
2. It is concluded that project management strategies are important towards enhancing accountability and transparency of operations and management issues of the water projects. Effective project management strategies enhance efficient project management during and after implementation thereby countering setbacks such as poor management of finances, corruption, poor definition of organization structures and inadequate strategic plans. It is concluded that sources of funding implementation and maintenances of the water projects greatly determined a sense of ownership among community members.
3. It was concluded that community members' participation in conception, design and implementation of the water projects greatly influenced sustainability. The study also concluded that gender balance and stakeholders representation in management committee enhanced fair representation of opinions and interests among the various community groupings. Study findings thereby conclude that in order to achieve the desired benefits active community participation in projects' activities in all phases of the project is of outmost importance. Active involvement of community members influences positive decisions for the entire community.
4. It was concluded from the study findings that community training and education was an important factor in enhancing sustainability of community water projects. It is concluded that relevant and adequate training is important towards successful implementation and operations of the project. Community training on a range of subjects such as financial management, record keeping, procurement, tariff setting and conflict resolution is of outmost importance to building capacity at the local level. Project success is as a result of adequate skills among project implementers and managers.

5.5 Recommendations of the study

The following recommendations were made in order to enhance sustainability of community water projects:

1. There is need to create awareness among community members on the importance and rationale of water resources conservation. It is recommended that conservation practices should be integrated in the water projects implementation plans to conserve the limited water resources. It is further recommended that diverse range of feasible conservation interventions such as catchment conservation, rainwater harvesting and water pricing be introduced in the water projects' long term plans. Community members should also be sensitized and encouraged to actively participate in the conservation practices to enhance reliability and adequacy of the water sources.
2. Effective project management strategies should be adopted to enhance accountability and transparency among community members on management issues and steer away conflict. To achieve this, committee members need to develop local constitution for each of the water project organization to guide and direct management of their finances, election of committee members and define a functional organization structure.
3. There is need to adapt an assets based approach in the management of the water projects. Through the guidance of the Government Water Officers, the community organizations need to adopt a policy of paying for the water supply services to cater for the operations and maintenances expenses.
4. It is recommended that community participation from conception through design and implementation is of outmost importance to enhance ownership of the water projects. The opinions of the community members should be considered in all decisions concerning the water project. Community members should be encouraged to participate in contributing cash, materials or labor during implementation and post implementation phases.
5. It is also recommended that water management committees, project implementers and water operators should be trained adequately on financial management, procurement, operations, tariff setting, record keeping and conflict resolution to enhance their skills in the management of the water facilities.
6. It is recommended that all water projects should be registered with the relevant Government bodies in order to promote legal recognition. Committee members

should also seek registration with the water resources users association to enhance compliance with Government policies.

5.6 Suggestions for further research

The following are suggestions for further studies;

1. It is suggested that further research on sustainability of community water projects should be conducted with a focus on economic factors.
2. Secondly, a study on factors influencing water resources conservation for improved livelihoods should be conducted.
3. Lastly, another study can be done on determinants of sustainability of community water projects in urban areas.

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APPENDICES

Appendix 1: Letter of Transmittal

Mary Mwangi
P.O Box 1089-10100
Nyeri
0725523113

Dear Sir/Madam,

Ref: Request for participation in research study

I am a student of the University of Nairobi pursuing Master of Arts Degree in Project Planning and Management. I am carrying out a research project on determinants of sustainability of Community Water Projects in Kieni East District of Nyeri County.

I will appreciate if you could kindly take part in the study. Your identity and information provided will be treated with outmost confidentiality. Thank you.

Yours faithfully,

Mary Mwangi
L50/65482/2013

Appendix 2: Research permit

COUNTY GOVERNMENT OF NYERI



**District Water Officer
Kieni East Sub County
P.O. BOX 29
Naromoru
Date: 17th April 2014**

**OFFICE OF THE COUNTY EXECUTIVE SECRETARY
WATER, ENVIRONMENT, NATURAL RESOURCES & IRRIGATION**

Our ref: WD/KE/TP/1/1

Mary W. Mwangi
P. O Box 598-10100
Nyeri

REF: RESEARCH STUDY

This office is in receipt of your request for the above referenced activity dated 14th April 2014.

We are glad to inform you that your request is hereby granted between the months of April and June 2014. You are further advised to kindly produce your introduction letter when collecting your data especially for the management committees of the water projects for any assistance.


**Philip Kabiru
District Water Officer**

Appendix 3: Questionnaire for Consumers of the water projects

Instructions

Please tick in the appropriate box and also fill in the blank spaces provided for those questions where elaborate answers are required. Please do not include your name on the questionnaire. Participation will be voluntary and information will be used for research only. Kindly spare your time to provide answers as honestly and objectively as possible.

Respondents location

A. Demographic Characteristics

1. Please indicate your gender Male () Female ()

2. Please indicate your age group

Below 20 years () 21-30 years () 31-40 years ()

41-50 year () Over 50 years ()

3. What is your marital status?
Married () unmarried ()

4. Please indicate the highest level of education attained

Never attended school () Primary level () Secondary level ()

University level () Never attended ()

5. Please indicate the type of your family.

Male headed () Female headed () Child headed ()

B. Water Resources Conservation Practices

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

Surface water () groundwater () rainwater () other ()

7. Does the CBO of your water project practice water resources conservation measures?

Yes () No ()

8. If yes above, what conservation measures does your CBO practice to conserve and protect the water resources?

Water harvesting () Storage reservoir () water pricing ()

Planting of trees () fencing around water sources () None ()

9. How adequate is the water supply to your yard connection?

Satisfactorily adequate () fairly adequate ()

not adequate ()

10. To what extent do you think conservation of water sources has contributed to reliability and functionality of your water project?

Great extent () moderate extent () low extent ()

C. Project management strategies

11. Which is the main source of funding for implementation of your project?

Government/Donor () Community contribution ()

12. In case of breakdown who always meet the cost of operations and maintenances?

Government/Donor () Community contribution ()

13. How clear are the project goals and objectives?

Clear () Not clear ()

14. Are the functions, responsibilities and lines of authority of water project management committees properly defined?

Yes () No ()

15. How do you rate the knowledge and skills of the project manager and implementation team of the water project?

Adequate () Not adequate ()

16. How do you rate the use of standard management tools and techniques such as work plans and monitoring and evaluation plans in the management of your water project?

Poor () Good () Excellent ()

17. Does your Community Based organisation hold progress review meetings of the water project?

Yes () No ()

18. If yes above, how often are the progress review meetings?

Monthly () Quarterly () Yearly ()

D. Community Participation

19. How do you rate the participation of community members in the conception, design, and implementation of the water projects?

Poor () Good () Excellent ()

20. How is women representation in the management committees of the water projects?

Poor () Fair () Good ()

21. Do community members participate in operations and maintenance activities of the project?

Yes () No ()

22. Do community members make contributions in kind and cash towards operations and maintenances of the water project?

Yes () No ()

E. Community Education and Training

23. Have you been trained on operations and maintenance or management of water systems?

Yes () No ()

24. If yes how many trainings have you received on operation and maintenance of water systems?
 1 – 5 () 6- 10 () above 10 ()
25. Were the trainings facilitated by trainers with technical background in water resources?
 Yes () No ()
26. To what extent has the trainings been useful in operations and maintenance of the water systems?
 Very useful () moderately useful () Not at all useful ()
27. Are the trained members of your water committee involved in the operation and maintenance of the water projects?
 Yes () No ()
28. If NO why?
 Lack of the technical skills ()
 Donors responsible for maintenance ()
 Government responsible for maintenance ()
 Individual philanthropists responsible ()

Any other (specify).....

Recommendations

In your own opinion what recommendations would you propose in order to have reliable and functional water projects?

.....

.....

.....

Thank you

Appendix 4: Questionnaire for C.B.O committee members of the water projects

Instructions

Please tick in the appropriate box and also fill in the blank spaces provided for those questions where elaborate answers are required. Please do not include your name on the questionnaire. Participation will be voluntary and information will be used for research only. Kindly spare your time to provide answers as honestly and objectively as possible.

Respondents location

A. Demographic Characteristics

- 1. Please indicate your gender Male () Female ()

- 2. Please indicate your age group

21-35 years () 36-50 years () 51-65 year ()

Over 65 years ()

- 3. What is your marital status?

Married () Single () Windowed ()

- 4. Please indicate the highest level of education attained

Never attended school () Primary level ()

Secondary level () University level ()

- 5. Please indicate the type of your family.

Male headed () Female headed () Child headed ()

B: Water Resources Conservation practices

6. What are the main sources of water for community water projects?

- i.
- ii.
- iii.

7. What strategies does your CBO practice to conserve the water resources?

- i.
- ii.

iii.

8. To what extent do the measures and strategies implemented to conserve the present water resources contribute to sustainability of the water projects?

Great extent () Moderate extent () Low extent ()

C. Project Management Strategies

9. Does your CBO have a functioning strategic plan?

Yes () No ()

10. Are the functions, responsibilities and lines of authority of the project management team and water committees properly defined?

Yes () No ()

11. Does the project operator possess adequate knowledge and skills required for successful implementation of water projects?

Yes () No ()

12. How do you rate the use of standard management tools and techniques such as work plans and monitoring and evaluation plans in managing the water project?

Poor () Fair () Good ()

13. How often do water committee members hold project meetings to report implementation, operation and maintenances of the water project?

Monthly () Quarterly () Yearly ()

D. Community Participation

14. To what extent do community members participate in the conception, design and implementation of the water projects?

Great extent () Moderate extent () Low extent ()

15. To what extent do community contributions influence decisions made during conception, design and implementation of water projects?

Great extent () Moderate extent () Low extent ()

16. Do community members make contributions in kind or cash for operations and maintenance of the water projects?

Yes () No ()

17. How is the stakeholders' representation in the committee structures for management of water projects?

Good () Fair () Poor ()

E. Community Education and trainings

18. Have water management committee members been trained on operation and maintenance and management of the water systems?

Yes () No ()

19. How relevant were the trainings carried out towards enhancing the capacity of the community members to operate and maintain the water systems?

Very relevant () Fairly relevant () Irrelevant ()

20. How do you rate the skills and qualifications of the trainers?

Poor () Fairly good () Excellent ()

Thank you

Appendix 5: Interview guide for Government Officers

A: Respondents Details

1. Position of the respondent.....

B: Water Resources Conservation practices

1. In your own assessment, what is the main source of water for community water projects?
2. In your own opinion are the water sources adequate to sustain the beneficiaries throughout the year?
3. What strategies are in place to conserving the water resources?
4. In your own opinion, what measures and strategies can the stakeholders implement to ensure conservation of the present water resources?

C. Project Management Strategies

5. In your own assessment, do community water projects have clear goals and objectives?
6. In your own observation are the functions, responsibilities and lines of authority of the project management and water committees properly defined?
7. In your own opinion does the project operator has the necessary knowledge and skills required for successful implementation of water projects?
8. Do community members use standard management tools and techniques such as work plans and monitoring and evaluation plans in managing the project?
9. In your own assessment how often do water committee members hold project meetings to report implementation, operation and maintenances of the water project?

D. Community Participation

10. To what extent do community members participate in the conception and design of the water projects?
11. How do community members participate in the implementation of the water projects?
12. In your opinion, do you feel that your contributions influenced decisions made during conception, design and implementation of water projects?
13. Do community members make contributions in kind or cash for implementation and maintenance of water projects?
14. In your own assessment of how is women representation in the membership of community structures for management of water projects?

E. Community Education and trainings

15. Have water management committee members been trained on operation and maintenance and management of water systems?

16. In your opinion, were the trainings carried out relevant towards enhancing the capacity of the community members to operate and maintain the water systems?

17. Who facilitated the training sessions and what were their qualifications?

Recommendations

What are your recommendations in improving sustainability of water projects?

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Thank you

Appendix 6: List of community Water Projects in Kieni East District

	Name of the Water Project	Location	Registered Household Members
1	Gatei water project	Thegu	422
2	Maragima-Ngonde water project		418
3	Ngogithi water project		440
4	Gikanga water project	Kabaru	445
5	Kandune water project		415
6	Ndathi-Mbiriri water project		423
7	Warazo – Luisoi water project		427
8	Warazo-Lusoi dam		450
9	Kirinyaga Nyange water project	Narumoro	408
10	Naromoru Water Project		442
11	Ndiriti Aguthi water project		408
12	Burguret water project	Gakawa	452
13	Kaga water project		398
14	Kamangura water project		352
15	Kwahuku water project		548
16	Mikumbune water project		475
17	Mureru water project		425
18	Mwea ‘B’ water project		465
19	Ruai water project		446
20	Gatune water project	Kiamathaga	450
21	Kabendera water project		456
22	Njoguini-Gitero-Kabati water project		444
23	Kabunda water project		419
24	Kigama (Mwichuri) WP		405