FACTORS INFLUENCING ADOPTION OF RAIN WATER HARVESTING TECHNOLOGIES AMONG HOUSEHOLDS IN MBEERE SOUTH SUB-COUNTY, KENYA.

BY

ERIC MUCHANGI MBOGO

A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI.

2014

DECLARATION

This research project report is my original work and has not been presented for a degree or other award in any other University.

Signature: é é é é é é é é é é é . Date:é é é é é é é é é ..

Eric Muchangi Mbogo

L50/82344/2012

This research project report has been submitted for examination with our approval as University Supervisors.

Signature:é é é é é é é é é é é .. Date:é é é é é é é é é

Prof. Timothy Maitho

Department of Public Health, Pharmacology and Toxicology

Signature:é é é é é é é é é é é .. Date:é é é é é é é é é

Dr. John Rugendo Chandi

Lecturer

Department of Extra Mural Studies

School of Continuing and Distance Education

DEDICATION

This research project report is dedicated to my beloved wife Catherine Njoki Ndwiga and my child Lewis Mutugi Muchangi for their prayers and support during this study.

ACKNOWLEDGEMENT

My special thanks goes to my supervisors Professor Timothy Maitho and Dr. John Rugendo Chandi for their technical, moral support and guidance without which I would not have completed this project. I acknowledge all the lecturers of the University of Nairobi, School of Continuing and Distance Education, Meru and Embu Extramural Centre for shaping me positively and impacting on me with skills and acknowledge. My special thanks goes to all the staff of the Embu and Meru Extramural Centre for being there for me whenever I needed your support. I sincerely thank all the students of 2011 Master of Arts Degree in project planning and managements for their encouragement and team work. I am also very grateful to the typist who was always there for me to make sure all my work was well typed and set. Finally, I am also grateful to all other people whom I may not be able to thank individually bit rendered their contributions in one way or another in this research including the respondents.

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ABBREVIATIONS AND ACRONYMS

CBO	Community Based Organization.
DANIDA	Danish International Development Assistance
DFID	Department for International Development
FAO	Food and Agricultural Organization
GOK	Government of Kenya
GRWHC	Global Rain Harvesting Collective
KNBS	Kenya National Bureau of Statistics
MDGs	Millennium Development Goals
NEMA	National Environment Management Authority
NGO	Non Governmental Organization
RWHT	Rain Water Harvesting Technologies
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Scientific and Cultural Organization
WCED	World Commission on Environment and Development

ABSTRACT

The Kenya Vision 2030 recognizes the role of science, technology and innovation in a modern economy, in which new knowledge plays a central role in wealth creation, social welfare and international competitiveness. Kenya has been classified as a water scarce country according to a World Health Organization report released in 2005 and only 48 % of the countryøs rural population has access to an improved drinking water source and this has reduced the countryøs national development progress. As a result of this water scarcity the Government and lead agencies in the water sector have come up with water harvesting technologies like roof water harvesting and runoff harvesting in attempt to address this alarming problem. The study assessed the factors influencing adoption rain water harvesting technologies among households in Mbeere South Sub County. The objectives of the study were to identify the types of water harvesting technologies in Mbeere South Sub County, assess the influence of ecological factors on adoption rain water harvesting among households, assess the influence of social economic factors on adoption of rain water harvesting among households and to determine how training and extension services influenced adoption of rain water harvesting among households. The study was based on diffusion of innovation theory and the study used a descriptive survey design. The study focused on all the entire population of 30,036 households of Mbeere South Sub County. A sample size of 204 respondents was picked using stratified random sampling and proportionate sampling. Questionnaires were used to collect data. Pilot testing was carried out in 10 households before the commencement of the study. Data analysis was done using Statistical Package for Social Sciences and Ms Excel. Descriptive statistics was computed and data presented using tables. The findings show that the type of roof influences the adoption of the water harvesting technology. A total of 86% of the respondents adopted roof water harvesting technology. A total of 83% of the respondents supported that ecological factors influence adoption of Rain water harvesting. Social economic factors influence adoption of Rain water harvesting. A total of 55% of the respondents showed the ability to raise funds either from financial institutions or their economic activities for adoption of water harvesting technologies. From the study, training and extension service (29.5%) indicated that demonstration was the main method used in training. The research findings generated may be used by farmers, Government agencies and other stakeholders to understand factors influencing rain water harvesting technologies and their contribution towards food security among households.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

According to Worm and Hattum (2006), millions of people throughout the world do not have access to clean water for domestic purposes and in many parts of the world conventional piped water is either absent, unreliable or too expensive. However according to UNEP (2006), African countries suffering or facing water shortages as a result of climate change have a massive potential in rainwater harvesting, with nations like Ethiopia and Kenya capable of meeting the needs of six to seven times their current populations. United Nations Environmental Programme (UNEP 2006) further reported that the quantity of rain falling across the continent is equivalent to the needs of 9 billion people, one and half times the current global population. About a third of Africa is deemed suitable for rainwater harvesting if a threshold of 200 millimetres of arrival rainfall, considered being at the lower end of the scale, is used. UNEP therefore reported that the water crisis in Africa is more of an economic problem from lack of investment, and not a matter of physical scarcity.

According to Prempridi and Chatuthasry (1982), the history of rainwater harvesting in Asia can be traced back to about the 9th or 10th Century and the small-scale collection of rainwater from roofs and simple brush dam constructions in the rural areas of South and South-east Asia. Rainwater collection from the eaves of roofs or via simple gutters into traditional jars and pots has been traced back almost 2 000 years in Thailand. According to Garrity (2006), in South Australia, over 40 per cent of households use rainwater stored in tanks as their main source of drinking water while Germany has over half a million rainwater harvesting schemes.

Steiner (2006) reported that unlike big dams, which collect and store water over large areas, small-scale rainwater harvesting projects lose less water to evaporation because the rain or run-off is collected locally and can be stored in a variety of ways. Therefore Conserving and rehabilitating lakes, wetlands, big dams and other freshwater ecosystems

is vital. Steiner (2006), further reported that Kenya, with a population of about 40 million people, has enough rainfall to supply the needs of six to seven times its current population, according to the study.
Ethiopia, where just over a fifth of the population is covered by domestic water supply and an estimated 46 per cent of the population suffer hunger, has a potential rainwater harvest equivalent to the needs of over 520 million people.

In an attempt to improve water harvesting and storage, Global Rain Harvesting Collective (GRWHC) has been established is to provide drinking water to schools facing an acute shortage all over the world, through roof top rain water harvesting in schools. The aim was to deliver tangible and sustainable results through a large number of small projects in many different countries at minimal operational and management cost. The `Demonstration Effects of these projects may induce other stakeholders to replicate the process. Education, poverty alleviation, gender equity objectives, implementation of environmental plans and community development programs can be achieved through rain water harvesting. According to Nega and Kimeu (2002) Rainwater harvesting is one solution to the problems of water shortage in the drier areas of Africa, but its implementation presents a number of challenges, of which storage is the main one. Many people in rural areas who would like to harvest rainwater lack the resources to do so. Conventional stone, brick or ferrocement tanks are costly, and therefore there is a great need for cheaper alternatives.

According to rain water partnership secretariat (2005), rainwater harvesting is a simple and low cost supply technology that has been practiced for thousands of years. In modern times, it has received little or no attention despite its high potential in contributing to the achievement of Millennium Development Goals with a view to eradicating poverty and hunger, providing safe drinking water, promoting gender equity and empowerment of women. Kenya has been classified as a water scarce country according to a World Health Organization report released in 2005. Only 48 percent of the countryös rural population has access to an improved drinking water source. The time spent in pursuit of water collection often prevents people, particularly women, from concentrating on income generating activities, or in the case of school going children, leads to poor school attendance and performance. Due to the water scarcity in the rural areas, waterborne diseases are not uncommon. Furthermore, during the times of drought, hundreds of people die of starvation unless they get some food aid. This sobering situation has definitely reduced the countryô s national development progress.

According to National Environment and Management (2007), some of the ground water in Mbeere District yields saline water. The quality of water in the shallow wells cannot be ascertained since some are close to pit latrines that serve as source of water pollution while others are unused quarries where run off collects and have high contamination levels. NEMA (2007) further reported that Mbeere District has about 37,036 households of which 8548 households has piped water, 9,972 households has access to potable water. The number of dams in the district is 122 and the average distance to nearest potable water point is 4km.

1.2 Problem Statement

According to Worm and Hattum (2006), one of the biggest challenges of the 21st century is to overcome the growing water shortage. Much actual or potential water shortages can be relieved if rainwater harvesting is practised more widely. People collect and store rainwater in buckets, tanks, ponds and wells. The collected rainwater is a valuable supplement that would otherwise be lost by surface run-off or evaporation. Rain Water Harvesting (RWH) has thus regained its importance as a valuable alternative or supplementary water resource, along with more conventional water supply technologies. Much actual or potential water shortages can be relieved if rainwater harvesting is practised more widely. Rainwater can be used for multiple purposes ranging from irrigating crops to washing, cooking and drinking.

According to rain water partnership secretariat (2005), rainwater harvesting is a simple and low cost supply technology that has been practised for thousands of years. Despite rain harvesting being simple and low cost technology, many households in the Mbeere South Sub-county have not adopted it despite its high potential in contributing to the achievement of Millennium Development Goals and the Vision 2030 with a view to eradicating poverty and hunger, providing safe drinking water, promoting gender equity. This study therefore intends to assess the factors influencing the adoption of rain water harvesting and storage technologies in Mbeere South Sub-County.

1.3 Purpose of the Study

The purpose of the study was to assess the factors influencing adoption of rain water harvesting and storage technologies in Mbeere south Sub County.

1.4 Objectives of the Study

The specific objectives of the study were:

1. To establish the influence of the types of roof water harvesting technologies in Mbeere South Sub County
2. To establish the influence of ecological factors on adoption rain water harvesting among households of the Mbeere South Sub County.
3. To establish the influence of social economic factors on adoption of rain water harvesting among households of the Mbeere South Sub County.
4. To establish how training and extension services influence adoption of rain water harvesting among households of the Mbeere South Sub County.

1.5 Research Questions

The study sought to answer the following research questions:

1. What are the types of water harvesting technologies adopted by the households in Mbeere South Sub County?
2. How do ecological factors influence adoption of rain water harvesting among households of the Mbeere South Sub County?

3.To what extent does social economic factors on adoption of rain water harvesting among households of the Mbeere South Sub County?

4.How does the training and extension services influence adoption of rain water harvesting and storage among households of the Mbeere South Sub County?

1.6 Significance of the Study

The study determined factors which influence adoption of rain water harvesting and storage among households in Mbeere South Sub-County.

The research findings generated new information which may help farmers to understand the factors influencing adoption of rain water harvesting and storage among households. The generated information may also help Government departments in the Ministry of water to come up with water harvesting and storage technologies which may benefit farmers and other water users. The study may also help policy makers in planning the strategies for encouraging households to adopt water harvesting and storage technologies. The study may also be useful to future scholars as it may also add to the existing body of knowledge. This may improve provision of water for domestic use and for irrigation and hence achievement of millennium development goals and vision 2030.

1.7 Limitations of the study

The study was limited by the research design that was used (descriptive survey). It only examined the situation of the sampled households of Mbeere South Sub-County as they were without changing or modifying in any way their situation because the study was descriptive survey. The research tools and instrument were also limited to only acquiring information about opinions, altitudes and experiences of the household respondents on how training and extension services influenced them to adopt rain harvesting technologies, their perspective on how social economic factors influenced them and how the ecological factors also affected. This was done by administering questionnaires to the sampled household respondents after which their responses were tabulated through the statistical package for social sciences.

1.8 Delimitations of the study

The study was conducted in Mbeere South Sub-County and focused on factors influencing adoption of rain water harvesting and storage technologies among households in Mbeere South Sub-County. The study focused on water harvesting and storage technologies for domestic use from households in Mbeere South Sub-County.

1.9 Basic Assumptions of the study

The study was based on the following assumptions: It is assumed that all respondents would be available and answer the questions correctly without any bias. The interpreters understood the questionnaire and interpreted correctly to the respondents.

1.10 Definition of significant terms

Adoption	Itôs a process of acceptance and implementing of technology. Itôs a process by which technology is communicated through certain channels over time among the members of a social system..
Ecological factors	These include water, air, soil, temperature, light and presence of their relationships to organisms. The science of the relationships between organisms and their environments.
Household	Group of individuals who eat together and live together, performing and sharing most of domestic responsibilities as a means of survival.
Rainwater	This is the precipitation of water from the clouds through the relief or conventional methods.
Rainwater harvesting	Refers to accumulation and keeping of rainwater for reuse, before it reaches the aquifer
Rainwater harvesting technologies	Refer to initiatives undertaken to collect water. In this study the technologies will be roof water harvesting.
Storage technologies	These are the apparatus used for collecting water. They include water pans, plastic storage, dams and underground storage technologies.
Social economic factors	Factors which influence household interactions and financial well being of the household members in relation to water harvesting technologies.

1.11 Organization of the study

The report contains five chapter and chapter One covers the background of the study and statement of the problem. This is be followed by setting of research objectives and research questions. Then justification of the study, limitations, delimitations, significance of the study, definition of key terms and conclude with the organization of the study. Chapter Two covers literature review from various sources to establish work done by other researchers, their findings, conclusions and identification of knowledge gaps which forms the basis of setting objectives and research questions for the study. The theoretical and conceptual framework is explained. Chapter Three covers the research design, population and sampling, sample size and sampling procedures. This is followed by data collection methods, data collection instruments, validity, reliability, data analysis procedures, ethical considerations and Operational definition of variables. Chapter four emphasized on data presentation, analysis and interpretation. Chapter five gives the summary, conclusions and the recommendations derived from the study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of empirical literature on factors influencing adoption of water harvesting and storage technologies. These determinants include ecological factors, social economic factors, training and extension services and stakeholder support services. The chapter also presents the theoretical frame work of the study, conceptual framework and the research gaps for further study.

2.2 Overview of Rain water harvesting

Rainwater Harvesting is a simple technique of catching and holding rainwater where its falls. Either, we can store it in tanks or we can use it to recharge groundwater depending upon the situation. Water resources are limited and water is becoming a scarce commodity everyday due to ever-increasing demand in proportion to the rapidly increasing population. Now it is high time we must conserve this natural resource. But rainwater harvesting has become more and more neglected since the advent of large centralized water supply systems, in spite of their high-energy input and serious environmental problems. The Millennium Development Goals (MDGs) the blueprint for the world to accelerate development and measure progress was adopted by Heads of State in the year 2000. It contains a set of time bound and measurable goals and targets for combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women. Goal 7 ensures Environmental Sustainability and focuses on water. However, all the MDGs depend on the availability of water in acceptable quality and adequate quantities to meet their targets.

Kenya Vision 2030, this report therefore presents various ways to achieve sustainable development and management of water resources for people, their crops, livestock, rangelands, ecosystems and economic development in the ASALs. It draws from examples of successful water interventions in other dry areas of Africa and the Middle East, focusing on technologies and practices that are generally adaptable by poor and smallholder land users.

Special attention is given to water for livestock, particularly under pastoral and agro-pastoral systems. Some of the technologies described in the paper include; harvesting rainwater, its storage in structures or in the soil profile, ways to improve recharge of shallow aquifers, utilization of ground water, conserving water, making use of brackish/saline water, and innovations in crop selection and water management.

2.2.1 Rain water harvesting global overview

According to the UNEP and World Agroforestry Center (2005) rain water harvesting is not new. There is evidence of its existence about 4000 years ago in Palestine and Greece. In ancient Rome, residences were built with individual cisterns and paved courtyards to capture rainwater to augment water from cityös aqueducts. As early as the third millennium BC, farming communities in Baluchistan and Kutch impounded rain water and used it for irrigation. In Tunisia, jessours have been used for centuries to collect run-off from long hill slopes. Farmers build earthen dams across the valley floors to trap the run-off water and silt. In the desert areas of Arizona and northwest New Mexico, floodwater farming has been practiced for at least 1000 years. In the ñKhadinò system of India and the spate irrigation system of the Great Horn of Africa, floodwater is impounded behind earth bunds, and crops then planted into the residual moisture when the water infiltrates.

Kenyaös water policy takes into account all the relevant issues including water conservation and preservation of its quality. In this regard, mainstreaming of rainwater harvesting is very prominent. In agricultural production; rainwater harvesting is mainstreamed into the soil and water conservation. This approach promotes rainwater harvesting on the field thus minimizing run off.

2.2.2 Rain water harvesting technologies

According to Hugger (2013), although close to three fourths of our planet is made of water, not all of it is suitable for use. The water in the oceans and seas cannot be used as drinking water and little of it can be utilized for other purposes. As a result, there is a constant shortage of water that is either good for drinking or home and industrial use.

Areas on the planet that have long faced water shortage were able to combat this problem by harvesting what little rain water they received. This slowly started spreading to areas where there was plenty of rainfall. As a result, the modern day rainwater harvesting system was bought into place. The Rainwater collected from the roofs of houses, tents and local institutions make an important contribution to the availability of drinking water. According to Ngigi (2001) rainwater harvesting is broadly defined as the collection and concentration of runoff for productive purposes (crop, fodder, pasture or trees production, livestock and domestic water supply), has ancient roots and still forms an integral part of many farming systems worldwide. It includes all methods of concentrating, diverting, collecting, storing, and utilizing and managing runoff for productive use. However, in situ system which is on-farm/cropland water conservation enhances soil infiltration and water holding capacity. Due to the low volumes of water stored compared with crop water requirements, improved benefits of these systems are derived by incorporating efficient water application methods such as low pressure drip irrigation.

Rainwater harvesting systems are simple to construct from inexpensive local materials and are potentially successful in most habitable locations. Roof rainwater cannot be of good quality and may require treatment before consumption. According to Skinner and Cotton (1992),although some rooftop materials may produce rainwater that is harmful to human health, it can be useful in flushing toilets, washing clothes, watering the garden and washing cars and therefore these uses alone halve the amount of water used by a typical home. Household rainfall catchment systems are appropriate in areas with an average rainfall greater than 200 mm (7.9 in) per year and no other accessible water sources is available.

According to the Mbeere South Sub-County administration report 2013, there are 30,036 households in Mbeere South Sub-County as shown in Table 2.1.

Table 2.1 Households in Mbeere Sub-County and target population of the study

Sub County	Ward	Population	Number of Households
Mbeere South	Mwea	30,177	6959
	Makima	21,291	4910
	Mbeti South	29,579	6823
	Mavuria	34,139	7872
	Kiambere	15,059	3472
Total		130,245	30,036

Source: Mbeere South Sub-County Provincial Administration Report 2012

Rainwater may be harvested from roofs, ground surfaces as well as from intermittent or ephemeral watercourses. The most commonly used method of water storage is the use of the plastic water tanks. Water pans are becoming popular with the household practicing small scale irrigation.

2.3 Factors influencing adoption of water harvesting technologies

According to Goyal (2005),there are new water harvesting technological which involves social (such as gender issues influencing the adoption and use of rainwater harvesting systems), ecological (effect on local biodiversity and crop production, ground water levels and soil erosion) and economic (such as willingness to pay, seasonal variations in water costs etc.) implications. The better rainwater harvesting practices/ technologies, which are driven by a clear understanding of the specification, can conserve the biodiversity in home gardens by promotion of agro forestry systems.

According to rain water partnership secretariat (2005), rainwater harvesting is a simple and low cost supply technology that has been practised for thousands of years. In modern times, it has received little or no attention despite its high potential in contributing to the achievement of Millennium Development Goals with a view to eradicating poverty and hunger, providing safe drinking water, promoting gender equity and empowerment of women. According to Fengrui et al, (2000), Rainwater harvesting provide farmers in water-limiting environments with access to the water needed to meet domestic and agricultural water needs. The adoption of rain water harvesting and storage entails consideration of a range of technological, agro-hydrological, ecological, social, cultural, economic, and political factors. In particular, there is a need to provide training and extension services to farmers, to develop and disseminate more effective and affordable types of Rain harvesting and storage technologies as alternatives and to design and develop alternative policy instruments and social institutions that facilitate adoption of Rain harvesting and storage practices.

2.4 Types of water harvesting technologies and their influence on adoption of rain water harvesting.

According to Worm (2006), Rainwater Harvesting (RWH) is cheap, sustainable and has low operation and maintenance costs. Although For subsistence, technological advances in irrigation offers some hope for increasing agricultural production and shall continue to play a vital role in the Millennium Development Goals (MDGs) in terms of health, livelihood, environmental conservation and economic growth for the rural poor. According to Kariuki (2003), Kenya receives an average of 323 billion cubic metres of rainfall per year mainly in the coastal and high altitude areas. Some of the high potential areas receive as much as 1800mm of rain per annum but in the ASAL areas rainfall is generally less than 200mm in many places. The inadequacy of installed Rain Water Harvesting facilities contributes to floods, siltation in reservoirs, loss of topsoil, droughts and desertification while missing out on opportunities to conserve water for households in rural areas. Decreasing per capita water supply is a result of increasing population, agricultural activity and a growing industrial base. Currently, the per capita water supply stands at 630 cu m which is far below the global benchmark of 1000 cu m. Spatial and temporal distribution of rainfall in the country and changes in rainfall pattern aggravate the situation making it difficult to predict sufficiency of fresh water for various uses. Several regions in the medium and high potential areas are getting decreasing than 200 mm in many areas.

Peterson (2011), reported that, rain water harvesting systems in the absence of reliable potable water supplies is undoubtedly the best option for supplementing water supplies and is an important option for water resource development especially in ASAL areas where surface and ground water resources are limited. Water is collected from roofs, ground and rock surfaces and stored in pans, rock catchment dams, sand dams, subsurface dams and in tanks. Presently there are 3000 small pans and dams in Kenya with a total storage of approximately 124 million cubic metres. Underground storage reservoirs are recommended for groundwater recharge and runoff control. Above ground storage tanks are generally used for rainwater harvested from roofs and may be constructed of rubble stone, ferrocement, masonry and reinforced concrete.

Kariuki (2003) reported that in attempts to develop suitable solutions, the Kenya Rainwater Association, in co-operation with the Ministry of Agriculture and other development partners have come up with low cost cylindrical plastic lined underground tanks and spherical tanks utilizing local available clay or cement plaster. The rainwater technologies include in-situ rainwater conservation to control erosion and runoff Conservation tillage to minimize loss of soil and water, Runoff based rain water harvesting systems entailing surface runoff and supplemental irrigation, storage rain water harvesting systems using rock catchment dams, sand dams, subsurface dams and pans, flood diversion and developing catchment systems. Kariuki further stated that rain water harvesting initiatives also militates against negative socio-economic and environmental impacts of waste disposal into important water bodies and trans-boundary waters while runoff harvesting and sub-surface dams are critical in dry season emergency storage. Rain water harvesting initiatives offers new opportunities for income generation activities including small-scale irrigation, zero grazing, light industry, soil and water conservation for higher yielding varieties in agricultural produce, fruit farming and fast growing trees for domestic use and development of tree nurseries, bee-keeping and sustainable sand harvesting. Water has an economic value in all its competing uses and should be recognized for its social values and its economic good. Its development and management should therefore be based on a participatory approach involving users, planners and policy makers at all levels and recognizing that women play a central role in its provision, management and safe handling.

According to Pushand (2013), there are several rain water storage options depending on rainwater supply, demand, projected length of dry spells without rain, catchment surface area, aesthetics, personal preference and budget. The available options are fiberglass tanks, polythene, in ground polyethylene, wood tank, galvanized sheet metal tanks, concrete tanks, ferrocement tank, stone or mason tanks and plastered tire cisterns. The engineering measures adopted differ with location, slope of the land, soil type, amount and intensity of rainfall.

2.5 Ecological Factors and their influence on adoption of rain water

Goyal (2005), a sufficient, clean drinking water supply is essential to life but millions of people throughout the world do not have access to this basic necessity. Even after the intensive efforts of engineers, planners, builders, governmental and Non Governmental Organizations (NGOs) to bring potable water to the poorer people of the world, the situation is still dire. This is because of cost, climate, technology, hydrology, social and political reasons. Goyal (2005) further reported that the sustainability of the watershed project depends on the ecological and technical parameters like construction of water harvesting structures, soil and water conservation measures. Similarly, the economic parameters are like the benefits to the masses in comparison to the cost in terms of water and irrigation security, food security, fodder security and ensured employment through agriculture. But the major contribution is from peopleÕs participation or social sustainability of the project. If peoplesô participation is achieved it can lead to better implementation of the project, growth of the project and maintenance of the created infrastructures on sustainable basis. This study will focus at the following ecological aspects namely water sources and water supply, soils and water harvesting catchments and storage structures.

2.5.1 Rainfall and water supply

According to Erickson (2012), among the eco-climatic conditions, rainfall quantity and pattern are the most important factors. Rainfall quantity is the most unpredictable variable in the calculation. Hence reliable rainfall data for a period of at least ten years is considered to calculate the potential rainfall supply for a given catchment. The rainfall data from the nearest stations with comparable conditions are preferably considered. Rainfall pattern or the number of annual rainy days influences the need and design for rainwater harvesting. The need for the collection of rainwater in a region is more if the dry period is long or the annual rainy days are fewer. Big storage tanks would be needed to store rainwater if the dry period is too long. In such regions using rainwater to recharge groundwater aquifers is a better alternative than storing it.

According to Xiaoyan and Ruiling (2002), Water is the major limiting factor for farming, forestry and animal husbandry and it is the key factor for environmental improvement. Limited and erratic precipitation often results in crop failure as well as serious soil and water loss but rainfall harvesting can change the distribution pattern of rainfall runoff in time and space, which would supply humankind with steady water sources to some extent. Rainwater harvesting would provide the possibilities of setting up new agricultural ecological system and whereby improve ecological environments. However Hartung (2002), stated that water is life. Yet millions of people throughout the world lack enough of this basic commodity for their hygiene and/or have no good quality water for drinking and preparing food. In many families both women and men also need water for animals, vegetables, crops and trees. Where groundwater and surface water sources are in short supply, rainwater may be a sustainable alternative or supplement.

Sharda and Ojasvi (2005),the gap between water supply and demands necessitates harnessing of available water resources with efficient water conservation and management techniques. It has been amply demonstrated that participatory water resource development in watershed management programmes has significantly increased food grain and biomass production and resulted in moderation of floods, mitigation of droughts, augmentation of water ground recharge, employment generation and improvement of socio-economic conditions of the local people. The water harvesting practices include in-situ water conservation, micro-catchments, and ex-situ water harvesting and storage systems. Rainwater harvesting technologies are highly location specific and practices evolved in a given agro-ecological region have limited applicability in other regions. Of the various factors affecting water harvesting technology, rainfall is most important parameter due to its erratic temporal and spatial variations. The water harvesting practices in various parts of the country can, therefore, be best described based on agro-ecological regions which are having homogeneity in bio-physical attributes of soil, climate, topography and land uses.

2.5.2 Soils and water harvesting

According to Sivanappa (2007), water is essential for all life and is used for food production, drinking and domestic uses and industrial use. It is also part of the larger ecosystem on which bio diversity depends. Precipitation, converted to soil and groundwater and thus accessible to vegetation and people, is the dominant pre-condition for biomass production and social development in dry lands. The amount of available water is equivalent to the water moving through the landscape.

It also fluctuates between the wet and dry periods. Fresh water scarcity is not limited to the arid climatic regions only since even in areas with good supply, the access to safe water is becoming a critical problem. Lack of water is caused by low water storage capacity, low infiltration capacity, large inter-annual and annual fluctuations of precipitation and high evaporative demand. During good rainy years, excess rainwater should be stored in the soil and also underground using suitable soil moisture conservation measures and water harvesting structures on a watershed basis. This stored water can subsequently be used for irrigation.

According to Anschutz (2003), the type of the soil depends on the structure (how sticky is the soil) and texture (size of the soil particles) of the soil. There are three types of the soil depending on soil texture namely sand, clay and loam soil. Water infiltration is higher on sandy soils. Water retention is high on the loam soil followed by the clay soil which has the highest retention rate.

2.6 Social Economic factors and their influence on adoption of rain water harvesting

Goyal (2005),reported that economic parameters are like the benefits to the masses in comparison to the cost in terms of water and irrigation security, food security, fodder security and ensured employment through agriculture. But the major contribution is from peopleôs participation or social sustainability of the project. If peoplesô participation is achieved it can lead to better implementation of the project, growth of the project and maintenance of the created infrastructures on sustainable basis.

According to Cheserek (2013), the socio-economic factors influencing farmersô decisions to adopt rain water harvesting techniques were categorized in household variables (gender, education and age) and economic variables (wealth status, access to credit, social status and household membersô perception). All the factors have different effects on the adoption rate of the rain water harvesting techniques. The important role of financial, human and land resources endowment of a household is very vital in the decision of the household on whether to adopt any newly introduced agricultural techniques. Cheserek (2013) further observed that rich farmers are most enthusiastic in adopting rain water harvesting technology than poor farmers. In addition most the rich household invest in the costly concrete lined ponds and concert lined circular ponds. This is because the financial bequest of the rich and middle income households motivates them to take credit and invest in the Rain water harvesting technology. However, the poor households preferred either not to adopt the Rain water harvesting techniques or adopt the less expensive ones.

Pani (2004) reported that water harvesting improves agriculture, forest covers, animal husbandry and the ecology. It also resolves many social issues and enhances the people's capacities to assess the situation and examine possibilities for addressing drought more constructively and organize themselves into groups to tackle the problem collectively. It will put a check on protests, demonstrations, road-blockades, riots of city dwellers against farmers, villages against towns, towns against cities, citizens against the government, and people against people.

2.6.1 Capital

According to Wanjohi (2013), most countries were hopeful that opportunities provided by strengthened democratic governance, and improving economies will accelerate progress. However, poverty levels still remain high. On becoming a republic in 1964, Kenyan leaders vowed to eradicate poverty, disease and illiteracy. Today the proportion of the population living on less than one US dollar a day, that is the poverty line, is higher than ever before.

According to Murgor (2013), one of the potential limitations to farmers in adopting modern technologies and inputs is the financial related problems such as cost of hired labour is too high, transportation cost is high for agricultural products, cost of construction material is high and lack of credit access or shortage of capital. It is difficult to increase agricultural sector productivity without efficient credit facility, given the fact that the majority of farmers are resource-poor.

According to Stanford (2010), the capital cost of rainwater harvesting systems is highly dependent on the type of catchment, conveyance and storage tank materials used. Compared to deep and shallow tube wells, rainwater collection systems are more cost effective, especially if the initial investment does not include the cost of roofing materials. However, Raja (2012), reported that the associated cost of rain water harvesting system are for installation, operation and maintenance. Of the costs installation, the storage tanks represent the largest investment which can vary between 30 and 45% of the total cost of the system dependent on a system size. A pump, a pressure controller and fittings in addition to plumberôs labor represent other major costs of the investment.

2.6.2 Income generation

UEnd Foundation (2010) reported that water harvesting provides water to homesteads for irrigation purposes. This improved irrigation will lead to better crop yield, increasing household food security and enabling households to generate greater income from agricultural business ventures that are currently in place. According to Gitau (2012),water is an essential commodity to plants and animals alike. More than often, water has been equated to life and thus life on planet earth is depended on it. Water is needed in all spheres of life and that is why from the beginning of human civilization people have always settled close to water sources. Despite its immense importance, many people especially in the rural areas do not yet have access to safe, reliable and convenient sources of water (Wanyoni, 2002).Kenya has been classified as a water scarce country according to a World Health Organization report released in 2005.

Only 48 percent of the country͡s rural population has access to an improved drinking water source. The time spent in pursuit of water collection often prevents people, particularly women, from concentrating on income generating activities, or in the case of school going children, leads to poor school attendance and performance. Due to the water scarcity in the rural areas, waterborne diseases are not uncommon. Furthermore, during the times of drought, hundreds of people die of starvation unless they get some food aid. This sobering situation has definitely reduced the country͡s national development progress.

Rainwater harvesting will improve water supply, food production, and ultimately food security. Since rainwater harvesting leads to water supply which leads to food security, this will greatly contribute to income generation.

2.6.3 Labour

According to Anschutz (2003), the major cost of water harvesting scheme are in the earth and stone work. The quantity of digging of drains, collection and transport of stones, maintenance of the structures will provide an indication of the costs of the scheme. Usually these labour requirements are high. Most water harvesting structures are dug in the dry season and farmers are engaged in other activities like cattle herding or wage labour on plantations or in urban areas. Labour requirements depend very much on power sources available. The choice of the equipments depends on power sources available. In small scale systems labour is mostly carried out using hand tools. Drought animals like oxen, donkeys and horses can be used for ridging and bed making. Simple ridging equipment exist which may be drawn by animals for instance mould board ridgers.

According to Ibraimo and Munguambe (2007), despite the effectiveness of some water conservation techniques, adoption by farmers has been poor mainly because of several factors among them high labour intensity. To address these challenges, there is a need of a more efficient capture and use of the scarce water resources in arid and semi-arid areas. An optimization of the rainfall management, through water harvesting in sustainable and integrated production systems can result in improved livelihood of the small-scale farmersô through improved rain fed agriculture production.

2.7 Training and extension services and their influence on adoption on rain water harvesting

According to Ministry of Agriculture, Livestock and Fisheries (2003), extension in Kenya has evolved from supply driven (necessary for awareness creation) to demand driven. Extension has become more complex with many informed players in the sector. It involves providing leadership, technical staff capacity building, facilitating and managing uptake and adoption of appropriate agricultural technologies for improved agricultural productivity, food security and incomes.

According to Prackash, (2011), the rain water harvesting training offers instructions on the concept and technology of rainwater harvesting for domestic use and how it fits into the overall picture of appropriate rural and urban water supply linking the relevancy to the context of the existing situation. The topics which are covered includes water optimization, common rainwater harvesting systems, selection of appropriate rainwater harvesting technology, storing methods, contaminants in rain water harvesting system, treatment, maintenance and cleaning supply and the basic construction, installation, operation and maintenance of roof top and surface catchments including exercise on calculating harvestable roof rain water, recent technologies and innovative techniques to fit them into current applications. The training should also include teachings on the household water optimization alternatives, social, economic and environmental considerations regarding rain water harvesting practices. A proper understanding of these elements is essential for the correct application of household rainwater harvesting systems. The training should also introduced the global impact of clean water, hygiene and sanitation and linkage of climate change and changing rainfall pattern on implementing rainwater harvesting as reliable alternative water.

2.7.1 Training and extension service providers

According to Agriculture Research Centre (2008), the problem is that farmers and communities do not have the knowledge or the means to implement suitable techniques in the appropriate way. In addition it is necessary that some be tested under current conditions. The capacity of the communities and the national research program and extension services needs enhancement in the area of water harvesting. Conditions are now suitable for mobilizing human and financial resources for improving the situation under appropriate physical and socioeconomic environments. Success achieved in water harvesting implementation in similar areas encourages adoption of these approaches at large scale in this area. According to Kariuki (2003), the promotion of rain water harvesting technologies is done through Government ministries, communities, individuals, development partners, institutions of research and higher learning, NGOs, CBOs and private companies.

2.8 Factors hindering to adoption of rain water harvesting technologies

According to Roger (2003), the innovation decision process involve different stages namely knowledge, persuasion, decision making, implementation, confirmation and adoption.

At the decision Stage, a person makes the choice to reject or adopt the technology. This personal process involves the weighing of advantages, disadvantages, costs, benefits, and trade-offs.

The process of adoption over time is typically illustrated as a classical normal distribution or bell curve. The model indicates that the first group of people to use a new product is innovators, followed by early adopters, then early and late majority, and finally laggards. The graph below shows technology adoption lifecycle model Figure 1.

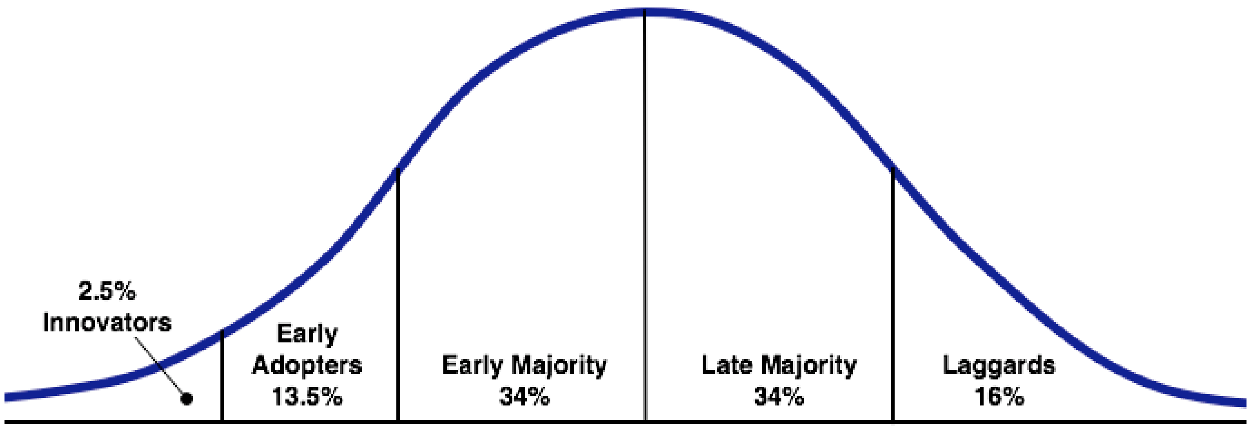

Figure 1. A graph of Everett Rogers Technology Adoption Lifecycle model

According to Hans (1989), research studies have been ineffective because in most cases researchers fail to build on the practice and experience of the people and the households whose problems they were to address. Thus not fully incorporating the enormous amount of human capital embedded in traditional water harvesting and storage skills. These make research recommendations that were inconsistent with traditional water harvesting and storage practices to be rejected by traditional people who had knowledge and experience of the region.

Heidhues et. al, (2004) said that many African governments have not shown adequate political will and commitment to successfully push through programmes of water harvesting and storage for self reliance and food security.

Even where these objectives had been nominally declared, they have not been translated into programmes and budgetary priorities. Policies have been inconsistent, un-harmonized and discontinuous.

International Fund for Agricultural Development (2012) indicated that there has been neglect of irrigated agriculture, especially of the small and medium scale type, through which Africaôs dependence on rain fed agriculture could be reduced, thereby promoting increased African food production in the process.

2.9 Theoretical frame work

The study heavily relies on the diffusion of innovations theory. Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures.

2.9.1 Diffusion of innovations theory

Everett Roger popularized the theory in his book Diffusion of Innovations (1962). According to Roger, diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. The book espouses the theory that there are four main elements that influence the spread of a new idea: the innovation, communication channels, time, and a social system. Roger's work asserts that 4 main elements influence the spread of a new idea: the innovation, communication channels, time, and a social system.

These elements work in conjunction with one another: diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Rogers adds that central to this theory is process. Individuals experience 5 stages of accepting a new innovation: knowledge, persuasion, decision, implementation, and confirmation. The theoretical basis in regard to this study is that an innovation (new technology) after being communicated to households is adopted and hence householdsô production improves and hence food security status improves. The study has independent variables which include water harvesting technologies, ecological factors, social economic factors and; training and extension services.

The study has adoption of water harvesting technologies as dependent variable (Figure 2). After adoption of rain water harvesting and storage technologies there will be water harvesting structures, adequate water for domestic and irrigation, improved food production and improved standard of living**.** The moderating and intervening variables also influence water harvesting technologies directly or indirectly. That is indirectly by affecting the implementation of water harvesting technologies and consequently contributing positively or negative to improvement of households.

2.10 Conceptual Framework

According to Bogdan and Biklen (2003), a conceptual framework is a basic structure that consists of certain abstract blocks which represent the observational, the experiential and the analytical or synthetically aspects of a process or system being conceived. The interconnection of these blocks completes the framework for certain expected outcomes.
An independent variable is that variable which is presumed to affect or determine a dependent variable. It can be changed as required, and its values do not represent a problem requiring explanation in an analysis, but are taken simply as given (Florian, 2006).

The independent variables in this study are: Ecological factors influencing adoption of water harvesting and storage technologies in Mbeere South Sub-County, Social economic factors influencing adoption of water harvesting and storage technologies, training and extension services influencing adoption of water harvesting and storage technologies and stakeholder support services influencing adoption of water harvesting and storage technologies. A dependent variable is what is measured in the experiment and what is affected during the experiment. The dependent variable responds to the independent variable. The dependent variable in this study is adoption of water harvesting and storage technologies in Mbeere South Sub County. The conceptual framework of the study is shown in Figure 2.

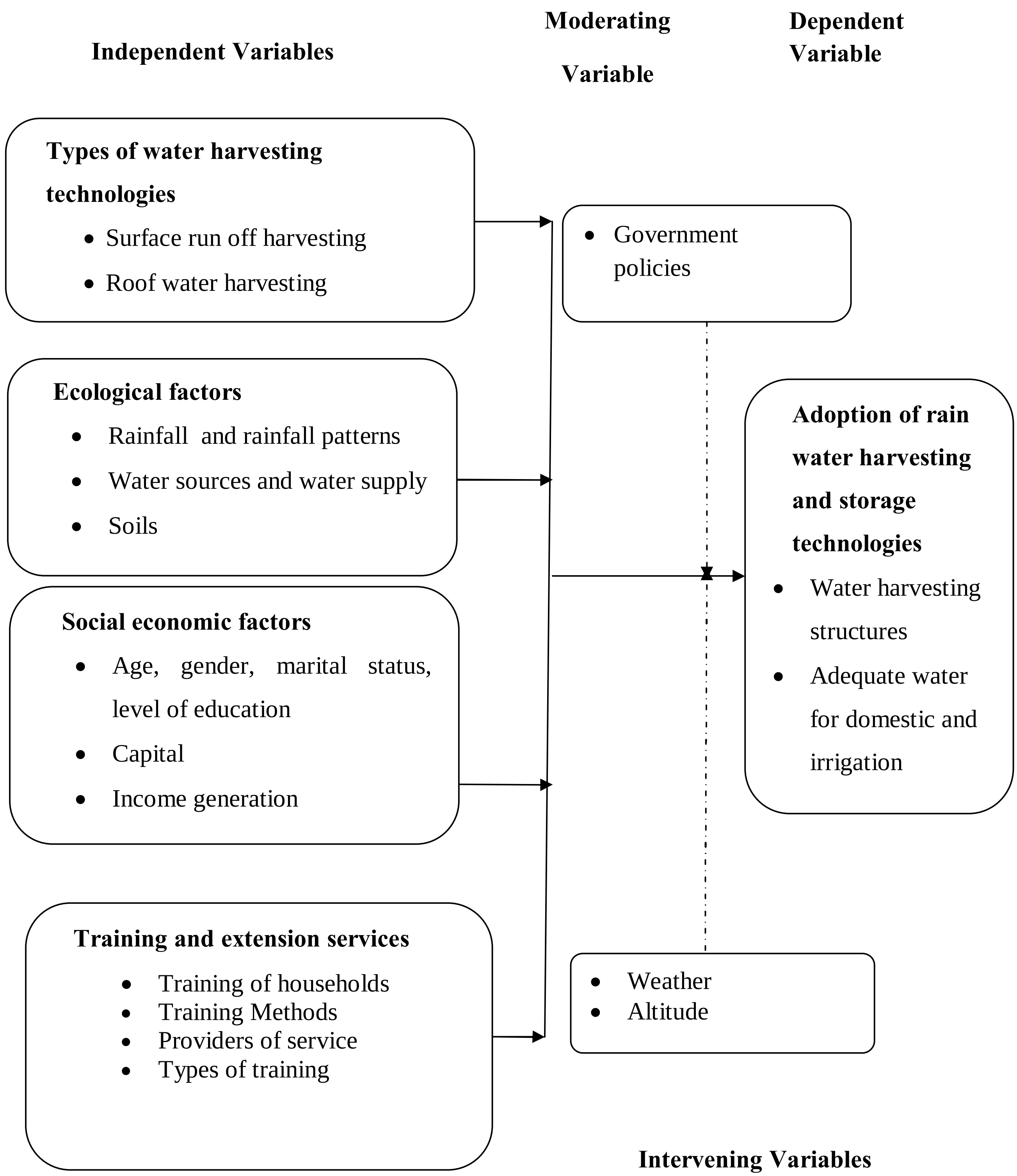

Figure 2: Conceptual Framework

2.11 Knowledge Gap

Many families and professionals now endorse the adoption of rain water harvesting and storage technologies in households for food security.

According to Nega and Kimeu (2002) Rainwater harvesting is one solution to the problems of water shortage in the drier areas of Africa, but its implementation presents a number of challenges, of which storage is the main one. Many people in rural areas who would like to harvest rainwater lack the resources to do so. Conventional stone, brick or ferrocement tanks are costly, and therefore there is a great need for cheaper alternatives.

The study reflects on ecological factors; Social economic factors; training and extension services and stakeholder support services influencing adoption of water harvesting and storage technologies in Mbeere South Sub County. The study has not considered about the influence of other government departments activities on adoption of rain water harvesting and storage technologies hence creating a gap for further study.

Thereôs therefore the need to carry out further research on the influence of other government departments on the adoption of rain water harvesting and storage technologies.

2.12 Summary of the chapter

The literature review of this study shows that the adoption of rain water harvesting and storage technologies in households will play a great role in contributing to the achievement of Millennium Development Goals with a view to eradicating poverty and hunger, providing safe drinking water, promoting gender equity and empowerment of women.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology which was used in order to find answers to the research questions. The chapter gives research design, target population, sampling technique and sample size, data collection methods, instruments of data collection, reliability and validity of the data collection instruments. Finally the data analysis procedure is presented in the chapter and ethical considerations.

3.2 Research Design

Data was collected using a descriptive survey design. The design was used because it looks at the phenomena, events and issues the way they are (Mugenda and Mugenda, 2003).The design also identified factors which influenced adoption of rain harvesting technologies in Mbeere South Sub-county. The design was used because it examined the problem at hand thoroughly to define it, clarify it and obtain pertinent information that can be of use to stakeholders in special education The design was able to accommodate large sample sizes and it is good in generalization of the results. It is also easy to administer and record answers in this design.

3.3 Target Population of the Study

The study focused on all the 30,036 households in Mbeere South Sub-County.

Table 3.1: Target Population

Sub County	Ward	Population	Number of Households
Mbeere South	Mwea	30,177	6959
	Makima	21,291	4910
	Mbeti South	29,579	6823
	Mavuria	34,139	7872
	Kiambere	15,059	3472
Total		130,245	30,036

Source: Mbeere South Sub-County Provincial Administration Report 2012

3.4 Sample size and sampling procedures

According to Yamane (1967), a total of 30,036 households required a sample was used in this study resulting to 204 households (appendix 4). The study used stratified sampling and proportionate sampling. This included 47 households from Mwea ward, 33 from Makima ward, 46 from Mbeti South ward, 53 Mavuria ward and 25 from Kiambeere ward.

In total, 204 respondents filled questionnaires as shown in Table 3.1. The Study used stratified sampling since five wards were covered. Proportionate sampling was used because each ward was allocated a sample of households depending on its proportion to the total number of respondents. Proportionate sampling enabled the researcher to achieve greater representativeness in the sample of the population. This was accomplished by selecting individuals at random from subgroups (stratified random sampling) in proportion to the actual size of the group in the total population (Van Dalen, 1979).

Table 3.2 Sample size from Mbeere South Sub-County

Sub County	Ward	Population	Number of Households	Sample size
Mbeere South	Mwea	30,177	6959	47
	Makima	21,291	4910	33
	Mbeti South	29,579	6823	46
	Mavuria	34,139	7872	53
	Kiambere	15,059	3472	25
Total		130,245	30,036	204

Source: Mbeere South Sub-County Provincial Administration Report, 2012

3.5 Data Collection Instruments

Data was collected using questionnaires with open and closed ended questions. Questionnaires are cheap to administer with the help of an interpreter to respondents who are scattered over a large area. It is convenient for collecting information from a large population within a short span of time. The structured questions were used in an effort to conserve time and money as well as to facilitate in easier analysis as they were in immediate usable form; while the unstructured questions were used to encourage the respondent to give an in-depth and felt response without feeling held back in revealing of any information.

3.6 Validity of Instruments

Validity is the accuracy, soundness or effectiveness with which an instrument measures what it is intended to measure.

In this study, the instruments was first discussed between the researcher and the supervisors who provided their expertise and ensured that the instruments measured what they intended to measure as recommended by Kumar (2005).This was further ascertained by a panel of extension experts or scientists drawn from Nairobi University. The experts ensured that the items and concepts represented were adequate and covered relevant issues under investigation and complied with recommendations of Mugenda and Mugenda (2008).

3.7 Reliability of Instruments

This research study used test-retest method which involved administering the same scale or measure to the same group of respondents at two separate times. This was after a time lapse of one week. A pilot study was conducted in the Sub County. Ten households practicing roof water harvesting were picked randomly for the pilot study. Test re-test method was used to test for reliability of the instrument. The instruments were administered to the respondents and be re-administered to the same respondents after one week. This was in line with (Shuttleworth, 2009), who stated that the instrument should be administered at two different times and then the correlation between the two sets of scores were computed using Pearsons Product-Moment correlation coefficient Formula and a correlation coefficient of 0.8 was got and therefore the instrument were deemed to be reliable and measurable.

3.8 Data Analysis techniques

The questionnaires were edited for the purpose of checking completeness, clarity and consistency in answering research questions. The data was coded, tabulated and analyzed using Statistical Package for Social Sciences and MS Excel based on study objectives. Descriptive statistics was computed and study findings presented using mean, percentages and tables and interpretations made.

3.9 Ethical considerations

All respondents were treated with courtesy and respect in order to avoid misunderstanding between the enumerators and respondents and they were informed of the purpose of the study. Each respondent was politely requested to fill the questionnaire and was assured of confidentiality with regard to any information they will provide.

3.10 Operational definition of variables

The operational definition of variables is given in Table 3.3.

Table 3.3: Operational definition of variables

Objectives	**Type of Variable independent**	**Indicator(s)**	**Measure(s)**	**Measurement scale**	**Tools of analysis**	**Type of analysis**
To identify the types of water harvesting technologies in Mbeere South Sub-County	Water harvesting technologies	Water pans	Number of water pans	Ratio	Percentages Means	Descriptive
		Dams	Number of dams	Ratio	Percentages Means	Descriptive
		Roof catchment	Type of roof houses	Ratio	Percentages Means	Descriptive
	Types	Plastic tanks, Metals, stones jericans, others	Quantity in litres of water storage containers	Ratio	Percentages Means	Descriptive

To assess the influence of ecological factors on adoption rain water harvesting and storage among households in Mbeere South Sub County	Ecological Factors	Rainfall	Volume of water harvested in Litres			Descriptive
		Water sources	Distance from nearest water source	Ratio	Percentages Means	Descriptive
		Soils	Type of soils	Ratio	Percentages Means	Descripti ve
		Trees	Type of trees indigenou s exotic or both	Ratio	Percentages means	Descriptive
To assess the influence of social economic factors on adoption of rain water harvesting and storage among households.	Social economic factors	Capital	Amount of money used in purchasing or constructin g of water harvesting structure	Ratio	Percentages Means	Descriptive
		Household income	Amount of money saved from purchase of water through water harvesting and storage	Ratio	Percentages Means	Descriptive
		Labour	Number of hours used in fetching water			Descriptive
To determine how training and extension services influence adoption of rain water	Training and extension services	Trainings	Number of trainings held per year	Ratio	Percentage s Means	Descriptive
			Number of persons trained	Ratio		Descriptive

harvesting and storage among households.						
			Providers of services	Ratio	Percentages	Descriptive
			Nature of Service providers	Ratio	Percentages Means	Descriptive
	Dependent Variable	**Indicators**	**Measures**	**Measurement scale**	**Tools of analysis**	**Type of analysis**
	Adoption Rain water harvesting and storage among households	Water harvesting structures Adequate water for domestic and irrigation Improved food production	Number of water harvesting structures Amount of water in litres harvested Amount of food crop produced in kilogrammes from irrigated area	Ratio	Percentages Means	Descriptive

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter contains data analysis, presentation and interpretation of findings. The factors influencing adoption of rain water harvesting technologies among households in Mbeere South Sub-County, Kenya were investigated in the study. The chapter contains results and interpretation of the study under the following headings: questionnaire return rate, factors namely types of water harvesting technologies, ecological factors, social economic factors and training and extension services influencing adoption of rain water harvesting technologies among households.

4.2 Questionnaire Return Rate

The questionnaire return rate was 200 (98%), as 204 questionnaires were used. This was possible since the questionnaires were administered by trained research assistants who administered questionnaires, waited for the respondent to complete and collect immediately. The return rate was above 90% which was deemed adequate for the analysis as cited by Mugenda and Mugenda (2003).

4.3 Demographic Characteristics of the respondents

This section discusses the respondentôs gender, head of household, age, marital status, size of household and highest academic education. These social attributes were relevant to the study since they enabled the respondent to provide information that is valid, reliable and relevant to the study.

4.3.1 Distribution of the respondents by gender

The respondents from Mbeere South Sub-County who were practicing rain water harvesting technologies were asked to indicate their gender. The responses are shown in Table 4.1.

Table 4.1 Distribution of gender of the respondents

Gender of respondent	Frequency	Percentage
Male	133	66.5
Female	67	33.5
Total	**200**	**100.0**

Table 4.1. shows that 133 (66.5%) respondents were males who were more than 67 (33.5%) respondents who were females. This shows that majority were males and therefore suitable in undertaking water harvesting technologies activities which require energy and effective decision making.

4.3.2 Respondents by household head

The respondents were asked to indicate whether they were household head. The respondents responses are shown in Table 4.2

Table 4.2 Whether the respondent is a household head

Household heads	Frequency	Percentage
Yes	156	78.0
No	44	22.0
Total	**200**	**100.0**

Table 4.2 shows that 156 (78%) respondents were household heads while 44 (22%) respondents were not household head. Household heads are able to make independent decisions concerning implementation of water harvesting technologies.

4.3.3 The age distribution of the respondents

The respondents were asked to indicate their ages from among choices of age classes given. The respondentsô responses are shown in Table 4.3

Table 4.3 The Age distribution of respondents

Age of respondents in years	Frequency	Percentage
Below 35	31	15.5
36-45	110	55.0
46-55	40	20.0
56-65	11	5.5
Above 65	8	4.0
Total	**200**	**100.0**

Table 4.3 shows that 31 (15.5%) respondents are below 35 years in age, 110 (55%) respondents are in age bracket of 36-45 years while 40 (20%) respondents are between 46-55 years. This indicates that majority of the respondents are in their middle age and therefore suitable in undertaking water harvesting technologies activities which require energy and effective decision making.

4.3.4 Marital status of the respondents.

The respondents were asked to indicate their marital status. Table 4.4 shows the distribution of the respondents by marital status.

Table 4.4 Marital status of the respondents

Marital status	Frequency	Percentage
Married	175	87.5
Single	18	9.0
Divorced	5	2.5
Widow	2	1.0
Total	**200**	**100.0**

Table 4.4. shows that 175 (87.5%) respondents were married and 18 (9.0%) respondents were singles. Marriage ascribes familial responsibilities to students and therefore takes education more serious.

4.3.5 Size of your household or family of the respondents.

The respondents were asked to indicate the size of the household or family of the respondents. Table 4.5 shows the size of the household.

Table 4.5 Size of your household

Size of your household	Frequency	Percentage
Below 3	11	5.5
3-5	138	69.0
6-8	37	18.5
over 8	7	3.5
5.00	7	3.5
Total	**200**	**100.0**

Table 4.5 shows that 138 (69.0%) respondents had 3-5 household members while 37 (18.5%) respondents had 6-8 household members. Household members helped in the construction of water harvesting structures and implementation of water harvesting technologies.

4.3.6 Highest academic qualification of the respondents.

The respondents were asked to indicate their highest academic qualification of the respondents. Table 4.6 shows the responses.

Table 4.6 Highest academic qualification

Highest academic qualification	Frequency	Percentage
Primary	53	26.5
Secondary	139	69.5
Tertiary	3	1.5
University	5	2.5
Total	**200**	**100.0**

Table 4.6 shows that majority of the respondents 139 (69.5%) respondents had attained secondary education while 53 (26.5%) respondents had attained primary level of education. This indicates that majority of the respondents are literate and therefore could undertake water harvesting technologies.

4.4 Influence of water harvesting technologies on adoption of rain water harvesting among households

4.4.1 The respondents proof of practice of roof water harvesting

The respondents were requested to indicate whether they practice roof water harvesting. Table 4.7 shows the responses.

Table 4.7 Whether the respondents practice roof water harvesting

Whether practice roof water harvesting	Frequency	Percentage
Yes	172	86.0
No	28	14.0
Total	**200**	**100.0**

Table 4.7 shows that 172 (86 %) respondents practice roof water harvesting while 28 (14%) respondents do not practice roof water harvesting. Roof water harvesting enables the respondents to conserve water for domestic and irrigation use. The respondents were asked to indicate the volume of water held in your water storage containers. Table 4.8 shows the responses

4.4.2 Volume of water held in water storage containers

The respondents were asked to indicate the volume of water held in your water storage containers. Table 4.8 shows the responses

Table 4.8 Volume of water held in water storage containers

Volume of water	Frequency	Percentage
Less than 100litres	63	31.5
100-500litres	91	45.5
501-1000litres	31	15.5
1001-5000litres	8	4.0
More than 5000litres	3	1.5
Not applicable	4	2.0
Total	**200**	**100.0**

Table 4.8 shows that of 91 (45.5%) respondents stored 100-500 litres in water storage containers while 63 (31.5%) respondents stored less than 100 litres in water storage containers. Stored water enables the respondents to conserve water for domestic and irrigation use.

4.4.3 Type of house roof and the adoption of rain water harvesting

The respondents were asked to indicate the type of house roof and Table 4.9 shows the results.

Table 4.9 Type of house roof and the adoption of rain water harvesting

Type of house roof	Frequency	Percentage
Iron sheets	187	93.5
Tiles	13	6.5
Total	**200**	**100.0**

Table 4.9 shows that 187 (93.7 %) respondents had their houses roofed with iron sheets while 13 (6.5%) respondents had houses roofed with tiles. The roof tops helped in collecting water for use for domestic and irrigation services.

4.4.4 Size of your house and the adoption of rain water harvesting

The respondents were asked to indicate the size of their houses. Table 4.10 shows the responses.

Table 4.10 Size of your house and the adoption of rain water harvesting

Size of your house	Frequency	Percentage
One bedroom	84	42.0
Two bedroom	76	38.0
Three bedroom	30	15.0
Others	10	5.0
Total	**200**	**100.0**

Table 4.10 shows that 84 (42%) respondents indicated that they had one bed roomed houses while 76 (38.0%) respondents had two bed roomed houses.

4.4.5 Surface of runoff water harvesting

The respondents were requested to indicate their position held in the institution. Table 4.11 shows the position held in the institution.

Table 4.11 Surface of runoff water harvesting

Surface of runoff water harvesting	Frequency	Percentage
Yes	67	33.5
No	133	66.5
Total	**200**	**100.0**

Table 4.11 showed that 67 (33.5 %) respondents carryout service runoff harvesting while 133 (66.5%) respondents do not carryout service runoff harvesting. Therefore majority of respondent need to be taught on service runoff harvesting.

4.4.6 Volume of water harvested

The respondents were asked to indicate the volume of water harvested.

Table 4.12 shows the responses

Table 4.12 Volume of water harvested

Volume of water harvested	Frequency	Percentage
Less than 400litres	62	31.0
401-1000litres	67	33.5
1001s-5000litre	40	20.0
5001-10,000litres	20	10.0
More than 10000litres	7	3.5
Not applicable	4	2.0
Total	**200**	**100.0**

Table 4.12 showed that 67 (33.5 %) respondents harvested 401-1000litres while 62 (31 %) respondents harvested less than 400litres. This harvested is used for domestic and irrigation purposes. It saves the time which would otherwise be used in fetching water. The saved time can be used in constructive and profitable work.

4.4.7 Do you own water pan

The respondents were asked to indicate whether they own water pan. Table 4.13 shows the results.

Table 4.13 Whether the respondents own water pan

Whether own water pan	Frequency	Percentage
Yes	83	41.5
No	117	58.5
Total	**200**	**100.0**

Table 4.13 showed that 83 (41.5%) respondents owned water pans while 117 (58.5%) respondents do not own any water pans.

4.4.8 Number of water pans and volume

The respondents were asked to indicate the number of water pans and volume of water harvested. Table 4.14 shows the responses.

Table 4.14 Number of water pans and volume

Number of water pans and volume	Frequency	Percentage
0 water pans o litres	117	58.5
1 water pan 0-500litres	64	32.0
2 water pan 5000-10000litres	13	6.5
3 water pan 10000-15000litres	6	3.0
Total	**200**	**100.0**

Table 4.14 showed that 117 (58.5%) respondents had no water pans while 64 (32.0%) respondents had one water pan of 500 litres and 13 (6.5%) respondents had two water pans of 5000-10000litres.

4.5 Influence of ecological factors on adoption of rain water harvesting among households

Ecological factors influence adoption of rain water harvesting among households.

4.5.1 Pattern of rainfall received

The respondents were asked to indicate the pattern of rainfall received. Table 4.15 shows the responses.

Table 4.15 Pattern of rainfall received

Pattern of rainfall received	Frequency	Percentage
Evenly distributed	43	21.5
Bimodal in nature	120	60.0
Unimodal	34	17.0
Any other	3	1.5
Total	**200**	**100.0**

Table 4.15 showed that 120 (60.0%) respondents indicated that their area receive bimodal rainfall while 34 (17%) respondents receive unimodal rainfall. The water received need to conserve for domestic and irrigation use.

4.5.2 Whether rainfall adequate in provision of domestic water

The respondents were requested to indicate whether rainfall adequate in provision of domestic water. Table 4.16 shows the responses.

Table 4.16 Whether rainfall adequate in provision of domestic water

Whether rainfall adequate in provision of domestic water	Frequency	Percentage
Yes	34	17.0
No	166	83.0
Total	**200**	**100.0**

Table 4.16 showed that 166 (83.0 %) respondents indicated that the rainfall received is not adequate in the provision of domestic water. This implies that the rainfall received need to be conserved for domestic use or irrigation.

4.5.3 Source of extra water

The respondents were asked to indicate the source of extra water. Table 4.17 shows the responses

Table 4.17 source of extra water

How long the position was held	Frequency	Percentage
Piped water	74	37.0
Roof water harvesting	108	54.0
Run off harvesting	14	7.0
Not applicable	4	2.0
Total	**200**	**100.0**

Table 4.17 showed that of 108 (54%) respondents indicated that they received extra source of water from roof water harvesting while 74 (37 %) respondents from tapped water. This implies that roof water harvesting is very important in this area.

4.5.4 Dominant soil type

The respondents were asked to indicate the dominant soil type in their farm. Table 4.18 shows the results.

Table 4.18 Dominant soil type

Dominant soil type	Frequency	Percentage
sandy soil	78	39.0
clay soil	49	24.5
loam soil	72	36.0
any other type	1	.5
Total	**200**	**100.0**

The findings show that 78 (39 %) respondents had sandy soils in their farm, 49 (24.5%) respondents had clay soils and 72 (36%) respondents had loam soils.

Sandy soils has higher percolation rate and in such areas water containers are required. Clay soils has low percolation rate and in these areas construction of waterpans and dams is recommended.

4.5.5 The number of water pans and volume

The respondents were asked to indicate whether they practice irrigation in their farm. Table 4.19 Shows the responses.

Table 4.19 Do you practice irrigation in your farm

Do you practice irrigation in your farm	Frequency	Percentage
Yes	87	43.5
No	113	56.5
Total	**200**	**100.0**

Table 4.19 showed 87 (43.5%) respondents indicated that they practice irrigation in their farm. Irrigation of crops enable crop production when there is no rainfall.

4.5.6 Crops grown through irrigation

The respondents were asked to indicate the crops grown through irrigation.

Table 4.20 shows the responses.

Table 4.20 Crops grown through irrigation

Crops grown through irrigation	Frequency	Percentage
Miraa	37	18.5
Beans	34	17.0
Coffee	18	9.0
Tomatoes	19	9.5
Not applicable	92	46.0
Total	**200**	**100.0**

Table 4.20, shows that 37 (18.5%) respondents indicated that they grow miraa through irrigation, 34 (17%) respondents indicated that they grow beans while 19 (9.5%) respondents indicated that they grow tomatoes using irrigation. Irrigation enables farmers to grow crops during dry period.

4.5.7 How water get in to farm area

The respondents were requested to indicate how water get in to farm area. Table 4.21 shows the responses.

Table 4.21 How water get in to farm area

How water get in to farm area	Frequency	Percentage
Gravity	77	38.5
Pumping	63	31.5
Others	60	30.0
Total	**200**	**100.0**

Table 4.21 shows that 77 (38.5 %) respondents get water to the farm area through gravity and 63 (31.5%) respondents get water to the farm area through pumping. Water flowing through gravity require very low cost to implement.

4.5.8 Are equipments required for pan or dam construction available

The respondents were asked to indicate whether the equipments required for pan or dam construction available. Table 4.22 shows the responses.

Table 4.22 Are equipments required for pan or dam construction available

Are equipments required for pan or dam construction available	**Frequency**	**Percentage**
Yes	129	64.5
No	71	35.5
Total	**200**	**100.0**

Table 4.22 shows that of 129 (64.5%) respondents indicated that the equipments required for pan or dam construction are available while 71 (35.5%) respondents indicated that the equipments required for pan or dam construction are not available.

4.5.9 Do you plant trees in your farm

The respondents were asked to indicate whether they plant trees in their farm and Table 4.23 Shows the results.

Table 4.23 Do you plant trees in your farm

Do you plant trees in your farm	**Frequency**	**Percentage**
Yes	165	82.5
No	35	17.5
Total	**200**	**100.0**

Table 4.23 shows that 165 (82.5%) respondents had planted trees in their farms while 35 (17.5%) respondents had not planted trees in their farms.

4.5.10 Type of trees planted

The respondents were asked to indicate the type of trees they planted. Table 4.24 shows the responses.

Table 4.24 Type of trees planted

Type of trees planted	Frequency	Percentage
Exotic	49	24.5
Indigenous	87	43.5
Both	29	14.5
Not applicable	35	17.5
Total	**200**	**100.0**

Table 4.24 shows that 87 (43.5%) respondents indicated that the type of trees planted are indigenous in type, 49 (24.5%) respondents indicated that they have planted exotic trees while 29 (14.5%) respondents indicated that they planted both indigenous and exotic types.

4.5.11 Frequency of planting trees

The respondents were asked to indicate their frequency of planting trees. Table 4.25 shows the responses.

Table 4.25 Frequency of planting trees

Frequency of planting trees	Frequency	Percentage
Once a year	57	28.5
Twice a year	61	30.5
Thrice a year	47	23.5
Not applicable	35	17.5
Total	**200**	**100.0**

Table 4.25 shows that 61 (30.5%) respondents indicated that they plant trees twice a year, 57 (28.5%) respondents plant trees once a year while 47 (23.5%)respondents indicated that they plant trees thrice per year.

4.6 Influence of social economic factors on adoption of rain water harvesting among households

4.6.1 How respondents raise funds

The respondents were requested to indicate how they raise funds. Table 4.26 shows how respondents raise funds.

Table 4.26 How you raise funds

How you raise funds	Frequency	Percentage
Own money	111	55.5
Bank loan	44	22.0
Cooperative society loan	18	9.0
Government support	27	13.5
Total	**200**	**100.0**

Table 4.26 shows that 111 (55.5 %) respondents raise funds for water harvesting activities from their own money (savings), 44 (22%) respondents raise funds for water harvesting activities from bank loan, 27 (13.5%)respondent from Government support and 18 (9%) respondent from cooperative society loan.

4.6.2 How much money spent in water harvesting

The respondents were asked to indicate how much money was spent in water harvesting. Table 4.27 shows the responses

Table 4.27 How much money spent in water harvesting

How much money spent in water harvesting	Frequency	Percentage
Less than 1000 shillings	50	25.0
1001-3000	52	26.0
3001-5000	35	17.5
More than 5000	30	15.0
5.00	33	16.5
Total	**200**	**100.0**

Table 4.27 shows that of 52 (26.0 %) respondents indicated that they spent Kshs.1001-3000 while 30 (15 %) respondents spent more than Kshs. 5000.

4.6.3 Percentage of farming as a source of income

The respondents were asked to indicate the percentage of farming as a source of income and Table 4.28 shows the results.

Table 4.28 Percentage of farming as a source of income

Percentage of farming as a source of income	Frequency	Percentage
Less than 10%	19	9.5
10-30%	52	26.0
31-50%	62	31.0
51-80%	66	33
More than 80%	1	0.5
Total	**200**	**100.0**

Table 4.28 shows that 66 (33 %) respondents indicated that the percentage of farming as a source of income was 51-80% while 62 (31%) respondents indicated that the percentage of farming as a source of income was 31-50%. This shows that farming is the major source of income in the study area.

4.6.4 Who does rain water harvesting activity in your household

The respondents were asked to indicate the one who does rain water harvesting activity in the household. Table 4.29 shows the responses.

Table 4.29 Do you practice irrigation in your farm

Do you practice irrigation in your farm	Frequency	Percentage
Myself	90	45.0
My family assist me	67	33.5
Employee	43	21.5
Total	**200**	**100.0**

Table 4.29 shows 90 (45%) respondents indicated that they practice irrigation in their farm themselves, 67 (33.5%) respondents indicated that they are assisted by their family to practice irrigation in their farm themselves while 43 (21.5%) respondents indicated that they are assisted by employees.

4.6.5 Ownership in land tenure

The respondents were asked to indicate ownership in land. Table 4.30 shows the responses.

Table 4.30 Ownership in land

Ownership in land	Frequency	Percentage
Freehold	4	2.0
Family land	137	68.5
Leasehold	3	1.5
Own land	56	28.0
Total	**200**	**100.0**

Table 4.30 shows that 137 (68.5%) respondents indicated that the land is family land while 56 (28%) respondents indicated that they practice water harvesting in their own land. Using their land make them make independent decisions.

4.6.6 Amount of distance to the nearest watering point or river

The respondents were requested to indicate the amount of distance to the nearest watering point or river. Table 4.31 shows the amount of distance to the nearest watering point or river.

Table 4.31 Distance to the nearest watering point or river

Distance to the nearest watering point or river	Frequency	Percentage
Less than 50m	108	54.0
Family land 51-100m	74	37.0
101-500m	17	8.5
More than 500m	1	.5
Total	**200**	**100.0**

Table 4.31 shows that 108(54 %) respondents indicated that the distance from the watering point was less than 50 meters while 74 (37%) respondents indicated that the distance from the watering point was less than 51-100 meters walking long distances to fetch water waste a lot of time which could be used in constructive work.

4.6.7 Factors influencing adoption of water harvesting technologies

The respondents were asked to indicate factors influencing adoption of water harvesting technologies. Table 4.32 shows the responses

Table 4.32 Factors influencing adoption of water harvesting technologies

Aspect	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Adoption can make contribution to poverty alleviation	**98**	**49**	**81**	**40.5**	**19**	**9.5**	**2**	**1.0**	**0**	**0**
adoption improve household	**62**	**31.0**	**81**	**40.5**	**29**	**14.5**	**15**	**7.5**	**13**	**6.5**

food supply adoption boosts rural economic development	**62**	**31**	**83**	**41.5**	**35**	**17.5**	**12**	**6**	**8**	**4.0**
Mean	**74**	**37**	**82**	**41**	**28**	**14**	**10**	**5**	**7**	**3.5**

Table 4.32 shows that 98(49%) respondents strongly agreed that adoption of water harvesting technologies can make contribution to poverty alleviation, 61(50.4%) respondents agreed that adoption of water harvesting technologies improve household food supply and 83(41.5%) respondents agreed that adoption of water harvesting technologies boosts rural economic development. On average 74(37%) respondents strongly agreed on all aspects.

4.7 Influence of training and extension on adoption of rain water harvesting among households

4.7.1 Method of training

The respondents were asked to indicate their method of training. Their responses are in shown in Table 4.33.

Table 4.33 Method of training

Method of training	Frequency	Percentage
Demonstration	59	29.5
Workshop/seminar	51	25.5
Other	2	1.0
Not applicable	88	44.0
Total	**200**	**100.0**

Table 4.33 shows that 59 (29.5%) respondents indicated that demonstration is the method used in training while 51 (25.5%) respondents indicated that workshop and seminars are the method used in training.

4.7.2 Number of trainings received in the year 2013

The respondents were asked to indicate the number of trainings received last year (2013).Their responses are in table 4.34.

Table 4.34 Number of trainings received in 2013

Number of trainings received last year (2013)	Frequency	Percentage
0.00	87	43.5
1-3	60	30.0
4-6	43	21.5
7-9	10	5.0
Total	**200**	**100.0**

Table 4.34, 60 (30%) respondents indicated that the number of trainings received last year were 1-3 trainings while 43 (21.5%) respondents indicated that the number of trainings received in 2013 were 4-6 trainings.

4.7.3 Adoption of water harvesting technologies

The respondents were asked to indicate the adoption of water harvesting technologies. Their responses are in Table 4.35.

Table 4.35 Adoption of water harvesting technologies

Aspect	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Do ministry offer extension services	68	34	68	34	29	14.5	30	15.0	5	2.5
Government policies in place for water harvesting technologies	99	49.5	80	40.0	21	10.5	0	0	0	0
Ministry staff have adequate skills in implementing water technologies	92	45	81	40.5	11	5.5	16	8.0	0	0
Government initiatives aimed at adoption of water harvesting technologies	51	25.5	95	47.5	47	23.5	7	3.5	0	0
Mean	65	32.5	57	28.5	15	7.5	11	5.5	1	0.5

Table 4.35 shows that 68 (34%) respondents strongly agreed that Ministry of water offers extension services, 99 (49.5%) respondents strongly agreed that there are government policies in place for water harvesting technologies, 92 (45%) respondents strongly agreed that Ministry staff have adequate skills in implementing water technologies and 95 (47.5%) respondents agreed that there are government initiatives aimed at adoption of water harvesting. On average 65 (32.5%) respondents strongly agreed on all aspects.

4.7.4 Problems encountered when adopting water harvesting technologies

The respondents were asked to indicate the problems encountered when adopting water harvesting technologies. Their responses are in Table 4.36.

Table 4.36 Problems encountered when adopting water harvesting technologies

Problems encountered when adopting water harvesting technologies	Frequency	Percentage
Lack of capital outlay	119	59.5
Lack of skill	71	35.5
Insecurity	10	5.0
Total	**200**	**100.0**

Table 4.36 shows that 119 (59.5%) respondents indicated that lack of capital outlay is the main problem encountered when implementing water harvesting technologies while 71 (35.5%) respondents indicated that lack of skill is the main problem encountered when implementing water harvesting technologies.

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CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the summary of findings of the study which formed the foundation for discussions. The discussions provides a firm basis upon which conclusions and recommendations were advanced in order to address factors influencing adoption of rain water harvesting technologies among households in Mbeere South Sub-County, Kenya. It also includes with suggested areas for further research and contributions made to the body of knowledge.

5.2 Summary of Findings

The summary of findings is presented following the four objectives of the study.
The summary of the findings of on the first objective which was to establish the types of water harvesting technologies in Mbeere South Sub-County.

The findings revealed that 172 (86 %) respondents practice roof water harvesting. Roof water harvesting enables the respondents to conserve water for domestic and irrigation use. The study also showed that of 91 (45.5%) respondents stored 100-500 litres in water storage containers while the others stored less than 100 litres in water storage containers. Stored water enables the respondents to conserve water for domestic and irrigation use. The findings show that 187 (93.7%) respondents had their houses roofed with iron sheets while the other respondents had houses roofed with tiles. The roofed tops help in collecting water for use for domestic and irrigation services. From the study, 84 (42%) respondents indicated that they had one bed roomed houses while 76 (38.0%) respondents had two bed roomed houses. The study showed that 67 (33.5 %) respondents carryout service runoff harvesting while 133 (66.5%) respondents do not carry out service runoff harvesting. The majority need to be taught on service runoff harvesting. The study showed that 67 (33.5 %) respondents harvested 401-1000 litres while the others respondents harvested less than 400 litres.

The water harvested is used for domestic and irrigation purposes. It saves the time which would otherwise be used in fetching water. The saved time can be used in constructive and profitable work. The findings show that 83 (41.5%) respondents own water pans while 117 (58.5%) respondents do not own any water pans. From the study, 117 (58.5%) respondents had no water pans while 64 (32.0%) respondents had one water pan of 500 litres and 13 (6.5%) respondents had two water pans of 5000-10000 litres.

The summary of the findings on objective two which was to establish the influence of ecological factors on adoption rain water harvesting among households of the Mbeere South Sub County.

Ecological factors influence adoption of rain water harvesting among households.

From the study, 120 (60.0%) respondents indicated that their area receive bimodal rainfall while other respondents receive unimodal rainfall. The water received need to conserve for domestic and irrigation use. The study showed that 166 (83.0 %) respondents indicated that the rainfall received is not adequate in the provision of domestic water. This implies that the rainfall received need to be conserved for domestic use or irrigation. The study also showed that of 108 (54%) respondents indicated that they received extra source of water from roof water harvesting while 74 (37 %) respondents from tapped water. This implies that roof water harvesting is very important in this area. The findings show that 78 (39 %) respondents had sandy soils in their farm, 49 (24.5%) respondents had clay soils and 72 (36%) respondents had loam soils. Sandy soils has higher percolation rate and in such areas water containers are required. Clay soils has low percolation rate and in these areas construction of water pans and dams is recommended. From the study, 87 (43.5%) respondents indicated that they practice irrigation in their farm. Irrigation of crops enables crop production when there is no rainfall.

The findings of the study further revealed that 37 (18.5%) respondents indicated that they grow Miraa through irrigation, 34 (17%) respondents indicated that they grow beans while 19 (9.5%) respondents indicated that they grow tomatoes using irrigation. Irrigation enables farmers to grow crops during dry period.

The study also revealed that 77 (38.5 %) respondents get water to the farm area through gravity and 63 (31.5%) respondents get water to the farm area through pumping. Water flowing through gravity require very low cost to implement. 129 (64.5%) respondents indicated that the equipments required for pan or dam construction are available while 71 (35.5%) respondents indicated that the equipments required for pan or dam construction are not available. The findings show that 165 (82.5%) respondents had planted trees in their farms while the other respondents had not planted trees in their farms. From the study, 87 (43.5%) respondents indicated that the type of trees planted are indigenous in type, 49 (24.5%) respondents indicated that they have planted exotic trees while 29 (14.5%) respondents indicated that they planted both indigenous and exotic types. The study, 61 (30.5%) respondents indicated that they plant trees twice a year, 57 (28.5%) respondents plant trees once a year while 47 (23.5%) respondents indicated that they plant trees thrice per year.

The summary of the findings on objective three which was to establish the influence of social economic factors on adoption of rain water harvesting among households of the Mbeere South Sub-County. 111 (55.5%) respondents raise funds for water harvesting activities from their own money (savings), 44 (22%) respondents raise funds for water harvesting activities from bank loan, 27 (13.5%) respondents from Government support and 18 (9%) respondents from cooperative society loan. The findings revealed that 66 (33%) respondents indicated that the percentage of farming as a source of income was 51-80% while 62 (31%) respondents indicated that the percentage of farming as a source of income was 31-50%. This shows that farming is the major source of income in the study area. From the study, 90 (45%) respondents indicated that they practice irrigation in their farm themselves, 67 (33.5%) respondents indicated that they are assisted by their family to practice irrigation in their farm themselves while 43 (21.5%) respondents indicated that they are assisted by employees. From the study, 137 (68.5%) respondents indicated that the land is family land while 56 (28%) respondents indicated that they practice water harvesting in their own land. Using their land make them make independent decisions.

108 (54%) respondents indicated that the distance from the watering point was less than 50M while 74 (37%) respondents indicated that the distance from the watering point was less than 51-100M walking long distances to fetch water waste a lot of time which could be used in constructive work. 98 respondents (49%) strongly agreed that adoption of water harvesting technologies can make contribution to poverty alleviation, 61 (50.4%) respondents agreed that adoption of water harvesting technologies improve household food supply and 83 (41.5%) respondents agreed that adoption of water harvesting technologies boosts rural economic development. On average 74 (37%) respondents strongly agreed on all aspects.

The summary of the findings on objective four which was to establish how training and extension services influence adoption of rain water harvesting among households of the Mbeere South Sub-County.

59 (29.5%) respondents indicated that demonstration is the method used in training while 51 (25.5%) respondents indicated that workshop and seminars are the method used in training. From the study, 60 (30%) respondents indicated that the number of trainings received last year (2013) were 1-3 trainings while 43 (21.5%) respondents indicated that the number of trainings received in year (2013) were 4-6 trainings.

The findings indicated that 68 (34%) respondents strongly agreed that Ministry offer extension services, 99 (49.5%) respondents strongly agreed that there are government policies in place for water harvesting technologies, 92 (45%) respondents strongly agreed that Ministry staff have adequate skills in implementing water technologies and 95 (47.5%) respondents agreed that there are government initiatives aimed at adoption of water harvesting. On average 65 (32.5%) respondents strongly agreed on all aspects. From the study, 119 (59.5%) respondents indicated that lack of capital outlay is the main problem encountered when implementing water harvesting technologies while 71 (35.5%) respondents indicated that lack of skill is the main problem encountered when implementing water harvesting technologies.

5.3 Discussion of Findings

A discussion of the findings on the four objectives of the study is presented below.

5.3.1 Influence water harvesting technologies on adoption rain water harvesting among households

172 (86%) respondents practice roof water harvesting. Roof water harvesting enables the respondents to conserve water for domestic and irrigation use. This agrees with Hugger (2013) who reported that the Rainwater collected from the roofs of houses, tents and local institutions make an important contribution to the availability of drinking water.

The study also revealed that of 91 (45.5%) respondentsô stored 100-500 litres in water storage containers while the others respondents stored less than 100 litres in water storage containers. Stored water enables the respondents to conserve water for domestic and irrigation use. This agrees with Ngigi (2001) who stated that rainwater may be harvested from roofs, ground surfaces as well as from intermittent or ephemeral watercourses and be stored in plastic water tanks and be used for productive purposes like crop, fodder, pasture or trees production, livestock and domestic water supply. The study is also supported by Fengrui et al, (2000), who reported that rainwater harvesting provide farmers in water-limiting environments with access to the water needed to meet domestic and agricultural water needs.

The findings of the study revealed that 187 (93.7 %) respondents had their houses roofed with iron sheets while the other respondents had houses roofed with tiles. The roofed tops help in collecting water for use for domestic and irrigation services or purely for other purposes. This collaborates study by Skinner and Cotton (1992) some rooftop materials may produce rainwater that is harmful to human health, it can be useful in flushing toilets, washing clothes, watering the garden and washing cars and therefore these uses alone halve the amount of water used by a typical home. From the study, 84 (42%) respondents indicated that they had one bed roomed houses while 76 (38.0%) respondents had two bed roomed houses.

67(33.5%) respondents carryout service runoff harvesting while the other respondents do not carry out service runoff harvesting. Therefore majority need to be taught on service runoff harvesting. This agrees with Fengrui et al, (2000) who said that there is a need to provide training and extension services to farmers, to develop and disseminate more effective and affordable types of rain harvesting and storage technologies as alternatives and to design and develop alternative policy instruments and social institutions that facilitate adoption of Rain harvesting and storage practices. 67(33.5%) respondents harvested 401-1000 litres. This water harvested is used for domestic and irrigation purposes. This is supported by Peterson (2011) who reported that, rain water harvesting systems in the absence of reliable potable water supplies is undoubtedly the best option for supplementing water supplies and is an important option for water resource development especially in ASAL areas where surface and ground water resources are limited. Water is collected from roofs, ground and rock surfaces and stored in pans, rock catchment dams, sand dams, subsurface dams and in tanks.

83 (41.5%) respondents own water pans, 64 (32.0%) respondents had one water pan of 500 litres and 13 (6.5%) respondents had two water pans of 5000-10000litres. This water pans increase agricultural production. This collaborates study by Worm (2006), who stated that although for subsistence, technological advances in irrigation offers some hope for increasing agricultural production and shall continue to play a vital role in the Millennium Development Goals (MDGs) in terms of health, livelihood, environmental conservation and economic growth for the rural poor.

5.3.2 Influence of ecological factors on adoption rain water harvesting among households

From the study, 120 (60.0%) respondents indicated that their area receive bimodal rainfall while 166 (83.0%) respondents indicated that the rainfall received is not adequate in the provision of domestic water. This implies that the rainfall received need to be conserved for domestic use or irrigation. This is supported by Erickson (2012) who reported rainfall pattern or the number of annual rainy days influences the need and design for rainwater harvesting. The need for the collection of rainwater in a region is more if the dry period is long or the annual rainy days are fewer. Big storage tanks would be needed to store rainwater if the dry period is too long. The study also agrees with Xiaoyan and Ruiling (2002), water is the major limiting factor for farming, forestry and animal husbandry and it is the key factor for environmental improvement. Limited and erratic precipitation often results in crop failure as well as serious soil and water loss but rainfall harvesting can change the distribution pattern of rainfall runoff in time and space, which would supply humankind with steady water sources to some extent. Rainwater harvesting would provide the possibilities of setting up new agricultural ecological system and whereby improve ecological environments.

108(54%) respondents indicated that they received extra source of water from roof water harvesting while 74(37%) respondents from tapped water. This implies that roof water harvesting is very important in this area since it conserves water and control vices like soil erosion and flooding. This agrees with Sharda and Ojasvi(2005) who reported that the gap between water supply and demands necessitates harnessing of available water resources with efficient water conservation and management techniques. It has been amply demonstrated that participatory water resource development in watershed management programmes has significantly increased food grain and biomass production and resulted in moderation of floods, mitigation of droughts, augmentation of water ground recharge, employment generation and improvement of socio-economic conditions of the local people.

78(39%) respondents had sandy soils in their farm, 49 (24.5%) respondents had clay soils and 72 (36%) respondents had loam soils. Sandy soils has higher percolation rate and in such areas water containers are required. Clay soils has low percolation rate and in these areas construction of water pans and dams is recommended. This agrees with Anschutz (2003) who said that the type of the soil depends on the structure (how sticky is the soil) and texture (size of the soil particles) of the soil. There are three types of the soil depending on soil texture namely sand, clay and loam soil. Water infiltration is higher on sandy soils. Water retention is high on the loam soil followed by the clay soil which has the highest retention rate.

The study revealed, 87 (43.5%) respondents indicated that they practice irrigation in their farm. Irrigation of crops enables crop production when there is no rainfall. From the study, 37(18.5%) respondents indicated that they grow miraa through irrigation, 34 (17%) respondents indicated that they grow beans while 19 (9.5%) respondents indicated that they grow tomatoes using irrigation. Irrigation enables farmers to grow crops during dry period. This agrees with Kariuki (2003) who stated that rain water harvesting initiatives offers new opportunities for income generation activities including small-scale irrigation, zero grazing, light industry, soil and water conservation for higher yielding varieties in agricultural produce, fruit farming and fast growing trees for domestic use and development of tree nurseries, bee-keeping and sustainable sand harvesting. Water has an economic value in all its competing uses and should be recognized for its social values and its economic good. 77(38.5%) respondents get water to the farm area through gravity and 63 (31.5%) respondents get water to the farm area through pumping. Water flowing through gravity require very low cost to implement. The study also revealed that of 129(64.5%) respondents indicated that the equipments required for pan or dam construction are available. This agrees with rain water partnership secretariat (2005) who reported that rainwater harvesting is a simple and low cost supply technology that has been practiced for thousands of years. The study also reviewed that 165 (82.5%) respondents had planted trees in their farms while the other respondents had not planted trees in their farms. 87 (43.5%) respondents indicated that the type of trees planted are indigenous in type, 49 (24.5%) respondents indicated that they have planted exotic trees while 29 (14.5%) respondents indicated that they planted both indigenous and exotic types. This is supported by Sivanappa (2007) who stated that water is essential for all life and is used for food production, drinking and domestic uses and industrial use. It is also part of the larger ecosystem on which bio diversity depends. Precipitation, converted to soil and groundwater and thus accessible to vegetation and people, is the dominant pre-condition for biomass production and social development in dry lands.

5.3.3 Influence of social economic factors on adoption of rain water harvesting among households

111(55.5%) respondents raise funds for water harvesting activities from their own money (savings), 44 (22%) respondents raise funds for water harvesting activities from bank loan, 27 (13.5%) respondents from Government support and 18 (9%) respondents from cooperative society loan. The ability to raise funds influences adoption of water harvesting technologies. This collaborates study by Cheserek (2013) who stated that socio-economic factors influencing farmersô decisions to adopt rain water harvesting techniques were categorized in household variables (gender, education and age) and economic variables (wealth status, access to credit, social status and household membersô perception). All the factors have different effects on the adoption rate of the rain water harvesting techniques.

90 (45%) respondents indicated that they practice irrigation in their farm themselves, 67 (33.5%) respondents indicated that they are assisted by their family to practice irrigation in their farm themselves while 43 (21.5%) respondents indicated that they are assisted by employees. Labour availability influence adoption of water harvesting technologies. This agrees with Ibraimo and Munguambe (2007) who reported that despite the effectiveness of some water conservation techniques, adoption by farmers has been poor mainly because of several factors among them high labour intensity.

The study is further supported by Anschutz (2003) who reported that the major cost of water harvesting scheme are in the earth and stone work. The quantity of digging of drains, collection and transport of stones, maintenance of the structures will provide an indication of the costs of the scheme. Usually these labour requirements are high. In small scale systems labour is mostly carried out using hand tools. Drought animals like oxen, donkeys and horses can be used for ridging and bed making. 137(68.5%) respondents indicated that the land is family land while 56 (28%) respondents indicated that they practice water harvesting in their own land. Using their land make them make independent decisions.

98 (49%) respondents strongly agreed that adoption of water harvesting technologies can make contribution to poverty alleviation and 61(50.4 %) respondents agreed that adoption of water harvesting technologies improve household food supply. This agrees with Uend Foundation (2010) who reported that improved irrigation leads to better crop yield, increasing household food security and enabling households to generate greater income from agricultural business ventures that are currently in place. 83 (41.5 %) respondents agreed that adoption of water harvesting technologies boosts rural economic development. This is supported by Pani (2004) who reported that water harvesting improves agriculture, forest covers, animal husbandry and the ecology. It also resolves many social issues and enhances the people's capacities to assess the situation and examine possibilities for addressing drought more constructively and organize themselves into groups to tackle the problem collectively. It will put a check on protests, demonstrations, road-blockades, riots of city dwellers against farmers, villages against towns, towns against cities, citizens against the government, and people against people.

5.3.4 Influence of training and extension services on adoption of rain water harvesting.

59 (29.5%) respondents indicated that demonstration is the main method used in training. 60 (30%) respondents indicated that the number of trainings received last year (2013) were 1-3 trainings while 43 (21.5%) respondents indicated that the number of trainings received last year (2013) were 4-6 trainings. This is supported by Prackash, (2011) who reported that rain water harvesting training offers instructions on the concept and technology of rainwater harvesting for domestic use. The topics which are covered includes water optimization, common rainwater harvesting systems, selection of appropriate rainwater harvesting technology, storing methods, contaminants in rain water harvesting system, treatment, maintenance and cleaning supply and the basic construction, installation, operation and maintenance of roof top and surface catchments including exercise on calculating harvestable roof rain water, recent technologies and innovative techniques to fit them into current applications.

The training should also include teachings on the household water optimization alternatives, social, economic and environmental considerations regarding rain water harvesting practices. The method of training should be effective like carrying out of demonstrations.

68(34%) respondents strongly agreed that Ministry offer extension services, 99 (49.5%) respondents strongly agreed that there are government policies in place for water harvesting technologies, 92 (45%) respondents strongly agreed that Ministry staff have adequate skills in implementing water technologies and 95 (47.5%) respondents agreed that there are government initiatives aimed at adoption of water harvesting. This is supported by Ministry of Agriculture, Livestock and Fisheries (2003) who reported that extension in Kenya has evolved from supply driven (necessary for awareness creation) to demand driven. Extension has become more complex with many informed players in the sector. It involves providing leadership, technical staff capacity building, facilitating and managing uptake and adoption of appropriate agricultural technologies for improved agricultural productivity, food security and incomes. 119 (59.5%) respondents indicated that lack of capital outlay is the main problem encountered when implementing water harvesting technologies. This agrees with Murgor (2013) who reported that one of the potential limitations to farmers in adopting modern technologies and inputs is the financial related problems such as cost of hired labour is too high, transportation cost is high for agricultural products, cost of construction material is high and lack of credit access or shortage of capital. It is difficult to increase agricultural sector productivity without efficient credit facility, given the fact that the majority of farmers are resource-poor.

5.4 Conclusions

The four factors influencing adoption of rain water harvesting technologies are of great influence among the households in Mbeere South Sub County. They impact greatly on social economic aspects of the households, the ecological aspects and greatly reduce the poverty levels of the households. If the water harvesting technologies are adopted this would reduce the time wasted when looking for water and create home for more economic issues.

Rainwater collected from the roofs of houses, tents and local institutions make an important contribution to the availability of drinking water and for productive purposes like crop, fodder, pasture or trees production, livestock and other domestic water supply.

Labour availability influence adoption of water harvesting technologies. Drought animals like oxen, donkeys and horses can be used for ridging and bed making. Adoption of water harvesting technologies make contribution to poverty alleviation, improve household food supply, increasing household food security and generate greater income from a The training should also include teachings on the household water optimization alternatives, social, economic and environmental considerations regarding rain water harvesting practices. The Ministry offer extension services, has policies in place for water harvesting technologies, Ministry staff have adequate skills in implementing water technologies and the government has initiatives aimed at adoption of water harvesting. Agricultural business ventures.

5.5 Recommendations

The following policy recommendations were made from the findings of the study

1. Rainwater collected from the roofs of houses, tents and local institutions make an important contribution to the availability of drinking water.
2. The rainfall received should be conserved for domestic use or irrigation. The rainfall pattern or the number of annual rainy days influences the need and design for rainwater harvesting. The need for the collection of rainwater in a region is more if the dry period is long or the annual rainy days are fewer.
3. Labour availability influence adoption of water harvesting technologies. Therefore, source of labour must be identified before embarking on implementation of roof water harvesting technologies.
4. There is a need to provide training and extension services to farmers, to develop and disseminate more effective and affordable types of rain harvesting and storage technologies as alternatives and to design and develop alternative policy

instruments and social institutions that facilitate adoption of Rain harvesting and storage practices.

5.6 Suggested areas for further Research

The following areas are suggested for further studies from the results of this study

1. A research on the factors influencing adoption of rain water harvesting technologies among households in other parts of the Country should be carried out.
2. A study to establish the most appropriate water harvesting technology in Mbeere South Sub County, Embu County should be done.
3. A study to find out viable income generating activities which can be supported by rain water harvested in Mbeere South Sub County, Embu-County should be carried out.

5.7 Contribution to the body of knowledge

Objective	Contribution to knowledge
To establish the types of water harvesting technologies in Mbeere South Sub County	The study showed that 172 (86%) respondents practice roof water harvesting. Roof water harvesting enables the respondents to conserve water for domestic and irrigation use. Rainwater collected from the roofs of houses, tents and local institutions make an important contribution to the availability of drinking water and for productive purposes like crop, fodder, pasture or trees production, livestock and other domestic water supply.
To establish the influence of ecological factors on adoption rain water harvesting among households of the Mbeere South Sub County.	From the study, 120 (60.0%) respondents indicated that their area receive bimodal rainfall while 166 (83.0 %) respondents indicated that the rainfall received is not adequate in the provision of domestic water. This implies that the rainfall received need to be conserved for domestic use or for irrigation. The rainfall pattern or the number of annual rainy days influences the need and design for rainwater harvesting. The need for the collection of rainwater in a region is more if the dry period is long or the annual rainy days are fewer. Big storage tanks would be needed to store rainwater if the dry period is too long.

To establish the influence of social economic factors on adoption of rain water harvesting among households of the Mbeere South Sub County.	The study showed that 111 (55.5%) respondents raise funds for water harvesting activities from their own money (savings), 44 (22%) respondents raise funds for water harvesting activities from bank loan, 27 (13.5%) respondents from Government support and 18 (9%) respondents from cooperative society loan. The ability to raise funds influences adoption of water harvesting technologies. Labour availability influence adoption of water harvesting technologies. Drought animals like oxen, donkeys and horses can be used for ridging and bed making. Adoption of water harvesting technologies make contribution to poverty alleviation, improve household food supply, increasing household food security and generate greater income from agricultural business ventures.
To establish how training and extension services influence adoption of rain water harvesting among households of the Mbeere South Sub County	From the study, 59 (29.5%) respondents indicated that demonstration is the main method used in training. The topics which need to covered during training includes water optimization, common rainwater harvesting systems, selection of appropriate rainwater harvesting technology, storing methods, contaminants in rain water harvesting system, treatment, maintenance and cleaning supply and the basic construction, installation, operation and maintenance of roof top and surface catchments including exercise on calculating harvestable roof rain water, recent technologies and innovative techniques to fit them into current applications. The training should also include teachings on the household water optimization alternatives, social, economic and environmental considerations regarding rain water harvesting practices. The Ministry offer extension services, has policies in place for water harvesting technologies, Ministry staff have adequate skills in implementing water technologies and the government has initiatives aimed at adoption of water harvesting.

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APPENDICES

APPENDIX 1: Authority Letter to Carry out Research Work

P.O. BOX 1204

Embu.

The Deputy County Commissioner

Mbeere Sub County

P.O. Box 36

Embu.

Dear Sir/Madam,

RE: PERMISSION TO CARRY OUT ACADEMIC RESEARCH

I am a graduate student undertaking a Master of Arts Degree in Project Planning and Management in the University of Nairobi and I am conducting a research study entitled ñFactors influencing adoption of rain water harvesting technologies among households in Mbeere South Sub-County.ò

The purpose of this letter is to request for permission to interview households using the attached questionnaire copies. The information obtained is strictly for academic purpose and shall be treated with utmost confidentiality.

Thank You,

Yours faithfully,

ERIC MBOGO

L50/82344/2012

APPENDIX 2: Letter Requesting Respondents to fill Questionnaire

P.O. Box 1204
Embu.

Dear Sir/Madam,

I am a graduate student undertaking a Master of Arts Degree in Project Planning and Management at the University of Nairobi. I am conducting a research study entitled ñ ñFactors influencing adoption of rain water harvesting technologies among households in Mbeere South Sub-County.ò You have been selected to assist in providing the required information because your views are considered important to this study.

I am therefore kindly requesting you to fill this questionnaire. Please note that any information given will be treated with utmost confidentiality and will only be used for the purpose of this study.

Thank You.

Yours faithfully,

ERIC MBOGO
L50/82344/2012

APPENDIX 3: Research Questionnaire for Household Heads

Instructions

The purpose of this questionnaire is to obtain information on adoption of Rain Water Harvesting Technologies (RWHT).

Please fill the relevant boxes and blank spaces.

Section A: Background Information

1. Please indicate your gender?

(a) Male [ ] (b) Female [ ]

2. Are you the head of the household?

(a) Yes [ ] (b) No [ ]

3. Please indicate your age.

(a) Below 35 [ ] (b) 36 ï 45 [ ] (c) 46 ï 55 [ ] (d) 56 ï 65 [ ] (e) above 65 [ ]

4. Please indicate your marital status?

(a) Married [ ] (b) Single [ ] (c) Divorced [ ] (e) Widow [ ] (f) Widower [ ]

5. What is the size of your household/family?

(a) Below 3 [ ] (b) 3-5[ ] (c) 6-8 [ ] (d) Over 8 [ ]

6. Please indicate your highest academic qualification?

(a) Primary [ ] (b) Secondary [ ] (c) Tertiary [ ] (d) University [ ]

(e) Others (specify)

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Section B: Water Harvesting Technologies

7. Do you practice roof water harvesting?

(a) Yes [ ] (b) No [ ]

If the answer is yes in question (7), please indicate the volume of water in litres which can be held by your water storage containers

(a) Less than 100lires [ ] (b) 100-500 litres [ ] (c) 501-1000litres [ ] (e) 1001-5000litres [ ] (f) more than 5000litres [ ]

8. What is the type of roof of the house?

(a) Iron sheets [ ] (b) shrubs [ ] (c) grass [ ]

9. Please indicate the size of your house?

(a) One bedroom [ ] (b) Two bedroom [ ] (c) Three bedroom [ ] (e) Others [ ]

10 . Do you practice surface runoff water harvesting?

(a) Yes [ ] (b) No [ ]

If the answer is yes in question (9), please indicate the volume of water you harvest per year from surface run off harvesting in M3

(a) Less than 400 litres [ ] (b) 401-1000 litres [ ] (c) 1001 -5000 litres [ ] (e) 5001-1000 litres [ ] (f) more than 10,000litres [ ]

11. Do you own a water pan/ water pans?

(a) Yes [ ] (b) No [ ]

If yes in question (8) please indicate the number and total volume in litres

é é .water pans and ofé é litres.

Section C: Ecological Factors

12. Please indicate the pattern of rainfall received in your area?

(a) Evenly distributed [ ] (b) bimodal in nature [ ] (c) Uni modal [ ] (e) Any other please specifyé é é é é é é é ..

13 (a) In your own opinion, is the rainfall adequate in provision of domestic water?

(a) Yes [ ] (b) No [ ]

(b). If the answer is No, please indicate the source of extra water

(a)Piped water [ ] (b) Roof water harvesting [ ] (c) Run off harvesting [ ]

(d) Any other, please specifyé é é é é é . [

14. Please indicate the dominant soil type in your farm.

(a)Sandy soil [ ] (b) Clay soil [ ] (c) Loam soil [ ] (d) Any other type (please specify)é é é é é é é é é é ..

15. (a)Do you practice irrigation in your farm?

(a) Yes [ ] (b) No [ ]

(b) Please indicate the two main crops you grow using irrigation

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c. How does water get in to the farming area?

(a) Gravity [ ] (b) Pumping [ ] (c) Others é é é é é é é é é é é é é é é é é ...

16. Are the equipments required for pan/dam construction available in your area?

(a)Yes [ ] (b) No [ ]

17. Do you plant trees in your area?

(a)Yes [ ] (b) No [ ]

b) Please indicate the type.

(a) Exotic [ ] (b) indigenous [ ] (c) both [ ]

18. What is the frequency of planting the trees?

(a) Once a year [ ] (b) Twice a year [ ] (c) Thrice a year [ ]

C: Social Economic Factors

19. How did you raise money to start your water harvesting?

(a)Own money [ ] (b) Bank loan [ ] (c) Co-operative society loan [ ]

(d)Government Support [ ] (e) others (please specify)é é é é é é é é é é é

20. How much money did you spend in water harvesting technologies last year (2013)?

(a) Less than Kshs.1000 [ ] (b) Kshs.1001-3000 [ ](c) Kshs.3001-5000[ ](d) More than Kshs 5000[ ]

21. How much money did you obtain from farm yields produced through use of harvested water last year (2013)?

(a) Less than Kshs.5000 [ ] (b) Kshs.5001-20,000 [ ] (c) Kshs.20,001-50,000[ ](d) More than Kshs 50,000[ ]

22. (a) Is farming your main source of income?

(a)Yes [ ] (b No [ ]

(b) If the answer is No in question. 19, please indicate the percentage of farming as source of your income

(a) Less than 10% [ ] (b 10-30% [ ] (c)31-50% [ ] 51-80% (d)More than 80% [ ]

23. Who does rain water harvesting activity in your household?

(a) Myself [ ] (b) My family assist me [ ] (c) Employee [ ]

24. What is the ownership of the land tenure on which you do rain water harvesting?

(a)Freehold [ ] (b) Family land [ ] (c) leasehold [ ]

(d) Own land [ ]

25. Please indicate the amount of time in hours spent in fetching by the following

a. Wifeé é é é b. Husbandé é é c. Childrené é é d. Employeeé é é é é

26. Please indicate the amount of distance to the nearest watering point or river

(a) Less than 50M [ ] (b) Family lan51-100M [ ] (c) 101-500M [ ] (d) More than 500M [ ]

27. The following are some of the factors influencing adoption of water harvesting technologies, what is your level of agreement? Use a scale where 1- Strongly Agree, 2- Agree, 3- Neutral, 4- Disagree and 5-Strongly Disagree.

	1	2	3	4	5
Factors influencing adoption of water harvesting technologies					
Adoption of water harvesting technologies can make an important contribution to poverty alleviation address the problems of poverty and food security for households					
Adoption of water harvesting technologies an makes important contribution in social well-being hence promoting social equity					
Adoption of water harvesting technologies improve household their food supply, increase their income and become self-sustained farmers.					
Adoption of water harvesting technologies boosts rural economic development.					

d. To assess the influence of trainings and extension services on adoption of water harvesting technologies

28. Have you attended any training organised by Ministry of water and other service providers?

(a) Yes [ ] (b) No [ ]

If yes please explain the following information about the trainings and extension services conducted

Name of training institutioné .

Method of training used 1. Demonstration [ ] 2. Workshop/seminar [ ] 3. Other[ ]

Number of trainings received last year (2003)é é é é é é é é é é é é é é é é é é é é

29. Do you think the training and extension services influence adoption of water harvesting technologies in this area? (a) Yes [ ] (b) [ ]

If yes explain é

30. Indicate your level of agreement with the following statements regarding the adoption of water harvesting technologies. Please tick on your level of agreement.

	Strongly Agree	Agree	Disagree	Strongly Disagree
The ministry of water offers enough extension services in fish farming to the farmers				
The Government has policies in place to be followed by fish farmers				
The ministry staff have adequate skills in implementing water harvesting technologies				
There are Government initiatives aimed at adoption of water harvesting technologies				

31. Please indicate two problems encountered when adopting water harvesting technologies

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32. Any other comment

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Thank you for your time and participation

APPENDIX 4:. Sample Size Population Determination by Yamane,

Sample Size for ±3%, ±5%, ±7%, and ±10% Precision Levels where Confidence Level is 95% and P=.5.

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	A	222	145	83
600	A	240	152	86
700	A	255	158	88
800	A	267	163	89
900	A	277	166	90
1,000	A	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100
a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled. N=N/(1+N(e2)				