FACTORS INFLUENCING THE ADOPTION OF SUSTAINABLE LAND MANAGEMENT PRACTICES IN THE UPPER MARA RIVER BASIN: AMALO AND KIPLABOTWA LOCATIONS, KENYA

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DECLARATION AND RECOMMEDATION

I declare that this thesis is my original work and has not, wholly or in part, been submitted or presented for examination or award of a degree in any other university.

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DEDICATION

This thesis is dedicated to my mother Silvia Gaiti Njuki. She is a beacon of hope and inspiration to me and many others.

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ABSTRACT

The Mara River Basin (MRB) is a trans-boundary resource being shared between Kenya (65%) and Tanzania (35%). The basin supports the livelihoods of many Kenyans through economic activities such as forestry, agriculture and tourism. However, in the past two decades the upper MRB has undergone major changes in land use with conversion of natural landscapes such as forests and grasslands into agricultural lands. Coupled with an increase in human population, these changes are leading to environmental degradation in the basin. This study was conducted in two locations situated in the upper MRB; Amalo and Kiplabotwa locations. The broad objective was to assess factors influencing the adoption of land management practices (LMPs) in the upper MRB. A multi-stage purposeful sampling procedure was used in the research. Stage I - Olenguruone and Longisa divisions were chosen as agro-ecosystems located in the upper MRB and Stage II - Amalo and Kiplabotwa Locations were chosen due to their proximity to the river. A sample of 214 households was used in the study. Households interviewed using questionnaires were proportionate to the total households within each location. Households in close proximity to the river were purposefully selected through simple systematic sampling. Data collection tools that were used included: questionnaires, interviews, focus group discussions (FGDs) and observation. The Statistical Package for the Social Sciences (SPSS) was used for qualitative and quantitative analysis of data. The findings indicated that the most commonly adopted LMPs were agroforestry, mulching and grass strips. The major factors influencing the adoption of Structural Land Management Practices (SLMPs) were: the perception of environmental degradation, the extension staff visit(s), the membership in self-help group(s) and the farm size while on the other hand, major factors influencing the adoption of the Vegetative Land Management Practices (VLMPs) were: the perception of environmental degradation, the perceived effectiveness of VLMPs, the leadership position of the respondents, the topography of the farm and the on-farm income. The study concluded that, institutional factors had a major influence on the adoption of SLMPs while socio-economic factors had major influence on the adoption of VLMPs. The study recommends that conservation efforts in the upper MRB should focus their interventions on institutional factors and socio-economic factors for SLMPs and VLMPs respectively.

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LIST OF ABBREVIATIONS AND ACCRONYMS

CBO	Community Based Organization
ESRAPO	Eastern and Southern Africa Regional Programme Office
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FRP	Forestry Research Programme
IBM	International Business Machine
ICRAF	International Centre for Research in Agroforestry
KFWG	Kenya Forest Working Group
KNBS	Kenya National Bureau of Statistics
LMP(s)	Land Management Practice(s)
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
MRB	Mara River Basin
NRM	Natural Resource Management
PES	Payment for Environmental Service
RUSLE	Revised Universal Soil Loss Equation
SLM	Sustainable Land Management
SLMP(s)	Structural Land Management Practice(s)
UNCED	United Nations Conference on Environment and Development
USLE	Universal Soil Loss Equation
VLMP(s)	Vegetative Land Management Practice(s)
WAC	World Agroforestry Centre
WWF	World Wide Fund for Nature

CHAPTER ONE:

INTRODUCTION

1.1 Background Information

Most of the natural landscapes on the earth's surface have been significantly altered by human activities over the past two decades (UNEP, 2007). Through land use activities such as clearing forests, intensifying agricultural production and expanding urban centers, humans are changing the world's landscape at an unprecedented rate (Sherbinin, 2002). This modification of the land has had profound, both positive and negative, effects upon the natural environment and consequently land use is a primary component of many environmental concerns today.

The Mara River Basin (MRB) is found within the Lake Victoria Basin (LVB). It covers approximately 13,750 km^2 and is shared between Kenya (65%) and Tanzania (35%) (LVBC and WWF-ESRAPO, 2010). In Kenya, the MRB covers the administrative areas of Nakuru, Bomet and Narok (Mati *et al.*, 2005). The MRB is a diverse landscape and supports a number of land uses. On the northern part of the basin, in Nakuru County is the Mau forest. Adjacent to the forest are human settlements where small-scale farming is prevalent. Large-scale tea plantations are found south of the forest area also in combination with human settlements. In addition, some urban settlements including Olenguruone, Bomet and Mulot towns are found in this region. Further south, towards Narok County, large-scale mechanized agricultural farms and small private irrigation farms and group ranches surround the outskirts of the Masai Mara National Reserve. As the MRB nears Lake Victoria in the Tanzanian side, the landscape changes to swampland commonly referred to as the Mara Swamp (LVBC and WWF-ESRAPO, 2010).

Land use and management are major environmental concerns in the upper MRB (LVBC and WWF-ESRAPO, 2010). This is because land on the upper MRB acts as a watershed for the Mara River and supports a number of land uses such as forestry, agriculture and human settlements. The basin has over the last two decades undergone major changes in land use and land cover. The main forested area the Mau forest, gazetted as early as 1902 by the colonial government, plays an important role in preserving and maintaining water balance of the MRB but has significantly been reduced over the past decades. Due to anthropogenic processes the main

forested area has reduced by over 50% during the last four decades (KFWG, 2003). There has been a significant reduction in forest and shrubland versus a significant increase in cropland and rangelands in the MRB. Between 1985 and 2010 there was an increase in cropland/ rangeland by 28% and a decrease of forest and shrubland by 38% in the MRB (Waithaka *et al.*, 2012). Moreover, water resources in the MRB including basin swamps, wetlands, rivers and artificial water pans have reduced by 10% during the same period (Waithaka *et al.*, 2012). Other studies have shown that between the years 1986 and 2000 there was a decrease of closed forest from 892.7 Km^2 to 688.6 Km^2 (23%) and a decrease of shrub and grassland from 9593.8 Km^2 to 7244.5 Km^2 (24%) (Mati *et al.*, 2005). Moreover, the studies have shown that there was an increase in open forest/ tea plantations from 1072.9 Km^2 to 1948 Km^2 (82%) and agricultural land from 1617.4 Km^2 to 2503.5 Km^2 (55%) during the same period (Mati *et al.*, 2005). This trend continues unabated with an all-time high rise in human population in the MRB.

There is rampant increase in human population in areas within the upper MRB, specifically the counties of Nakuru and Bomet. For instance, in Olenguruone Division population was projected to rise from 32,030 in 2009 to 49,654 in 2012 representing a 35% increase in human population in a period of three years (Ministry of State for Planning, National Development and Vision 2030, 2009). In Bomet county, Longisa division, the population density was projected to increase from 294 people per square Km in 1999 to 391 persons per square Km in 2010 (NEMA, 2009). This rapid increase in human population has placed immense strain on natural resources and has led to the unsustainable use of natural resources in the basin. This is threatening the livelihoods of the numerous people who rely on the Mara River not only for water but also for income from economic activities such as tourism and agriculture.

Sustainable land management (SLM) is a knowledge based procedure that helps to integrate land, water, biodiversity and environmental management to meet the rising food and fiber demand while sustaining ecosystems services and livelihoods (World Bank, 2008). It is necessary for meeting the requirements of a growing population and involves activities that preserve, conserve and enhance the productive capacity of agricultural lands and watersheds. In addition, SLM practices help to stop and reverse degradation and the adverse effects of earlier misuse of land. It is also a system of technologies and/ or planning that aims at integrating

ecological with socio-economic and political principles in the management of land for agriculture and other purposes so as to achieve intra and intergenerational equity (Hurni, 1997). The approach aims at enabling land users to maintain the economic and social benefits from the land while maintaining or enhancing the ecological support function of land resources (Liniger *et al*., 2011). The approach entails the use of appropriate, soil structural management practices, soil fertility management practices, agricultural water management, forestry and agroforestry, forage and rangeland management and application of these measures in an integrated way to satisfy community needs while solving ecological problems. The current situation in the upper MRB is characterized with the increased shift of land use towards agricultural use, the rampant increase in human population and declining environmental conditions. It is therefore crucial that land use and land management be assessed so as to obtain knowledge on the commonly used practices and to set a roadmap towards the achievement of SLM.

1.2 Statement of the Problem

Different human activities in the upper MRB over the years have continuously shaped the basin to what it is today. Human activities like clearing of riparian vegetation, deforestation, degradation of grazing lands and unsuitable cultivation methods have led to large scale environmental degradation in the upper MRB. Moreover, the demand on the natural resources in the upper MRB continues to increase with human population growing at a rate of more than 3% per annum (Hoffman, 2007). Environmental problems such as soil erosion, sedimentation, pollution and reduced water flows during the dry season are currently rampant in the basin. In order to attain sustainable utilization of natural resources in the upper MRB there is need to assess the Land Management Practices (LMPs) and factors influencing their adoption as a basis for adoption of SLM.

1.3 Broad Objective

The broad objective of this study was to assess the factors influencing the adoption of land management practices in the upper MRB.

1.4 Specific Objectives

The specific objectives were to:

i. Identify land management practices in the upper MRB.

ii. Examine the influence of socio-economic factors on the adoption of land management practices in the upper MRB.

iii. Assess the relationship between the farmland characteristics and the adoption of land management practices in the upper MRB.

iv. Evaluate the relationship between institutional factors and the adoption of land management practices in the upper MRB.

1.5 Research Questions

i. What are the land management practices in the upper MRB?

ii. How do socio-economic factors influence the adoption of land management practices in the upper MRB?

iii. How do farmland characteristics relate to the adoption of land management practices in the upper MRB?

iv. How do institutional factors relate to the adoption of land management practices in the upper MRB?

1.6 Significance of the Study

Land in the upper MRB, covering Nakuru and Bomet Counties, acts as a watershed for the Mara River. Three of the main tributaries of the Mara River, the Amala, the Nyangores and the Engare Ngito River source their waters from this region (Mati *et al.*, 2005). The MRB supports the livelihoods of many Kenyans through economic activities such as forestry, agriculture and tourism which contribute to the sustainability of the Kenyan economy. The MRB is part of the greater Nile basin supporting important tourism destinations such as the Masai Mara game reserve and the Serengeti National Park. As human population increases and environmental degradation continues, there is need to assess the LMPs in the upper MRB with an aim of reducing the degradation and enhancing land production. Currently, there is inadequate information on LMPs and factors influencing the adoption of LMPs in the upper MRB. There is need to evaluate the adoption of SLM practices on agricultural lands in the upper MRB as this information can be used for improving livelihoods of the community and controlling environmental degradation. The study of LMPs in the MRB was informed by a previous study

conducted in the basin. This study found the need to assess LMPs in the MRB as unsustainable LMPs were thought to contribute significantly to the degradation of the river ecosystem (LVBC and WWF-ESRAPO, 2010). The findings of this study will contribute towards enhancing sustainable management of the MRB and the existing knowledge on the management of agro-ecosystems found within river basins.

1.7 Scope and Limitations of the Study

The study was conducted in Amalo and Kiplabotwa Locations in Nakuru and Bomet Counties of Kenya respectively. Households were the main units of the study. The variables that were investigated include; land management practices, socio-economic factors, farmland characteristics and institutional factors. The main limitation of the study was language barrier between the respondents and the interviewer.

1.8 Definition of Terms

Catchment area: refers to an area where water is collected by the natural landscape.

Farmland Characteristics: refer to the physical characteristics of the farm that are hypothesized to influence the adoption of LMPs. In this study they include: the farm size, the distance of the farm from the river, the soil type and the topography of the farms.

Household: refers to a group of individuals, who live on the same farm, work together on at least one parcel of land and recognize the authority of a single head of household in major decisions relating to the farm.

Household Characteristics: refer to factors that are attributed to the household head or the household that are hypothesized to influence the adoption of LMPs. In this study they include: gender, marital status, age, education level, occupation and the household size.

Institutional factors: refer to the guidelines or knowledge of a given organization that are hypothesized to influence the adoption of LMPs. In this study they include awareness of NRM policies and legislation, membership in self-help groups or associations, extension staff visit(s) and land tenure.

Land Management: means the process that land as a natural resource is put to effective use.

Land Management Practices: refer to the soil and water conservation measures that have been adopted on a farm or field.

Natural Resource Management (NRM) policies and legislation are policies and laws that guide the management of natural resources and the environment in general. In this research, NRM policies include the Forest Act of 2005, the Water Act of 2002, the National Land policy Sessional Paper No.3 of 2009, and the Environmental Management and Coordination Act, 1999.

River Basin: refers to an area of land drained by a river and its tributaries.

Socio-Economic factors: refer to the social and economic characteristics attributed to a given household that are hypothesized to influence the adoption of LMPs. In this study they include: the household income, the leadership position of the respondents, the perception of environmental degradation and the perceived effectiveness of the LMPs.

Sustainable Land Management: refers to the wise use of soil and water resources on a farm or field to meet all the present household's needs while maintaining its potential to meet the needs of the future generations (World Bank, 2008)

Structural Land Management Practices (SLMPs): refer to soil conservation measures which control surface runoff and soil erosion by means of contour-aligned barriers (Liniger *et al.*, 2011). In this study they include grass strips, cut off drains, bunds/ barriers and terraces.

Vegetative Land Management Practices (VLMPs): refer to the soil conservation measures that use living or dead plant material to cover soil surfaces (Liniger *et al.*, 2011). In this study they include agroforestry and mulching.

Watershed: refers to an area where all the water under it or that drains from it moves in the same direction.

CHAPTER TWO:

LITERATURE REVIEW

2.1 Land Use, Cover and Management

Land use is the term used to describe human uses of land, or immediate actions modifying or converting land cover (Sherbinin, 2002). Land use also refers to the purpose to which land is committed including production of goods such as crops and fibre and provision of environmental services such as recreation and biodiversity (Lesslie, 2004). Land use includes such broad categories as human settlements, protected areas and agriculture within which there are more refined categories such as urban and rural settlements, irrigated and rainfed fields, national parks and forest reserves and infrastructure among others.

Land cover on the other hand refers to the observed physical surface of the earth, including various combinations of vegetation types, soils, exposed rocks and water bodies (Lesslie, 2004). Land cover also refers to the natural vegetative cover types that characterize a particular area (Sherbinin, 2002). These are generally a reflection of the local climate and landforms, though they too can be altered by human actions. Examples of broad cover categories include forest, tundra, savannah, desert or steppe, which in turn can be sub-divided into more refined categories representing specific plant communities. Land management refers to the means by which the land use objective is achieved (Lesslie, 2004). The purpose of managing land use is to enhance the sustainability of the land use activity by enhancing or maintaining production levels while protecting ecosystem services.

The scientific research community has previously called for substantive study of land-use and land-cover changes during the 1972 Stockholm Conference on the Human Environment and later at the 1992 United Nations Conference on Environment and Development (UNCED). In addition, the Rio plus twenty (Rio +20) UN conference has called for SLM and sustainable agriculture so as to ensure food security and nutrition is enhanced. The strong interest in land use and land cover results from their direct relationship to many of the earth's fundamental processes including the productivity of the land, the diversity of plant and animal species and the biogeochemical cycles.

Currently human activities, land use included, use up approximately a third to half of global ecosystem production and the increase in human population and development continues to mount pressures on the environment (World Bank, 2008). As a result there is increasing concern about the condition of the global ecosystems and ecosystem services. On one hand, many land use practices are absolutely essential for humanity because they provide critical natural resources and ecosystem services such as food, shelter, fiber and freshwater. On the other hand, some forms of land use are degrading to the ecosystems and services which we depend on. The question is how best we can manage land use activities so as to make them sustainable such that they do not degrade the environment and undermine ecosystem services and human welfare. Good LMPs lead to healthy ecosystems (Bellows, 2003). Appropriate land management in river basins is important for water quality protection, water capture and storage, stabilization of water flow, structural support of banks and flood control (Bellows, 2003).

2.2 Human Population and Land Use

Humans are a dominant force in global environmental change through their production and consumption patterns. Human population is an important driver of environmental change, leading to increased demand for food, water and energy and putting pressure on natural resources (Tiffen *et al.*, 1994). The world's population is on the rise and today's world population is three times larger than it was at the beginning of the 20th century (UNEP, 2007). Moreover, migration of people influences demographic changes and settlement patterns, particularly at regional levels. Human population has a complex relationship with the environment and if not properly managed may result to degradation of land and local ecosystems (UNEP, 2007). Anticipated human population increases and continued economic growth are likely to further the increase in exploitation of land resources over the next 50 years (UNEP, 2007). Rise in human population is foremost among other drivers of land use change such as technological and political change (UNEP, 2007). Globally, the most dynamic land use changes have been in forest cover and composition, expansion and intensification of cropland and the growth of urban areas (World Bank, 2008; UNEP 2007). Some of these land uses are unsustainable and drive land degradation through contamination and pollution, soil erosion and nutrient depletion.

Most theoretical perspectives on environmental change argue that at any given level of affluence and technology, population is the key determinant of natural resource consumption

(Axinn and Ghirime, 2007). Within a fixed local area the total effect of increasing numbers of people is predicted to be less land devoted to agricultural uses and vegetation. For instance, increase in human population results to increased consumption of vegetation and increased construction of buildings and infrastructure. Recent studies of micro-level connection between population change and land use however are beginning to indicate that numbers of households may be a more important predictor of land use patterns than numbers of people (Liu *et al.*, 2005). This seems reasonable because the number of household units may drive the actual micro-level patterns of consumption more closely than the number of people. To some extent households are the main consumers of vegetative resource, particularly in the form of fuel wood and fodder, and therefore greater numbers of households result in decreased land devoted to vegetation. Thus at the community level, change in the number of households may have a stronger influence on changes in land use than change in the number of people (Liu *et al.*, 2005). However, population size, measured by either the number of people or numbers of households, may not be the only dimension of human population that influences land use. Others such as the age structure, fertility, mortality and migration may affect the consumption of vegetation and the construction of buildings and infrastructure. These may also interact with the environment to reduce the local land area devoted to flora (Axinn and Ghimire, 2007).

2.3 Sustainable Land Management

According to Foster (1973), selecting the proper use of the different kinds of land on the farm is the first and most important step in conservation farming. The success of all other phases of the conservation program on the farm will depend on the judgment used in selecting a land-use pattern that is within the capability of the land. This entails deciding whether the field is suited for crops, pasture, woodlots or recreation. It requires an evaluation of the farm features including soil depth, soil color, soil texture, soil structure, movement of air and water through soil, depth of water table, slope, susceptibility to erosion, susceptibility to overflow, presence of unfavorable chemicals and climate of the area (Foster, 1973).

Sustainable Land Management (SLM) is 'a knowledge based procedure that helps to integrate land, water, biodiversity and environmental management to meet the rising food and fiber demand while sustaining ecosystems services and livelihoods' (World Bank, 2008). It is

necessary for meeting the requirements of a growing population and involves activities that preserve, conserve and enhance the productive capabilities of croplands, forestlands, grazing lands and watersheds (World Bank, 2008; World Bank, 2006). SLM has also been defined as the adoption of land use systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources (Liniger *et al.*, 2011). The latter definition gives a clear link between land use, LMPs and the socio-economic and ecological values of land. The concept of SLM is composed of three main components namely; the use of different technologies or practices, the need for participatory land management planning and implementation and the need for appropriate policy environment for its support (Liniger *et al.*, 2011). The focus of SLM is to increase land productivity, improve livelihoods and to sustain ecosystem functions and services (World Bank, 2008; World Bank, 2006).

2.3.1 Sustainable Land Management Practices

A common misconception is that SLM involves only the use of physical/ structural soil conservation measures (Liniger *et al.*, 2011; Hurni, 1996). On the contrary, SLM also includes the use of appropriate soil fertility management practices, agricultural water management, forestry and agroforestry, forage and range land management and application of these measures in an integrated way to satisfy community needs while solving ecological problems. SLM best practices are those that increase production, are profitable, cost efficient, are easy to learn, are socially and culturally acceptable, can be effectively adopted, environmental friendly and are appropriate for all stakeholders including socially marginalized groups (FAO, 2008). In addition, they cover major land use systems, represent solutions to various degradation types in different agro-ecological zones, have a potential for improvement in terms of both production and conservation, capture local innovation and strike a balance between prevention, mitigation and rehabilitation of land degradation (Liniger *et al.*, 2011; World Bank, 2008).

According to Liniger *et al.* (2011), SLM practices can be classified into four main categories namely; agronomic measures, vegetative measures, structural measures and management measures. Agronomic measures are those that relate to arable farming and they improve soil conditions and enhance organic matter input into the soil (Kuypers *et al.*, 2005). Vegetative

measures involve planting or reseeding of tree and shrub species, grasses and perennial herbaceous plants on the farm or field. Structural measures include establishment of cross-slope barriers for instance terraces, bunds, dams, pans, ditches, walls, barriers and palisades while management measures involve the change of land use type, change of production intensity level and change in timing of production activities.

According to Young (1997) there are two technical means of achieving soil and water conservation; the barrier approach and the cover approach. Barrier approaches conserve soil by checking runoff and soil removal primarily by means of contour-aligned barriers including terraces, ditch and bank earth structures, grass strips or hedgerows while cover approaches check raindrop impact and runoff through the maintenance of soil cover. The cover approach uses living or dead plant materials such as crop residues, herbaceous plants, tree litter and prunings on soil surfaces. Major techniques in this category include the use of cover crops, mulching and minimum tillage (Young, 1997).

Based on the Universal Soil-Loss Equation (USLE) (Figure 2.1), later revised to the Revised Universal Soil-Loss-Equation (RUSLE) (Wischmeier and Smith, 1978), soil conservation should be based on either the reduction of the effective slope length or increasing the soil cover.

$$A = R \times K \times L \times S \times C \times P$$

R is the rainfall factor

K is the soil erodibility factor

L is the slope length factor

S is the slope steepness factor

C is the cover factor

P is the supporting practice factor

Equation 2.1: Universal Soil Loss Equation

All other factors in the equation held constant, the relation between the slope length and erosion is approximately linear where reducing the slope length reduces erosion (Young, 1997). On the other hand, increasing the soil cover reduces soil erosion, with complete soil cover (100% cover) throughout the period of erosive rains reducing erosion substantially. In comparing the

two approaches however, it is noted that cover approach offers more potential for conservation on steep slopes as it is inherently cheaper and less labor intensive (Young, 1997).

A combination of these methods is nonetheless possible and sometimes necessary as there is no single panacea to problems which land users face. The choice of the most appropriate SLM practice in a particular situation will be determined by local stakeholders, based on the local topographic, soil and vegetation conditions and socioeconomic context. However, it should be noted that while good land management is important at the field or farm level, it is not enough to ensure sustainability (FRP, 2005). The planning and implementation of sound land management at the watershed level and even beyond is important for enhancing ecological integrity and ensuring that food and fiber systems are resilient enough to avoid degradation of land and water resources.

2.3.2 Structural Soil Conservation Measures

Cross-slope barriers are measures on sloping land in the form of earth or soil bunds, stone lines and/ or vegetative strips for reducing runoff velocity and soil loss, thereby contributing to soil, water and nutrient conservation (Liniger *et al.*, 2011). The barriers reduce steepness and/ or length of the slope. While the cross-slope barriers are primarily intended to reduce erosion, they also ease cultivation between the barriers (Liniger *et al.*, 2011).

Terraces are more or less horizontal beds on the slope, laid out along the contour (Kuypers *et al.*, 2005). The purpose of a terrace is to prevent water flowing too quickly over a sloping field and thus minimize the risk of erosion. Terraces are not usually constructed per se, but rather they develop gradually behind other cross slope barriers as a result of the movement of soil from the upper to the lower part of the terrace (Liniger *et al.*, 2011). They are usually constructed on cropland that slopes as much as 2% and where the slope is longer than 90 to 120m (Foster, 1973).

Depending on the function or the way they are built, there are different types of terraces: Based on function terraces can be categorized as earthen terraces, absorption terraces or drainage terraces while based on the way they are built they can be classified as bench terraces, *fanya juu* terraces or *fanya chini* terraces (Liniger *et al.*, 2011; Kuypers *et al.*, 2005). Earthen terraces are

the simplest kind of terrace and are the most common in hilly regions. These terraces contain two basic features namely; an earth bund and a drain. In dry areas the terrace drain is often laid down-slope while in wetter areas the drainage channel is laid out up-slope so as to reduce the risk of serious damage to the fields by a breakage in the earthen bund during heavy run-off (Kuypers *et al.*, 2005). *Fanya juu* terraces are made by digging ditches and trenches along the contour and throwing the soil uphill to form an embankment while in *fanya chini* terraces soil is piled below a contour trench (Liniger *et al.*, 2011). Bench terraces are developed on steep slopes as a result of constructing cross-slope barriers after which erosion progressively causes the bed to level. They are defined by a flat or slightly backward or forward sloping bed. They may be stabilized by grass, trees or stones depending on which is readily available. Apart from preventing erosion, absorption terraces have an extra important function of water conservation. These terraces collect runoff water after a rainstorm, store it up temporarily and then let it to infiltrate the soil. These are especially beneficial in dry areas where there is often a water shortage. In contrast to normal bench terraces absorption terraces slope slightly backwards to facilitate infiltration. Drainage terraces safely transport the runoff water from a field and are normally constructed on a slight slope (1%) parallel to the contour line (Kuypers *et al.*, 2005).

The width of a terrace depends on the steepness of the slope and other local conditions such as soil type and rainfall intensity. The table below shows the recommended width of a terrace based on the slope percentage.

Table 2.1: Width of Terrace versus Slope Percent

Slope (z/x * 100%)	Terrace distance (x)
1%	40-60m
2%	20-40m
6%	15-30m
10%	10-20m
40%	5-10m

Source: Kuypers *et al.*, (2005)

Earth bunds are soil conservation structures that involve construction of an earthen bund along the contour by excavating a channel and creating a small ridge on the downhill side. Usually the earth used to build the bund is taken from both above and below the structure. They are often reinforced by vegetative cover to stabilize the construction. In areas where stones are plentiful, stone lines are used to create bunds either as soil conservation measure or for rainwater harvesting. As a result stone bunds are formed. Stones are arranged in lines across the slope to form walls. Where these are used for rainwater harvesting, the permeable walls slow down the runoff, filter it and spread the water over the field, thus enhancing water infiltration and reducing erosion (Liniger *et al.*, 2011).

Vegetative strips are the least costly and labour-demanding type of cross-slope barriers. Such strips are popular way to terrace land especially in areas with relatively good rainfall. The spacing of the strips depends on the slope of the land. On gentle sloping land, the strips are given wide spacing (20-30m) while on steep land the spacing may be as little as 10-15m (Liniger *et al.*, 2011). These can also provide fodder for livestock if palatable varieties of grass are used.

Water ways or outlets (cut off drains) are one of the most common and basic conservation practices that are generally recognized, accepted and used by farmers (Foster, 1973). Wherever there is rainfall or when the soil is saturated, there are conditions under which a surplus of water will pass over the land in the form of runoff. This water will collect in the natural drainage and flow from the field. Safe removal of this surplus water is a common problem to many farms and the success of any soil conservation depends on the removal of this surplus water without damage to the land. Factors that are considered in the design of the waterway include; the size of the area from which the water will collect in the channel, the topography of the area, the nature of the soil and the vegetation cover (Foster, 1973). Vegetated waterways are more preferable to bare waterways as they reduce the amount of erosion within the channel. The shape of the waterway whether trapezoidal (flat bottom), parabolic (saucer-shaped) or V-shaped, should also be taken into consideration. Parabolic-shaped waterways however are the most common because they are easily shaped and hence easy to construct and is the common shape under natural conditions.

2.3.3 Agroforestry

The scientific rediscovery of agroforestry dates back to the mid 1970's, during when the International Development Research Centre was established, but the roots of agroforestry tradition date back to earlier times (Mahat, 1993). In the 1970's, the Bene commission concluded that the top priority in enhancing tropical forestry depended on agrisilviculture (Mahat, 1993). This term was later expanded and modified to encompass agroforestry. Agroforestry was defined as 'a sustainable management system for land that increases the overall production, combines agricultural crops, tree crops and forest plants and/ or animals simultaneously or sequentially and applies management practices that are compatible with the cultural patterns of the local population' (Bene *et al.*, 1977).

Noting that not all combinations of trees and/ or crops and/ or livestock would meet this criteria, agroforestry was later redefined by ICRAF as the deliberate integration, in space or time, of wood perennial with herbaceous crops and/ or animals on the same land management unit for a variety of benefits and services (Hassanuzzaman, 2012; Liniger *et al.*, 2011; Nuberg *et al.*, 2009; Young, 1988). The concept implies that there are ecological and economic interactions among the components of the system. Nevertheless, it is the ecological interactions that are the most distinctive feature, taking place above ground, below ground and through transfers of biomass when tree litter or prunings are added to the soil.

Another definition of Agroforestry that was adopted when International Centre for research in Agroforestry (ICRAF) was renamed to the World Agroforestry Centre (WAC) is that agroforestry is 'a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels' (FAO, 2008). In simple terms however, it can be noted that agroforestry is the growing of trees on farms (Johnson, 2006; Young, 1997).

The integration of agricultural crops, trees or/ and livestock can be either in a spatial mixture (simultaneous system) or in a temporal sequence (sequential system) (Hassanuzzaman, 2012; Verheji, 2003; Young, 1997). Agroforestry systems are distinctive types of agroforestry at any

level of generalization (Young, 1997). It is useful to distinguish between the broader classes such as boundary planting or improved tree fallows and particular local examples of these classes. Previously, there have been attempts to refer to the broader classes of agroforestry as agroforestry technologies or practices while reserving the term agroforestry systems for specific types (Nair, 1993; Young, 1989). However, the term agroforestry system is now being commonly used to refer to both cases.

Agroforestry ranges from very simple and sparse to very complex and dense systems. The broad groups are characterized mainly by distinctive arrangements of components in space and time, together with their objectives and functions (Hassanuzzaman, 2012; Liniger *et al.*, 2011; Young, 1997; Nair, 1993). Agroforestry systems embrace a wide range of practices such as alley cropping, farming with trees on contours, perimeter fencing with trees, multistory cropping, relay cropping, bush and tree fallows, parkland systems and home gardens among others. The more specific, often local, agroforestry systems are described by their physical environment, the plant and animal species present, management practices and social and economic functioning (Young, 1997). There are thousands of specific agroforestry systems in the world but only about twenty major groups.

In soil conservation, the primary objectives of any agroforestry design should be to reduce runoff, through increasing infiltration and maintenance of soil cover (Young, 1997). Trees and shrubs in agroforestry have both direct and supplementary uses in terms of soil erosion control. In supplementary use, the trees are not the primary means of checking runoff and erosion but are added to conventional conservation structures, while in direct use the trees or shrubs themselves are the primary means of checking erosion. In supplementary use, trees stabilize earth structures by their root systems and also they make productive use of the land occupied by the structural conservation measures. In direct use, trees increase soil cover by litter or prunings and hence reduce the raindrop impact, increase infiltration and hence reduce runoff. The trees provide partly permeable barriers to check runoff, they increase resistance to soil erosion through the maintenance of organic matter and also maintain soil fertility through decay of litter or prunings.

2.4 Factors Influencing Adoption of Land Management Practices

The sustainable management of land is crucial in enabling the long term use of the soils. Although soil degradation caused by poor agricultural practices is a process defined by technical, climatic and bio-physical factors, there is recognition that the underlying causes are to be found in the socio-economic, political and cultural context in which farmers operate (Prager and Posthumus, 2010; Akinbile and Odebode, 2007; Natasha *et al.*, 2007). The main emphasis of this research will be on soil conservation but bearing in mind that the way soils are managed has direct or indirect impact on water as well. Soil conservation efforts control runoff, contribute to flood risk management and/ or lead to reduction in water pollution.

Decision-making on farm management is strongly influenced by agricultural policies and economic incentives. However, the introduction of new policies and uptake of agri-environment schemes does not automatically guarantee success in the ecological and environmental outcomes (Prager *et al.*, 2010). It is therefore important to understand the factors that influence farmers' adoption of agri-environment measures in general and soil conservation practices in particular. An investigation of socio-economic factors in adoption decisions is linked to the specific conservation practice and the bio-geophysical conditions of a given place. In addition, the decision of a farmer to adopt a conservation practice is not only determined by factors relating to the farm and its management but by exogenous institutional and social factors beyond the farm finances and farmer characteristics. According to Prager and Posthumus (2010), the factors that determine the adoption of soil conservation practices can be grouped into four categories; Household factors representing the actors and in the case of this research the household heads; Environmental factors representing the bio-physical context; Economic factors representing the technical and financial aspects of the practices and Institutional factors representing the institutions and governance structures. There is however an overlap between the factors and the variables they are representing.

Environmental factors such as degree of degradation, climate and the soil type determine how quickly and severely degradation and its negative impacts become visible and also which technology is suitable, which restrictions are faced and which adaptations become necessary. Economic factors determine the adoption of technologies. The technology must be available,

accessible and compatible with existing processes and technologies on the farm. Economic constraints arise if the technology is too expensive to implement. Access to capital is a precondition for investments. A technology is evaluated by financial return such as the costs incurred or the profit generated from high yields. The technology must adequately address the land degradation problems and show environmental benefits along with economic benefits. Labour must be available to carry out the required operation. Family labour may facilitate adoption. The farming system should be flexible enough to accommodate the new technology practice or at least allow for an adaptation without major costs. The less change a conservation practice requires the more likely the adoption. Incentive schemes, where available, compensate for cost incurred resulting from the implementation of soil conservation measures. Indirect costs such as learning costs are incurred during the gathering of information about a land management practice. Costs for compliance with regulations or non-compliance should also be considered (Prager and Posthumus, 2010).

Institutional factors include; policies, legislation, incentive programs, land tenure and property rights, assistance networks, extension and training, enforcement mechanism and sanctions (Kutter *et al.*, 2010). Policies and legislation are used as 'carrot and stick' tools to encourage behavioral change. Information about policies and soil conservation must reach the farmer; therefore extension and access to adequate information are essential. The ownership of land and the security of land tenure may influence the willingness or ability of the farmer to undertake soil conservation. If policies contradict or if incentives provided through various schemes compete, the farmer is likely to choose the financially more attractive option.

Factors relating to the household head like education, age and experience, attitude towards soil conservation, risk perception, emotion, interests, trust and attitude towards method of change also influence adoption of conservation practices (Prager and Posthumus, 2010). Information must reach the farmer to facilitate the recognition of a problem and the awareness of potential solutions including practices and technologies. The most relevant information is knowledge of degradation processes and their mitigation measures together with information about perceptions and attitudes towards soil conservation. The personal perception of social and economic constraints may differ from person to person and changes over time. Attitudes and the

assessment of a risk of a technology based on values rely on social background and experience. If policies and technologies are perceived as justified, useful and effective, farmers are more likely to take up prescribed practices.

2.5 Climate Change and Sustainable Land Management

Climate change and land degradation are major threats to the survival and livelihoods of millions of people in sub-Saharan Africa (Woodfine, 2009). The high dependence of economies on rainfed agriculture coupled with high poverty levels, food insecurity and limited institutional capacities make coping with the effects of climate change a major challenge (TerrAfrica, 2006). Severe land degradation caused by conversion of forests, woodlands and bushlands to agricultural lands, overgrazing of rangelands, unsustainable agricultural practices on croplands, and excessive exploitation of natural habitats is reducing the primary productivity of the land with the most severe impacts in drylands and forest margins (TerrAfrica, 2006).

Climate variability and change can contribute to land degradation by exposing unprotected soil to more extreme conditions and straining the capacity of existing LMPs to maintain the quality of resources. In addition, climate change can contribute to de-vegetation, soil erosion and depletion of organic matter among other forms of degradation. These changes can cause LMPs that were sustainable under a certain set of climate conditions to become unsustainable and induce more rapid conversion of forest or rangeland to unsustainable agricultural uses. Alternatively, climate change can offer new opportunities for productive and SLM practices such as reforestation, improved water management, integrated soil fertility management, conservation agriculture, agroforestry, improved rangeland management and others as a result of changing biophysical or economic conditions (Woodfine, 2009). New opportunities for SLM are arising from regulations and emerging markets to mitigate global emissions of greenhouse gases.

SLM can also reduce vulnerability and help people adapt to climate variability and change. Many SLM practices can simultaneously achieve both adaptation and mitigation goals, especially those that increase soil organic carbon. SLM represents a preventive approach to climate change that can reduce the need for costly post coping measures like changing

livelihoods and clearing new lands for agriculture and migration. SLM practices also reduce the variability of agricultural production while others can help to diversify agricultural income.

2.6 Conceptual Framework

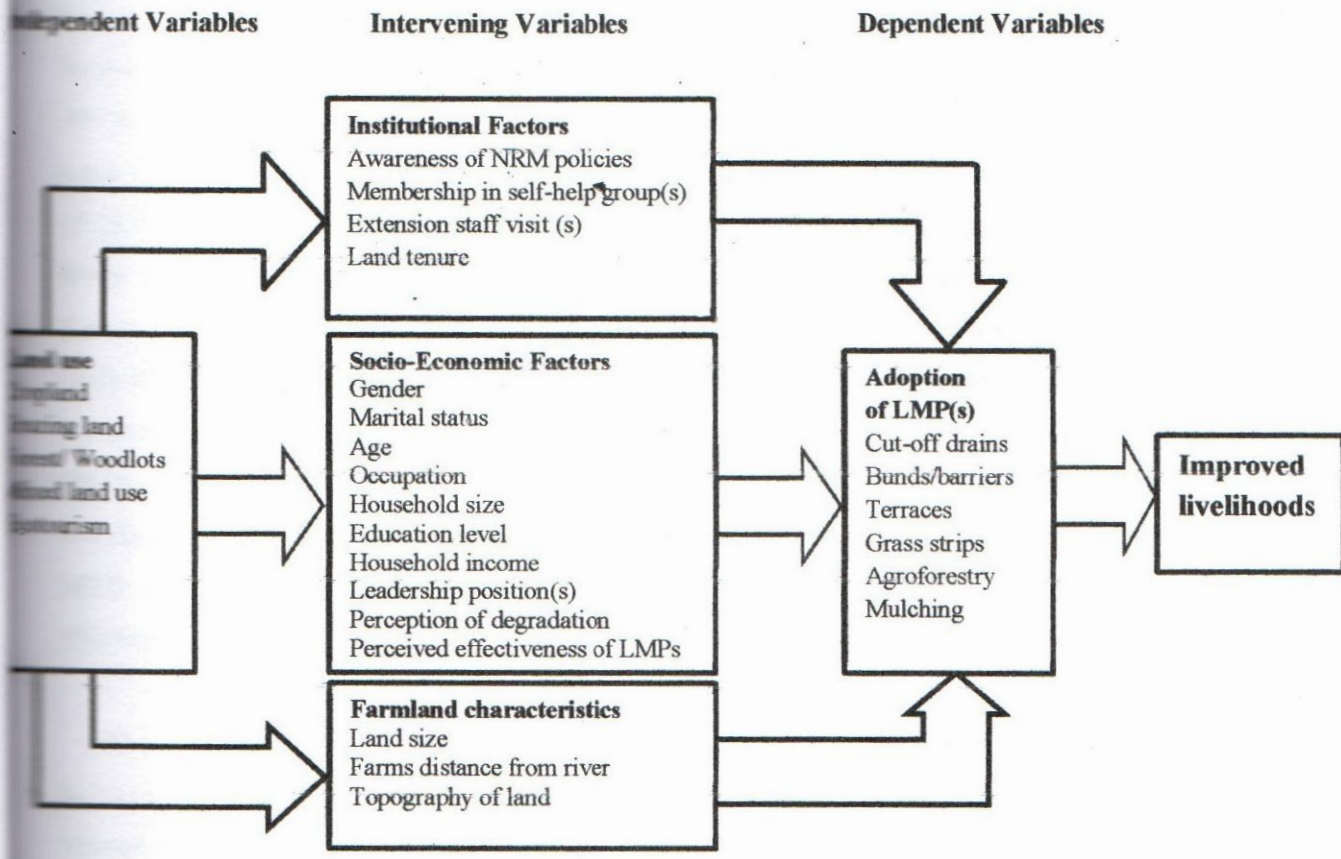


Figure 2.1: Conceptual Framework for Adoption of LMPs

The conceptual framework (figure 2.1) was informed by the sustainable livelihood framework. It shows the relationship between land use and LMPs. Land use entails productions systems such as farming, grazing, ecotourism and forestry while LMPs entail soil and water conservation practices. Land use determines the type of LMPs to be adopted and adoption of SLM leads to improved land production and improved livelihoods. Other factors such as socio-economic factors, institutional factors and farmland characteristics also play a key role in determining the LMPs to be adopted.

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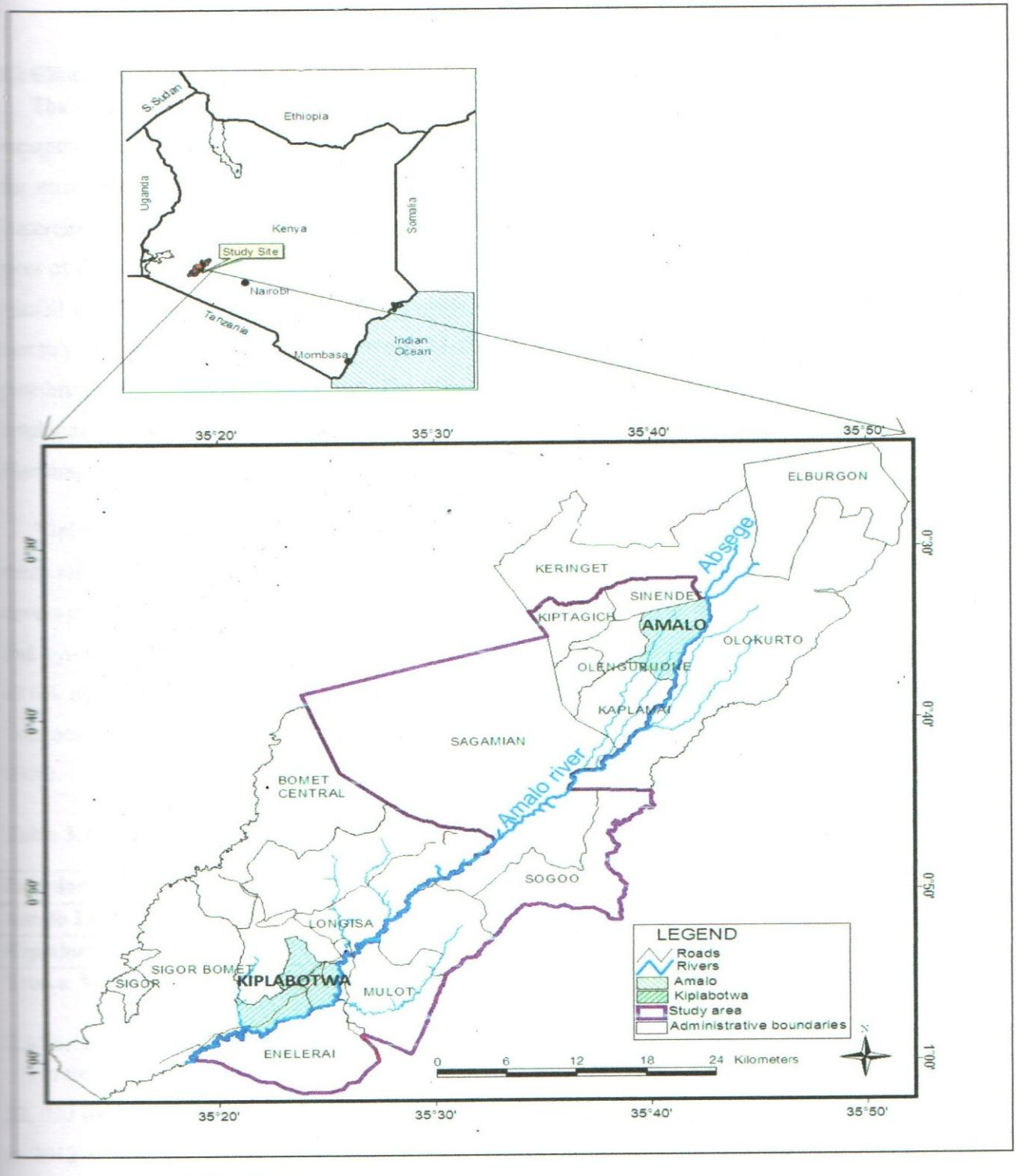
CHAPTER THREE:

METHODOLOGY

3.1 Study Area

The MRB is located between longitudes 33°47'E and 35°47'E and latitudes 0°28'S and latitude 1°52'S (LVBC and WWF-ESRAPO, 2010; Mati *et al.,* 2005). The MRB is a trans-boundary basin in East Africa shared by Kenya and Tanzania. The Mara River flows for about 395 Km from the source in the Mau Escarpment in Kenya to the Mouth on the Tanzania side of Lake Victoria (LVBC and WWF-ESRAPO, 2010; Hoffman, 2007). The MRB covers a land area of 13,750 Km^2 (Hoffman, 2007). The upper 65% (8,941 Km^2) is in Kenya while the remaining lower portion is in Tanzania (Mati *et al.,* 2005). The Mara River originates from the Mau Escarpment among streams and patches of the Mau forest. The main perennial tributaries of the Mara River are the Amalo and the Nyangores which drain in the western Mau catchment. Other tributaries include the Talek, the Engare Ngito and the Sand River (LVBC and WWF-ESRAPO, 2010). At the Mau catchment the rainfall ranges between 1000-1750 mm per annum while in the middle rangelands rainfall ranges from 900-1000 mm per annum (LVBC and WWF, 2010). The MRB covers three administrative counties in Kenya namely; Nakuru, Bomet and Narok (Hoffman, 2007).

Two locations within the upper MRB were selected namely; Amalo and Kiplabotwa locations (Figure 3.1). Amalo location is located in Olenguruone division of Nakuru county located between longitude 35° 28' and 35° 36' East and latitude 0° 13' and 1° 10' South. (Ministry of State for Planning, National Development and Vision 2030, 2009). Kiplabotwa location is situated in Longisa Division of Bomet county located between latitudes 0° 29' and 1°03' South and longitudes 35° 05' and 36° 35' East (Ministry of State for Planning, National Development and Vision 2030, 2009).



Source: Maina G.M. (2012)

Figure 3.1: Map of Study Area

3.2 Climate and Topography

The main topographic feature in the Olenguruone division, Amalo location is the Mau escarpment with an average altitude of 2500 m above sea level. The Mau Forest is located within the escarpment. Most of the forest is located in the Mau escarpment hence making it an important feature for the location. The forests influence the rainfall pattern in the division and most of the rivers including the Mara originate from it. Olenguruone receives an average annual rainfall of 1270 mm per annum covering areas of 1800-2400 m above sea level. The mean monthly temperature ranges from between 24-29 °C. The cool climate is highly suitable for pyrethrum farming and potato growing. The Mau forest is a major source of timber and firewood employing large populations in the districts both indirectly and directly (Ministry of State for Planning, National Development and Vision 2030, 2009).

Kiplabotwa location is located in the south-eastern part of Bomet County. The location has a mean rainfall of between 1,100 mm and 1,500 m and a mean monthly temperature of 18 °C. It covers areas of about 900-1200 m above sea level. The conditions favor dairy, tea, coffee, maize and pyrethrum. Kiplabotwa location is in a modified tropical zone with clay soils that cover 43.6% of the county. This zone lies in the high potential land for agricultural and improved livestock development (Ministry of State for Planning, National Development and Vision 2030, 2008).

Table 3.1: Geographical Information of the Study Areas

Location	Rainfall	Temperature	Altitude	Soil type
Amalo Location	1270 mm	24-29 °C	1800-2400 m	Loams
Kiplabotwa Location	1100 mm	18 °C	900-1200 m	Clayey loams

Source: Ministry of State for Planning, National Development and Vision 2030 (2009; 2008)

3.3 Socio-Economic Profile

In the 2009 census, the total number of people that were living in Olenguruone division was 32, 030 with a population density of 185. The population was projected to rise rapidly to 49,513 in 2012 with a population density of 247. The most integral economic sector in this area is agriculture with most of the people practising subsistence agriculture. The average farm size for small scale farmers was 2.5 acres and the average farm size for large scale farmers was 100 acres (Ministry of State for Planning, National Development and Vision 2030, 2009).

In 2009, Longisa division had a population of 97,862 with a population density of 379 per Km^2 and a population growth rate of 2.7% per annum (KNBS, 2010). Agriculture/ livestock production contributes 62% of the household's income in Longisa with wage employment contributing to 27% and rural self-employment contributing approximately 6%. The average household size was 5 and the average farm size was 5 acres for small scale farmers and 15ha for large scale farmers (Ministry of State for Planning, National Development and Vision 2030, 2008).

3.4 Research design

The study involved a social survey design. A multi-stage purposeful sampling technique was used and 214 households from the two locations were included in the survey. The households surveyed were proportionate to the total household units in each location. Questionnaires and in-depth interviews were used to collect data. A questionnaire was preferred because of the ease of administration, scoring and analysis of data (Mugenda and Mugenda, 2003). The items on the questionnaire were developed on the basis of the study objectives. The questionnaires and interview schedules were administered by the researcher himself and where language was a barrier a translator was used. This enabled the respondents to understand clearly the items on the questionnaire. In-depth interviews were used to collect information from key informants such as environmental officers, agricultural extension workers, Ministry of Water officers and leaders of community based organizations involved in land management in the areas of study.

3.4.1 Sampling procedure and Sample size

Two hundred and fourteen households were sampled for the study (Table 3.2). Kathuri and Pals (1993) recommend that for a survey research 100 cases are adequate for each major sub-group. Since the study involved two major sub-groups, Amalo and Kiplabotwa locations, 200 cases or more were regarded as adequate. The sample was obtained using a multistage purposeful random sampling to select the household units. The Amala River was used as a criterion for purposeful random sampling. The villages situated alongside the river in the two locations were used to enable random selection of households to be included in the study. The sampled household units were proportionately calculated from the total number of households in the study areas. This is shown in table 3.2 below.

Table 3.2: Sample Size of Households

Location	Area (Km^2)	Total No. of Households	No. of households surveyed
Amalo Location	34.2	2035	90
Kiplabotwa Location	42.1	2828	124
TOTAL	76.3	4863	214

Source: KNBS (2010)

3.4.3 Data Collection

The multistage purposeful sampling procedure was used as follows. In stage I two divisions in the upper catchment of the Mara River were chosen: Olenguruone and Longisa Divisions. In Stage II Locations within the upper MRB with farming as the main activity and the main source of water as the Mara River were chosen: Amalo location in Olenguruone division and Kiplabotwa location in Longisa division.

In Amalo location households in the following villages were surveyed: Number one, Kipteden, Kabartonjo, Kapkorio, Kaprochwa, Kitoben, Nyambuko, Longet, Lelaitich and Motito. In Kiplabotwa location households in the following villages were surveyed: Simotwet, Chemilda, Kejingo, Kaproret, Olokyin, Nyahururu, Mulot rural, Kapuswo and Kapliyo. In these villages, households in close proximity to the river were purposefully selected through simple systematic sampling. Households living near the river were selected because these communities derive most benefits from the river and directly affect the river by their activities.

Thirty questionnaires were used for the pretest at Enelerai location with similar river basin characteristics. After the pre-test, errors in the questionnaire were rectified and it was later administered to the households in the selected villages for the actual data collection. The focus of the interviews during data collection was on the heads of the households so as to ensure uniformity of data. In the event that the household head was absent a guardian was interviewed. This is a member who had been entrusted with the responsibility of overseeing the running of the household in the absence of the household head. In addition, details of telephone contacts were captured on the questionnaire, in case clarification of information was required later.

In-depth interviews were used to collect information from the key informants namely; Environmental officers, Agricultural extension workers, Ministry of Water Officials, Forest officers, Government administrators and Leaders of CBOs involved in land management in the two locations. Focus Group Discussions (FGDs) were also used to collect qualitative information on LMPs. Observations were made to complement the information being sought by the questionnaire. Observations were made on the various types of LMPs and on environmental degradation. Photography was used to recode the observed data.

3.4.4 Reliability

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials (Mugenda and Mugenda, 2003). The questionnaires were pre-tested with a sample of 30 household units in an area similar to the study area. This was done in Enelerai location which nieghbours Kiplabotwa location to the south. Enelerai location is also located in the upper MRB and most of the residents are also small-holder farmers. Thirty questionnaires were chosen for the pre-testing because it is the smallest number that can yield meaningful results for data analysis in a correlational research (Kathuri and Pals, 1993).

3.4.5 Validity

Validity is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study (Mugenda and Mugenda, 2003). It has to do with how accurate the data obtained in the study represents the variables of the study. The supervisors and peers reviewed the research instruments to ensure accuracy and precision of the variables to be measured in the study.

3.4.6 Data analysis

After data collection, mistakes found in the questionnaires were corrected. Coded data was then entered for analysis. Quantitative and qualitative data was analyzed by the use of the International Business Machines(IBM) Statistical Package for the Social Sciences (SPSS) version 17 (Polar Engineering and Consulting, 2008). Qualitative data was re-coded into numeric data sets for Chi-square test, Spearman rho correlation and Regression analysis.

Both descriptive and inferential statistics were used in the analysis of data derived from the social survey. Inferential statistics helped to generalize the results of the study from the samples to the target population while descriptive statistics were used to describe the data. Parametric tests such as the Spearman rho correlation and Regression analysis were used to determine the relationships between the variables under study. Non-parametric tests such as the chi-square were also used to determine the relationships between categorical variables in the study.

Table 3.3: Research Questions, Variables and Methods of Analysis

Research questions	Variables	Analysis Method
1. What are the land management practices in the upper MRB?	– Cut off drains – Terraces – Bunds and barriers – Grass strips – Agroforestry – Mulching	– Cross tabulation – Chi-square tests
2. How do socio-economic factors influence the adoption of land management practices in the upper MRB?	– Gender – Marital Status – Age – Education level – Occupation – Household size – Household income ▪ On-farm income ▪ Off-farm income – Leadership position of respondents – Perception of degradation – Perceived effectiveness of LMPs	– Cross tabulation – Chi-square test – Spearman's rho correlation – Regression
3. How do institutional factors relate to the adoption of land management practices in the upper MRB?	– Awareness level of NRM policies and legislation – Membership in self-help group(s) – Extension staff visit(s) – Land tenure	– Cross tabulation – Chi-square test – Spearman's rho correlation – Regression
4. How do farmland characteristics relate to the adoption of land management practices in the upper MRB?	– Land size – Topography of the land – Distance from the River	– Cross tabulation – Chi-square test – Spearman's rho correlation – Regression

CHAPTER FOUR:

RESULTS AND DISCUSSION

4.1 Land Management Practices

The LMPs that were assessed in the study were categorized into two main groups: structural land management practices (SLMPs) and vegetative land management practices (VLMPs). The SLMPs that were found included: use of grass strips, cut off drains, terraces and bunds/ barriers while the VLMPs that were found included: agroforestry and mulching.

4.1.1 Structural Land Management Practices

For the SLMPs, 31.8% of the respondents were using grass strips on their farms, 15.9% were using cut off drains, 9.8% were using terraces while 15.0% were using bunds/ barriers (Table 4.1). The reason why grass strips were preferred to other SLMPs was that they were dual-purpose in nature and could also be used to provide fodder for livestock alongside soil conservation. Only 6.7% of the respondents in Amalo Location were using grass strips while 50.0% of the respondents in Kiplabotwa had grass strips on their farms.

For cut off drains, only 8.9% of the respondents in Amalo location had adopted cut off drains as compared to 21.0% of the respondents in Kiplabotwa location. This could be attributed to farmland characteristics such as the drainage and the topography of the land whereby most of the farms in Amalo had steep slopes as opposed to Kiplabotwa where most of the farms were moderately sloppy and nearly level in nature. It therefore could be that most of the farmers in Amalo location found no reason to adopt the cut off drains. Most of the respondents who had adopted the cut off drains noted that these were mostly constructed on a seasonal basis especially during the rainy season so as to direct excess runoff from the farms. For those who had adopted the cut off drains they were not well maintained. It was observed that they were not grassed properly so as to reduce soil erosion within the channels.

For terraces, 18.9% of the respondents in Amalo location had adopted terraces as opposed to only 3.2% of the respondents in Kiplabotwa location. Again this discrepancy could probably be attributed to farmland characteristics such as the topography of the land and land size with the

terraces mostly being adopted on farms with very steep slopes and adequate spacing. For the few (3.2%) that had adopted terraces in Kiplabotwa, these SLMPs were found on farms with moderate slopes and were widely spaced.

For bunds/ barriers, only 2.2% of the respondents in Amalo location had adopted the bunds/ barriers as compared to 24.2% of the respondents in Kiplabotwa location. This again could be attributed to farmland characteristics such as the topography whereby bunds/ barriers placed along the contour were taken as an alternative to terraces in the gentle and moderately sloppy farms of Kiplabotwa location.

Other SLMPs that were used by the respondents included gabions and check dams. However, these were applied and maintained by the community members in collaboration with local environmental organizations to curb the development of gullies, to reduce severe bank erosion and to avoid the destruction of bridges by severe erosion.



Plate 4.1: Gabions in Kiplabotwa Location

4.1.2 Vegetative Land Management Practices

For VLMPs, 74.3% of the respondents were practicing agroforestry while 49.5% were practicing mulching on their farms (Table 4.1). Generally, agroforestry was widely adopted by the farmers because of the multiple-use of the trees. Most of the trees that were adopted by the farmers were multipurpose in nature. Tree species that were commonly used by the respondents

were *Juniperus procera*, *Olea africana*, *Acacia mearnsii*, *Eucalyptus globulus*, *Cypressus lustanica*, *Grevillea robusta* and *Hagenia abyssicnica* among others. Other commonly used tree species are shown in appendix two. In addition to playing a significant role in soil conservation the trees also provided fodder, timber, firewood, could be used as windbreaks and also as nurse plants, hence probably making agroforestry more widely adopted than other practices. Mulching involved leaving the crop residues and tree cuttings on the fields and was practiced in most cases in conjunction with agroforestry.

The focus group discussions found out other VLMPs that were adopted by the respondents on a smaller scale were the use of minimum tillage and fallows. The latter involved leaving some land uncultivated for duration of time while the former involved cultivation with minimum disturbance to the soil structure. It was found that minimum tillage as a LMP was not widely adopted by the respondents in the two locations because of the perceived risks of spreading diseases and pests to the crops and of weeds competing with the crops. Fallowing was adopted by farmers who had large tracts of farmland. The respondents noted that the fallow period of the farms had however reduced with time from five to three years to durations of even less than one year as more farmers had adopted intensive cultivation intended to cater for the food supply needs of the increasing population within the locations.

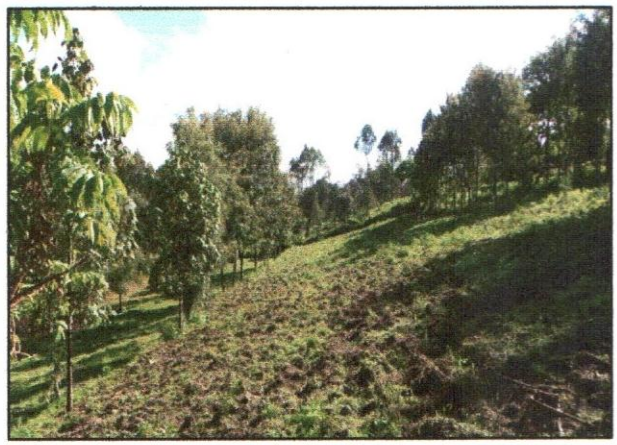
Table 4.1: Land Management Practices (Multiple Response - in %)

Land Management Practices	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Structural Land Management Practices			
Grass strips	6.7	50.0	31.8
Cut off drains	8.9	21.0	15.9
Terraces	18.9	3.2	9.8
Bunds/ Barriers	2.2	24.2	15.0
Vegetative Land Management Practices			
Agroforestry	81.1	69.4	74.3
Mulching	50.0	49.2	49.5

Source: Survey data (2012)



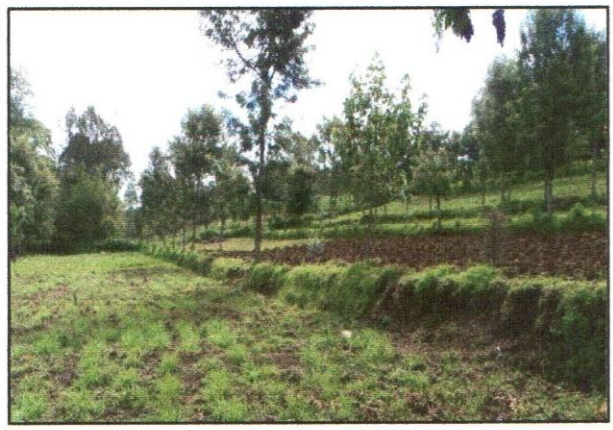
a



b



c.



d



e.

Plate 4.2: Land Management Practices in the Upper MRB

a. Grass strips
b. Alley cropping
c. Cut off drain
d. Terraces
e. Woodlots

The four common types of agroforestry systems that were observed were: on farm trees, live fence, woodlots and alley cropping. On farm trees had been adopted by 64% of the respondents, 91.0% had adopted live fences, 47.7% had adopted woodlots while only 5.1% practiced alley cropping (Table 4.2). Live fence was widely adopted than other forms of agroforestry practices because the respondents stated that it did not take up a large land area for cultivation and grazing and that it provided a cheap means of fencing-off land and paddocks. Alley cropping was the least adopted practices as respondents perceived that it took a lot of time and labour to establish and that it took up land that could otherwise be used for cultivation or grazing.

Table 4.2: Agroforestry Systems (Multiple Response - in %)

Agroforestry systems	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
On farm trees	74.4	56.5	64.0
Live fence	88.9	92.7	91.1
Woodlots	51.1	45.2	47.7
Alley cropping	1.1	8.1	5.1

Source: Survey data (2012)

There was a significant association of the area of residence and the adoption of SLMPs ($P = 0.000$, $\chi^2 = 30.359$) but no significant association between the area of residence and the adoption of VLMPs ($P = 0.282$, $\chi^2 = 2.533$). For instance there was a significant difference in the adoption of terraces and bund/ barriers in the two locations. In Amalo location, 18.9% of the respondents had adopted terraces as compared to 3.2% of the respondents in Kiplabotwa while 2.2% of the respondents in Amalo location had adopted the bunds/ barriers as compared to 24.5% of the respondents in Kiplabotwa location (Table 4.1). The significant difference in the adoption of the SLMPs in the two locations could be attributed to the physical factors such as topography and farm size.

4.2 Socio-Economic Factors

Socio-economic information about the household head was studied in order to understand how it influenced the adoption of LMPs in the two locations. Information about the household head that was studied comprised of the following variables: the respondent's, gender, age, education level, marital status, leadership position and occupation. In addition, other information

pertaining to the household such as the household size, household income, perception of environmental degradation and the perception of effectiveness of LMPs were also studied.

4.2.1 Gender of the Respondents

In terms of gender, 73.4 % of the respondents were men while 26.6 % were women. In Amalo location, 68.9% of the respondents were men while only 31.1% were women. In Kiplabotwa location, there were more male respondents (76.6%) and correspondingly lesser women respondents (23.4%) than Amalo location (figure 4.1). In both locations, 73.4% of the respondents were males since in most traditional communities in Kenya, including the Kipsigis, men are considered the most influential members of the community and hence heads of households (Bulow, 1992). This high percentage of male respondents could be that women and children are only considered heads of the household when the husband/ father is absent. In most traditional Kenyan societies including the Kipsigis, gender is important because it determines the level of access to resources, level of user rights and influences decision making within a household (Kiptot and Franzel, 2011).

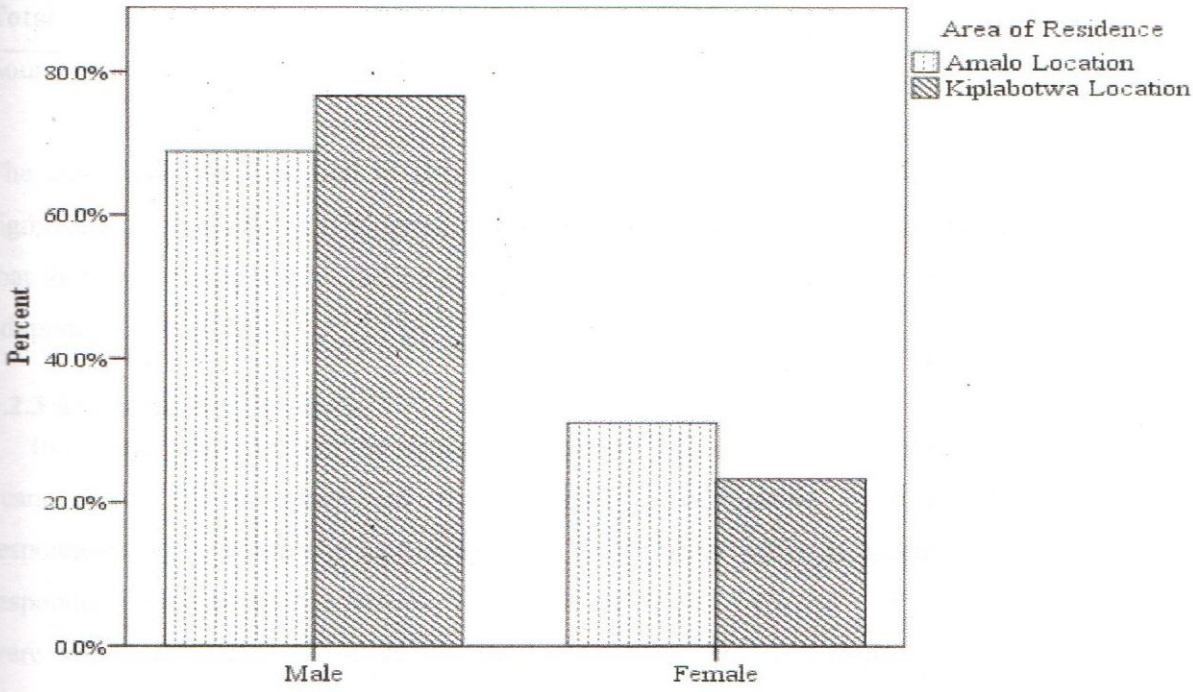


Figure 4.1: Gender of the Respondents (in %)

The chi-square test was used to check whether gender of the respondents was significantly associated with the adoption of LMPs. The findings revealed that the gender of the respondent

did not have any significant relationship with the adoption of both SLMPs and VLMPs in the two locations (Table 4.18).

4.2.2 Marital Status of the Respondents

On average 85.5% of the respondents stated they were married with 85.6% in Amalo Location and 85.5% in Kiplabotwa Location. In contrast, only 5.6% and 1.6% of the respondents stated they were single, 2% and 1.6% were separated/ divorced while 6.7% and 11.3% were widowed in Amalo and Kiplabotwa respectively (Table 4.3).

Table 4.3: Marital Status of Respondents (in %)

Marital Status	Amalo Location (n=90)	Kiplabotwa Location (n=124)	Total (n=214)
Married	85.6	85.5	85.5
Single	5.6	1.6	3.3
Separated/ Divorced	2.2	1.6	1.9
Widowed	6.7	11.3	9.3
Total	100.0	100.0	100.0

Source: Survey data (2012)

The chi-square test was used to check whether the marital status of the respondents had a significant association to the adoption of LMPs in the two locations. The test however revealed that there was no significant association between the marital status of the respondents and the adoption of both SLMPs and VLMPs (Table 4.18).

4.2.3 Age of the Respondents

In terms of age, 31.8% of the respondents interviewed were within the age category of 36-45 years with 17.8% in Amalo and 41.9% in Kiplabotwa location. In Amalo, 37.8% of the respondents were within the age category of 26-35 years while in Kiplabotwa 25% of the respondents were in this age bracket. For the two locations, 14% and 17.8% of the respondents were within age category of 46-55 years and above 55 years respectively. The smallest proportion (6.1%) of the respondents interviewed was below 25 years old. The mean age of the respondents was 42.58 years while the mode was 45 years old (Table 4.4).

These results show that the population in Amalo location is a relatively young and growing population compared to that of Kiplabotwa hence growth at a faster rate through natural increase is expected. This is because most of the respondents (37.8%) in Amalo location were in the age bracket of 25-35years as opposed to Kiplabotwa location where most of the respondents (41.9%) were in the age bracket of 36-45 years. According to the Ministry of State for Planning, National Development and Vision 2030 (2009; 2008) reports, the population growth rate in Molo district (Amalo location) is 3.4% per annum while that for Bomet district (Kiplabotwa Location) is 2.7% per annum.

Table 4.4: Age of Respondents (in %)

Respondents' Age	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 25 yrs.	12.2	1.6	6.1
26-35yrs	37.8	25.0	30.4
36-45yrs	17.8	41.9	31.8
46-55yrs	7.8	18.5	14.0
Above 55 yrs.	24.4	12.9	17.8
Total	100.0 x=41.23 s=16.671	100.0 x=43.56 s=10.285	100.0 x=42.58 s=13.361

Source: Survey data (2012)

Table 4.5: Age Structure of the Households (in %)

Age Structure of Households	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 12 years	22.12	22.06	22.08
13 – 18 years	12.39	22.56	18.88
19 – 35 years	35.40	29.32	31.52
35 – 55 years	19.47	22.06	21.12
Above 55 years	10.62	4.01	6.4
Total	100.0	100.0	100.0

Source: Survey data (2012)

In both locations, 71.52% of the household members were between 13-55 years indicating that a large labour force for the adoption of LMPs was available. From previous studies, the relationship between age and adoption of LMPs is not very clear. In some cases age has been

found to negatively influence the adoption of LMPs (Biadu-Forson, 1999), while in some cases it has been found to have a positive influence on the adoption of LMPs (Amsalu and de Graff, 2007).

The study revealed that the age of the household heads had a positive significant but weak relationship with the adoption of SLMPs (P = 0.027, Υ = 0.151) and no significant association with the adoption of VLMPs (P = 0.423, Υ =- 0.055) (Table 4.19). The findings revealed that there was an increase in the adoption intensity of SLMPs with the age of the respondent. This may be because of the experience of the older respondents to perceive environmental problems and also because of the limited involvement of older respondents in off-farm activities as opposed to their younger counter parts. In addition, young respondents were found to have smaller farm sizes as opposed to older respondents and this probably influenced their adoption of SLMPs which require substantial sizes of farmland. These results are in line with the findings of Amsalu and de Graff (2006) and Mengstie (2009) who found a positive significant relationship between the age of the respondents and the adoption of soil and water conservation measures. Amsalu and de Graff (2006) for instance, found a significant relationship between age and the adoption of stone terraces while Mengstie (2009) found a significant relationship between age and the adoption of cut off drains. In both studies, older respondents had adopted more intense SLMPs that their younger counterparts. The results are however contrary to the findings of Biadu-Forson (1999) who found that age had no significant relationship to the adoption of earth bunds.

4.2.4 Education Level of the Respondents

In terms of education level, 90.7% of the respondents stated that they had acquired formal education while only 9.3% were illiterate. Of those who had acquired formal education, 43.5% of the respondents had attained basic primary education, 26.2% secondary education while 21.1% tertiary education. In general however, the literacy levels were higher in Amalo than in Kiplabotwa with 93.3% having acquired formal education in Amalo as compared to 88.7% in Kiplabotwa. Moreover, respondents in Amalo location had attained higher levels of education than in Kiplabotwa with 26.6% of the respondents in Amalo attaining tertiary education as compared to 20.1% in Kiplabotwa and 31.1% of the respondents in Amalo attaining secondary

education as compared to only 19.4% in Kiplabotwa (Figure 4.2). This discrepancy in the level of secondary education may be attributed to the high secondary drop-out rates of 17% in Kiplabotwa as compared to 4.3% in Amalo location due to lack of school fees and early marriages especially for young girls (Ministry of State for Planning, National Development and Vision 2030, 2009; 2008).

Generally, better educated households have a better perception of environmental problems and have more knowledge related to LMPs and hence can be more easily involved in the adoption of conservation practices (Aberha, 2008). It is also known that more educated households are commonly well informed and receptive, which indicates a higher likelihood of adopting and engaging in conservation technologies (Ersado *et al.*, 2003).

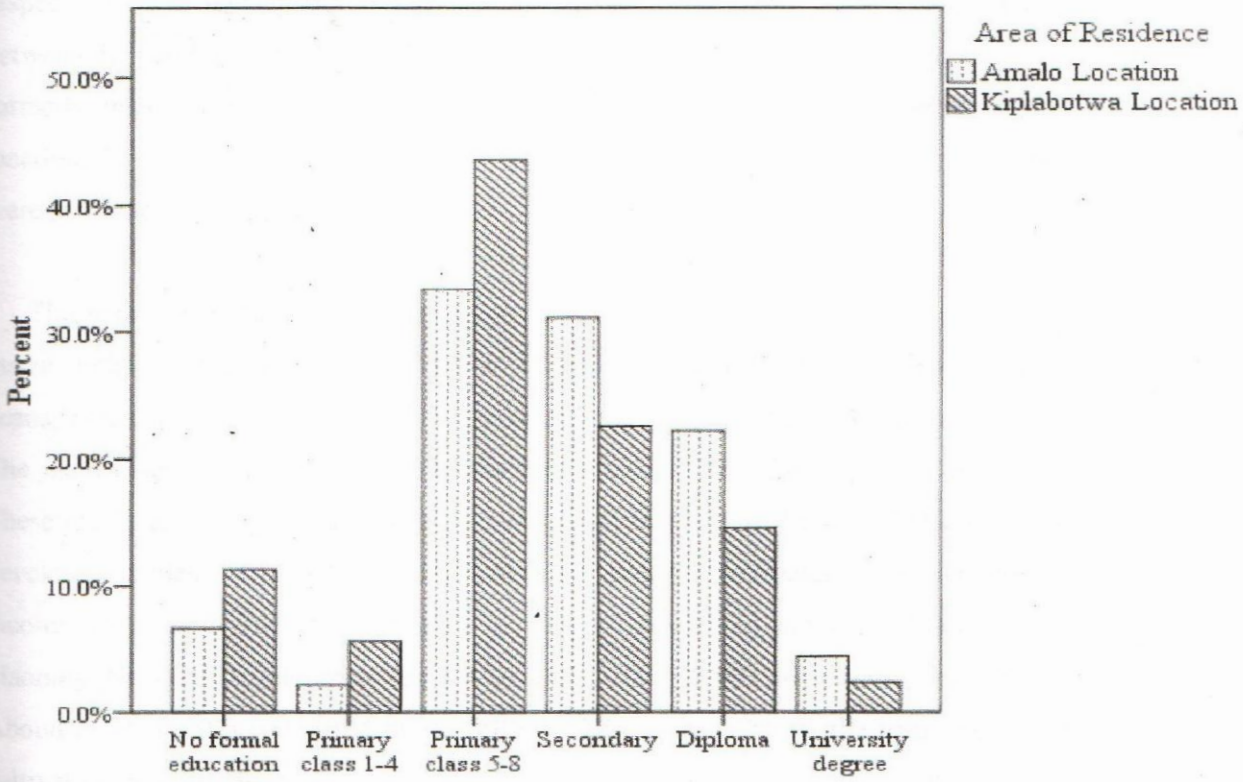


Figure 4.2: Education Level of the Respondents (in %)

The study found out that the educational level of the respondents had a marginally significant relationship with the adoption of the VLMPs ($P = 0.051$, $\chi^2 = 20.938$) but not with the adoption of the SLMPs ($P = 0.655$, $\chi^2 = 15.013$) (Table 4.18). The cross tabulation revealed that

comparatively educated respondents had adopted more intense VLMPs than illiterate respondents. This is possible because of high awareness in primary and secondary schools concerning the VLMPs and because of ease of adoption. These results are consistent with the findings of Krishana *et al.*, (2008) and Mengstie (2009) who found out that there was a significant relationship between the education level of the household head and the adoption of LMPs. However, they are inconsistent with the findings of the study by Aberha (2008) who found no significant association between the two variables.

4.2.5 Occupation of the Respondents

The main occupation for 67.8% of the respondents was farming with most of them practicing mixed farming while 19.2 % and 13.1% were formally employed and self-employed respectively. The discrepancy in terms of the occupation of the household heads was not great between the two locations. In Amalo location, 70% of the respondents were farmers, 18.9% were formally employed and 11.1% were self-employed/ running their own businesses. In Kiplabotwa location, 66.1% of the respondents were farmers, 19.4% were formally employed while 14.5% were self-employed (Figure 4.3).

The main crops that were being grown in Amalo location during of the study period were maize, potatoes, tea, peas and vegetables while in Kiplabotwa location they included maize, beans, potatoes, sweet potatoes and vegetables such as kales, cabbages, tomatoes and onions. The main types of livestock reared in the two areas included cattle, poultry, goats and sheep. These results are supported by the district development plans of Molo and Bomet districts. The development plans note that in Molo district agriculture contributes to 70% of the household income while in Bomet it contributes to 62% of household income (Ministry of State for Planning, National Development and Vision 2030, 2009; 2008). In addition, another research by Aboud *et al.*, (2002) conducted in the MRB found out that 62% of the respondents mentioned cultivation as their major occupation, 65% mentioned livestock rearing as their second major occupation while 21% mentioned self-run businesses as their third major occupation. According to Aberha (2008) respondents who are heavily engaged in off-farm activities do not have sufficient time and labor allotted to the continued use of soil and water conservation measures.

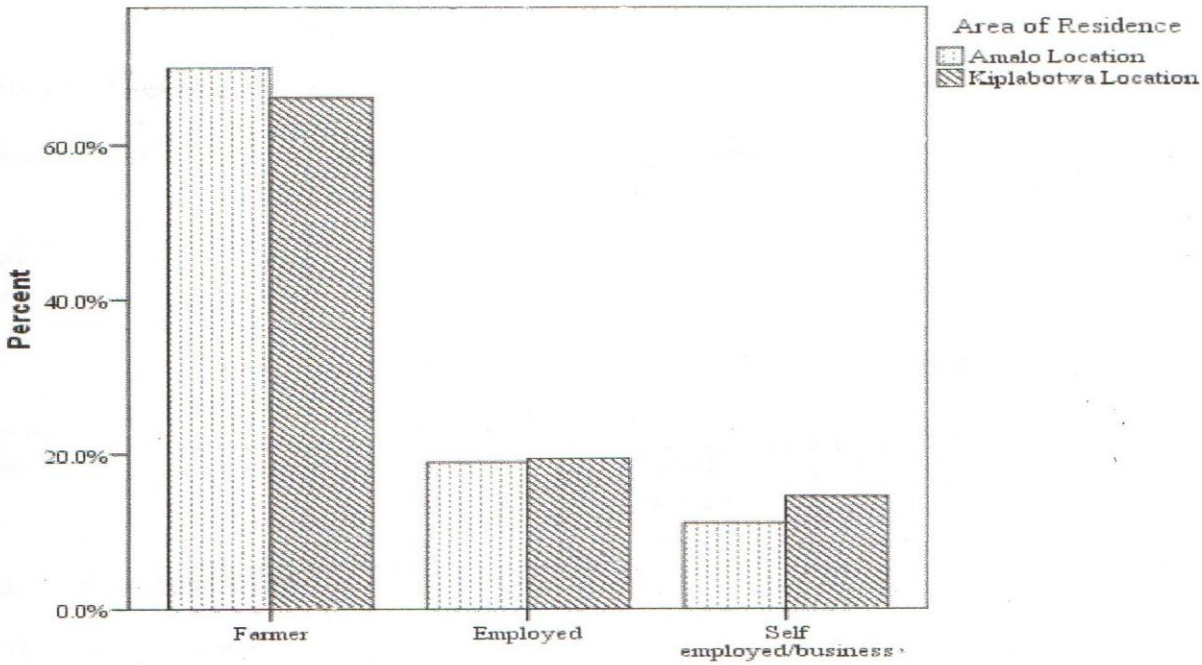


Figure 4.3: Occupation of the Respondents (in %)

The chi-square test was used to assess the association between the occupation of the respondents and the adoption of SLMPs and VLMPs. The results found out that there was no significant association between the occupation of the respondents in Amalo and Kiplabotwa and the adoption of LMPs. The occupation of the respondent however had a marginally significant relationship with the adoption of SLMPs ($P = 0.197$, $\chi^2 = 8.602$) (Table 4.18).

4.2.6 Household Size of the Respondents

The average number of males and females per household in both Amalo and Kiplabotwa Locations were 3 and 4 respectively while the average total household size was 6 in Amalo and 7 in Kiplabotwa. Most of the households (47.8%) in Amalo location had between 3-5 people while most of the households (59.7%) in Kiplabotwa location had between 6-10 people. Table 4.6 shows that Kiplabotwa location had comparatively larger household sizes than Amalo location probably because of numerous early marriages and high birth rates. In Amalo location, the crude birth rate was 41 per 1000 people per year while in Kiplabotwa it was 51 per 1000 people per year (Ministry of State for Planning, National Development and Vision 2030, 2009; 2008).

Table 4.6: Household Size (in %)

Household Size	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 2	10.0	0.8	4.7
3 - 5	47.8	27.4	36.0
6 – 10	31.1	59.7	47.7
11 – 15	11.1	10.5	10.7
16 – 20	0.0	0.8	0.5
Above 20	0.0	0.8	0.5
Total	100.0 x=5.61 s=3.30	100.0 x=7.29 s=3.215	100.0 x=6.58 s=3.348

Source: Survey data (2012)

The average number of persons per household in both Amalo and Kiplabotwa was 7 with majority of the household members (71.52%) being between 13-55 years (Table 4.5). This indicated that there was a large labor force available in both Amalo and Kiplabotwa locations and therefore this was expected to positively influence the adoption of LMPs. The size of the household has been found to have mixed effects on the adoption of LMPs. Mengstie (2009) and Nkegbe *et al.*, (2011) show that the increase in household members positively influences the adoption of LMPs by increasing the labour force available for adoption.

The household size was found to have a positive and significant relationship with the adoption of SLMPs (P = 0.003, Υ = 0.200) but a negative and non-significant association with the adoption of the VLMPs (Table 4.19). This is possibly because the SLMPs are more labor intensive in terms of both construction and maintenance when compared to the VLMPs. These findings were consistent with those of Nkegbe *et al.*, (2011) who found out that the household size had mixed effects on the adoption of LMPs in northern Ghana. According to Nkegbe *et al.*, (2011) the size of household increases the probability of adopting labor intensive LMPs such as stone bunds and composting while reducing the probability of adopting less labor intensive LMPs. However, Bekele and Drake (2003) found a significant negative correlation of the size of the household and the adoption of LMPs and they noted that in large households there arises competition for labor between off-farm activities and adoption of LMPs.

4.2.7 Household Income of the Respondents

The mean monthly household income was Ksh 16 628. In both Amalo and Kiplabotwa locations, 36.92% of the respondents earned a monthly income ranging from Ksh 5 000 to 15 000, 25.7% earned a monthly income of below Ksh 5 000, 19.6% earned an income ranging from Ksh 15 001 to 30 000, 13.6% earned an income ranging from Ksh 30 000 to 50 000, while 4.2% earned a monthly income of above Ksh 50 000 (Table 4.7).

The occupations of the respondents were categorized into three: farming, formal employment and self-employment (figure 4.3). In relation to the respondents' occupation, farmers had the lowest monthly income with an average of Ksh 12 406 while the formally employed and the self-employed had an average monthly income of Ksh 27 577 and Ksh 22 463 respectively. Consequentially, there were more respondents (28.9%) earning below Ksh 5 000 in Amalo location as compared to 23.4% in Kiplabotwa location because most of the respondents in Amalo location were more dependent on farming.

Table 4.7: Household Income per Month (in %)

Household Income (Ksh.)	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 5,000	28.9	23.4	25.7
5,000-15,000	32.2	40.3	36.9
15,001-30,000	17.8	21.0	19.6
30,000-50,000	16.7	11.3	13.6
Above 50,000	4.4	4.0	4.2
Total	100.0 x=17,600.40 s=17,987.97	100.0 x=15,923.43 s=14,237.45	100.0 x=16,628.70 s=15,904.18

Source: Survey data (2012)

The household income of the respondents was split into on-farm and off-farm income (Table 4.8) according to (Ervin, 1981). The on-farm income is the amount of income that is gotten from livelihood activities that are practiced within the farm such as the sale of agricultural products and agricultural wages while on the other hand the off-farm income is the amount of income gotten from livelihood activities that are practiced outside the farm for example from formal employment and running business. High on-farm income was expected to positively influence

the adoption of LMPs whereas high off-farm income was expected to negatively influence the adoption of the practices.

Table 4.8: On-farm and Off-farm Income per Month (in %)

On-farm income per month (Ksh.)	**Amalo Location n=90**	**Kiplabotwa Location n=124**	**Total n=214**
Below 5,000	38.9	44.4	42.1
5,000-15,000	41.1	41.9	41.6
15,001-30,000	13.3	10.5	11.7
30,000-50,000	6.7	3.2	4.7
Above 50,000	0.0	0.0	0.0
Total	100.0 x=10,031.33 s=9,840.17	100.0 x=8,734.71 s=8,084.16	100.0 x=9,280.02 s=8,866.23
Off- farm income per month (Ksh.)			
Below 5,000	70.0	66.9	68.2
5,000-15,000	14.4	16.1	15.4
15,001-30,000	7.8	9.7	8.9
30,000-50,000	4.4	7.3	6.1
Above 50,000	3.3	0.0	1.4
Total	100.0 x=7569.07 s=15,493.90	100.0 x=7,188.73 s=11,310.33	100.0 x=7,348.68 s=13,199.01

Source: Survey data (2012)

The two types of household income; on-farm income and off-farm income were tested for significance with the adoption of the LMPs. A bivariate correlation between the on-farm income and the adoption of the SLMPs revealed that there was a positive significant association between the two variables ($P = 0.000$, $\Upsilon = 0.271$) while on the other hand the relationship between the on-farm income of the household and the adoption of VLMPs was not significant (Table 4.19). Surprisingly, however there was a non-significant relationship between the off-farm income and the adoption of both the SLMPs and VLMPs in the locations but the results showed that the relationship between the off-farm income and adoption of SLMPs measures remained negative as anticipated. The findings revealed that the association between the on-farm income and the adoption of SLMPs practices was such that respondents who got better monthly on-farm income had adopted more intense SLMPs on their farms. This is in line with Kessler (2006) who found

out that income from agriculture had a significant correlation with investments in soil and water conservation measures. These results are also echoed by Aberha (2008) who found a significant and positive correlation between the household's annual income and the continued use of soil and water conservation practices and a non-significant relationship between the off-farm activities and continued work on soil and water conservation. Aberha (2008) noted that farmers who got more off-farm earnings were less involved in continued conservation work because of the possibility of them spending more time on cash generation and on satisfying immediate needs than on investing in soil and water conservation activities. According to Akinbile and Odebode (2007), income plays a key role in influencing the adoption of LMPs. The findings of this study showed that the more on-farm income the respondents make the more likely they were involved in sustainable soil conservation practices. Ervin (1981) had postulated a negative relationship between soil erosion control and off-farm income. The study suggested that relatively larger contributions of off-farm income reflect need for supplemental income which means less time available to adopt and maintain LMPs.

4.2.8 Leadership Position of the Respondents

Information on the leadership position of the respondents was categorized into: faith-based, administrative and community-based leadership (Table 4.9). Faith-based leaders were spiritual leaders; administrative leaders were government appointed leaders including village elders and chiefs while community-based leaders were leaders of local self-help groups. In terms of leadership, 11.7% of respondents interviewed held leadership positions while 88.4% of the respondents held no leadership positions. Of those with leadership positions, 4.2% were faith based leaders, 3.7% were administrative leaders while 3.7% were leaders in community based organizations (Table 4.9).

Table 4.9: Types of Leadership (in %)

Type of Leadership	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Faith based	4.4	4.0	4.2
Administrative	2.2	4.8	3.7
Community based	1.1	5.6	3.7
Not Applicable	92.3	85.6	88.4
Total	100.0	100.0	100.0

Source: Survey data (2012)

The study expected that leadership would positively influence the adoption of LMPs since it provides a platform of access to information regarding LMPs. The leaders are also expected to play a lead role for the community members in terms of environmental conservation by identifying environmental problems and challenges and determining solutions to the problems (Timmer, 2004). However, contrary to expectations the study found that the leadership position of the respondents did not have a significant association with the adoption of SLMPs and VLMPs in the two study locations (Table 4.18).

4.2.9 Perception of Environmental Degradation

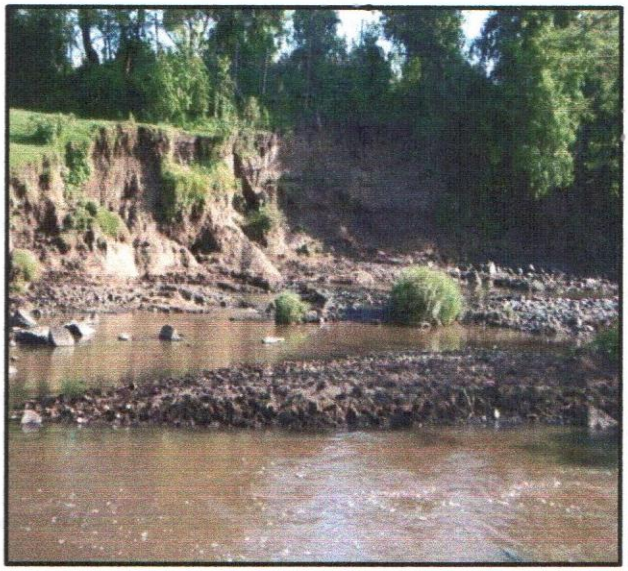
The perception of the respondents towards environmental degradation was studied in order to understand how it influenced the adoption of LMPs. The perception of environmental degradation comprised of the following variables: The perception of the extent of soil erosion, soil fertility loss, river bank erosion, river pollution and river level decline during dry seasons. An environmental degradation index was developed from these variables to represent the perception of environmental degradation (Appendix five).

In both Amalo and Kiplabotwa locations, 30.8% of the respondents perceived severe erosion on their farms while 32.2% and 36.9% perceived moderate and no erosion respectively. Of the respondents who perceived severe erosion 42.2% were from Amalo Location while 22.6% were from Kiplabotwa Location. This could be attributed to the slope and the soil characteristics of the locations. In Amalo location, most of the surveyed farms were moderately sloping as compared to most of the farms in Kiplabotwa that were gently sloping. Moreover, the dominant soils in Amalo location were loams while in Kiplabotwa the dominant soils were clays. For river bank

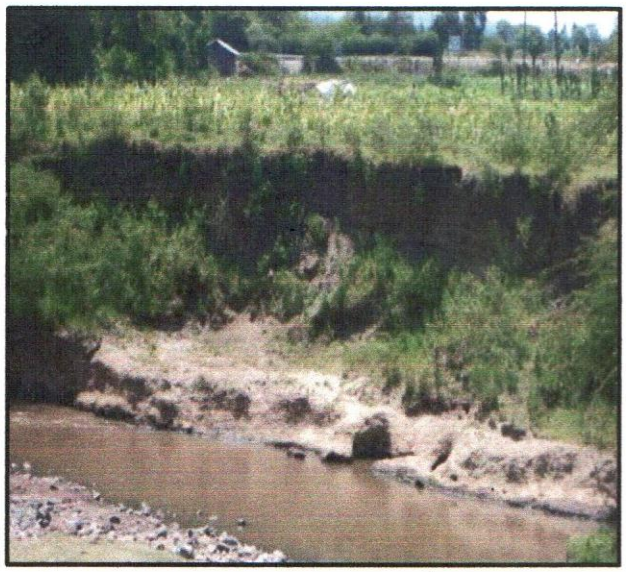
erosion, only 23.4% of the respondents perceived severe erosion while 35% and 41.6% perceived moderate erosion and no river bank erosion respectively. Of the respondents who perceived severe bank erosion only 6.7% were from Amalo Location while 35.5% were from Kiplabotwa Location. It was observed that there was extensive damage of riparian vegetation at Kiplabotwa location as a result of encroachment onto the riparian zone by human activities. For instance, uncontrolled watering of livestock at watering points had resulted to severe destruction of the river banks in Kiplabotwa.

For river pollution, 27.1% of the respondents perceived severe river pollution, 41.1% perceived moderate pollution while 47.8% perceived no apparent pollution. Of the respondents who perceived severe river pollution only 13.3% were from Amalo Location while 37.1% were from Kiplabotwa Location. The perceived pollution was mainly from polythene bags, waste water, farm water runoff and sediments. The main reason why there was a higher perception of pollution in Kiplabotwa than in Amalo could be because Kiplabotwa was located downstream Amalo where the signs of pollution were easily manifested. For river level decline 30.8% of the respondents perceived severe decline in the river level during dry seasons, 32.2% perceived moderate decline in river level while 36.9% perceived no apparent decline. Of the respondents who perceived severe decline 13.3% were from Amalo location while 35.5% were from Kiplabotwa location. Of those who perceived no apparent decline 47.8% were from Amalo location while 8.1% were from Kiplabotwa location.

For soil fertility loss, 16.4% of the respondents perceived severe soil fertility loss, 52.4% perceived moderate fertility loss while 30.8% stated that they perceived no apparent loss in fertility. The distribution of the above mentioned percentages was even in the locations such that the discrepancy between Amalo and Kiplabotwa location was not great (Table 4.10).



a



b



c

Plate 4.3: Environmental Degradation in the Upper MRB

a. Severe destruction of the river bank at Kiplabotwa location
b. River water decline at Kiplabotwa during the dry season
c. Severe erosion at the edge of a farm in Amalo location

Table 4.10: Perception of Environmental Degradation (in %)

Perception of Environmental Degradation	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214	Mean ($\bar{X}$)	Standard Deviation (S)
Perception of Soil Erosion					
Severe	42.2	22.6	30.8		
Moderate	30.0	33.9	32.2		
No apparent erosion	27.8	43.5	36.9	1.94	0.823
Total	100.0	100.0	100.0		
Perception of River Bank Erosion					
Severe	6.7	35.5	23.4		
Moderate	28.9	39.5	35.0		
No apparent erosion	64.4	25.0	41.6	1.86	0.673
Total	100.0	100.0	100.0		
Perception of River pollution					
Severe	13.3	37.1	27.1		
Moderate	38.9	42.7	41.1		
No apparent pollution	47.8	20.2	31.8	1.82	0.787
Total	100.0	100.0	100.0		
Perception of Soil Fertility Loss					
Severe	16.7	16.1	16.4		
Moderate	56.7	50.0	52.8		
No apparent loss	26.7	33.9	30.8	1.95	0.768
Total	100.0	100.0	100.0		
Perception of River level decline					
Severe	13.3	35.5	30.8		
Moderate	38.9	56.5	32.2		
No apparent decline	47.8	8.1	36.9	2.01	0.715
Total	100.0	100.0	100.0		

Source: Survey data (2012)

A bivariate correlation between the perception of environmental degradation and the adoption of SLMPs revealed a strong, positive and significant association between the two variables (P = 0.000, Υ = 0.550), while a correlation between the perception of environmental degradation and the adoption of VLMPs revealed a weak but positive and significant relationship

between the two variables (P = 0.019, Υ = 0.160) (Table 4.19). The perception of environmental degradation is a very important variable in terms of influencing the adoption of LMPs. According to Ervin (1981), perception of environmental degradation and specifically soil erosion is positively related to the willingness to adopt additional LMPs. This is also observed by Gebremedhin and Swinton (2003), Prager and Posthumus (2010) and Mengstie (2009) who noted that those farmers who perceive soil erosion as a problem having negative effects on productivity and who expect positive returns from conservation are likely to decide in favor of adopting available conservation technologies. On the other hand, those who do not acknowledge soil erosion as a problem will not expect benefits from controlling erosion and it is likely that they will decide against adopting any conservation technologies. However, Mengstie (2009) noted that the correct perception of the soil erosion problem may be necessary but not sufficient for farm-level adoption of LMPs.

4.2.10 Perceived Effectiveness of Land Management Practices

The perceived effectiveness of the LMPs in controlling environmental degradation and improving the quality of the land was assessed in order to determine practices that were preferred by the respondents for adoption. Most of the respondents stated that they prefer the practices that they perceived as very effective in terms of soil erosion control and in terms of enhancing the profitability of the farm. The perceived effectiveness of LMPs was divided into two categories; the perceived effectiveness of SLMPs and VLMPs.

For the SLMPs, 61.2% of the respondents stated that cut off drains were very effective as compared to 31.3%, 20.6% and 10.3% of the respondents who stated that terraces, bunds/ barriers and grass strips were respectively very effective. This corresponds with the mean indices of 2.53 for cut off drains, 2.14 for terraces, 1.90 for bunds/ barriers and 1.82 for grass strips. This means that for the SLMPs most of the respondents were more willing to adopt cut off drains with a higher mean index rather than grass strips which had a lower mean index (Table 4.11).

For the VLMPs, 83.6% of the respondents stated that agroforestry was very effective in controlling soil erosion as compared to 4.7% of the respondents who stated that mulching was very effective. This corresponds with the mean indices which noted that agroforestry was perceived as most effective with a mean index of 2.79 and mulching with an index of 1.82. This

means that for the VLMPs most of the respondents were more willing to adopt agroforestry which had a higher mean index rather than mulching which had a lower mean index (Table 4.12).

Table 4.11: Perceived Effectiveness of SLMPs (in %)

Effectiveness of Structural Land Management Practices	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214	Mean (X)	Standard Deviation (S)
Grass Strips					
Not effective	31.1	25.8	28.0		
Effective	60.0	62.9	61.7		
Very effective	8.9	11.3	10.3	1.82	0.594
Total	100.0	100.0	100.0		
Cut off drains					
Not effective	6.7	8.9	7.9		
Effective	37.8	25.8	30.8		
Very effective	55.6	65.3	61.2	2.53	0.640
Total	100.0	100.0	100.0		
Terraces					
Not effective	18.9	16.9	17.8		
Effective	53.3	49.2	50.9		
Very effective	27.8	33.9	31.3	2.14	0.689
Total	100.0	100.0	100.0		
Bunds/ Barriers					
Not effective	30.0	30.6	30.4		
Effective	52.2	46.8	49.1		
Very effective	17.8	22.6	20.6	1.90	0.709
Total	100.0	100.0	100.0		

Source: Survey data (2012)

Table 4.12: Perceived Effectiveness of VLMPs (in %)

Effectiveness of Vegetative Land Management Practices	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214	Mean (x)	Standard Deviation (S)
Agroforestry					
Not effective	4.4	4.8	4.7		
Effective	16.7	8.1	11.7		
Very effective	78.9	87.1	83.6	2.79	0.511
Total	100.0	100.0	100.0		
Mulching					
Not effective	83.3	57.3	68.2		
Effective	15.6	35.5	27.1		
Very effective	1.1	7.3	4.7	1.82	0.594
Total	100.0	100.0	100.0		

Source: Survey data (2012)

The perceived effectiveness of LMPs was used as a proxy for the profitability of the LMPs in the locations. According to de Graff *et al.*, (2008) this is one of the common and most important factors for the adoption of LMPs in that if farmers have a prospect of gaining long-term financial benefits for instance from increased production, reduced labor input and higher on farm income from a given LMP they will be motivated to adopt and maintain that LMP. This study revealed that there was a significant relationship between the perceived effectiveness of VLMPs and the adoption of VLMPs ($P = 0.000$, $\Upsilon = 0.278$) (Table 4.19) but no significant association between the perceived effectiveness of SLMPs and the adoption of SLMPs. This could probably be attributed to the ease of adoption of VLMPs as opposed to SLMPs and the multiple uses of most of the VLMPs.

4.3 Farmland Characteristics

4.3.1 Farm Size

The average total land acreage occupied by the households was 7.2 acres in Amalo location while in Kiplabotwa location it was 5.6 acres. Most of the households (34.4%) in Amalo location occupied land ranging from 5.1 to 10.0 acres while in Kiplabotwa the most of the households (52.4%) had land ranging from 2.1 to 5.0 acres (Table 4.13). The average size of land under woodlots in Amalo location was 1.12 acres while in Kiplabotwa location it was 0.325 acres.

Table 4.13: Farm Size (in %)

Farm Size	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 2.0 acres	17.8	10.5	13.6
2.1 – 5.0 acres	33.3	52.4	44.4
5.1 – 10.0 acres	34.4	25.8	29.4
10.1 – 25.0 acres	10.0	9.7	9.8
25.1 – 50 acres	2.2	1.6	1.9
Above 50 acres	2.2	0.0	0.9
Total	100.0	100.0	100.0
	x=7.244	x=5.578	x=6.279
	s=9.928	s=4.340	s=7.263

Source: Survey data (2012)

A correlation test revealed that the size of the farmland had a positive and significant relation to both the adoption of the SLMPs (P = 0.000, Υ = 0.308) and of VLMPs (P = 0.040, Υ = 0.141) (Table 4.19). This analysis revealed that increase in land size favored increased intensity of adoption of both SLMPs and VLMPs in both locations. These results are consistent with the findings of Akinbile and Odebode (2007), Amsalu and de Graff (2007), Aberha (2008) Mengstie (2009) and Adimassu *et al.*, (2012). For example, Mengstie (2009) found out the farmland size had a positive and significant influence on the adoption of improved bunds, terraces and cut-off drains such that for every one hectare increase in the farmland the probability of adoption of bunds increases by 20%. Aberha (2008) also noted from his study that farmers with more than one hectare were much more likely to be involved in soil and water conservation. This is possibly the case because larger land plots are less affected by the loss of land for construction of LMPs (Adimassu *et al.*, 2012) and because larger land holding is associated with greater wealth and increased availability of capital thus making investment in capital more feasible (Amsalu and de Graff, 2006).

4.3.2 Farms' Distance from the River

Table 4.14: Farms' Distance from the River (in %)

Distance from the River	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Below 1Km	46.7	42.7	44.4
1-2Km	53.3	37.9	44.4
Above 2Km	0.0	19.4	11.2
Total	100.0	100.0	100.0

Source: Survey data (2012)

The distance from Amala River of most of the households surveyed (88.8%) was below 2Km (Table 4.14). This meant that they could easily access the river and were directly dependent on it for their day to day activities. In addition, they greatly affected the status of the river in terms of riparian management. Majority of these households stated that they used the river as their main source of water for both domestic and agricultural use. In terms of water for domestic use 66.8% of the respondents stated that the river was their main source of water for domestic use while 63.6% stated that the river was their main source of water for agriculture including watering of livestock during dry seasons (Figure 4.4). This study answered the question that households that were greatly depend on the river as their source of water for both domestic and agricultural use would have more initiative for adopting LMPs.

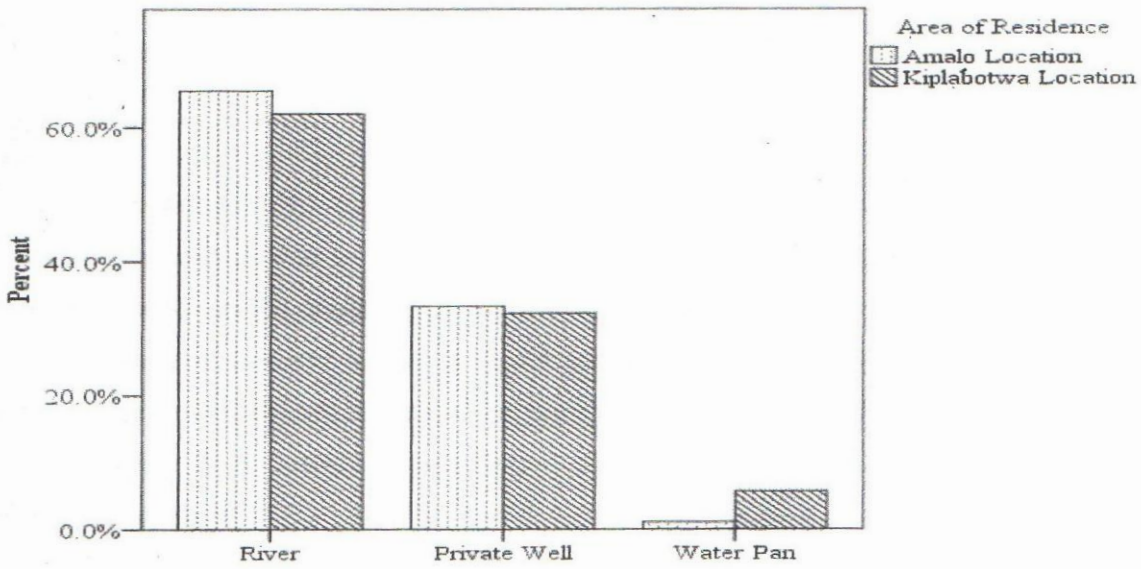


Figure 4.4: Sources of Water for Agriculture (in %)

The results of the cross-tabulation showed that there was a significant association between the distance of the farm from the river and the adoption of SLMPs ($P = 0.003$, $\chi^2 = 19.491$) (Table 4.18). The results indicated that respondents with farms near the Amala River had adopted more SLMPs as opposed to those living further away from the river. The farms' distance from the river however did not have any significant relationship with the adoption of the VLMPs.

4.3.3 Topography of the farmlands

In terms of topography, 16.8% of the farms surveyed were nearly level, 37.8% had gently slopes, 27.6% had moderate slopes, 10.7% had steep slopes while only a small fraction (7.5%) were undulating. In comparison, most of the farms in Amalo location (43.3%) had moderate slopes while most of the farms in Kiplabotwa (42.7%) had gentle slopes. In addition, 25.6% of the farms that were surveyed in Amalo had steep slopes while none in Kiplabotwa had steep slopes (Table 4.15).

Table 4.15: Topography of the farms (in %)

Topography of the farms	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Nearly level	0.0	29.0	16.8
Gentle Slope	30.0	42.7	37.8
Moderate Slope	43.3	16.1	27.6
Steep Slope	25.6	0.0	10.7
Undulating	1.1	12.1	7.5
Total	100.0	100.0	100.0

Source: Survey data (2012)

The slope of the field was used as an indicator of soil erosion potential. Although erosion in a given area depends on the rainfall pattern, the soil physical characteristics and the slope of the field, the slope was expected to play a significant role because the rainfall patterns and soil physical characteristics did not have much variation within the locations. The study expected that the type of slope would influence the adoption of LMPs with steep slopes meaning a higher likelihood of adoption.

As expected the topography of the farm as perceived by the respondents was found to have a significant relationship with the adoption of both the SLMPs ($P = 0.010$, $\chi^2 = 26.181$) and the adoption of the VLMPs ($P = 0.012$, $\chi^2 = 19.653$) (Table 4.18). The study revealed that on average the respondents who had moderately sloppy, very steep and undulating farmlands had adopted more intense LMPs than respondents who occupied nearly level or gently sloppy farmlands. Gebremedhin and Swinton (2003), Amsalu and de Graff (2006), Kessler (2006), Aberha (2008) and Mengstie (2009) have found a positive significant relationship between the slope and the adoption of LMPs. This is possibly the case because environmental degradation problems such as soil erosion are more rampant on steep slopes and therefore the respondents tend to invest on the steep slopes because of the perceived erosion problem and because on these slopes they can see short-term impacts of their investments (Kessler, 2006).

4.4 Institutional Factors

4.4.1 Awareness of NRM Policies/ Legislation

The awareness levels of the respondents on NRM policies/ legislation such as The Forest Act, 2005, The Water Act, 2002, The Environmental Management and Coordination Act, 1999 and the National Land Policy Sessional Paper No.3 of 2009 were assessed. For NRM policy/ legislation awareness, 35.5% of the respondents had low awareness meaning that they could not clearly state the policies/ legislation but were vaguely aware the contents while 18.2% and 32.7% of the respondents were highly informed and moderately informed respectively. The highly informed respondents could state and describe information contained in two of the above mentioned policies/ legislation. The moderately informed respondents could state and describe information contained in at least one of the NRM policies and most these respondents were only aware of The Forest Act, 2005. Only 13.55% of the total respondents were not informed of any NRM policy/ legislation (Figure 4.5). This study anticipated that high NRM policy/ legislation awareness would translate to a higher likelihood of adoption of LMPs and vice-versa.

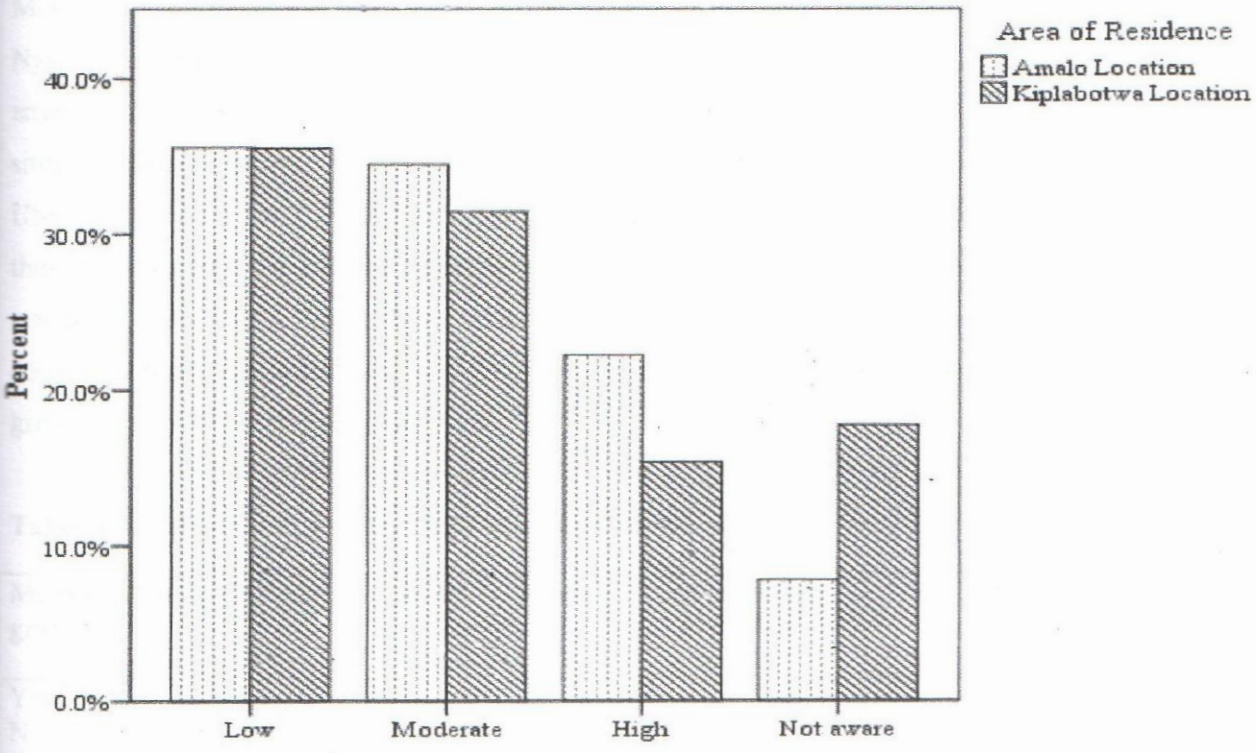


Figure 4.5: Awareness of NRM Policies (in %)

The awareness of level of NRM policies/ legislation had a significant relationship with the adoption of the VLMPs ($P = 0.030$, $\chi^2 = 7.028$) but not with the adoption of the SLMPs (Table 4.18). It has been noted that policies and legislation are used as 'carrot and stick' to encourage behavioral change (Prager and Posthumus, 2010) and therefore knowledge of NRM policies and legislation may impact the adoption of LMPs as is the case with VLMPs.

4.4.2 Membership in Self-Help Group(s)

In relation to membership in self-help group(s), 31.3% of the respondents were members of at least one self-help group while 68.7% of the respondents were not members of any group. The membership in self-help groups however varied greatly between the two locations. In Amalo location, only 4.4% of the respondents were members of self-help groups while in Kiplabotwa 50.8% were members (Table 4.16). Most of the respondents were affiliated to one group and most of them had been members of the group(s) for at least 36 months. In Amalo location, it was found that the respondents were affiliated to one self-help group; the Techgaa Community Forest Association while in Kiplabotwa the respondents were affiliated to the following groups;

Murandanik self-help group, Kaproriet group, Kejingo group, Simotwet group, Visionary group, Nyahururu self-help group, Olokyin self-help group, Cheptare farmers group, Keer tai environmental group and Kapliyo self-help group. The two major conservation organizations situated in the locations were; the Pro-Mara project for Amalo location and Mara River Water Users Association for Kiplabotwa location. The respondents stated that they would approach these organizations for technical assistance on conservation issues. In addition, the respondents stated that the Mara River Water Users Association in conjuction with Olerai farm had conducted field demonstrations to willing farmers on improved farming techniques such as the growing of cover crops and napier grass.

Table 4.16: Membership in Self-help Group(s) (in %)

Membership in self-help group(s)	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Yes	4.4	50.8	31.3
No	95.6	49.2	68.7
Total	100.0	100.0	100.0

Source: Survey data (2012)

The membership in self-help groups and conservation organizations is expected to have a positive association with the adoption of the LMPs (Nkegbe *et al.*, 2011). During the focus group discussions it was noted that within the self-help groups the members would divide themselves into small labor groups according to villages and the small groups would take turns to work on individual farms. The advantage of the groups was that they would ensure that labor is readily available while eliminating the cost of labor. In addition, the groups would act as platforms on which the members would share ideas and experiences regarding farming and conservation.

The membership in self-help groups had a significant relationship with the adoption of SLMPs (P=0.000, χ^2=36.902) (Table 4.18). The groups acted as labor-exchange groups with the members benefiting from reduced labor costs and readily available labor. The results from the cross-tabulation revealed that respondents who were members of self-help groups had adopted more intense LMPs than their non-member counter parts. This is probably because the labor

exchange mechanism in the groups helped to reduce the labor constraint for the adoption of the SLMPs which are labor intensive. In addition, the groups also acted as platforms for disseminating information on the LMPs. These results are consistent with the study by Lapar and Pandey (1999) that found that membership in self-help groups known as *alayon* had positive effect on the adoption of soil conservation measures.

4.4.3 Extension Services

For extension services, 22.9% of the respondents had been visited by extension staff while 77.1% had not been visited. In both Amalo and Kiplabotwa locations, 10.3% of the respondents had extension services on grass strips, 3.7% on cut off drains, 5.6% on terraces and 5.6% on bunds and barriers. A comparison of the two areas of study showed that 33.1% of the respondents in Kiplabotwa location had received extension services on LMPs as opposed to only 8.9% in Amalo location (Table 4.17).The study anticipated that extension staff visits would positively influence the adoption of the LMPs.

Table 4.17: Extension Staff Visit(s) (in %)

Response	Amalo Location n=90	Kiplabotwa Location n=124	Total n=214
Yes	8.9	33.1	22.9
No	91.1	66.9	77.1
Total	100.0	100.0	100.0

Source: Survey data (2012)

Extension staff visit(s) to the respondents had a strong significant association with the adoption of SLMPs ($P = 0.000$, $\chi^2 = 44.404$) (Table 4.18). Extension staff visit(s) however did not have a significant association with the adoption of the VLMPs. According to Nkegbe *et al.*, (2011) farmers' access to information on LMPs is measured by the contact with extension staff. This makes extension services crucial in terms of influencing decisions on the adoption of LMPs. This has been supported by Bekele and Drake (2003) who also found extension services to have a significant effect on the decision to adopt soil and water conservation practices. Biadu-forson (1999) also found out that extension services to positively influence the adoption of earthen bunds. However, Nkonya *et al.* (2005), Gebremedhin and Swinton (2003) and Amsalu and de

Graaff (2007) did not find any significant effect of extension sevices on the adoption of conservation measures.

4.4.4 Land Tenure

Most of the respondents in the upper MRB did not respond to the question on land tenure. Most did not disclose the status of their land ownership and were suspicious of questions to do with land. This was especially the case with Amalo location in villages such as Motito, Lelaitich, Longet and Nyambuko located adjacent to the Mau forest. The respondents were suspicious and stated the information on the status of land ownership if disclosed may be used in future to evict them from their lands. This led to lack of accuracy and completeness and therefore the data analysis of factors influencing the adoption of LMPs in relation to land ownership was not done.

However, according to Lapar and Pandey (1999) the security of tenure is a very crucial factor in determining investments in soil conservation measures. These researchers noted that if property rights in a given area are well defined and enforced, farmers will have incentives to conserve soil as future benefits from soil conservation will be gotten by the farmer who makes the investment while on the other hand if the property rights are poorly defined a production strategy based on rapid exhaustion of resources will be adopted leading to the tragedy of the commons. In addition, Gebremedhin and Swinton (2003) noted that security of tenure increases the planning horizon of the farmers and encourages adoption of long term soil conservation measures such as the terraces.

Table 4.18: Chi-square Tests for Factors Influencing the Adoption of LMPs

Factors	Adoption of SLMPs		Adoption of VLMPs	
Socio-Economic Factors	**χ^2 value**	**Sig. (2 sided)**	**χ^2 value**	**Sig. (2 sided)**
Gender	3.097	0.377	2.874	0.238
Marital Status	4.208	0.897	3.139	0.791
Educational level	15.103	0.655	20.938	0.051
Occupation of the HH	8.602	0.197	4.466	0.347
Leadership position	2.728	0.435	3.374	0.185
Farmland Characteristics				
Distance from river	19.491	**0.003***	2.785	0.594
Topography	26.181	**0.010***	19.653	0.012*
Institutional Factors				
Extension staff visit(s)	44.404	**0.000***	0.492	0.782
Awareness of NRM policies	4.150	0.246	7.028	0.030*
Membership in self-help group(s)	36.902	**0.000***	1.426	0.490

Table 4.19: Correlation of Factors Influencing the Adoption of LMPs

Factors	Adoption of SLMPs		Adoption of VLMPs	
Socio-Economic Factors	**Υ value**	**Sig. (2 sided)**	**Υ value**	**Sig. (2 sided)**
Age	0.151	**0.027***	-0.055	0.423
Household's size	0.200	**0.003****	-0.043	0.532
On-farm income	0.271	**0.000****	0.128	0.061
Off-farm income	-0.035	0.613	0.037	0.587
Perception of degradation	0.550	**0.000****	0.160	0.019*
Perception of effectiveness of SLMPs	0.016	0.817	0.015	0.828
Perception of effectiveness of VLMPs	0.124	0.070	0.278	0.000**
Farmland Characteristics				
Land size	0.308	**0.000****	0.141	0.040*

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

* Correlation is significant at the 0.05 level (2-tailed)

4.5 Multiple Regression Models

Stepwise multiple regression models were used to find out the most important factors that contributed to the adoption of LMPs in the locations. Unlike the chi-square tests and the bi-variate correlations which focused on the association between one factor and the adoption of LMPs, multiple regression models were used to determine whether the group of factors together predicted the adoption of the LMPs (Mugenda and Mugenda, 2003). All the predictor variables including the socio-economic factors, the farmland characteristics and the institutional factors

were used to construct the regression models. Two multiple regression models were constructed. Model number one determined the factors that were most important in influencing the adoption of SLMPs while model number two determined the factors that were most important in influencing the adoption of VLMPs (Equation 4.1).

Stepwise regression in model number one revealed that the most important factors influencing the adoption of SLMPs were; the perception of environmental degradation (P = 0.000, t = 8.013), the extension staff visit(s) (P = 0.000, t = -3.765), the membership in self-help group(s) (P = 0.000, t = -3.773) and the land size (P = 0.000, t = 2.997). Stepwise regression in model number two on the other hand revealed that the most important factors influencing the adoption of VLMPs were; the topography of the land (P = 0.001, t = 3.378), the perceived effectiveness of the VLMPs (P = 0.001, t=3.355), the leadership position of the respondents (P = 0.022, t = -2.310), the perception of environmental degradation (P = 0.011, t = -2.582) and the on-farm income (P = 0.020, t = 2.348) (Tables 4.20 and 4.21).

1. $Y_1 = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + \varepsilon$

Where Y_1 is the Adoption of SLMPs

B_0 is the Constant

X_1 is the Perception of environmental degradation

X_2 is the Contact with extension staff

X_3 is the Membership in self-help groups

X_4 is the land size and

ε is the Error term

2. $Y_2 = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + \varepsilon$

Where $Y_{2\,is}$ the Adoption of VLMPs

B_0 is the Constant

X_1 is the topography of the farmland

X_2 is the perceived effectiveness of the VLMP

X_3 is the community leadership position held by the HH

X_4 is the perception of environmental degradation

X_5 is the on-farm income and

ε is the Error term

Equation 4.1: Regression Models

Table 4.20: Regression Results for Adoption of SLMPs

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
	B	Std. Error	Beta		
(Constant)	0.542	0.329		1.645	0.102
Perception of degradation	0.161	0.020	0.427	8.013	0.000*
Extension staff visit(s)	-0.452	0.120	-0.218	-3.765	0.000*
Membership in self-help group(s)	-0.402	0.107	-0.214	-3.773	0.000*
Land size	0.019	0.006	0.157	2.997	0.003*

Dependent Variable: Adoption of SLMPs

R^2=0.486

Table 4.21: Regression Results for Adoption of VLMPs

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
	B	Std. Error	Beta		
(Constant)	1.090	0.370		2.948	0.004
The topography of the Land	0.125	0.037	0.217	3.378	0.001*
Perceived effectiveness	0.175	0.052	0.215	3.355	0.001*
Leadership position	-0.296	0.128	-0.148	-2.310	0.022*
Perception of degradation	-0.046	0.018	-0.166	-2.582	0.011*
On-farm income	1.100E-5	0.000	0.151	2.348	0.020*

Dependent Variable: Adoption of VLMPs

R^2=0.204

CHAPTER FIVE:

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study found out that most of the respondents in the two locations had adopted VLMPs as opposed to the SLMPs. The study also found that the major factors influencing the adoption of SLMPs were the perception of environmental degradation, the extension staff visit(s), the membership in self-help group(s) and the land size while the major factors influencing the adoption of VLMPs were the topography of the farmland, the perceived effectiveness of the VLMPs, the leadership position of the respondent, the perception of environmental degradation and the on-farm income. The study noted that the institutional factors had a major influence on the adoption of SLMPs while the socio-economic factors had major influence on the adoption of VLMPs.

5.2 Recommendations

The study recommends that conservation efforts in the upper MRB should focus on the integration of SLMPs and VLMPs by residents at the watershed level rather than at the farm level. The study also recommends that measures and programs to control environmental degradation through the adoption of SLMPs should focus on strengthening the capacity of extension workers and of already existing self-help groups while measures and programs to control environmental degradation through the adoption of VLMPs should focus on enhancing the ability of residents to perceive environmental degradation and the effectiveness of VLMPs through sensitization and training. Conservation programs aimed at enhancing the adoption of VLMPs should also focus on activities that increase the on-farm income of residents in the upper MRB. The study also recommends that the relationship between climate change, land tenure, proximity of the residents to the forest, culture and the adoption of LMPs in the upper MRB should be explored. In addition, factors influencing the continued use of LMPs in the upper MRB and the impact of adopting LMPs on farm productivity should also be explored as areas of further research.

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APPENDICES:

Appendix One: Questionnaire for the Survey of Households

QUESTIONNAIRE FOR THE SURVEY OF HOUSEHOLDS

I am a student of Egerton University from the Department of Environmental Science conducting a research on ***factors influencing the adoption of land management practices in the Mara River Basin****. The questions in this questionnaire are for research purpose only. The information you provide will be treated with utmost confidentiality. Your assistance in answering the questions truthfully and accurately will be highly appreciated.*

1.0 GENERAL INFORMATION

1.1 Name of the Interviewer	
1.2 Date of Interview	
1.3Time of Interview	
1.4 Name of the Respondent	
1.5 Respondent's Telephone contact (optional)	
1.6Area of Residence (tick as appropriate)	1. Amalo Location [ ] 2. Kiplabotwa Location [ ]
1.7 Name of Village	

2.0 HOUSEHOLD INFORMATION

2.1 INFORMATION ABOUT THE HEAD OF THE HOUSEHOLD

2.1.1 What is the age of the household head?..... (Specify in years)

2.1.2 What is gender of the household head? (Tick as appropriate)

1. Male [ ]	2. Female [ ]

2.1.3 What is the marital status of the household head? (Tick as appropriate)

1. Married [ ]	2. Single [ ]
3. Separated/Divorced [ ]	4. Widowed [ ]

2.1.4 What is the education level of the household head? (Tick as appropriate)

1. Illiterate [ ]	2. Primary class 1-4 [ ]	3.Primary class 5-8 [ ]
4. Secondary [ ]	5. A-levels 5-6 [ ]	6.Diploma [ ]
7. University degree [ ]		

2.1.5 Does the household head hold any leadership position in the community? (Tick as appropriate)

1. Yes [ ]	2. No [ ]

2.1.6 If Yes above, Specify

.....

2.1.7 What is the main occupation of the Household head?

1. Farmer [ ]	2. Employed (specify) [ ].....
3. Self-employed (specify) [ ].....	

2.1.8 How long has the Household head practiced this occupation? ..... (Specify in years)

2.2 HOUSEHOLD DEMOGRAPHICS

2.2.1 Information about the household members (Including the household head)

	Tick where applicable	**Indicate the numbers**
Sex	1. Males [ ]	
	2. Females [ ]	
Age	1. Below 12 years [ ]	
	2. 13-18 years [ ]	
	3. 18-35 years [ ]	
	4. 35-55 years [ ]	
	5. Above 55 years [ ]	
Education Level	1. Illiterate [ ]	
	2. Primary class 1-4 [ ]	
	3. Primary class 5-6 [ ]	
	4. Secondary form 1-4 [ ]	
	5. Post-Secondary form 5-6 [ ]	
	6. Diploma [ ]	
	7. Degree [ ]	

2.3 What your main source of water for domestic use? (Tick as appropriate)

1.Public well [ ]	2.Public borehole [ ]	3.River [ ]
4.Private well [ ]	5.Private borehole [ ]	6.Water Pan [ ]
7.	8.	9.

2.4 What your main source of water for agriculture? (Tick as appropriate)

1.Public well [ ]	2.Public borehole [ ]	3.River [ ]
4.Private well [ ]	5.Private borehole [ ]	6.Water Pan [ ]
7.	8.	9.

3.0 LIVELIHOOD AND INCOME

3.1 What type of crops do you grow? (Tick as appropriate)

1. Maize [ ]	2. Beans [ ]	3. Tomatoes [ ]
4. Pyrethrum [ ]	5. Potatoes [ ]	6. Wheat [ ]
7. Barley [ ]	8. Sweet potatoes [ ]	9.
10.	11.	12.
13.	14.	15.

3.2 What type of livestock do you keep? (Tick as appropriate and indicate their numbers)

Type of Livestock	**Number of Livestock**
1. Cattle [ ]	
2. Goats [ ]	
3. Poultry [ ]	
4. Sheep [ ]	
5. Donkey [ ]	
6. Pigs [ ]	
7. Others (specify).....	

3.3 Specify the income that is generated by your household during the previous year

Agricultural based income (tick where applicable)	**Amount (Ksh.)**
1. Annual income from crop production [ ]	
2. Annual income from livestock production [ ]	
3. Annual income from sale of tree products [ ]	
4. Annual income from agricultural wages [ ]	
5. Annual income from renting agricultural equipment [ ]	
6. Annual income from formal employment [ ]	
7. Annual income from non-agricultural business [ ]	

4.0 LAND MANAGEMENT

4.1 What is the land tenure system in the land that you are occupying? (Tick as appropriate)

1. Private Ownership (title) [ ]	2. Rented [ ]	3. Communal ownership [ ]
4. Private (no title) [ ]	5.	6.

4.2 What is the distance from the Mara River in kilometres? (tick as appropriate)

1. Below 1Km [ ]	2. 1-2Km [ ]	3. 1-3Km [ ]
4. 3-4Km [ ]	5. Above 4Km	

4.3 Indicate the topography of the land (tick as appropriate)

1.Steep slope (More than (37°)	[ ]	2.Gentle slope (11-37°)	[ ]
3.Flat (Below 11°)	[ ]	4.Undulating	[ ]

4.4 Indicate the subdivision of the land and the acreage in the table that follows

No.	Land use and subdivision	Tick if applicable	Indicate the acreage
1	Do you have any cultivated land?	[ ]	
2	Do you have any grazing land?	[ ]	
3	Do you have any cultivation land that is fallow?	[ ]	
4	What land area is covered by your household?	[ ]	
5	What land is set aside for woodlots?	[ ]	
6	What other uses have you allocated for your land? (Specify).....		

4.5 Do you own any other tract of land apart from the one described above? (Tick as appropriate)

1. Yes	[ ]	2. No	[ ]

4.6 If yes above (4.5) briefly state the following

Location.....

Size.....

Use.....

4.7 What type of sustainable land management practise(s) are you aware of? (Please tick where applicable)

1. Agroforestry	[ ]	2. Grass strips	[ ]	3. Cut off drains	[ ]
4. Terraces	[ ]	5. Bunds and barriers	[ ]	6. Mulching	[ ]
7.		8.		9.	
10.		11.		12.	

4.8 Rate the level of use of the land management practice(s) (please tick where applicable)

Land Management practices	Never use	Rarely use	Always use
1. Agroforestry	[ ]	[ ]	[ ]
2. Grass strips	[ ]	[ ]	[ ]
3. Cut off drains	[ ]	[ ]	[ ]
4. Terraces	[ ]	[ ]	[ ]
5. Bunds/ barriers	[ ]	[ ]	[ ]

6. Mulching	[ ]	[ ]	[ ]
7.			
8.			

Key Never use- Not applied the practice in the past 10 years. Rarely use- not currently using but have applied the practice in the past 5 years. Always use- applied the practice in the past one year

4.8 What type of agroforestry practice (s) is/are being used on your farm? (Tick as appropriate and make observations)

Type of Agroforestry	**Number of trees**	**Name of Tree species (use local name)**
1. On Farm trees [ ]		1 2 3 4
2. Live fence [ ]		1 2 3 4
3. Woodlots [ ]		1 2 3 4
4. Alley cropping [ ]		1 2 3 4

4.9 Specify the number of rows (indicate) and the length of the structural soil conservation measures (tick as appropriate) in the table below

	Structural measures (tick as appropriate)	**No. of rows**	**Length one row**				
			Less than 10M	**10-20M**	**20-40M**	**40-60M**	**Above 60M**
1	Grass strips [ ]		[ ]	[ ]	[ ]	[ ]	[ ]
2	Cut off drains [ ]		[ ]	[ ]	[ ]	[ ]	[ ]
3	Terraces [ ]		[ ]	[ ]	[ ]	[ ]	[ ]
4	Bunds / Barriers [ ]		[ ]	[ ]	[ ]	[ ]	[ ]
5			[ ]	[ ]	[ ]	[ ]	[ ]
6							

4.10 Specify the distance in between the structural soil conservation measures (tick as appropriate)

	Structural measures (tick as appropriate)	**Distance**				
		Less than 2M	**2-5M**	**5-10M**	**10-20M**	**Above 20M**
1	Grass strips [ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2	Cut off drains [ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3	Terraces [ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4	Bunds / Barriers [ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5		[ ]	[ ]	[ ]	[ ]	[ ]
6						

4.11 Rank the severity of environmental problems that you have experienced in the previous year. (Tick where applicable)

Environmental Problems	**Rank of the environmental problems**
1.Soil erosion [ ]	1. Severe [ ]
	2. Moderate [ ]
	3. No perceived erosion [ ]
2.Soil fertility loss [ ]	1. Severe [ ]
	2. Moderate [ ]
	3. Not perceived [ ]
3.River bank destruction [ ]	1. Severe [ ]
	2. Moderate [ ]
	3. Minimal [ ]
4. River level decline [ ]	1. Severe [ ]
	2. Moderate [ ]
	3. Not perceived [ ]

Key: Severe = more than ½ of land affected, Moderate = ¼ to ½, Minimal = less than ¼.

4.12 Please rank the effectiveness of the following sustainable land management practices in controlling environmental problems (tick as appropriate)

		Not effective	**Somewhat effective**	**Effective**	**Very effective**
1	Agroforestry	[ ]	[ ]	[ ]	[ ]
2	Grass Strips	[ ]	[ ]	[ ]	[ ]
3	Cut off drains	[ ]	[ ]	[ ]	[ ]
4	Terraces	[ ]	[ ]	[ ]	[ ]
5	Bunds/Barriers	[ ]	[ ]	[ ]	[ ]
6	Mulching	[ ]	[ ]	[ ]	[ ]

7		[ ]	[ ]	[ ]	[ ]
8		[ ]	[ ]	[ ]	[ ]

Key: Not effective= Does not control the problems, somewhat effective= Controls 1/4 to 1/2 of the problems, Effective = Controls 1/2 to 3/4 of the problems Very effective= Controls more than 3/4 of the problems

5.0 INSTITUTIONAL AND POLICY FACTORS

5.1 Have you received any extension services/training on land management practices in the past three years? (Tick as appropriate)

1. Yes [ ]	2. No [ ]

5.2 If Yes above, Indicate the number of training session(s) attended and the when the last training was conducted

Land Management Practices	**Indicate the number of training session(s) attended**	**When the previous training was conducted? (Months)**
1.Agroforestry [ ]		
2.Grass strips [ ]		
3.Cut off drains [ ]		
4.Terraces [ ]		
5.Bunds and barriers [ ]		
6.Mulching [.]		

5.3 Did the extension service(s)/training influence you to adopt any sustainable land management practices? (Tick as appropriate)

1. Yes [ ]	2. No [ ]

5.4 If yes above (5.3) briefly explain how

.....

.....

5.5 Are you a member of any self-help group in your locality? (Tick where applicable)

1. Yes [ ]	2. No [ ]

5.5.1 If yes above indicate the self-help group(s) and the duration of membership in the table below.

Name of self-help group (s)	**How long have you been a member?**
1.	
2.	
3.	
4.	

5.6 Are you aware of any natural resource management policies/laws in Kenya? (Tick as appropriate)

1. Yes	[ ]	2. No	[ ]

5.7 If yes above (5.6) list the natural resource management policies/laws that you are aware of

1.....

2.....

3.....

4.....

5.....

5.8 Are you aware of any customary/indigenous laws or knowledge on land management in your community? (Tick as appropriate)

1. Yes	[ ]	2. No	[ ]

5.9 If yes above (5.11) list the customary /indigenous laws/knowledge that you are aware of

1.....

2.....

3.....

4.....

5.10 Has awareness of the above mentioned laws (in 5.3) influenced you to adopt any sustainable land management practices? (Tick as appropriate)

1. Yes	[ ]	2. No	[ ]

5.11.1 If Yes above (5.18), briefly explain

.....

.....

Thank you for your cooperation!!

Appendix Two: Focus Group Discussion Questions

I am a student of Egerton University from the Department of Environmental Science conducting a research on ***factors influencing the adoption of sustainable land management practices in the Mara River Basin****. The questions in this interview are for research purpose only. The information you provide will be treated with utmost confidentiality. Your assistance in answering the questions truthfully and accurately will be highly appreciated.*

1. What are the main land management practices have been adopted by residents in this area? (Briefly list)

Structural measures

.....

Cover measures

.....

2. In your opinion are the land management practices used effective for controlling environmental problems like soil erosion? Yes/No (briefly explain)

.....

3. Of these which are do you think are the most effective methods? (Rank and explain)

.....

4. Which methods would you prefer to implement? (Briefly explain)

.....

4. Where do you get advice on land management practices? (Briefly list)

Self-help groups

.....

Conservation projects

.....

Government organizations

.....

4. In your opinion is the advice on land management practices helpful/sufficient? Yes/No (briefly explain)

.....

5. What natural resource management policies/laws are you aware of? (briefly state)

.....

6. Are the laws helpful in implementing influencing the adoption of land management practices (briefly explain)

.....

7. In your opinion are the farmers adequately sensitized on these policies/laws? Yes/No (briefly explain)

.....

8. Do the community members have any indigenous system/cultural systems/laws of land management? Which ones?

.....

9. How do the households make decisions regarding the adoption of land management practices? (Briefly explain)

Who makes the decision?

.....

How are the decision implemented? (explain)

.....

10. What factors exert influence on the adoption of land management practices? (Briefly explain)

.....

.....

Thank you for your cooperation!!

Appendix Three: In-depth Interviews for Key Informants

I am a student of Egerton University from the Department of Environmental Science conducting a research on ***factors influencing the adoption of land management practices in the Mara River Basin****. The questions in this interview are for research purpose only. The information you provide will be treated with utmost confidentiality. Your assistance in answering the questions truthfully and accurately will be highly appreciated.*

GENERAL INFORMATION

1.1 Name of the Interviewer	
1.2 Date of Interview	
1.3Time of Interview	
1.4 Name of the Respondent	
1.5 Respondent's Telephone contact (optional)	
1.6Area of Residence (tick as appropriate)	1. Amalo Location [ ] 2. Kiplabotwa Location [ ]
1.7 Place of Interview	

1. What land management practices have been adopted by residents in this area? (Briefly tate)

Structural measures

……

Cover measures

……

What tree species do farmers prefer for land management? Why?

……

……

2. What role does you organization play in terms of enhancing land management practices (Briefly state)

……

……

3. Does your organization have any programs on land management practices?

Have they been conducted (explain when where and the targets groups)?

How are they conducted?

.....

.....

Are the programs effective (briefly explain)?

.....

.....

4. In your opinion are the implemented land management practices effective in controlling environmental problems? (Each practice at a time)

.....

.....

How could they be enhanced? (each practice at a time)

.....

.....

5. How do the land owners perceive natural resource management policies on land management? (briefly explain)

.....

.....

7. In your opinion are the farmers adequately sensitized on these policies/laws? Yes/No (briefly explain)

.....

.....

8. Do the community members have any indigenous system/cultural systems/laws of land management? Yes/No (briefly explain)

Are they effective?

.....

.....

9. How do the households make decisions regarding the adoption of land management practices? (Briefly explain)

.....

.....

10. What factors exert influence on the adoption of land management practices? (Briefly explain)

.....

.....

Thank you for your cooperation.

Appendix Four: Common Tree Species in the Upper Mara River Basin

Location	Scientific Name	Local Name of tree species
Amalo	– *Juniperus procera*	– Tarakwet (cedar)
	– *Cypressus lusitanica*	– Cheropus (cypress)
	– *Acacia mearnsii*	– Wattle (black wattle tree)
	– *Eucalyptus globulus*	– Plugum (blue gum)
	– *Dombeya torrida*	– Silibwet
	– *Olea africana*	– Emitiot (brown olive)
	– *Schefflera volkensii*	– Tinet
	– *Spathodea campanulata*	– Sebetaiyet (Nandi flame)
	– *Celtis Africana*	– Chepkeleliet
	– *Diospyros abbysinica*	– Cheptuiyet
	– *Croton macrostachyus*	– Tebeswet
	– *Dichrocephala chrysanthenfolia*	– Ararwet
	– *Hagenia abyssicnica*	– Bondet (rose wood)
	– *Solanum phoxocarpum*	– Sigawet
	– *Elaeodendron buchananii*	– Saunet
	– *Podocarpus falcatus*	– Saptet
	– *Arundinaria alpina*	– Tegat (bamboo)
Kiplabotwa	– *Elaeodendron buchananii*	– Saunet
	– *Acokanthera schimperi*	– Kelyot (arrow poison)
	– *Vangueria infausta*	– Kimolwet
	– *Olea africana*	– Emitiot (wild olive)
	– *Warburgia ugandensis*	– Soket/Soget
	– *Tarchonanthus camphoratus*	– Lelechwet (camphor bush)
	– *Prunus africana*	– Tendwet
	– *Ficus sp*	– Torowet (fig tree)
	– *Croton macrostachyus*	– Tebeswet
	– *Euclea Divinorum*	– Usuet
	– *Eucalyptus globulus*	– Plugum (blue gum)
	– *Grevillea robusta*	– Sebesebet (silky oak)
	– *Podocarpus falcatus*	– Saptet
	– *Cypressus lusitanica*	– Cheropus (cypress)
	– *Teclea simplicifolia*	– Kuriot

Appendix Five: Formulation of Indices

1. Structural Land Management Index

Use of Cut off Drains

Score	Condition
0	No
1	Yes

Use of Terraces

Score	Condition
0	No
1	Yes

Use of Bunds/Barriers

Score	Condition
0	No
1	Yes

Use of Grass strips

Score	Condition
0	No
1	Yes

Structural Land Management Index = Use of Grass strips + Use of Cut off drains + Use of Bunds/Barriers + Use of Terraces

2. Vegetative Land Management Index

Use of Agroforestry

Score	Condition
0	No
1	Yes

Use of Mulching

Score	Condition
0	No
1	Yes

Vegetative Land Management Index = Use of Agroforestry + Use of Mulching

3. Perception of Environmental Degradation Index

Perception of soil erosion extent

Score	Condition
1	No apparent erosion
2	Moderate
3	Severe

Perception of the extent of river bank erosion

Score	Condition
1	No apparent erosion
2	Moderate
3	Severe

Perception of the extent of river pollution

Score	Condition
1	No apparent pollution
2	Moderate
3	Severe

Perception of the extent of river level decline

Score	Condition
1	No apparent decline
2	Moderate
3	Severe

Perception of the extent of soil fertility loss

Score	Condition
1	No apparent fertility loss
2	Moderate
3	Severe

Perception of Environmental Degradation (Environmental Degradation Index) = Perception of extent of soil erosion + Perception of extent of river bank erosion + Perception of extent of river pollution + Perception of extent of river level decline + Perception of extent of soil fertility loss

3. Perceived effectiveness of sustainable land management practices index

Perceived effectiveness of Grass strips

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of Cut-off drains

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of Bunds/barriers

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of terraces

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of SLMPs = Perceived effectiveness of Grass strips + Perceived effectiveness of Cut off drains + Perceived effectiveness of Bunds/Barriers + Perceived effectiveness of Terraces

4. Perceived effectiveness of Vegetative land management practices index

Perceived effectiveness of Agroforestry

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of Mulching

Score	Condition
1	Not effective
2	Effective
3	Very effective

Perceived effectiveness of VLMPs = Perceived effectiveness of Agroforestry + Perceived effectiveness of Mulching

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