SOCIOECONOMIC FACTORS AND THEIR EFFECTS ON THE ADOPTION OF ENVIRONMENTAL CONSERVATION PRACTICES WITHIN THE KIMAO DAM CATCHMENT AREA IN BARINGO COUNTY, KENYA

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Masters of Science in Environment and Natural Resources Management in the Department of Environment and Natural Resource Management and the School of Science and Technology of Africa Nazarene University

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DECLARATION

I declare that this document and the research that it describes are my original work and that they have not been presented in any other university for academic work.

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This research was conducted under our supervision and is submitted with our approval as university supervisors.

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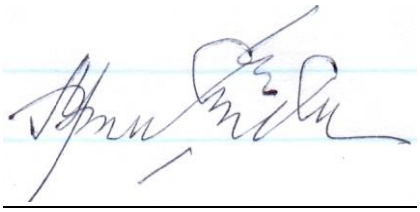

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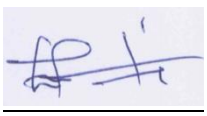

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DEDICATION

This thesis is fondly dedicated to my late parents, Mum Grace and Dad Daniel for their inspiration and encouragement, without which this project would not have reached this far and to my children, daughter Alexis and son Zack for their understanding, may the almighty God bless you abundantly.

ACKNOWLEDGEMENTS

I thank God for the strength, provision and grace that He accorded me to enable me to come this far. I owe enormous debt to the following who have contributed in many ways to the success of this thesis: the Rufford small grants foundation (UK) for sponsoring the research; my supervisors Dr. Mark Ndunda Mutinda and Dr. Shadrack Kinyua Inoti for their guidance and all the assistance they accorded me; my course mate Harriet Maiyo for her concern and support during my studies; the household heads, who provided me with the information used in this study; and finally the enumerators, who assisted me in data collection. May the almighty God bless you all.

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ABSTRACT

Sedimentation of Lake Baringo and other water bodies in Baringo County has been occurring at an alarming rate. The increased sedimentation of the water bodies can be attributed to steep topography and reduced vegetation cover, which enhances soil loss during torrential rains, resulting in an increase in sedimentation of the Lakes and other water bodies. Many interventions to reduce soil loss and increase vegetation cover by the government and non-governmental organization over the years have failed to bear fruits due to low adoption rate of the environmental conservation measures by the land owners. This study therefore, aimed at assessing some of the factors that cause the low adoption rate of the environmental conservation practices using households located within the Kimao catchment area in Kimalel location. The objectives of the study were to: (i) determine the effects of social and demographic factors (age, gender, household number) on the adoption of environmental conservation practices, (ii) establish the effects of land size owned by households on the adoption of environmental conservation practices, (iii) determine the effect of household heads' knowledge on environmental conservation practices on their adoption, (iv) determine the effect of affordability of environmental conservation practices on their adoption, (v) determine the effects of participation in collective action on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County. The *ex-post-facto* research design was used. A stratified proportional random sample of 225 households were surveyed using a structured questionnaire. The data was analysed using descriptive and inferential statistics in a Statistical Package for the Social Sciences (IBM SPSS version 26). The results showed that the level of adoption of environmental conservation practices was low (M=9.47, SD=4.7) on a scale of 1 to 22. The level of adoption of environmental conservation practices within the Kimao dam catchment area was found to be affected by age of the household head (β=.294, t=4.59, p=.001) and household number (β= .147, t=2.22, p=.027) but not gender (t=-.648, df=223, p=.518). The Land size (β=.162, t-2.45, p=.015), knowledge (β=.872, t=26.59, p<.001), affordability (β=.650, t=12.77, p<.001), and participation in collective action (β=.906, t=31.91, p< .001) also affected the level of adoption of environmental conservation practices. The study concluded that a multiplicity of factors affected the level of land owner's adoption of environmental conservation practices in the Kimao dam catchment area. Based on this conclusion, the following recommendations were suggested to the County government and other stakeholders: there is need to provide the much needed inputs for conservation practices by providing seeds and seedlings for planting, implement a payment for environmental services (PES) scheme to encourage the households to implement the practices and enhance land owners' knowledge on practices through farmer to farmer training initiatives. The findings of the study will influence policy development in implementing environmental conservation practices in Baringo County.

DEFINITION OF TERMS

Crop Residue: Any type of vegetative cover retained in the field and may include standing stubble, dispersed straw, living vegetation, or mulch (Gachene et al., 2019).

Land Degradation: natural and human-induced processes that that negatively affect the capacity of land to function effectively within an ecosystem and the processes include; declining quality of soil, water, and/or vegetation (UNEP, 1992)

Soil Degradation is the decline in soil condition caused by its improper use or poor management, usually for agricultural, industrial or urban purposes. (FAO & ITPS, 2015).

ABBREVIATION AND ACRONYMS

CBO: Community Based Organization

DAEO: District Agriculture Extension Office

DFID: Department for International Development

FGD: Focus Group Discussions

ILCA: International Livestock Centre for Africa

KARLO: Kenya Agricultural Research and Livestock Organization

NGO: Non-Governmental Organizations

SEWB: Socio-Economic Wellbeing

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The thesis assessed the effects of socioeconomic factors on the adoption of environmental conservation practices by households in the Kimao dam catchment area of Baringo County. The study specifically assessed the effects of the following independent variables; sociodemographic factors, land size owned by households, household head knowledge of environmental conservation practices, affordability of the practices, and household participation in collective action associated with environmental conservation. The dependent variable was the level of adoption of environmental conservation practices. The study covered households located within the Kimao dam catchment area, which lies in three sub-locations of Kimalel location, which are Koriema, Kimalel and Sabor in Baringo County.

This section of the thesis covers the background of the study, statement of the problem, objectives of the research, research questions, significance of the study, limitations of the study, delimitations of the study, theoretical framework and the conceptual framework of the study.

1.2 Background to the Study

In 2015, the United Nations member states adopted the 17 interlinked global sustainable development goals (SDGs). The sustainable development goal number 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (United Nations, 2015). The SDG has two specific targets dealing with land degradation; specific target (15.5) stated as; “take urgent and significant action to

reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species and specific target (15.3) stated as: “to combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world by year 2030” (United Nations, 2015).

Land degradation is the reduction in the capacity of the land to provide ecosystem goods and services and assure its functions over a period of time for its beneficiaries (FAO, 2011). The Ecosystem goods mentioned are products of land, which have an economic and/or social value: they include land availability, animal and plant production, soil health and water quantity and quality, while Ecosystem services” include biodiversity and the maintenance of hydrological, nutrient and carbon cycles (Nachtergaele et al., 2011)..

In Kenya, a 20-year assessment of land degradation from 1999 to 2010 using remote sensed data revealed serious degradation in all the 47 counties. The report estimated 61.4 % of the total area of Kenya as experiencing high degradation rates and 27.2 % was experiencing very high rates of degradation. The ASALs were the most affected due to their highly erodible soils and high intensity storms that create excessive runoff and soil erosion (Republic of Kenya, 2016).

Land degradation often leads to reduced natural land cover. Natural land cover stabilizes soil, minimizing erosion and sediment loading (Crowder, 1987). Natural land cover also has lower loading than most human land-uses of excess nutrients, such as nitrogen (N) and phosphorus (P), and other pollutants (MEA, 2005; Richardson, 1995).

Soil degradation inherently reduces or eliminates soil functions and their ability to support ecosystem services essential for human well-being (FAO & ITPS, 2015). When natural land cover in the water sources or watersheds are is converted to other uses such as agriculture or housing, the loss of natural land cover decreases ecosystem services of water quality and quantity. The degradation of the watersheds globally leads to increased sedimentation diminishing the capacity of reservoirs and increasing pollution of the water, which would require increased costs to clean it for human consumption in populated areas such as cities and towns (McDonald et al., 2016).

Over past decades, environmental conservation measures have been promoted in Baringo County (Anderson, 2002; Odada et al., 2006) to aid in watershed management by conserving the soil and water. These environmental conservation practices include bench terraces, check dams, contour bunds and hedgerows, stone bunds, terraces, planting pits / zai pits, stone lines, trash lines, grass strips, grassed waterways, cut-off drains, mulching, cover crops, Agroforestry, wind breaks/ shelter belts, manure application, woodlots, riparian vegetation buffer strips, conservation agriculture, revegetation of damaged lands, conservation tillage and contour ditches (Chasek et al., 2015; Cowie et al., 2018; Kust et al., 2018; Namirembe et al., 2015). However, in the absence of locally available materials, many of these environmental conservation measures require substantial investment of resources that are not affordable to many households (CoR & OECD, 2019). The top-down approach used to plan and implement soil conservation projects also led communities to shy away from the adoption of new measures. Since nearly 80% of the lands in the low lands of Baringo are under communal ownership, the pressure on land has been gradually overexploited with the increase in human population (Baringo County Government, 2018). In the Tugen Hills however, the conflicts between the authorities and communities keeps arising because

of high tendency to encroach lands. The direct causes of soil erosion are well known. Yet, the underlying root causes are embedded in the socio-economic conditions of the society. Many studies have pointed out that the problem of low adoption of soil conservation is often not due to the technology, but rather due to the incompatibility of the technology with prevailing socio-economic conditions of the community (Aheeyar, 2000). Thus, the limited success in the adoption of soil conservation measures necessitates the investigation of the social and economic factors that influence farmers' willingness to invest on conservation measures. In this context, this study was conducted to evaluate social and economic factors that influence the adoption of environmental conservation measures in the Kimau dam in Baringo County. Environmental degradation in the Tugen Hills has led to constant shrinkage of these dams, altered hydrological conditions and has led to climate change, bare land cover and soil erosion.

During the last decade both the depth and the area of these dams has decreased dramatically (Onyando, 2002). The study aims to show that the shrinkage of the dams is due to both siltation and inadequate water volumes flowing to the dams resulting in a negative water balance. The increased erosion and sediment transport to the dams and change in hydrologic pattern is primarily caused by altered land cover, deforestation in the catchment area, but amplified by changed rainfall conditions. The soil erosion has a large impact on the arable land, water availability, etc. The bare land is increasing mainly/as a result of extensive overgrazing, which leads to a constantly decreasing vegetation cover. The changed land cover is in many respects an effect of the increased population combined with the large social importance of livestock. Conclusively, these

detrimental processes resulting to resources degradation are human-made and founded in the community socio-economic and cultural dictates.

In most developing countries**,** agriculture remains one of the largest sectors in the economy both in terms of its contributions to the GDP and generating employment (Shiferaw & Holden, 1999). In Baringo County, soil erosion is a serious environmental problem and a-major threat to the sustainable development. Since the promulgation of constitution in 2008, which has led to establishment of County governments, the county government of Baringo has paid a great deal of attention to issues of soil and water conservation to promote economic development and better environmental management. Hence, this research investigates the soil and water conservation techniques adopted in arid and semi-arid regions of Baringo and discuss the problems and perspectives for soil and water conservation strategies. The land management practices, and measures for soil conservation are discussed including effects of topography, tillage and crop rotation management, mulching and rainwater harvesting system.

1.3 Statement of the Problem

The steep topography, loss of plant cover and torrential rains in the Tugen hills of Baringo central have caused the loss of fertile top soil which ends up in water reservoirs including Lake Baringo causing siltation and failure of the water dams. Research in this area has shown that the application of environmental conservation practices can aid in alleviating the problem. The recommended practices such as terracing, maintaining soil cover with plants, management of the physical conditions of the soil and conserving soil moisture by reducing runoff can protect the land from loss of soil and water.

Many projects have been undertaken in the area by the government and non-governmental organizations for last hundred years, to try and institute conservation practices in this area (Anderson, 2002; Odada et al., 2006), but the adoption of these practices by the land owners, have been low leading to severe soil degradation, water loss and siltation of water dams and the Lake Baringo. There is therefore a need to institute these environmental conservation measures to rehabilitate the degraded land and to enhance soil and water conservation in the area or else the loss of soil will lead to low crop production, hunger, poverty and loss of water resources used by the community.

The direct causes of soil loss are well known, the underlying root causes are embedded in socio-economic conditions of the society. The remedies for this problem are also known, but there are many underlying factors that may hinder the land owners to implement the environmental conservation structures. This study therefore endeavored to investigate how the household socioeconomic factors affect the adoption of environmental conservation practices by the landowners. Specifically, the study looked at how adoption of environmental conservation practices by the land owners are affected by sociodemographic, size of land owned by the households, knowledge of environmental conservation practices, affordability of the practices, and participation in collective action involved in conservation practices.

1.4 Purpose of the Study

The objective of this study was to attempt and identify factors related to the households' constraints to the adoption of soil conservation measures in Baringo County, to study the association between constraints and the investment in soil conservation and to make recommendations to overcome the problems under prevailing conditions.

1.5 General Objective

To determine the effects of socioeconomic factors on the adoption of environmental conservation practices by land owners living within the Kimao dam catchment area in Baringo County

1.5 1 Specific Objectives of the Study

The specific objectives of this study were to:

(i) Determine the effects of social and demographic factors (age, gender, education level) on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.

(ii) Establish the effects of land size owned by households on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.

(iii) Determine the effect of household heads' knowledge on environmental conservation practices on their adoption by households within the catchment area of Kimao dam in Baringo County.

(iv) Determine the effect of affordability of environmental conservation practices on their adoption by households within the catchment area of Kimao dam in Baringo County.

(v) Determine the effects of participation in collective action on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.

(vi) Predict household adaptation of environmental conservation practices and determine the order of importance of sociodemographic factors, land size, knowledge of practices, affordability of practices, and collective action on adoption of environmental practices in Baringo County.

1.6 Research Questions

The following were the research question of this study;

(i) What are the effects of social and demographic factors (age, gender, education level) on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County?

(ii) How does of land size owned by households affect the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County?

(iii) How does household heads' knowledge on environmental conservation practices affect their adoption by households within the catchment area of Kimao dam in Baringo County?

(iv) How does the effect of affordability of environmental conservation practices affect their adoption by households within the catchment area of Kimao dam in Baringo County?

(v) How does collective action affect the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County?

(vi) How well do the independent variables predict household adaptation of environmental conservation practices and what is the order of importance of sociodemographic factors, land size, knowledge of practices, affordability of practices, and collective action on adoption of environmental practices in Baringo County?

1.7 Significance of the Study

Soils are essential components for life to exist on earth. They help in regulating the processes across the diverse terrestrial and aquatic ecosystems. Soils help diverse biodiversity species to interact with the atmosphere. In Kirandich dam and Kimau dam,

soil conservation is constrained by a variety of challenges including economic, social, political factors and the land ownership system, which has led to massive siltation and the resultant reduction of water volume and depth. Hence, there is a crucial need to embrace the study of soil conservation as well as investigating the challenges hindering the adoption of soil conservation measures. There is need to reduce negative impacts of soil degradation around these water bodies, improve the relevance, and recognition of soil science as well as promote collaboration beyond traditionally defined soil science research disciplines. Such revitalization and collaboration may be fostered by a shift from discipline-focused soil science research to cross-disciplinary research approaches and issue-driven research. This proposal will investigate the major challenges to the adoption of soil conservation in the study area in the hope of presenting the outcomes of an initiative to identify priority measures to adopt as a tool for guiding future soil conservation.

1.8 Scope of the Study

This study was carried out in communities around Kimau dam in Baringo Central, North Rift of Kenya. The dam is situated in the Tugen Hills. The Tugen Hills which forms a major catchment is characterized by steep topographic gradients giving rise to considerable climatic and ecological differences.

1.9 Delimitations of the study

In this study, the research only considered the impacts of social, economic factors in the adoption of soil conservation. This work is essential to the success in addressing key issues that are associated with soil degradation and the development of sustainable land management. However, the study does not intend to carry out in-depth study into the impacts of siltation on the aquatic life and the adverse effects of loss of soil nutrients

due to soil degradation. This study considers the existing socio-economic factors as imperative in the adoption of soil conservation measures as a baseline for assessing what new, promising areas need to be considered and how these factors might be adjusted and better linked and coordinated.

1.10 Limitations of the Study

The study area covered the Kimau dam catchment area in Baringo County, which has been purposely selected for this research. The area experiences massive soil loss due to its topography and human influences and exemplify most of the problems associated with this study. Baringo County is a very large area and has a lot of variation in its physical and socio-cultural factors and due to the budget constraints, only this very small section of the entire area was covered by this study.

1.11 Assumptions

It is assumed in this study that the response to be collected from the respondents shall be true and honest and that the results and recommendation forwarded to the responsible institutions will be fully implemented.

1.12 Theoretical Framework

The theory that was used to guide this study is the diffusion of innovation theory, developed by Everett Rogers in 1962 (Rogers, 2003). This theory attempts to explain and determine how an idea gains momentum, is adopted and diffuses within a population. The end result of diffusion culminates in full adopting of new behavior trends which means that people stop doing things as they were in the past and rather adopt new ways of addressing problems and challenges in their daily lives. According to Rogers (2003) this theory is based on the fact that adoption of any new behavior such as conservation of land resources does not occur instantly but rather is a process in

which some individuals (in this case farmers) are faster at adopting and diffusing the new idea than others. Each of these groups of individuals have different characteristics which in turn determine their rate of adoption. According to this theory there are five types of adopter categories as shown in the Figure 1.1:

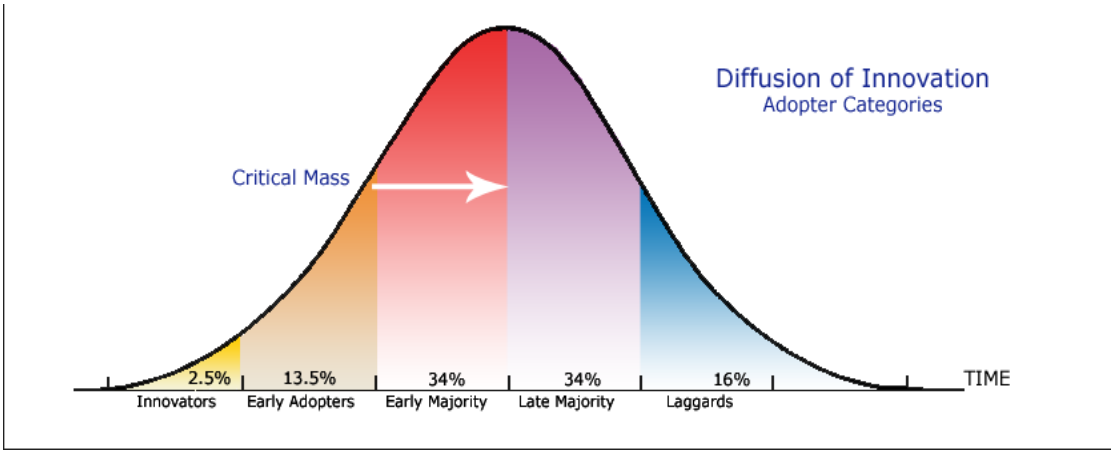

Figure 1.1: Types of adopter categories suggested by Rogers in the diffusion of innovation theory

Innovators: these are the first people to buy into the idea. They want to try it first and are willing to take risks to develop and participate in adoption of any new ideas. They can be termed as technology enthusiasts and constitute to 2.5% of the population. They are mainly change agents, gate keepers for the next group of adopters, and can therefore be recruited as peer educators. They are risk takers, appreciate technology for its own sake and can understand and apply complex technical knowledge and cope with high degree of uncertainty.

Early adopters: these individuals are often in leadership positions within the community. They are aware of the need to change in order to maintain social order within the community and are therefore willing to adopt the new ideas. They require very little information to convince them to change traditional ways. They can be termed

as visionaries and constitute 13.5 % of the population. They desire to be trend setters, adventurous, and are excellent as tester subjects.

Early majority: for this group, evidence that the new ideas are necessary and that they work is necessary to necessitate adoption. Although they are willing to adopt the new ideas, they are less willing to take risks for the same. They can be termed as pragmatists and constitute 34 % of the population. They normally desire applications that have been proved and are reliable, they normally avoid risk, and are prudent desiring to stay within the budget. They always make slow, steady progress and need simple user-friendly training.

Late majority: this group does not necessarily believe in the need for change, they lack the motivation that is necessary to become adopters. They only take up adoption once the majority has proven that the investment and risk involved is necessary and in fact fruitful. They can be termed as conservatives and constitute 34 % of the population. They are require bullet-proof solutions and tend to shy off from technology. Respond to peer pressure and are cost sensitive.

Laggards: despite the evidence, this group is often stuck in traditions and is rigid in terms of adopting change whether such change is proven necessary and vital for their survival. They can be referred to as skeptics and constitute 16 % of the population. They are normally isolated from the opinion leaders, suspicious of innovations and normally refer to the past how things were done then as they prefer to maintain the status quo. They will only invest in technology, only when the other alternatives are worse.

The diffusion of innovation theory is a process that has been used explains the adoption of new ideas and technology within a community and it differs from dissemination activities (Dearing & Cox, 2018). The rate of adoption can be influenced by various

factors. Factors affecting each community are different and an understanding of such factors provides a solid ground for the adoption of positive new ideas. The concept of peer networks is important in the Diffusion of Innovation theory. It is the critical mass achieved through the influence of innovators and early adopters who serve as opinion leaders that sparks the initial "take off" point in the innovation adoption process. These opinion leaders serve as valuable integral change agents who influence their peers through peer to peer communication, role modeling, and networking. This process works well within an organization or in society at large. A prime example is the use of social media networking to influence people through opinion leader tactics (Kaminski, 2011).

1.13 Conceptual Framework

The conceptual frame work depicts four independent variables that are thought to affect the adoption of soil and water conservation in Baringo County. The independent variables of this study include: (i) socio-demographic factors of the land owners, which are: age, household number and gender of the land owners, (ii) the size of land owned by the households in hectares, (iii) household heads' knowledge of environmental conservation practices, (iv) affordability of the conservation practices indicated by income of the households and (v) participation in collective action in environmental practices. The dependent variable adoption of environmental conservation practices, has the different conservation practices as the indicators, they include: construction of terraces, planting grass strips, building of gabions, re-afforestation, mulching, cover crop and participation in group activities related to soil and water activities. The relationship between the independent and dependent variable can be affected by the intervening variable climate characteristics of the innovation.

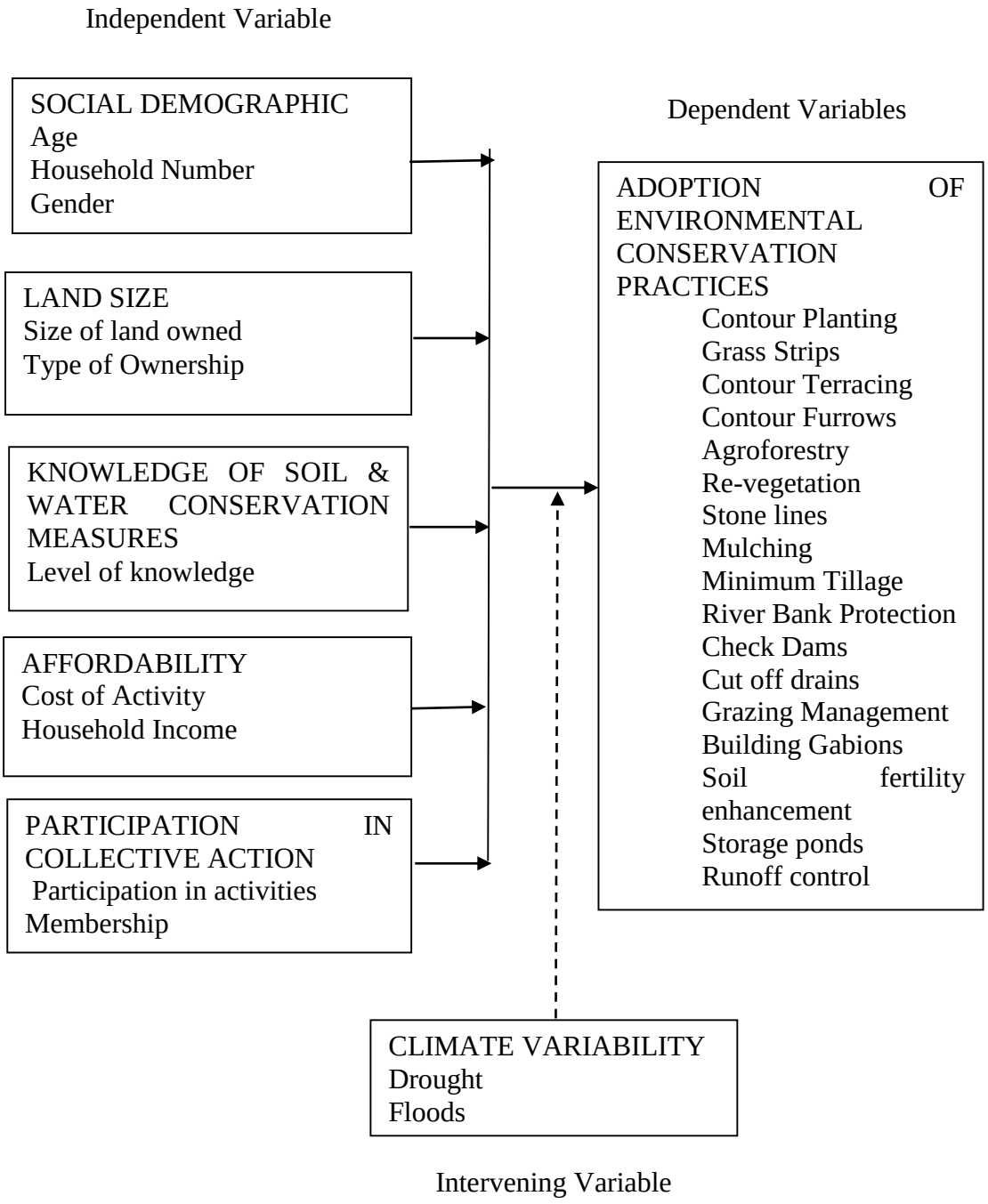

Figure 1.1: Conceptual Framework showing the relationship between the factors influencing the adoption of soil and water conservation practices by households in Baringo

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter contains the review of the literature with respect to the research variables which are soil degradation, theoretical review of literature, technology adoption by farmers, Baringo population and farming systems, concept of soil conservation, water conservation measures, social economic factors affecting soil and water conservation, farmers knowledge and awareness on water management technology, household cultural factors, summary and research gaps.

2.2 Soil Degradation

Soil is a non-renewable resource over the human time scale. It is dynamic and prone to rapid degradation with land misuse. Productive lands are finite and represent only <11% of earth's land area but supply food to more than six billion people increasing at the rate of 1.3% per year (Eswaran et al., 2001). Water erosion affects nearly 1,100 million hectares (Mha) worldwide, representing about 56% of the total degraded land while wind erosion affects about 28% of the total degraded land area (Oldeman, 1994). Attempts to remedy land degradation particularly soil erosion are referred to as soil conservation measures.

FAO and Intergovernmental Technical Panel on Soils [ITPS] (2015) described in detail how rapid population increase and increased cultivation has led to serious soil degradation and soil fertility loss. Overutilization of farmlands and forests, overgrazing and adoption of old and archaic measures are consequences of severe erosion (Republic of Kenya, 2016). Troeh et al. (2004) also reviewed past and current erosion rates around the world. Knowledge of the historic erosion is critical to understanding the severity

and consequences of erosion and developing strategies for effective management of present and future soil erosion. Research is still ongoing and increasingly focuses on very detailed topics to be adopted in improving soil quality, reduce soil erosion processes as well as its modeling. The following literature review is concentrating on the relevant topics in terms of soil erosion and how it can be detected. As well, as how input parameters are being assessed towards soil conservation. Moreover, the literature review is primarily focusing on the scientific literature of the last several years.

2.3 Theoretical Considerations

The theory guiding this study is the system theory and the theory of the tragedy of the commons. According to Hardin (1968), the tragedy of the commons is an economic theory of a situation within a shared-resource system where individual users acting independently according to their own self-interest behave contrary to the common good of all users by depleting or spoiling that resource through their collective action.

Systems Theory, was proposed in the 1940's by the biologist Ludwig von Bertalanffy, and furthered by Ross Ashby (Ashby, 1956). Von Bertalanffy was both reacting against reductionism and attempting to revive the unity of science. He emphasized that real systems are open to, and interact with, their environments, and that they can acquire qualitatively new properties through emergence, resulting in continual evolution. Rather than reducing an entity (for example, the human body) to the properties of its parts or elements (for example, organs or cells), systems theory focuses on the arrangement of and relations between the parts, which connect them into a whole (cf. holism). This particular organization determines a system, which is independent of the concrete substance of the elements (such as particles, cells, transistors, people, and others). Thus, the same concepts and principles of organization underlie the different

disciplines (physics, biology, technology, sociology, etc.), providing a basis for their unification. Systems concepts include: system-environment boundary, input, output, process, state, hierarchy, goal-directedness, and information. System can therefore be described as the trans-disciplinary study of the abstract organization of phenomena, independent of their substance, type, or spatial or temporal scale of existence. It investigates both the principles common to all complex entities, and the (usually mathematical) models, which can be used to describe them.

2.4 Technology Adoption by Farmers

Technology adoption by farmers has been found to be in a two-tiered progression, beginning with early adopters who receive information from the external organizations (Ramirez, 2013). After the initial implementation of the technology from external organization by the farmers, the technology is transferred to other farmers through kinship relations or collective action groups, which create more opportunities for the farmers to be exposed to new technologies. The farmers in the first tier group have been identified by Kiptot and Franzel (2015) as volunteer farmer trainers (VFTs) having technical skills and overcoming process-related challenges that hinder them from achieving the desired outcomes in what is termed as farmer to farmer extension (FFT).

Factors that influence knowledge flows among farmers have a negative effect on the adoption of technologies by farmers, these are: socio-economic factors, including poverty, land fragmentation; difference in land users, politics, low standard of living and earning are cited as drivers contributing to the increased risk of watersheds (MEA, 2005).

2.5 Baringo Population Composition and Farming System

The 2019 population and housing census (KNBS, 2019) revealed that that Baringo County had a total population of 666,763 and a population density of 61 persons per square km. The households in the county number 142,518. The Tugen speakers of the Kalenjin community are the major inhabitants. The Pokot and Il Chamus constitute the population of Baringo County with 35% and 12% respectively (Bryan & Sutherland 1992).

There are two major zones dividing the county: the highlands and the lowlands. The higher elevations of the county are in the modified tropical zones. The well-drained and fertile soil are the major types characteristic of the region. This zone contains the high potential areas for agricultural and improved livestock development. Coffee farming is predominantly practiced in small scale in the Tugen hills; in addition, food crops like cereals, fruit trees and horticultural crops are also cultivated. These agricultural activities are combined with elaborate soil conservation measures. In the southwest part, there is large-scale farming of cereals and horticultural crops, while Kerio Valley has potential for cotton production (Walsh, 1969).

The lowlands are in a semi-arid to arid climatic zone. They have adverse soils with various textures and drainage conditions, which are as a result of alluvial deposits. Some of these soils are saline. Shallow stony sandy soils with rock outcrops, volcanic ash and lava boulders characterize a large area (Hautot & Tarits, 2000). This zone is essentially a rangeland and apart from scattered isolated pockets of dry land subsistence agriculture and small-scale irrigation in Marigat, Kollowa and Barwessa, the major

socio-economic activities centre on livestock and bee keeping (Baringo County Government, 2018).

2.6 Concept of Soil Conservation

Soil is the key parameter on which agricultural practice is based on. Therefore, soil should be managed with great concern in order to sustain long-term agricultural productivity (Namirembe et al., 2015). Soil conservation practices are those acts that are applied to protect land from being degraded. Soil erosion is the main consequence resulting from unsustainable land use (Hudson 2015). Soil conservation has been practiced for many years in many countries, often with use of technical and financial support from a range of organizations. Soil conservation management is the formulation and carrying out a course of actions involving the manipulation of resources to provide soil quality, increase crop production and alleviate poverty (Blanco & Lan, 2010). Hence, soil conservation management is a logical planning that sustains land development and depends on the interaction of all activities aimed at preventing soil degradation. Many aspects of resource land development can also be evaluated, including on-site and off-site impacts (FAO, 2011).

In the past, focus was put only on restoration of severely affected areas by erosion. The modern approach slightly differs with the previous concept. Here, soil conservation is treated as a comprehensive and more positive role. The central concept is that, the available resources should be improved by preserving them (FAO & ITPS, 2015) .

Today, various practices in agriculture result in misuse and degradation of previously fertile land. Bad cropping patterns, unsuitable cultivation techniques, misuse of tractor power, improper choice of implements and machines, the abuse of natural pastures and

forests, the extension of cultivation to marginal and sub-marginal lands, and faulty irrigation and drainage systems are mostly responsible for the present situation. In the attempt to solve some of these problems, many mistakes have been made resulting in failures and worsening of the situation in many developing countries. The basic concept of a multi-disciplinary approach to the solution of the problems has unfortunately been overlooked in most cases.

2.7 Water Conservation Measures

Due to a diverse number of factors, such as drought, water contamination and increasing populations the formerly finite amount of water is quickly dwindling so that the future communities and even current societies are at a risk of lacking access to clean and usable water. Zheng et al. (2016) highlight that water conservation involves changing habits. However, because such habits have been generated and cultivated over a lifetime they are not only difficult but in some cases seem resistant to change. Surprisingly water conservation habits only involve simple changes in the smallest of behavioral trends that are common to human beings and farmers in specific.

Water conservation calls for the farmer to consider both the water quantity and quality that he is making use of. Therefore, farmers are called upon to adopt more efficient ways of making use of available water as well as ideal water storage methods. Abdullai and Huffaman (2014) indicates that water conservation can be characterized in three categories: physical, which involves the use of mechanical processes and machinery such as sprinklers and drips to increase water usage efficiency.

Secondly, it includes biological measures where farmers make use of both flora and fauna to control water usage by employing techniques such as collected drinking water

for animals, and cover vegetation to prevent evaporation of irrigated water (McDonald et al., 2016). Finally, the third category is known as agronomic measures which mainly rely on water management practices within the farm such as water storage, runoff efficiency and irrigation management.

2.8 Socio-economic Factors Affecting Soil and Water Conservation

In nature, socio-economic factors are some of the main potential barriers to the adoption of soil and water conservation (Pahl-Wostl, 2007). Socio-economics speak of the educational background, income and access to information for the community. Allan (2005) concurs indicating that often it has been falsely assumed that cultural barriers are the only issue that the water technologies have to contend with when it comes to adoption. However, even where individuals are willing and have noted by themselves the value of conservation technologies, the issue lies in the ability to maintain and initiate the use of conservation technologies.

Archer et al., (2010) underscores the lack of credit especially where capital to purchase equipment and training for the use of conservation is required. The higher the initial cost of purchasing equipment is, the more likely that farmers will be less inclined to purchase and initiate the use of conservation techniques. The focus should be directed at more affordable approaches that do not require the community to go out of the way in terms of adoption. Technology in itself however often requires a much higher investment thus making adoption quite difficult.

Kalbus et al (2012) in their study highlighted the need for higher education as a foundation for the adoption of conservation activities. Education provides an ideal foundation for the understanding of the value of water and soil conservation. It is

important for the individuals to understand the importance of water management for the future generations as well as sustainability of water access. However, as with any technical aspect, it is difficult for community members with low levels of education to understand such value. In addition, Schlüter et al. (2010) concurs that the most important aspect of water and soil conservation is the right use. Without proper use, the effect of water and soil conservation would not be significant and thus would draw fewer benefits for the community. Higher educated individuals are often more willing to take the risks associated with water and soil management technologies as well as adopt new methods of consumption use and conservation.

Earlier work by Sidibé (2005) coordinated the farm size with the initial decision for farmers to participate in adoption of conservation. He found that farmers with larger farms were often more willing to experiment and successfully implement the use of technologies. This is in line with the possibility of increasing productivity as well as the empirical evidence that supports the increase of capital that comes with larger farms. However, Zalidis et al. (2002) cautions that such evidence is skewed at best and often influenced by other factors that render farm size insignificant. Whatever the case, the socio-economic factors are the most significant factors influencing adoption. There is therefore need to gather evidence with regard to how each factor influences adoption of soil and water conservation and thus recommendations on how to address the socio-economic challenges that limit adoption of ideal soil and water conservation.

2.9 Farmer's Knowledge and Awareness on Water Management Technologies

Geerts and Raes (2009) found that farmers asked to state new forms of soil and water conservation were unable to do so. This is simply because they were unaware of such

technologies in existence. Awareness is determined by access to the information and the understanding of the value of the information. Awareness is the first step towards any form of adoption. Farmers need to be aware of the existence of soil and water conservation and the benefits that accrue from the adoption of such technologies. Roe *et al.* (2005) cites that in the first attempt in improving awareness come in the form of extension services. Extension officers are the first and most crucial resource with regard to disseminating the information that is needed to the farmers. Manjunatha et al., (2013) in their study highlighted that the largest number of adopters in agricultural technologies and new forms of agriculture, which is 55.8% of the population had interacted with extension officers.

Awareness increases not just the possibility but also the rate of adoption among small scale farmers. No one can adopt what they do not know about. Further as shown by Becu et al., (2003) knowledge and awareness on their own level increases the level of efficiency and use of soil and water conservation. Knowledge allows the farmers to identify their challenges they are facing together. There are situations where the farmers are not aware of their own challenges and thus are not aware of the need for change. Set of actions can only be highlighted and actively pursued when understanding has been reached. To increase the level of community participation, community members must be aware of their challenges and the available solutions that they can access.

The second aspect of awareness as Lubell (2004) includes identifying the best possible solution. The solution should not only actively resolve the problems but also include benefits that are sustainable over a period of time. When it comes to soil and water conservation often the solutions available are short term at best. Traditional solutions

to water shortage have often failed in resolving the problem, however when the community is not aware of the possibility of the advantages of the same solutions in the long term they are less likely to adopt the new systems opting instead to remain with the old traditional systems which are not as effective. Studies that have been conducted measuring levels of adoption but lacking the aspect of awareness are limited. On the one hand, adoption rates without consideration of awareness may give a false positive where the researchers focus on an ideal respondent population. On the other hand, there is also the possibility under-estimation that arises from false adoption rates.

2.10 Household Cultural Factors that Influence Soil Conservation

Baringo county inhabitants rely heavily on agriculture for their livelihood. The major economic activities are pastoral and apiculture. The system of farming impact directly to land degradation which impact soil productivity directly or indirectly. For instance, the natural forests have been depleted due land encroachment for farming and overgrazing by the cattle. Population of the region is also increasing faster than what the land can accommodate thus land is scarce. These activities leave the land bare and much more vulnerable to degradation.

In Baringo County, where most areas are in the Arid and Semi region degradation is not a new problem. It has been recognized since the 1930's (Sutherland et al., 1990). However, this problem has taken a new meaning with the considerable immigration of people into this marginal dry area and a growing population. The Baringo region exemplifies most of the problems of marginal semi-arid areas. Constant water shortages and environmental deterioration restrict productive agriculture and livestock keeping, i.e. the local people's primary livelihood (Sanyu, 2001). The main reason for accelerated soil erosion is over-exploitation of some natural resources due to an

increasing demand for food, fiber and fodder by the growing human and livestock population, without economic means to sustain the resources base. Soil conservation practices are implemented to deal with the problem of soil erosion processes. The key determinant to adoption of soil conservation practices are the farmers' perception of the problem of soil erosion, its cost and benefits (Wade & Heady, 1978). Farmers are aware of the problem of soil erosion. However they are quite often not concerned about soil conservation practices. The main reason is that they can substitute other inputs for soil depths. This causes the failure to incorporate long-term soil use benefit in their utility function (Lee, 1980).

2.11 Affordability of Available Technology

Financial matters or aspects related to cost of new technology has been found to negatively influence farmers' adoption of managerial practices or agricultural technology (Begho et al., 2022). Therefore, aspects that provide finance to farmers or reduce the cost of the technology or practice usually improves the probability or intensity of adoption by farmers, this includes aspects such as subsidies, access to credit, and the cost of technology. Studies have shown that access to credit improves on the adoption of new technology or practice (Liu et al., 2018), this due to the fact that credit enhances the farmers' capacity to purchase inputs needed for the new technology or practice. On the other hand, high costs of technology especially in the initial stages of the diffusion process, reduces the intensity of adoption (Liu et al., 2018).

2.12 Land Size Owned by Farmers

In planning for sustainable agriculture and environment, land as a resource tends to be indispensable. This is because it tends to be where the plants are grown and where the

people live (UNCCD, 2017). The size of land owned by the farmers has a direct influence on the adoption of land use and management practices (Akinola et al., 2014). Debonne et al. (2021), conducted a survey between November 2018 and January 2019 in sub-counties of Bahati, Kuresoi, Njoro and Subukia and classified farms into 3 groups: a group consisting of small scale farms (SSFs) with a managed land of below five hectares (<5 ha), another group consisting of medium scale farms (MSFs) with managed land of between five and fifty hectares (5–50 ha), and large scale farms (LSFs) with a managed land of above fifty hectares (>50 ha). The average farm size is falling and land distribution is becoming more concentrated, leading to significant constraints on production for small scale farmers, low adoption of sustainable land management practices and an increase in land degradation (Birch, 2018).

In Kenya, population growth has caused a steady fall in the average farm size in Kenya (Moore, 2018). Masters et al. (2013) noted that the mean land size for small scale farmers in Kenya reduced from 2.28 to 1.86 hectares between 1997 and 2010. The size was much when compared to other countries in the region, for example Ethiopia was found to be 1.8 ha and Tanzania 2.2 ha compared to Kenya's 1.2 hectares (Rapsomanikis, 2015). Mbithi (2018) while working in Kangudo, Kenya, concluded that as the land sizes decreased to .88 ha (2.19 acres), the food security index was affected negatively.

2.13 Collective Action and Sustainable Land Management

Collective action occurs when more than one individual is required to contribute to an effort in order to achieve an outcome. People living in rural areas and using natural resources engage in collective action on a daily basis when they: plant or harvest food together; use a common facility for marketing their products; maintain a local irrigation

system or patrol a local forest to see that users are following rules; and meet to decide on rules related to all of the above (Ostrom, 2004). Currently collective action ranging from innovations and use of traditional indigenous knowledge, to conflict resolution, management and networking is undertaken by formal institutions such as Community Based Organizations (CBOs), Local Non-Governmental Organizations (NGOs) and other legal entities involved in natural resource management (Graham et al, 2019). The involvement of many associations in collective action, there needs to be coordination of the different entities in order to provide sustainable land use management by these multi-stakeholder coalitions, which are referred to as institutional collective action (ICA) (Kim, 2021). Collective Action is now recognized as central to addressing the water governance challenge of delivering sustainable development and global environmental benefits (Suhardiman, 2017). Collective action aids in the efficient use and protection of natural resources and helps the poor secure land rights by advocating for themselves and their best interests (Delville et al., 2021; Mwangi et al., 2012), and in conflict resolution in natural resource management (Ratner et al., 2017).

2.14 Summary of Review Literature

Soil conservation concept is the backbone to agriculture. Conservation deals directly with solving atrocities such as fertility loss and degradation of land. Baringo County is inhabited by majority Tugen and minority Pokot and Il Chamus The major economic activity is cattle raring with a bit of farming. Farming is as a result of diminishing land for the cattle and also availability of the fertile land. Land is owned communally a habit that was inherited since the colonial period. Land and the general environment water included has really diminished due to overutilization. Due to this, many of the inhabitants have started conservation measures in collaboration with the authorities. Many strategies have been adopted and are in practice. They include terracing, gabion

building and contour farming. However, there are challenges which range from financial to the general ignorance of the population.

2.15 Research Gap

Land degradation remains a major threat to the provision of environmental services According to a study reported in (CBD 2011), Climate change and land degradation are interconnected, not only through effects of climate change on land management but also through changes in ecosystem functioning that affect climate change. Maintaining and restoring healthy ecosystems will therefore play a key role in adapting to and mitigating impacts of climate change.

Baringo has however over years experienced land degradation which has left lands bare. The soils carried by water flow during rainy season has led to siltation of water bodies thus affecting the aquatic life and water volume. Due to residents not adapting the soil conservation measures there is need for further studies in this field to identify reasons why these measures are not adopted and bridge the knowledge gap existing to ensure that there is sustainable soil conservation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter on research methodology outlines the procedures and activities that were conducted in order to obtain the data used in this study. The chapter is organized in the following sections: research design, research site, target population, study sample (size and sampling procedure), data collection (instruments, piloting, reliability, validity and data collection procedure), data analysis, and legal and ethical considerations.

3.2 Research Design

The study employed the *ex-post facto* research design aimed at examining the effect of a naturally occurring treatment after that treatment has occurred (Kathuri & Pals, 1993). The *ex-post facto* design was selected because it looks at situations that have been going on for some time without any manipulation whatsoever by the researcher. This was ideal for this study as it looked at the adoption of environmental conservation measures at present period and before. The researcher did not therefore introduce any treatment among the study subjects before, during and after the study.

3.3 Research Site

The study was conducted in Baringo County, which is one of the 47 counties in Kenya. The county is located in North Rift of Kenya and it borders Turkana and Samburu counties to the north, Laikipia to the east, Nakuru and Kericho to the south, Uasin Gishu to the southwest, and Elgeyo-Marakwet and West Pokot to the west. It is located between longitudes 35^0 30' and 36^0 30'East and between latitudes 0^0 10' South and 1^0 40', the Equator cuts across the county at the southern part. (Baringo County Government, 2013). Baringo County was selected because of the areas' proneness to

soil erosion due to steep hills and escarpments, sedimentary and volcanic soils covering its surface (Chapman & Brook, 1978; Hackman et al, 1988; Hautot & Tarits, 2000; Renaut et al, 2000; Walsh, 1969). The study area was the catchment area of the Kimao dam, located in Kimalel location of Marigat division of Baringo Central sub-county (Figure 3.1).

The area is representative of potential soil erosion zones in Baringo County with respect to soil properties, landscape, farming systems and the socio-economic conditions. The area has varying slope up to 100% and medium to high mountains with narrow valley bottoms. This topographic variation has created several microclimates and soil complexes within the catchment (Chapman & Brook, 1978; Hackman et al, 1988; Hautot & Tarits, 2000; Renaut et al, 2000; Walsh, 1969). The latest socioeconomics and geographic data of the county are outlined in the Baringo development plan for 1997 to 2013 (County Government, 2015).

The county covers an area of 11,015.3 km^2 of which 165 km^2 is covered by surface water surface. Lake Baringo 130 km^2, Lake Bogoria 9.5 km^2 and Lake Kamnarok 1 km^2. It is approximately 210 km long in the North south direction and 100 km wide in the southern area comprising of Mochongoi, Marigat and Kabarnet divisions. Not only is this particularly well endowed with road infrastructure but also covers a cross section of ecological zones (County Government of Baringo, 2013).

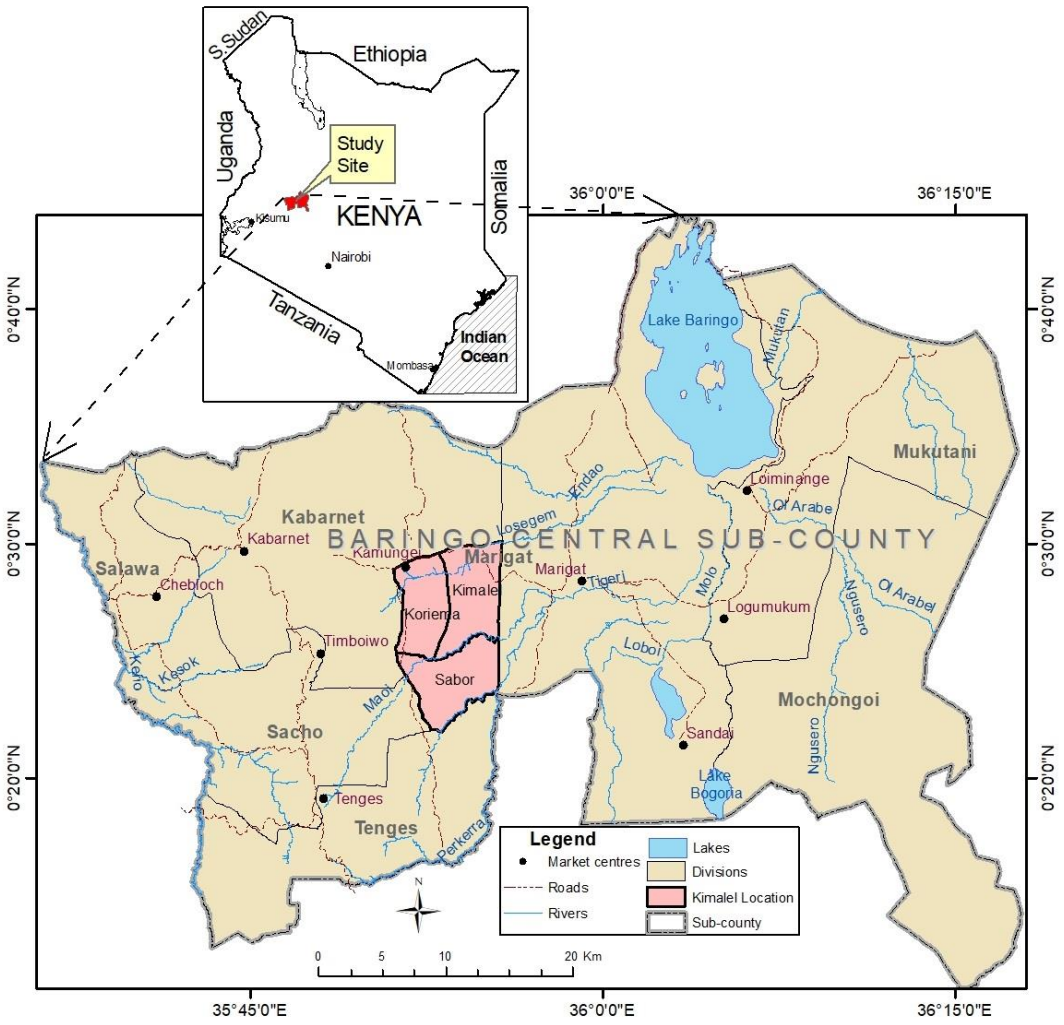

Figure 3.1: Map of Baringo central sub-county showing Kimalel location

3.4 Target Population

Target population is the entire group of people or objects to which the researcher wishes to generalise the research findings. The group must meet the criterion set by the researcher (Mishra & Alok, 2017).

The target population for this study was taken as the small-scale farmers in Baringo Central Sub-county undertaking agro-pastoralism in the hilly areas. The 2019 Kenya population census found a population of 666,763 people living in 142,518 Households (KNBS, 2019).

3.5 Study Sample

A sample is defined as a smaller set of data that a researcher chooses or selects from a larger population by using a pre-defined selection method. These elements are known as sample points, sampling units, or observations. Creating a sample is an efficient method of conducting research. In most cases, it is impossible or costly and time-consuming to research the whole population. Hence, examining the sample provides insights that the researcher can apply to the entire population (Mishra & Alok, 2017).

3.5.1 Study Sample Size

Sample size represents the total number of respondents retrieved from the target population that the researcher intends to study (Mugenda & Mugenda, 2012). The study used the households within the catchment area of Kimao dam in Kimalel location. The population in the study area was 7,064 people and the number of households in the study area was estimated as 1,872 (KNBS, 2019). The Kjercie and Morgan (1970) formula was used to calculate the sample size:

$$n = \frac{\chi^2 * N * P(1-P)}{(ME^2 * (N-1)) + (\chi^2 * P(1-P))}$$

Where:

n = the required sample size, given by the following:

N = the population within the study area [1,872 households]

χ^2 = the table value of chi square for one degree of freedom relative to the desired level of confidence, which was 0.95. (The chi-square value used was 3.841)

P = the population proportion (assumed to be 0.50), as this magnitude yields the maximum possible sample size required.

ME = desired margin of error (expressed as a proportion). This is the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample

proportion about the population *P*. the value of d was taken as 0.05, which is equal to plus or minus 1.96σp. $ME^2 = [0.05^2 = 0.0025]$

The study sample size *n* based on this calculation was 225 households,

3.5.2 Sampling Procedure

The stratified random sampling technique was used in selecting the households to be included in this study. The catchment area of Kimao dam lies in Kimalel location, which has three (3) sub locations named Kimalel, Sabor and Koriema. The sub locations formed the strata. The proportional allocation method was used to distribute the samples within the different sub locations as shown in Table 3.1.

Table 3.1: Proportional Allocation of the Study Samples to the Sub locations

Sub locations	Households	Proportional allocation	Sample
Kimalel	541	541/1872*225	65
Sabor	465	465/1872*225	56
Koriema	866	866/1872*225	104
Total	**1,872**		**225**

3.6 Data collection

This section explains the process that was used to collect data from the household heads. This is a systematic process of gathering, making observations or measurements on the qualitative and quantitative information of the study variables. During the process care was taken to collect good data that is clean, consistent and reliable to enable the evaluation of the outcome (Tan, 2018).

3.6.1 Data Collection Instrument

A researcher-administered structured questionnaire (Tan, 2018) was used to collect information from the household heads within the study area. The questionnaire

(Appendix B) was divided into six (6) sections: (i) demographic information, (ii) farming system in the Kimao dam catchment area, (iii) level of knowledge of environmental conservation activities, (iv) affordability of the soil and water conservation practices, (v) collective action (vi) adoption of environmental conservation activities on the farm. The dependent variable adoption of environmental conservation practices on the farm, was operationalized as an index, which combined household head response on the adoption of the different environmental conservation practices.

3.6.2 Pilot Testing of Research Instruments

Pilot-testing involves trying out a questionnaire on a small group of individuals (preferably 10 % of the sample size) to get an idea of how they react to it before the final version is created. The pilot testing enables the researcher to fine-tune the questionnaire for objectivity and efficiency of the process (Creswell, 2014).

A pilot-test was conducted on 23 households in the adjoining Kimondis location. The results of the pilot test assisted in fine-tuning of the research instrument for objectivity and efficiency of the data collection.

3.6.5 Data Collection Procedures

A letter of clearance was sought from the Board of Post Graduate Studies at Africa Nazarene University, to enable the researcher seek research permit from National Council of Science, Technology and Innovation (NACOSTI) and the Baringo County Government.

The sampling frame was then developed from Chiefs register of the households in the location. The sample households were then randomly selected using a table of random numbers. The enumerators were then trained and allocated households to cover in their survey. Data collection involved face to face interview with the farmers. The filled questionnaires were collected after one week.

3.7 Data Analysis

Once the measuring instrument was administered, the raw data was systematically organized through coding to facilitate analysis as summarized in Table 3.2. Descriptive and Inferential statistics were used to make inferences about the influence of socio-economic factors on adoption of environmental conservation practices. The Statistical Package for Social Sciences (IBM SPSS version 26) was used to aid in data analysis Inferential statistics used was regression analysis. Regression equation:

$Y=\alpha+b_1 X_1 +b_2 X_2 +.....b_n X_n$

For this study, the equation was: $Y=\alpha+b_1 X_1 +b_2 X_2 +b_3 X_4+ +b_4 X_4$

Where Y is dependent variable, which is adoption of environmental conservation technologies

α is a constant.

b_1 , b_2 , b_3, b_4 , b_5 are coefficients.

X_1 is independent variable 1, which is input social and demographic factors.

X_2 is independent variable 2, which is land size owned by households.

X_3 is independent variable 3, which is household heads' knowledge on environmental conservation

X_4 is independent variable 4, which is affordability of environmental conservation practices

X_5 is independent variable 5, which is collective action by households

Table 3.2: Summary of Data Analysis

Objective	Independent variable	Dependent variable	Statistics
Determine the effects of social and demographic factors (age, gender, education level) on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.	Socio-demographic	Adoption of soil and water conservation	Descriptive and regression analysis
Establish the effects of land size owned by households on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.	Land size owned	Adoption of soil and water conservation	Descriptive and regression analysis
Determine the effect of household heads' knowledge on environmental conservation practices on the adoption of environmental conservation by households within the catchment area of Kimao dam in Baringo County.	Household head knowledge on soil and water conservation	Adoption of soil and water conservation	Descriptive and regression analysis
Determine the effect of affordability of environmental conservation practices on their adoption by households within the catchment area of Kimao dams in Baringo County	Affordability of Practices	Adoption of soil and water conservation	Descriptive and regression analysis
Determine the effects of collective action on the adoption of environmental conservation practices by households within the Kimao dam catchment area in Baringo County.	Collective action	Adoption of soil and water conservation	Descriptive and regression analysis

CHAPTER FOUR

RESULTS AND ANALYSIS

4.1 Introduction

Chapter four of this thesis deals with data analysis and the findings of the study. The chapter is divided into the following sections: (i) response rate (ii) characteristics of the participants, (iii) Level of adoption of soil and water conservation practices in Kimao dam watershed, (iii) effects of household sociodemographic factors on the adoption of soil and water conservation practices, (iv) effects of land size owned on the adoption of soil and water conservation practices, (v) effects of knowledge of soil and water conservation practices on their adoption by the households, (vi) effects of affordability of soil and water practices on their adoption by households, (vii) effects of collective action on the adoption of soil and water conservation practices in Kimao dam catchment in Baringo County.

4.2 Response Rate

The sample size for this study was 225. The respondents that responded to the interview were 225, giving a 100% response rate.

4.3 Characteristics of the Respondents

The characteristics of the participants for this study are presented in the following sections: age of respondents, gender of respondents, marital status, formal education, household number and land size owned by the respondents.

4.3.1 Age of Respondents

Respondents were asked to indicate their year of birth, which was then used to calculate the exact age. The descriptive statistics and frequency distribution were calculated and are represented in the Table 4.1.

Table 4.1: Age of Respondents

Age Categories	Frequency	Percent
20-30	59	26.2
31-40	60	26.7
41-50	41	18.2
51-60	40	17.8
61-70	18	8.0
71-80	6	2.7
Above 81	1	0.4
Total	**225**	**100.0**

Mean 41.9±.96, Median 41.9, Mode 25, Std. Dev 14.46, minimum 20, Maximum 81

The majority (71.1 %) of the respondents were below 50 years old, while 28.9 % were above 60 years old. The average age for the respondents was (M=41.9, SD=14.46), while the minimum age was 20 and the maximum age was 81 years old.

4.3.2 Gender of the Household Head

Gender is a vital variable in determining who is most likely to adopt soil and water conservation. Gender of the respondents was noted during the interview and the information is summarised in Table 4.2.

Table 4.2: Gender of Household Heads

Gender	Frequency	Percent
Male headed households	165	73.3
Female headed households	60	26.7
Total	**225**	**100.0**

The majority (73.3 %) of the households were male led, while the women led households were 26.7 %.

4.3.3. Marital Status

The respondents were asked to state their marital status. Four categories emerged in the study area and their frequency distribution are presented in Table 4.3.

Table 4.3: Marital Status of Respondents

Marital Status	Frequency	Percent
Married	165	73.3
Single	31	13.8
Widowed	27	12.0
Divorced	2	0.9
Total	**225**	**100.0**

The majority (73.3 %) of the household heads were married, 13.8 % were single, 12 % widowed and 0.9 % were divorced.

4.3.4 Formal Education

The highest level of formal education attained by the household head was determined by asking the respondents to indicate the highest level in formal education they had attained. The information was analysed and the frequency distribution is presented in Table 4.4.

Table 4.4: Highest Level of Formal Education Attained by the Household Head

Level of Formal Education	Frequency	Percent
Never Went to School (illiterate)	24	10.7
Lower Primary (1-4)	13	5.8
Upper Primary (5-8)	41	18.2
KCSE (Form 4)	56	24.9
Teacher (P1)	39	17.3
College (Diploma)	22	9.8
Undergraduate Degree	28	12.4
Master and Above	2	0.9
Total	**225**	**100.0**

The majority (65.3 %) of the household heads had attained the form four level of formal education, indicating a reasonable level of understanding. Only 10.7 % were illiterate.

4.3.5 Household Number

The respondents were asked to state the number of people in their households. The information was analysed and the descriptive statistics and frequency distribution are shown in Table 4.5.

Table 4.5: Number of People Living in a Household

Number	Frequency	Percent
1.00	20	8.9
2.00	11	4.9
3.00	32	14.2
4.00	23	10.2
5.00	32	14.2
6.00	29	12.9
7.00	26	11.6
8.00	16	7.1
9.00	21	9.3
10.00	11	4.9
Above 10	4	1.7
Total	**225**	**100.0**

Mean 5.4±0.18, Median 5, Mode 3, Std. Dev 2.7, Minimum 1, Maximum 13

The average number of people living in the households was (M=5.4, SD=2.7), and ranged between 1 and 13.

4.4 Household Heads' Adoption of Environmental Conservation Practices

The dependent variable for this study was household heads' adoption of environmental conservation practices within the Kimao dam catchment area located in Kimalel location of Baringo County. The variable was operationalized as an index that combined environmental conservation practices into a single measure. The variable had three dimensions soil conservation, water conservation and soil enhancing management practices which when practiced would enhance the life of Kimao dam. The technologies included 22 practices, indicated as follows: terraces, grass strips contour planting, contour furrows, cut off drains, stone lines on contours, run-off water harvesting, gabions, storage ponds, plastic lined ponds, mulching, tree planting, agroforestry practices, seeding pastures, compost heap, fertilizer application, zero grazing, fodder plots, fodder conservation, riparian area revegetation, removing animals from riparian zone.

The household heads were asked to state the environmental conservation practices they had or practiced on their land out of the list of 22. This was verified by and the researcher by visiting and seeing the structures. The information was converted to a dummy or a 0, 1 variable. The household that was found to be applying a given environmental practice was given a score of one (1) for the particular practice and a score of zero (0) for not having the practice.

The farmer's adoption scores for each environmental practice were then summed together and then analysed to show the level of adoption by farmers for a particular practice on a scale of 0 to 1. The sum total, the mean and standard deviation of the

calculated scores for farmer's adoption of the different environmental conservation practices are shown in Table 4.6.

Table 4.6: Descriptive Statistics for Farmers Level of Adoption of the Different Environmental Conservation Practices in Kimao Watershed

Environmental Conservation Practices	Level of Adoption by Farmers in Kimao		
	Sum	Mean	Std. dev
Riparian area revegetation	183	.813	.390
Removing animals from riparian zone	172	.764	.425
Tree planting	156	.693	.462
Fertilizer application	146	.648	.478
Mulching	140	.622	.485
Agroforestry practices	136	.604	.490
Terraces on farms	129	.573	.495
Grass strips	109	.484	.500
Grass Seeding of pastures	104	.462	.499
Contour furrows	91	.404	.491
Stone lines on contours	90	.400	.490
Fodder conservation	87	.386	.488
Compost heap	84	.373	.484
Storage ponds	75	.333	.472
Contour planting	74	.328	.470
Cut off drains	58	.257	.438
Gabions	58	.257	.438
Plastic lined reservoirs/dams	57	.253	.435
Run-off water harvesting	55	.244	.430
Zero grazing	51	.226	.419
Grassed fallows /trash lines	48	.210	.418
Fodder plots (enclosures)	46	.204	.404

A ranked list of all the twenty-two (22) environmental conservation practices undertaken by farmers in Kimao dam catchment area are shown in Table 4.6. The level

of adoption of revegetation of riparian area was the highest (.813) on a scale of 0 to 1, while the lowest adoption was for fodder plots or enclosures (.204).

The index of level of adoption of environmental conservation practices for each household was determined by adding the scores for each practice undertaken, this created an index with a scale of 0 to 22, 0 indicating no adoption and 22 indicating a high level of adoption for the household. The descriptive statistics and the frequency distribution for the index are shown in Table 4.7.

Table 4.7: Descriptive Statistics and Frequency Distribution of Adoption of Environmental Conservation Practices

Scale	Frequency	Percent
1-3	19	8.4
3.1-5	46	20.4
5.1-7	20	8.9
7.01-9	23	10.2
9.01-11	29	12.9
11-01-13	39	17.3
13.01-15	25	11.1
15.01-17	16	7.1
17.01-19	5	2.2
Above 19	3	1.3
Total	**225**	**100.0**

Mean 9.47±.313, Median 10, Mode 4, Std. Dev 4.7, Minimum 1 and Maximum 22

The mean of the dependent variable adoption of environmental conservation practices by the household head in Kimao dam catchment area was (M=9.47, SD 4.7) and ranged between 1 and 22.

The index of adoption of environmental practices was then grouped into ten categories as follows: 1-3 depicting very low, 3.01-5, 5.01-7, 7.01-9, 9.01- 11, 11.01-13, 13.01-

15, 15.01-17, 17.01-19 and above 19 as very high level. The descriptive statistics and the frequency distribution for the index in ten categories are shown in Table 4.8.

Table 4.8: Chi-square Test for the Equality of Categories for the Level of Adoption of Environmental Conservation Practices by Households

	Observed			
Scale	**N**	**Expected N**	**Residual**	**Statistics**
1-3	19	22.5	-3.5	χ^2=72.02
3.01-5	46	22.5	23.5	*df*=9
5.01-7	20	22.5	-2.5	*p*=.001
7.01-9	23	22.5	.5	
9.01-11	29	22.5	6.5	
11-01-13	39	22.5	16.5	
13.01-15	25	22.5	2.5	
15.01-17	16	22.5	-6.5	
17.01-19	5	22.5	-17.5	
Above 19	3	22.5	-19.5	
Total	**225**			

The chi-square test revealed statistical ($p < .001$) significant differences among the different categories of household level of adoption of environmental practices. The category of low (3.01-5) was statistically significantly (χ^2=72.02, $df = 9$, $p < .001$) higher than the other categories, indicating that the majority of the households had a low level of adoption for environmental conservation practices in the Kimao dam catchment area. The adoption of environmental conservation practices in the Kimao dam catchment area by the households was low.

4.5 Effect of Sociodemographic factors on the Adoption of Environmental Conservation Practices

The first objective of this study was to determine the effects of social and demographic factors (age, gender, education level) on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County. The independent variable social demographic factors involved three variables: age, gender, household number and formal education level

4.5.1 Effect of Age on the Adoption of Environmental Conservation Practices

The independent variable age of household head has been described in section 4.3.1. The effect of age on the adoption of environmental conservation practices was determined by the use of simple linear regression, where age of household head was the independent variable and the index of adoption of environmental practices was the dependent variable. The results of the regression model are shown in Table 4.9.

Table 4.9: Regression Model Summary for Age and the Adoption of Environmental Conservation Practices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.294	.086	.082	4.509

The model indicates an adjusted R^2 value of .082; meaning that the independent variables age explained approximately 8.2 % of the variation in the dependent variable adoption of environmental conservation practices by households, which was low. The *F* test for the regression model is shown in the ANOVA Table 4.10

Table 4.10: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	***Mean Square***	***F***	***p***
Regression	429.12	1	429.12	21.10	.001
Residual	4534.93	223	20.33		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 21.10, p<.001). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.11.

Table 4.11: Regression Coefficients for Age and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	***Std. Error***	***Beta***	***t***	***p.***	***VIF***
(Constant)	5.456	.924		5.902	.001	
Age	.096	.021	.294	4.594	.001	1.000

The regression analysis shows that age of the household head significant (β= .294, t= 4.594, p = .001) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area. This could be due to the fact that the older household heads have had time to implement the practices compared to the younger.

4.5.2 Effect of Gender on the Adoption of Environmental Conservation Practices

The independent variable gender of the household head is described in 4.2.2. The effect of gender on the adoption of environmental conservation practices by households within the Kimao dam catchment area was determined by the use of the t-test. The

means for male and female-headed households' level of adoption are shown in Table 4.12.

Table 4.12: Mean Comparison

Household head Gender	N	Mean	Std. Deviation	Std. Error Mean
Male headed household	165	9.59	4.75	.370
Female headed household	60	9.13	4.58	.592

The mean of adoption for the male-headed households was 9.59, while for the female headed households was 9.13. The differences in the two means were tested using the *t*-test for the equality of means and the results are given in Table 4.13.

Table 4.13: *t*-test for the Equality of Means

					95% Confidence Interval of the Difference	
t	***df***	***p***	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
0.648	223	0.518	0.460	0.710	-.939	1.860

The mean differences for the adoption of environmental conservation practices for the male and females headed household were not statistically significantly (t = - 0.648, df =223, p =.518) different form each other, meaning that gender did not affect adoption.

4.5.3: Effect of Household Number on the Adoption of Environmental Conservation Practices

The effect of household number on the adoption of environmental conservation practices by households within the Kimao dam catchment area was determined by the use of bivariate linear regression. The independent variable was household number described in section 4.2.3, while the dependent variable was adoption of environmental conservation practices. The results of the regression model are shown in Table 4.14

Table 4.14: Regression Model Summary for Household Number and the Adoption of Environmental Conservation Prat ices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.147[a]	.022	.017	4.666

The model indicates an adjusted R^2 value of .022; meaning that the independent variables household number explained approximately 2.2 % of the variation in the dependent variable adoption of environmental conservation practices by households, which was low. The *F* test for the regression model is shown in the ANOVA Table 4.15.

Table 4.15: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	***Mean Square***	***F***	***p***
Regression	107.76	1	107.76	4.94	.027
Residual	4856.29	223	21.77		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 4.94, p=.027). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.16.

Table 4.16: Regression Coefficients for Household Number and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	***Std. Error***	***Beta***	***t***	***p***	***VIF***
(Constant)	8.07	.699		11.56	.001	
Household Number	.256	.115	.147	2.22	.027	1.000

The regression analysis shows that household number had significant (β= .147, *t*= 2.225, *p* = .027) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area. This could be due to the fact that the high number of people in the households provided labour to undertake the practices.

From the results in section 4.4.1, 4.4.2, and 4.4.3, the effects of socio-demographic factors on the adoption of environmental conservation practices by households within the Kimao dam catchment area can be summarised as: Age and household number had significant effects, while gender did not.

4.6 Effect of Land Size on the Adoption of Environmental Conservation Practices

The second objective of this study was to establish the effects of land size owned by households on the adoption of environmental conservation practices by households within the catchment area of Kimao dam in Baringo County.

4.6.1 Land Size Owned By the Households

The independent variable land size owned by the household was determined by asking the participants to state the sizes of their land. The information was analysed and the descriptive statistics and frequency distribution are presented in Table 4.17.

Table 4.17 Land Size Owned by the Households in the Study Area

Land Size in Ha	Frequency	Percent
Below .99	22	9.8
1-1.99	39	17.3
2-2.99	66	29.3
3-3.99	32	14.2
4-4.99	10	4.4
5-5.99	24	10.7
6-6.99	4	1.8
7-7.99	4	1.8
8-8.99	7	3.1
9-9.99	6	2.7
Above 10	11	4.9
Total	**225**	**100.0**

Mean 3.37±.22, Median 2, Mode 2, Std. Dev 3.31, Minimum 0.25, Maximum 30

The average land size owned by the households was (M=3.37, SD=3.31), the land size ranged between 0.25 ha and 30 ha.

4.6.2 Effect of Land Size Owned on the Adoption of Environmental Conservation Practices

The effect of land size on the adoption of environmental conservation practices by households within the Kimao dam was determined by the use of simple linear regression analysis. The land size owned by the households formed the independent variable, while the index of level of adoption of environmental conservation practices formed the dependent variable. The results of the regression model summary are shown in Table 4.18.

Table 4.18: Regression Model Summary for Land Size and the Adoption of Environmental Conservation Prat ices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.462	.213	.210	4.655

The model indicates an adjusted R^2 value of .213; meaning that the independent variable land size explained approximately 2.1 % of the variation in the dependent variable adoption of environmental conservation practices by households, which was low. The *F* test for the regression model is shown in the ANOVA Table 4.19.

Table 4.19: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	**Mean Square**	***F***	***p***
Regression	130.77	1	130.77	6.03	.015
Residual	4833.28	223	21.67		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 6.034, p=.015). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.20.

Table 4.20: Regression Coefficients for land Size and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	**Std. Error**	**Beta**	**t**	**p.**	**VIF**
(Constant)	8.69	.443		19.61	.001	
Land Size	.231	.094	.162	2.45	.015	1.000

The regression analysis shows that land size owned by household had statistically significant (β= .162, t= 2.456, p = .015) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area. This could be due to the fact that the larger sized farms provided an opportunity to implement the practices.

4.7 Effect of Household Heads' Knowledge on the Adoption of Environmental Conservation Practices

The third objective of this study was to determine the effect of household heads' environmental conservation practices knowledge on their adoption by households within the catchment area of Kimao dam in Baringo County.

4.7.1 Household Heads' Knowledge on Environmental Conservation Practices

The independent variable household heads' knowledge on environmental conservation practices was operationalized as an index that combined subjective assessment by the household heads on their knowledge of the different practices on a 5-point scale, where 1 depicted very low knowledge and 5 very high knowledge. The scores for each conservation practice were added together to form the index of knowledge on environmental conservation practices. The descriptive statistics and the frequency distribution of the index of knowledge is shown in Table 4.21.

Table 4.21: Descriptive Statistics and Frequency Distribution of the Level of Household Heads Knowledge on Environmental Conservation Practices

Level of Knowledge	Frequency	Percent
Very Low	53	23.6
Low	32	14.2
Medium	4	1.8
High	31	13.8
Very High	105	46.7
Total	**225**	**100.0**

Mean 30.8±1.13, median 38, Mode 48, Std. dev 17.07, Minimum 1 and Maximum 48

The level of knowledge on environmental conservation practices ranged between 1 and 48, with a mean of (M=30.8, SD 17.07)

4.7.2 Effect of Household Heads' Knowledge on the Adoption of Environmental Conservation Practices

The effect of household heads' knowledge on the adoption of environmental conservation practices was determined by the use of bivariate linear regression analysis. The level of household heads' knowledge on environmental conservation practices formed the independent variable, while the dependent variable was the adoption of environmental conservation practices. The results of the regression model summary are shown in Table 4.22.

Table 4.22: Regression Model Summary for Knowledge and the Adoption of Environmental Conservation Prat ices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.872[a]	.760	.759	2.30998

The model indicates an adjusted R^2 value of .759, meaning that the independent variable household heads' knowledge explained approximately 75.9 % of the variation in the dependent variable adoption of environmental conservation practices by households. The *F* test for the regression model is shown in the ANOVA Table 4.23

Table 4.23: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	*df*	*Mean Square*	*F*	*p*
Regression	3774.13	1	3774.13	707.29	.001
Residual	1189.92	223	5.33		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 5.336, p< .001). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.24.

Table 4.24: Regression Coefficients for Household Heads' Knowledge and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	***Std. Error***	***Beta***	***t***	***p***	***VIF***
(Constant)	2.05	.318		6.460	.001	
Knowledge	.240	.009	.872	26.595	.001	1.000

The regression analysis shows that household heads' knowledge on environmental conservation practices had statistically significant (β= .872, t= 26.59, p < .001) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area.

4.8 Effect of Affordability of Environmental Conservation Practices on their Adoption by Households

The fourth objective of this study was to determine the effect of affordability of environmental conservation practices on their adoption by households within the catchment area of Kimao dam in Baringo County.

4.8.1 Affordability of Environmental Conservation Practices

The independent variable affordability of environmental conservation practices by the households was operationalized as the monthly income the households were able to acquire. The income was taken to be an indication of the amount of money the households could afford to spend on the practices after meeting other household needs. The descriptive statistics and frequency distribution of the variable household income are shown in Table 4.25.

Table 4.25: Household Monthly Income

Income Categories	Frequency	Percent
Below 10,000	66	29.3
10,001-20,000	52	23.1
20,001- 30,000	31	13.8
30,001-40,000	26	11.6
40,001-50,000	31	13.8
50,001-60,000	11	4.9
Above 60,001	8	3.6
Total	**225**	**100.0**

24,394±1187, Median 20,000, Mode 20,000, Std. dev 17,807, Minimum 1,000 and Max 75,000

The variable affordability of environmental conservation practices had a mean of 24,394 and ranged between 1000 and 75,000. The chi-square test for the equality of categories was performed and the frequency distribution for the variable in seven categories are shown in Table 4.26.

Table 4.26: Chi-square Test for the Equality of Categories for the Affordability of Environmental Conservation Practices by Households

Income Categories	Observed N	Expected N	Residual	Statistics
Below 10,000	66	32.1	33.9	χ^2=81.22
10,001-20,000	52	32.1	19.9	*df*=6
20,001- 30,000	31	32.1	-1.1	*p*=.001
30,001-40,000	26	32.1	-6.1	
40,001-50,000	31	32.1	-1.1	
50,001-60,000	11	32.1	-21.1	
Above 60,001	8	32.1	-24.1	
Total	225			

The chi-square test for the equality of categories revealed statistical ($p < .001$) significant differences among the different categories of affordability of environmental

practices. The category of low (below 10,000) was statistically significantly (χ^2=81.22, *df* = 6, *p* < .001) higher than the other categories, indicating that the majority of the households had a low level of affordability for environmental conservation practices in the Kimao dam catchment area.

4.8.2 Effect of Affordability on the Adoption of Environmental Conservation Practices

The effect of household affordability on the adoption of environmental conservation practices was determined using the simple linear regression. The affordability was the independent variable, while the dependent variable was the adoption of environmental conservation practices by the households. The results of the regression model summary are shown in Table 4.27.

Table 4.27: Regression Model Summary for Affordability and the Adoption of Environmental Conservation Prat ices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.650	.422	.420	3.585

The model indicates an adjusted R^2 value of .420; meaning that the independent variable affordability explained approximately 42 % of the variation in the dependent variable adoption of environmental conservation practices by households. The *F* test for the regression model is shown in the ANOVA Table 4.28.

Table 4.28: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	df	Mean Square	F	p
Regression	2097.11	1	2097.11	163.120	.001
Residual	2866.94	223	12.85		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 12.85, p< .001). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.29.

Table 4.29: Regression Coefficients for Affordability and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	***Std. Error***	***Beta***	***t***	***p***	***VIF***
(Constant)	5.28	.406		13.003	.001	
Affordability	.001	.001	.650	12.772	.001	1.000

The regression analysis shows that affordability of environmental conservation practices had statistically significant (β= .650, t= 12.77, p < .001) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area.

4.9 Household Participation in Collective Action for Environmental Conservation and Adoption of Practices

The fifth objective of this study was to determine the effects of collective action on the adoption of environmental conservation practices by households within the Kimao dam catchment area in Baringo County.

4.9.1 Household Participation in Collective Action for Environmental Conservation

The independent variable participation in collective action for environmental conservation was operationalized as an index that gauged the level of participation in collective action meant for environment conservation practices. The household heads assessed their participation in collective action for environmental conservation on a 6-point rating scale, with 0=indicating no participation and 6 indicating very high level of participation. The descriptive statistics and frequency distribution for scale is shown in Table 4.30.

Table 4.30: Household Level of Participation in Environmental Conservation Practices

Level of Participation in Collective Action	Frequency	Percent
No Participation	23	10.2
Very Low	62	27.6
Low	24	10.7
Medium	22	9.8
High level	27	12.0
Very high	67	29.8
Total	225	100.0

Mean 2.75±.122, Median 3, Mode 5, Std. Dev 1.84, minimum 0 and Maximum 5

The variable affordability of environmental conservation practices had a mean of (M=2.75, SD=1.84) and ranged between 0 and 6. The chi-square test for the equality of categories was performed and the frequency distribution for the variable in six categories are shown in Table 4.31.

Table 4.31: Chi-square Test for the Equality of Categories for the Participation in Collective Action for Environmental Conservation Practices by Households

Level of Participation	Observed N	Expected N	Residual	Statistics
None	23	37.5	-14.5	χ^2=59.02
Very Low	62	37.5	24.5	*df*=5
Low	24	37.5	-13.5	*p*=.001
Medium	22	37.5	-15.5	
High level	27	37.5	-10.5	
Very high	67	37.5	29.5	
Total	225			

The chi-square test for the equality of categories revealed statistical ($p < .001$) significant differences among the different categories of level of participation in environmental practices. The category of very high (6) was statistically significantly (χ^2=59.02, $df = 5$, $p < .001$) higher than the other categories, indicating that the majority of the households had a very high level of participation in collective action for environmental conservation practices in the Kimao dam catchment area.

4.9.2 Effect of Household Participation in Collective Action on the Adoption of Environmental Conservation Practices

The effect of household participation in collective action on adoption of environmental conservation practices by households within the Kimao dam Catchment area was determined by bivariate linear regression analysis. The level of household participation in collective action for environmental conservation was the independent variable, while the dependent variable was the adoption of environmental conservation practices by the households. The results of the regression model summary are shown in Table 4.32.

Table 4.32: Regression Model Summary for Participation in Collective Action and the Adoption of Environmental Conservation Prat ices by Households

R	R Square	Adjusted R Square	Std. Error of the Estimate
.906[a]	.820	.820	1.999

The model indicates an adjusted R^2 value of .820; meaning that the independent variable participation in environmental conservation practices explained approximately 82 % of the variation in the dependent variable adoption of environmental conservation practices by households. The *F* test for the regression model is shown in the ANOVA Table 4.33.

Table 4.33: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	***Mean Square***	***F***	***p***
Regression	4072.59	1	4072.59	1018.75	.001
Residual	891.46	223	3.998		
Total	4964.06	224			

The overall regression model was found to be significant (F (1, 223) = 1018.75, p< .001). The regression coefficients of the model showing the *beta, t* statistics and the collinearity statics are shown in Table 4.34.

Table 4.34: Regression Coefficients for Participation in Collective Action and Adoption of Environmental Conservation Practices

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	***Std. Error***	***Beta***	***t***	***p.***	***VIF***
(Constant)	3.10	.240		12.93	.001	
Collective Action	2.31	.073	.906	31.91	.001	1.000

The regression analysis shows that household participation in collective action in environmental conservation practices had statistically significant (β= .906, t= 31.91, p < .001) effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area.

4.10 Adoption and Ranking of Independent Variables' Effect on the by their Effect to the of Environmental Conservation Practices

The sixth objective of this study was to predict household adoption of environmental conservation practices from the independent variables and to determine the order of importance of socioeconomic factors (age and household number), land size, knowledge of environmental practices, affordability of environmental practices, and collective action on adoption of environmental conservation practices by households within the Kimao dam catchment area in Baringo County.

4.10.1 Prediction of Adoption of Environmental Conservation Practices from the Independent Variables

Multiple linear regression analysis was used to predict the dependent variable adoption of environmental conservation practices from the five independent variables: socio-demographic (age and household number), land size, knowledge of environmental conservation practices, affordability of practices, and collective action. The results of the multiple regression model summaries are presented in Table 35.

Table 35: Multiple Linear Regression Summary

R	R Square	Adjusted R Square
.935[a]	.874	.871

The model indicates an adjusted R^2 value of 0.871; this means that the independent variables explained approximately 87.1 % of the variation in dependent variable

adoption of environmental conservation practices. The *F* test for the regression model showing the fit of the model is shown in Table 36.

Table 36: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	***df***	**Mean Square**	***F***	***p***
Regression	4338.534	6	723.089	252.000	.001
Residual	625.528	218	2.869		
Total	4964.062	224			

The statistical significance for the overall regression model was tested using the *F* test (Table 36). The regression equation was found to be statistically significant (F (6, 218) = 252.0, p =.001). The regression coefficients of the model showing the beta, *t* statistics and the tolerance levels using VIF are shown in Table 37.

Table 37: Regression Coefficients for the Independent Variables

	Unstandardized Coefficients		**Standardized Coefficients**			**Collinearity Statistics**
	B	***Std. Error***	***Beta***	***t***	***p***	***VIF***
(Constant)	1.835	.366		5.014	.001	
Age	.006	.011	.018	.549	.583	1.905
Land size	-.027	.036	-.019	-.735	.463	1.140
Household number.	-.008	.055	-.005	-.153	.878	1.705
Affordability	3.496	.000	.132	4.308	.001	1.630
Knowledge	.090	.013	.326	7.022	.001	3.735
Collective action	1.416	.115	.554	12.308	.001	3.507

The results of multiple linear regression indicated that there was a collective significant effect between sociodemographic, land size, knowledge, affordability, and collective action significant (F (6, 218) = 252.0, p =.001, R^2 = .871) as shown on Table 35.

The individual predictors when examined further (Table 36) indicated that Affordability of practices (t = 4.308, p=.001), knowledge of practices (t = 7.022, p=.001) and collective action (t = 12.308, p=.001) were statistically significant predictors in the model, while age (t = .549, p=.583), land size (t = -.735, p=0.463) and household number (t = -.153, p=0.878) were not.

The regression model was therefore stated as follows:

$$Y= b_0 + b_1X_1+ b_2X_2 + b_3X_3 +b_4X_4+b_5X_5.$$ Where;

Y is the household adoption of environmental conservation practices,

b_0 is the intercept, equal to 0

b_1 is the regression coefficient, which is a change in Y relative to one unit change in X_1after controlling for X_2 and X_3

b_1 is the regression coefficient, which is the change in Y relative to one unit change in X_2 after controlling for X_1 and X_3

b_3 is the regression coefficient, which is a change in Y relative to one unit change in X_3 after controlling for X_1 and X_3.

Xi distinct independent predictor variables (X_1 sociodemographic, X_2 is land size, X_3 knowledge of practices, X_4 affordability of practices, and X_5 is collective action)

The households in Kimao dam catchment area in Baringo County predicted their adoption of environmental conservation practices as equal to: 1.835 - 0.27 (land size) - .008 (household number) + 3.49 (affordability of practices) + .090 (knowledge of practices) + 1.416 (collective action). Where land size was measured as hectares owned by the household, household number was taken as the number of people living in the household, affordability of the practices was taken as household income per month, knowledge of environmental conservation practices was measured on a 6-point scale

0=no knowledge, 5 very high knowledge, collective action was measured as participation in group work related to environmental conservation on a 6-point scale (0=none and 5 very high participation).

The household level of adoption of environmental conservation practices increased by 1.835 for each unit change of increase in age after controlling for land size and household number. On the other hand, the household level of adoption of environmental conservation practices decreased by 0.006 for each unit increase in age after controlling for land size and number. Lastly, the household level of adoption of environmental conservation practices increased by .3.49 for each unit increase in collective action after controlling for affordability.

4.10.2 Ranking of the Independent Variables as to their Influence on Adoption of Environmental Conservation Practices

To determine the order of importance of age, household number, land size, knowledge, affordability, and collective action on their effect of household adoption of environmental conservation practices in Kimao dam catchment area in Baringo County.

The order of influence was determined by looking at the magnitude of the standardized regression coefficients (beta statistics 'β") in Table 37. The results indicate that collective action had (β= .554, t = 12.03, p=001), effect on household adoption of environmental conservation practices, while knowledge of practices had (β= .326, t = -7.022, p< .001), affordability of practices (β= .132, t = -.438, p= .001), land size (β= .019, t = -.735, p= .463), age (β= .018, t = .549, p=.583). and household number (β= .005, t = .153, p=.878).

The findings indicate that collective action (β=.554) was the most important variable followed by knowledge (β= .326), then affordability of practices (β=.132), land size (β=.019), age (β= .028), and household number (β= .005).

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section of the thesis presents the summary of the study, discussion of the results, conclusions of the study and the recommendations made.

5.2 Summary of the Study

This study aimed at assessing the effect of household factors on the adoption of environmental conservation practices by household found within the Kimao dam catchment area in Baringo. The study specifically examined the effects of five factors on the adoption of environmental conservation practices, these were: sociodemographic factors, land size owned by the households, knowledge of environmental conservation practices, affordability of the practices and participation in collective action for environmental conservation.

In achieving the study objectives, the study used primary data that was collected using a structured questionnaire that was organized according to the key thematic areas corresponding to specific objectives of the study. The study then utilized descriptive and inferential statistics to analyse the data.

The results showed that the adoption of environmental conservation practices by the households within the Kimao dam catchment area was affected by the land size owned, household heads' knowledge of environmental conservation practices, affordability of practices, and level of participation in environmental conservation practices.

5.3 Discussion

The study findings are discussed in this section based on the specific objectives stated in section 1.4 of this thesis.

5.3.1 Households Level of Adoption of Environmental Conservation Practices within the Kimao Dam Catchment Area

The level of adoption of environmental conservation practices by households within the Kimao dam catchment area was found to be low. This low level of adoption was attributed to affordability of the practices, household heads' knowledge of the practices, the size of the land owned and the level of participation in collective action. This finding is similar to other studies on farmers' adoption in that the factors affecting adoption are multidimensional and interconnected. Meijer et al. (2015) described this multidimensional phenomenon in an analytical framework in which he divided the different factors into: (i) extrinsic factors, that included characteristic of the farmers (personal and socioeconomic), characteristics of the physical environment, and characteristic of the innovation (or technology required), (ii) Intrinsic factors, this includes knowledge, attitudes and perceptions of the adopter, (iii) communication and extension, which plays an important role in developing attitudes, perceptions and knowledge on innovations (or technology).

A survey by Feder et al. (1985) in less developed countries (LDCs) identified factors causing the low adoption of agricultural innovations by farmers, these included: lack of credit, limited information, aversion to risk, inadequate farm size, inadequate incentives, associated with farm tenure arrangements, insufficient human capital, absence of equipment to relieve labour shortages (affecting timeliness of operations), chaotic supply of complementary inputs (such as seeds, chemicals, and water), and

inappropriate transportation infrastructure. These limiting factors to adoption tend to create a variation among the farmers in terms of their adoption to agricultural technologies. Kihoro et al. (2021) realized technology adoption by farmers was not uniform due to the differences existing among the farmers' intrinsic factors, which varied from one farmer to the other.

Specifically, different factors have been shown to affect adoption of environmental conservation practices. A study by Mango et al. (2017) concluded that farmers' heterogeneity in terms of household head's age, level of education, extension services outreach, and socio-economic characteristics influenced the adoption of land, soil and water conservation practices in Southern areas of Africa.

Poor soil and water conservation measures will lead to land degradation that are either natural or human induced. Natural hazards include land topography and climatic factors such as steep slopes, landslides from frequent floods, blowing of high velocity winds, rains of high intensity, strong leaching in humid regions and drought conditions in the dry regions. It is now common sense that soil and water conservation is the insurance for national ecology (Karuku, 2018).

5.3.2 Effect of Socio-demographic Factors on the Adoption of Environmental Conservation Practices

Two socio-demographic factors (age and household number) were found to affect the adoption of environmental conservation practices, while the third gender had no effect. Varied results exist in literature in the effect of sociodemographic factors on the adoption of environmental conservation practices by farmers. Llewellyn and Brown (2020) concluded that factors affecting adoption of technology by farmers were more

heterogeneous in nature. Soil and water conservation practices are labour intensive (Kpadonou et al., 2017), which is related to household number as they provide labour for the application of the practices. The study also found that children aged 6-14 played a key role in the adoption of soils and water conservation practices. This agrees with the finding of the study that household number has a positive and significant influence on the adoption of practices.

Age and education level of the farmer positively affected the adoption of environmental conservation by farmers (Mango et al., 2017). Roberts et al. (2004) found that younger, more educated farmers who operated larger farms and were optimistic about the future of precision farming were most likely to adopt site-specific information technology. In an environment with dynamic technology, Wallace (2020) concluded that farmers with more education are better able to make technology adoption decisions in a dynamic economic and technical environment. In contrast, Ramirez (2013) found that age, education level and land holding size had no influence on knowledge flow and in technology adoption. Maina et al. (2020) concluded that socioeconomic factors influenced farmer's adoption of *Brachiaria* grass species in Eastern and Western regions of Kenya.

5.3.3 Effect of Land Size on the Adoption of Environmental Conservation Practices

The size of land owned by the households in the Kimao catchment area statistically significantly affected the adoption of environmental conservation practices. Land size was found to positively influence the adoption of environmental practices, in that as the land sizes increased the adoption of the environmental practices by the households increased. The size of land owned by the farmers has been shown to influence the

adoption of improved maize seed varieties (Kassa et al., 2013; Simtowe et al., 2009; Tura et al., 2010), agroforestry practices (Mugure et al., 2013), inorganic fertilizer (Beshir et al., 2012), improved wheat varieties (Gebresilassie & Bekele, 2015), sustainable land management (SLM) in Ethiopia (Nigussie et al., 2017), and in the Niger basin of Benin (Lokonon & Mbaye, 2018), and forage/browse legume technologies (Mapiye et al., 2006).

The adoption of land or environmental conservation practices by small scale farmers in different river catchment can be affected the size of land owned among other factors, this was demonstrated in a study conducted within the Rwizi catchment in Uganda (Mugonola et al., 2013). Adoption of Agroforestry practices in rural Ethiopia was affected by land size and tenure security (Beyene et al., 2014). The number of SWC techniques practiced were affected by the arable land size owned by the farmer (Recha et al., 2015). Multiple adoption of innovations is mostly explained by access to key resources (credit, income and information), and size of land owned by the farmer (Makate et al., 2019). The adoption of precision agriculture by farmers in the US was found to be influenced by land size, among other factors (Daberkow & McBride, 2003). In contrast, Wubeneh, and Sanders, (2006) found that farm size was negatively related to fertilizer adoption on small farms, as small farms are more pressurized to adopt inorganic fertilizer and intensive production techniques. Farmers have been shown to avert risk by not adopting new innovations, this would explain the negative adoption (Simtowe, 2006). Miheretu and Yimer (2017) showed that land tenure security had significant influence of adoption of land management practices in Ethiopia.

Two aspects of land have been shown in studies to affect adoption, they include the size of the land and the tenure of the land. The security of tenure for the land enhances adoption of environmental practices (Nkomoki & Bavorová, 2018). A Kenyan study showed that land tenure problems (fragmentation, inheritance, gender imbalance, ownership, rights to land use) affected the adoption of agroforestry practices (Mugure et al., 2013). Adoption of conservation practices in the U.S. was found to be related to land tenure in that the farmer who owned the land were more likely to adopt conservation practices that provided benefits only over a longer period of time (grassed waterways, strip cropping and contour farming), when compared to farmers who were renting the land (Soule et al., 2000). Farmers who were renting their land showed less participation in soil and water conservation (SWC) activities mainly because of the preoccupation to earn additional income for their livelihoods (Biratu & Asmamaw, 2016; Gedefaw et al., 2018). Tambo and Mockshell (2018) in their study of Sub-Saharan Africa concluded that secure land rights had positive effect on their adoption by farmers. Land tenancy was found to affect adoption of improved potato varieties in Nepal (Kafle & Shah, 2012).

5.3.4 Effect of Household Heads' Knowledge on the Adoption of Environmental Conservation Practices

Household head's knowledge on environmental conservation practices was found to have statistically significant effect on the adoption of environmental conservation practices in the Kimao dam catchment area. This finding is in agreement with that of Meijer et al., (2015), who concluded that Knowledge, Attitudes and Perceptions (KAP) influenced the adoption of technology and innovations by farmers. This view was also upheld by David and Asamoah (2011) in their study, where they concluded that improved knowledge was likely to translate to improved practice. Kpadonou et al.

(2017) in their study concluded that soil and water conservation practices are knowledge intensive, in that the farmers need to understand the practice for them to be able to apply it on their farms.

Farming experience and knowledge on conservation practices of the land owners influenced the farmer's decision in investing in land management practices in the Central Rift Valley of Ethiopia (Adimassu et al., 2012). A study in western Kenya on adoption of orange flesh sweet potatoes, found that the district where the farmer comes from, knowledge on value addition and nutritional benefits, and availability of vines were the key factors for adoption (Kaguongo et al., 2012). Farmers' knowledge of conservation measures and adoption of land productivity practices were influenced by the household head's age, education, agricultural advice reception and farmer group membership (Mango et al., 2017). In Kenya farmer knowledge acquired by volunteer famer trainees (VFT) has been instrumental in farmer to farmer extension (FFE) which is playing a complementary role to formal extension services in facilitating the spread of agricultural technologies and improving farmers' capacities (Kiptot & Franzel, 2015).

The mechanisms for linking farmers (or adopters) with new knowledge on technology, innovations and practices or the knowledge transfer initiatives (KTI) are many and varied in terms of their efficiency (Garforth et al., 2004). The knowledge transfer initiatives can be through farmer to farmer extension through volunteer farmers trainers (VFTs) and formal extension services (Kiptot & Franzel, 2015), demonstrations conducted at farms belonging to farmers (Garforth et al., 2004),

5.3.5 Effect of Affordability of Environmental Conservation Practices on their Adoption

Affordability of environmental conservation practices was found to have statistically significant effect on the adoption of environmental conservation practices by households in the Kimao dam catchment area. These findings were found to be consistent with existing research in different areas of the world, as soil and water conservation practices have been found to be capital-intensive (Kpadonou et al., 2017). Household resource endowment were found to positively influence farmer's decision on how much to invest in land management (Adimassu et al., 2012). Access to credit was one of the key factors found by Feder et al. (1985) that influenced farmers' adoption of agricultural innovations in LDCs. Specifically in Mumberes division of Baringo County, Kenya, access to credit was found enhance adoption of improved potato varieties (Njuguna et al., 2015). Income from farming was found to be positive and significantly related to the adoption of soil and water conservation technology (Ashoori et al., 2016)

5.3.6 Effect of Household Participation in Collective Action on the Adoption of Environmental Conservation Practices

Household participation in collective action groups in environmental conservation practices was found to positively affect the adoption of environmental conservation practices by households in the Kimao dam catchment area. This finding is consistent with the work of Ramirez (2013), who concluded that farmers who participated as a group had a tendency of having a higher level of adoption of technology due to the fact that the main source of technology information was from peers (kinship and other farmers) as there existed a lot of trust among such groups. Strong community bonds have been found to be associated with higher odds of successful collective action (Call & Jagger, 2017).

In a study conducted in China by Zhang et al. (2020) it was realised that membership to cooperatives positively affected technology adoption by famers. Farmer group membership are critical in raising awareness and influence their adoption decisions (Mango et al., 2017). Farmer's social networks (informal organizations) have been shown to improve interaction and trust among the farmers and have positive effects on the efficiency of agricultural technology adoption by farmers in Minqin, China (Wang et al., 2020). In Kenya, Farmers membership to groups was found to influence the adoption of Brachiaria grass species in the Eastern and Western regions (Maina et al., 2020).

5.3.7 Prediction of Dependent Variable and Ranking of Independent Variables used in the Study

The independent variables used in this study influenced the dependent variable differently. Three of the variables knowledge of practices, affordability of practices, and collective action were found to have significant affect the dependent variable, while age, household number, and land size were found to have no significant effect.

5.4 Conclusions

The following conclusions were made from the study:

(i) The level of adoption of environmental conservation practices by households found within the Kimao dam catchment area was found to be low.

(ii) Socio-demographic factors (age and household number) had statistically significant effects on the adoption of environmental conservation practices, while gender of the household head had no effect.

(iii) The land size owned by the households was found to have a statistically significant effect on the adoption of environmental conservation practices by households within the Kimao dam catchment area.

(iv) Household heads' knowledge on environmental conservation practices had statistical significant effect on the adoption of practices

(v) Household affordability of environmental conservation practices had statistically significant effect on their adoption by households within the Kimao dam catchment area

(vi) Participation in collective action for environmental conservation was found to have statistical significant effect on the adoption of environmental practices by households in Kimao dam catchment area.

5.5 Recommendations

Based on the study findings, the following recommendations were made:

(i) Collective action on environmental conservation should be encouraged in the area as it will increase the level of adoption and provide an answer to affordability of the practices.

(ii) The county government to build the capacity of the participants in terms of knowledge on environmental conservation measures and create awareness of the problem of dam siltation due to activities conducted on the farms. This can be accomplished through farmer to farmer contact.

(iii) The county government to provide inputs needed in environmental conservation practices. This can be done by creating tree nurseries to provide seedlings to the households, provision of grass seeds for planting, and equipment for making soil conservation structures.

5.6 Recommendations for Further Research

The following are recommended to be done for further research within the Kimao catchment area in Kimalel location, Baringo County:

(a). Determine the influence of payment for ecosystem services (PES) on the adoption of environmental conservation practices in the study area.

(b). Determine the influence of input provision on the adoption of environmental conservation practices by households.

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APPENDICES

Appendix A: Introduction Letter

Dear Participant,

RE: REQUEST FOR YOUR PARTICIPATION IN SURVEY

I am a master's student in the Department of Environment and Natural Resources Management, conducting a research study entitled "household factors affecting the adoption of environmental conservation practices within Kimao dam in Kimalel location of Baringo County, Kenya" You have been identified and selected for this study. The purpose of this letter is to kindly request you to participate in this study by providing information about your household. The information obtained is strictly for academic purpose only and shall be treated with utmost confidentiality.

Thank you,

Emily Jepkorir Kiplagat
RESEARCHER,
17JO3EMEV003

Appendix B: Study Questionnaire

Instructions

Please answer all questions appropriately and tick (☑) *all that apply*

Part I: Demographic Information

Age: _____

Marital Status: _____ (Married/ Single/ Widow/ Divorced/

Ethnicity: _____

Household Number: _____ Male_____ Females _____

Education level: Kindly indicate your highest and partner's academic qualification

Highest academic level	Myself	Partner
Never went to school		
Lower primary (1-4)		
Upper primary (5-8)		
K.C.S.E (form 4)		
A' Level		
Teacher (P1)		
College (diploma)		
Undergraduate degree		
Masters and above		
Other (specify)		

Professional training: _____

Training in soil and water conservation: (Yes/ No)

Duration of training ……..

Farmer field schools ……..

Type of activities involved in: _____

Give some details of the enterprise:

_____

Income

Amount per month (self): _____ source: _____

Amount per month (spouse): _____source: _____

Other income sources: _____ (Yes/ No)

Explain the sources: _____

Amount of income from other sources: _____

Farming system

(i) Experience in farming (no of years in farming): _____

(ii) Which year did you start living here _____

(iii) Size of your farm _____

(iv) Area currently farming on _____

(v) Land ownership (land tenure):

(Owned with title /owned without title/ Rented/ Borrowed/ an empty plot)

(vi) Crops grown on your farm:

Crop	Acreage	Average production	Where marketed

Attitude towards soil and water management practices and techniques

Agree or disagree with the following statements related with water use management, using the following rating scale:

1=Strongly Disagree, 2=Disagree; 3=Moderately Agree; 4=Agree; 5=Strongly Agree.

Soil and Water management practices and technologies	**Rating**				
	1	**2**	**3**	**4**	**5**
Terraces are important to protect soil from erosion					
Contour farming assists in reducing soil erosion					
Gabions reduce erosion and stabilize gullies					

Planting of grass or vegetation strips along the contour can assist in protecting soil from erosion					
Protecting the riparian area					
Grass seeding on bare areas can help in stabilizing the soil					
Planting trees can aid in controlling soil erosion					
A lot of livestock cause overgrazing and soil loss					
You need to spend money to protect soil					
Working collectively as a group is easier in soil and water conservation activities					
We need to protect the environment					

Knowledge on soil and water conservation technology

(i) Are you trained in soil and water conservation practices: (Yes/No)

(ii) Where were you trained……

(iii) Length of training: …….

(iv) Have you visited other farmers undertaking soil and water conservation: (Yes/No)

(v) Level of knowledge on environmental conservation activities

Gauge your level of knowledge on the following practices related to environmental conservation practices on a scale of 0 to 5 (0= no knowledge, 1=very low knowledge, 2=low knowledge, 3=medium knowledge, 4=high knowledge, 5=very high knowledge)

Environmental conservation activities	**Rating on knowledge**					
	0	**1**	**2**	**3**	**4**	**5**
Terracing						
Contour farming						
Stone lines						
Grass strips or vegetation strips						
Protection of riparian areas						

Grazing management (conserve fodder)						
Planting trees						
Agroforestry						
Seeding with grass species						
Protecting trees to aid in soil stabilization						
Cultivation on steep slopes						
Gabions						
Types of soils						

Participation in Collective action foe Environmental conservation

(i) Membership to group (Yes/No)

(ii) Number of groups you are a member _____

(iii) Name of groups _____

(iv) Group activities: marketing of crops ( ); transport provision ( ); loans ( ); merry go round ( ); burial ( ); other name them

_____

(v) Are groups involved in soil and water conservation practices: (Yes/No)

(vi) Name of the groups_____

(vii) Level of participation in collective action involved in environmental conservation

0=no participation, 1=very low participation, 2=low participation, 3=medium participation, 4=high participation, 5=very high participation

Environmental conservation activities	**Level of participation**					
	0	**1**	**2**	**3**	**4**	**5**
Terracing						
Contour farming						
Stone lines						
Grass strips or vegetation strips						
Protection of riparian areas						
Grazing management (conserve fodder)						
Planting trees						

Agroforestry						
Seeding with grass species						
Protecting trees to aid in soil stabilization						
Cultivation on steep slopes						
Gabions						
Types of soils						

(viii) **Level of affordability of environmental conservation practices**
0=not affordable, 1=very low affordability, 2=low level of affordability, 3=medium level of affordability, 4=high level of affordability, 5=very high level of affordability

environmental conservation practices	**Rating Level of affordability**					
	0	**1**	**2**	**3**	**4**	**5**
Terracing						
Contour farming						
Stone lines						
Grass strips or vegetation strips						
Protection of riparian areas						
Grazing management (conserve fodder)						
Planting trees						
Agroforestry						
Seeding with grass species						
Protecting trees to aid in soil stabilization						
Cultivation on steep slopes						
Gabions						
Types of soils						

Section E: Adoption of environmental conservation activities on farm

(i) Terraces on your farm (Yes / No)

(ii) Type …….

(iii) Length of terraces on your farm ……

(iv) Grass strips (Yes / No)

(v) Length of grass or vegetation strips ……..

(vi) Grass species used on the grass strips …….

(vii) Contour planting (Yes /No)

(viii) Number of contour on your farm …….length ……

(ix) Cut off drains (Yes / No)

(x) Stone lines on contours (Yes / No)

(xi) Length of cut off drains on your farm ……

Water conservation

(i) Run off harvesting from roads (Yes/No)

(ii) Storage pond (Yes/No)……..pond lined with plastic (Yes/No)

(iii) Mulching (Yes/No) type of mulching (plastic/ dead plant material)

Tree planting/Agroforestry

Name of species	Number existing	Where planted: boundary, within the farm, woodlot

Soil Fertility Enhancement

(i) Compost heap (Yes/No)

(ii) Fertilizer application (Yes/No)

(iii) Amount of fertilizer per planting season …….

Grazing management

(i) Zero grazing (Yes/No);

(ii) Type and number of animals kept under zero grazing

…….

(iii) Fodder plots (Yes/No)

(iv) Size of fodder plot ……..

(v) Species planted on fodder plot ……..

(vi) Fodder conservation (Yes/No)

Riparian Area Management

Removing animals from the riparian zone (area on the banks of rivers and stream) (Yes / No)

Planting vegetation on the riparian area (Yes / No)

Species used:

……

……

……

Appendix C: Field Photos

Kimao dam wall and reservoir

Kimao dam reservoir

Steep slopes within the dam catchment area

Kimao dam showing the steep landscape of dam catchment

Riparian area near the Kimao dam

Tree seedlings within the tree nursery next to the Kimao dam

A well conserved farm showing with terraces and fruit trees

Stony soil surface indicating erosion on farms located in Kimao dam catchment

A crop farm located on steep slopes within the Kimao Catchment area

An eroded farm and a fenced farm in the background within Kimao catchment area

Homesteads within the Kimao dam catchment area

Animals grazing in the riparian area within the Kimao catchment

A degraded area within the Kimao catchment showing loss of top soil

A stone mantle showing severely eroded area within the Kimao catchment

Gullies in the catchment area

Gullies

Eroded stream banks

Erosion of top soil and formation of Gullies

Appendix D: ANU letter of Approval to Undertake Research

AFRICA NAZARENE
UNIVERSITY

19th June, 2018

RE: TO WHOM IT MAY CONCERN

Emily Jepkorir Kiplangat 17I03EMEV003 is a bonafide student at Africa Nazarene University. He/She has finished his/her course work and has defended his/her thesis proposal ***entitled "Household factors affecting adoption of soil and water conservation measures within the catchment of Kirandich and Kiman dam areas in Baringo County, Kenya.***

Any assistance accorded to him/her to facilitate data collection and finish his/her thesis is highly welcomed.

Prof. Rodney Reed
Deputy Vice Chancellor, Academic Affairs

PO Box 52069 - 00200 Nairobi, Kenya • Tel: 020 252 7001 5 • Fax: 020 701 2259 • Cell: 0735 874 311 • Email: registrar@anu.ac.ke • www.anu.ac.ke

Appendix E: NACOSTI Research License

THIS IS TO CERTIFY THAT:
MS. EMILY JEPKORIR KIPLAGAT
of AFRICAN NAZARENE UNIVERSITY,
419-30400 Kabarnet,has been permitted
to conduct research in *Baringo County*

Permit No : NACOSTI/P/18/32335/25146
Date Of Issue : 24th September,2018
Fee Recieved :Ksh 1000

on the topic: *HOUSEHOLD FACTORS AFFECTING ADOPTION OF SOIL AND WATER CONSERVATION MEASURES WITHIN KIRANDICH AND KIMAU CATCHMENT AREAS IN BARINGO COUNTY-KENYA*

for the period ending:
21st September,2019

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. The License is valid for the proposed research, location and specified period.
2. The License and any rights thereunder are non-transferable.
3. The Licensee shall inform the County Governor before commencement of the research.
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
5. The License does not give authority to transfer research materials.
6. NACOSTI may monitor and evaluate the licensed research project.
7. The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.

National Commission for Science, Technology and innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 20797

CONDITIONS: see back page

Appendix F: NACOSTI Research Authorization Letter

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
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Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/32335/25146**

Date: **24th September, 2018**

Emily Jepkorir Kiplagat
Africa Nazarene University
P.O. Box 53067-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Household factors affecting adoption of soil and water conservation measures within Kirandich and Kimau Catchment Areas in Baringo County-Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Baringo County** for the period ending **21st September, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Baringo County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

DR. MOSES RUGUTT, PHD, OGW
DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Baringo County.

The County Director of Education
Baringo County.