# IMPACTS OF LAND USE CHANGES ON ECOSYSTEM SERVICES IN SAIWA WETLAND, TRANS NZOIA COUNTY, KENYA

**BY**

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## DECLARATION

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

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## APPROVAL

This research project has been submitted with my approval as the University Supervisor.

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## DEDICATION

I dedicate this project to Ecology and Management of the Sudd Wetland Project, my Family and friends who supported me during my studies.

## ACKNOWLEGMENT

This work would have not been a success without the invaluable financial support from Ecology and Management of the Sudd Wetland Project, and University of Juba, South Sudan for granting me a study leave to pursue my postgraduate studies.

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## ABSTRACT

Kenya has a number of wetland ecosystems that support diverse habitats both at the rural and urban areas. These wetlands provide a number of ecosystems services even though they are under tremendous threat due to land use change, agricultural intensification manifested by the decrease in their hydrological, ecological and economic support they provide to the surrounding environment. Saiwa wetland is one of the largest wetlands in Trans Nzoia County that supports biodiversity development and act as a source of livelihood to communities living around it. This study therefore sought to find out the impacts of land use changes on wetland ecosystem services using Saiwa wetland as the case study. The objectives of the study was to review the existing legislations and policy framework that deal with protection and conservation, map the extent and patterns of land uses and investigate the impact of land use changes on socio-economic provisions of Saiwa wetland. The study employed a diagnostic research design; both primary and secondary data were collected. Primary data was collected through the use of interview schedules, questionnaires, photography and observation. Secondary data was solicited from existing records on the implication of land use changes on wetlands, wetland policy documents from government and non-governmental agencies and remotely sensed maps to study the chronological trends and patterns of land uses and land use change over the past 27 years. The collected data was analyzed using both qualitative and quantitative analysis techniques using descriptive statistics for calculation of frequencies, means and percentages. A GIS and Remote sensing-based assessment of land uses and land cover was carried out in order to facilitate presentation of summarized data and enable assimilation of data which provided a quick comparison of variables using different sets of data. The study finding indicates that local communities living around Saiwa wetland mainly depends on the wetland for their livelihoods which include farming, grazing, and water. During the period between 1988-2017, forest decreased by 8.96%, Grassland decreased by 103.33%, Shrub land decreased by 17.36%, Settlements increased by 101.64% and agriculture increased by 12.57 % respectively over the same period of time. Therefore, there is need to harmonize various land uses with the existing Saiwa wetland ecosystem for sustainable management of the Wetland.

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## ACRONYMS AND ABREVIATIONS

| | |
|---|---|
| MEMR | Ministry of Environment and Mineral Resources |
| MA | Millennium Ecosystem Assessment |
| EPA | Environmental Protection Agency |
| IPCC | International Panel on Climate Change |
| KNBS | Kenya National Bureau of Statistics |
| GIS | Geographic Information Systems |
| GPS | Global Positioning System |
| SPSS | Statistical Package for Social Sciences |
| ASDSP | Agricultural Sector Development Support Programme |
| NEMA | National Environmental Management Authority |
| KWS | Kenya Wildlife Service |
| KFS | Kenya Forest Service |
| WARMA | Water Resource Management Authority |
| EMCA | Environmental Management and Coordination Act |
| EIA | Environmental Impact Assessment |
| ASALs | Arid and Semi-Arid Areas |
| CBOs | Community Based Organizations |
| NWRMS | National Water Resources Management Strategy |

# CHAPTER ONE: INTRODUCTION

## 1.1 Background to the study

Wetlands are among the most biologically productive ecosystems as they are rich in species diversity (Mwakaje, 2009). They perform various functions and services such as; provisioning services, regulating services, supporting services and cultural services. The importance of wetlands, and threats to their existence has manifested in a number of international instruments that govern their preservation and use (Mwakaje,2009), such as the Ramsar Convention on Wetlands of 1971, the Kyoto Protocol of 1995, the Rio-De-Janeiro Conference and the Copenhagen Climate Meeting of 2009 which were as a result of the recognition that global and regional climate changes are a threat to the land resources on which human survival depends (Rebelo *et al*., 2009). As a signatory to these instruments, Kenya has progressively designated a number of lakes and sites as "Ramsar sites" (Ndarugu, 2009).

According to Turner (1990), wetland ecosystems account for about six per cent (6%) of the global land area and are considered by many authorities to be among the most threatened of all environmental resources. Both the physical extent of wetlands and their quality (in terms of species diversity) have declined greatly over the past years (Turner, 1990). Each wetland is however composed of a number of physical, biological and chemical components such as soils, water, plants and animal species, and nutrients. However, these important resources are fragile and have suffered deterioration due to human activities converting wetlands to other land uses, such as cultivation, grazing, urbanization and industrialization, water abstraction among others (Franken, 2002). Also, Sakataka *et al*., (2014) reported that in Ethiopia, wetland encroachment and subsequent degradation is caused by rapid growth in population. According to Dixon and Wood (2003), wetlands are becoming increasingly important and recognized as vital natural resources because they have wide range of environmental functions and products which are of social benefits to the local communities.

Disturbance to wetlands especially from agricultural activities is often considered as a cause for degradation of wetland hydrology (Dixon,2002), hence eliminating native species and introduction of weed species, that generally reduced value of ecological and socio-economic values of wetlands for dependent species. Many tropical wetlands are being directly exploited to support human livelihoods. Processes among and within these wetland components allow wetlands to perform certain functions such as flood control, shoreline stabilization, water purification, and general products such as wildlife, fisheries and forest resources. In addition, there are ecosystem scale attributes such as biological diversity and cultural uniqueness (Dixon, 2002).

Humans have lived with and within wetlands in East Africa throughout history using seasonal swamps as grazing lands, swamp plants as thatching materials and also exploiting wetlands for fisheries and aquaculture (Lauren *et al.*, 2001). Since 1950s however, large-scale swamp conversion and population pressure on wetlands have threatened the integrity of many East African wetlands, which has precipitated local declines in indigenous wetland organisms, and altered ecosystem functions (Lauren *et al.*, 2001). Approximately 3-4 % of Kenya's land area is occupied by wetlands (MEMR, 2012). Wetlands provide some critical ecosystem services to a large number of communities in the rural areas. Therefore, they are indispensable to the very survival, health and welfare of human beings and biodiversity (MEMR, 2012).

Saiwa wetland is located in the Trans-Nzoia County. Part of this wetland form Saiwa Swamp National Park which was established in 1974. It covers an area of 2.9 $km^2$ and was created specifically to protect the habitat and preservation of the rare Sitatunga, an aquatic antelope and varieties of birds and de brazza monkeys. The park attracts recreational activities such as tourism for both domestic and foreign tourists. Over the years, intensive encroachment of human settlements, agricultural activities have impacted on the wetland.

## 1.2 Problem Statement

Saiwa Wetland has been a subject to considerable land use changes over the last few decades. Community needs and economic forces have led to land reclamation and increased agricultural practices which are associated with loss of natural ecosystems, particularly the floodplains which are the most fertile and highly productive parts of landscape (Tedesse *et al.*, 2002). Rapid population increase in the areas adjacent to the wetland due to migration of people from other areas favored by settlement scheme in Trans- Nzoia County has led to increase in housing units in the recent years, and this has had a major impact on Saiwa wetland which has been encroached to give way for increased population demands.

Former land use decisions were primarily concerned with private benefits which have led to conversion of wetland to agricultural land use and settlement development (Barbier, 1993). However, if these services which are public in nature are considered, the picture might change. Thus, from a societal perspective, both public and private benefits need to be considered in land use planning and management.

Political framework influenced land use changes and development in Saiwa wetland basins and have also aimed to integrate environmental concerns to a different degree (Kimani *et al.*, 2004). Therefore, wetland restoration and conservation management that is associated with land use changes in floodplains has to balance conflicting needs and interests from a wider economic perspective, integrating the multiple purposes of landscape and demonstrating the effects on a wide range of provisioning ecosystem services. Consequently, the integration of the values of ecosystem services into policy making could contribute to an improved protection and management of Natural resources.

Most studies that have been done at Saiwa wetland have majorly focused on the socio-economic and ecological benefits of the wetland (Kamugisha *et al.*, 1997) without looking at the linkages between land uses and socio-economic provisions of Saiwa wetland; and ways of mitigating the adverse impacts by use of sound environmental management plans. This study therefore sought to find out the role of land use changes on socio-economic provisions of Saiwa wetland.

### 1.3 Research Questions

The study will be guided by the following research questions:

1. What policies and legislations have been set to protect and conserve Saiwa wetland?
2. What are the land use patterns in Saiwa wetland?
3. What are the impacts of land use changes on the socio-economic provisions of Saiwa wetland?

### 1.4 Research Objectives

#### 1.4.1 Main Objective

The overall objective is to investigate the impact of land use changes on socio-economic provisions of Saiwa wetland.

#### 1.4.2 Specific Objectives

1. To review the existing legislation and policy framework that deal with protection and conservation of the Saiwa wetland
2. To map the extent and patterns of land use changes on Saiwa wetland
3. To investigate the impact of land use changes on socio-economic provisions of Saiwa wetland

## 1.5 Research Premise

1. A number of legislation and policy frameworks that deals with protection and conservation of Saiwa wetland do exist.
2. Mapping can be done for the extent and pattern of land use on Saiwa wetland.
3. There exist a number of impacts of land use changes on socio-economic provisions of Saiwa wetland.

## 1.6 Justification and Significance of the Study

The government of Kenya appreciates the importance of wetlands and their contribution to her gross domestic product. Kenya ratified the Ramsar Convention, 1991 and has since embarked on comprehensive reforms to address sustainable utilization of wetland resources. Kenya already has six designated Ramsar sites and Saiwa wetland is one of them. The development of the Kenya Wetlands Atlas (2012) which maps the country's wetland resources to guide practical and transformative actions for the sustainable management of these complex ecosystems is also vital in management and conservation of wetlands.

Due to land use changes in most Counties wetlands have been subjected to severe pressure and rapid degradation despite the important ecosystem service they provide to communities living around these critical areas (MEMR, 2012). Hence, wetland restoration and conservation management that is associated with land use changes in protected areas has to balance conflicting needs and interests from a wider economic perspective, integrating the multiple purposes of the ecosystem and their values to the economic development of Counties where they are located.

The result of the study will be of great benefits since it will contribute to prevention of further wetland transformations and loss of other critical ecosystem services in Trans-Nzoia County

## 1.7 Conceptual Framework

### 1.7.1. The Sustainable Development Theory

This theory promotes wise use of wetland resources sustainably and encourages conservation of existing wetland ecosystems (Dincer *et al.,* 2007). Sustainable use of wetland ecosystems has gained momentum since the adoption of various wetland policies and conventions such as the Ramsar Convention in 1987 as a sustainable utilization of wetlands not only for the benefit of humankind but as well as the benefit of wildlife community in a way that is compatible with the conservation of the natural ecosystems (Ramsar Convention Secretariat, 2010).

In the context of ecological development, sustainable use of natural ecosystems recognizes that while some ecosystem development is unavoidable since most economic activities have important benefit to the community, these activities can be done through development plans and ecological techniques to avoid destruction of such important resources. The theory also allows communities to achieve a balanced use of wetland resources by delivering ecological, economic and social cultural values over the long run.

The theory of sustainable wetlands management analyzes the connection in the areas of policy, legal and institutional frameworks amongst all the actors, looking at the drivers, impacts and pressures on these areas, further looking at the community and stakeholders' involvement in the management of these areas, lastly looking at what can be done in terms of monitoring and evaluation and see what if any incentives can be introduced to encourage sustainable wetlands management.

### 1.7.2. The Ecosystem Approach

The approach provides a methodological framework for the integration of wetland management alongside meeting economic and sustainable development objective. The approach places human needs at the center of biological management. It also aims at managing ecosystems, based on multiple functions that ecosystems such as wetlands performs and multiple uses that are made of these functions. Compared to other approaches, ecosystem approach does not aim for short term economic gains from natural resources instead it aims to optimize use of an ecosystem without

damaging it (Kulvadee, 2007). The approach focuses on maintaining integrity and functioning of ecosystems as a whole to a void rapid undesirable ecological change due to land use changes within and around such ecosystems.

Saiwa Wetland as a case study area offers a scenario where various stakeholders such as the KWS, NEMA, WARMA and Kipsaina Crane and Wetland Conservation Group are involved in Conservation. These stakeholders obtain various benefits from the wetland thus affecting their use and management. Various stakeholders involved in usage and management of Saiwa Wetland are guided by sectoral mandates and institutional changes which many a times bring about conflicts hence degradation of wetland. There is need to effectively addressed these conflicting uses and management in order to attain sustainability of the wetland.

Conceptual framework was derived from Ecosystem Approach Theory which expresses explicit between status of natural ecosystems and ecosystem services that support human well-being. This theory focuses on maintaining integrity and functioning of ecosystems as a whole to avoid rapid undesirable ecological change due to land use changes within and around such ecosystems. The theory also recognizes that the impacts of land use changes to natural ecosystems caused by human activities are a matter of social choice and are as integral to ecosystem interactions as ecosystems are to human activities. This conceptual framework places land use changes as the central focus, while recognizing that biodiversity and wetland ecosystems also have intrinsic value and people make decisions concerning ecosystems based on considerations of well-being. According to ecosystem approach, the assumption is that there exist challenges and impacts to wetlands in terms of provision of ecosystem services due to land use changes and other human factors. Change in human condition serving to both direct and indirect drive changes wetlands and ecosystems causing change in ecosystem services provision. Many other factors independent of the environment change the human condition, and many natural forces are influencing the wetland ecosystems as shown in figure 1.1.

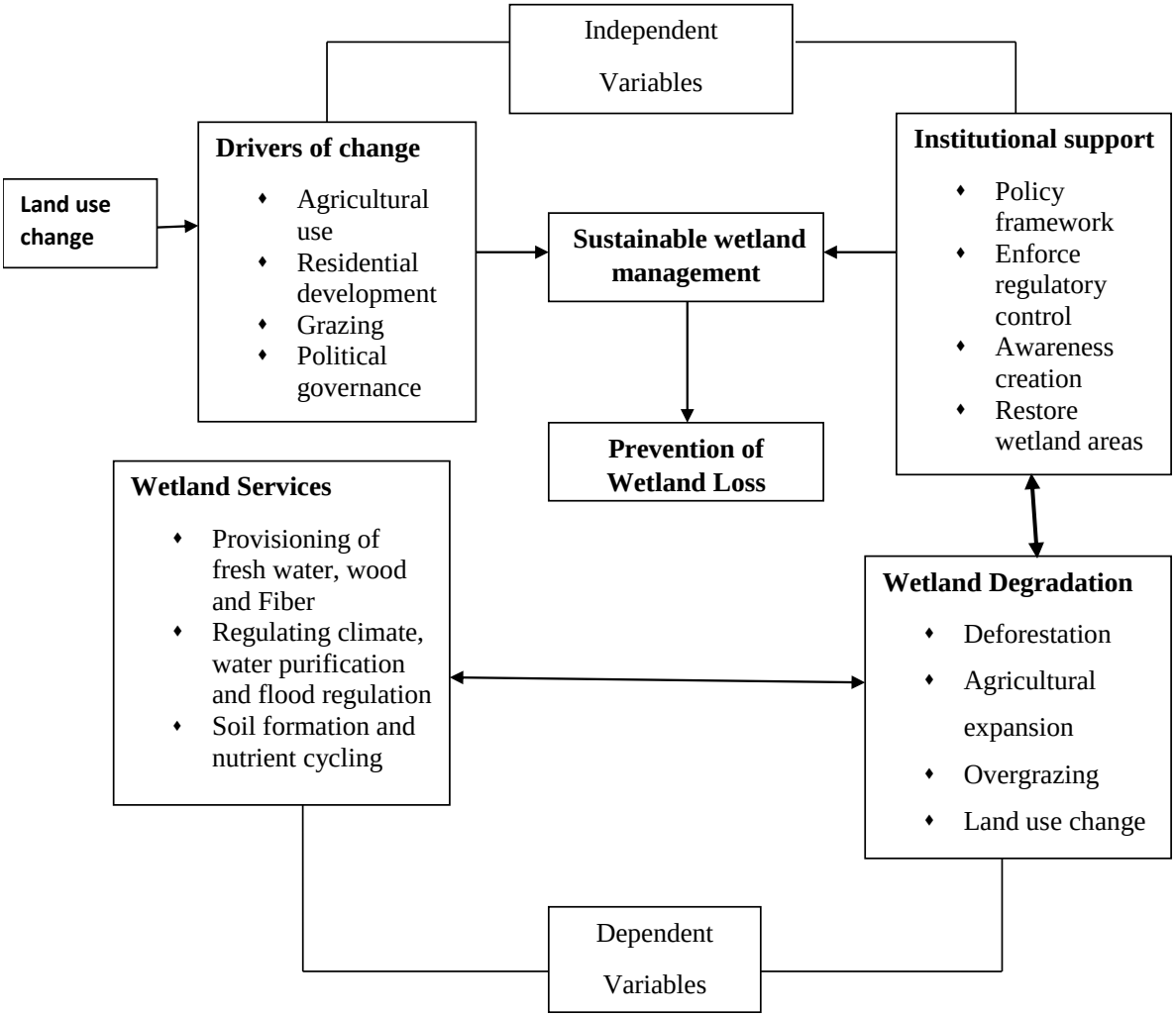


Figure 1.1: Conceptual Model for the impacts of land use changes on wetlands

Source: Author, 2017

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

Globally, Land use change has greatly altered the provision of wetland services. The conversion of wetlands into agricultural land due to high demand for food and other commodities has led to large increased in food production at the expense of wetlands and other ecosystem services. Despite wetlands being known as vital to provisioning of many ecosystem services, they are among ecosystems suffering greatest transformations globally (MA, 2005).

Land use change is the main driver behind wetland loss and other related ecosystem services (Fahrig *et al.*, 2007). Intensification of crops farming in fertile regions and the abandonment of farming in less favorable areas are affecting natural and cultivated ecosystems all over the world, especially in developing countries (Bakker, 2007). In Spain for example, land-use changes for intensive agriculture and urbanization are the main drivers behind biodiversity loss and has led to conversion of 60% of the original wetland area over the last five decades. According to the Spanish sub global ecosystem assessment, 62% of the ecosystem services delivered by wetlands have declined over the last fifty years, affecting regulating services in particular (EME, 2011). The decline in ecosystem services results not only from land-use intensification but also from abandonment (Van Landuyt, 2012).

## 2.2 Challenges Related to the Wetlands

Wetlands play crucial role in ecological, economic, social, and cultural functions. They are rich in fauna and flora resources as well as important sources of water for agricultural, industrial and domestic uses, in addition to their importance for fishing, flood regulation and wastes purification (Abebe and Geheb, 2003)

Efforts in wetlands management in most East African Countries are being challenged due to poor legal supports resulting from insufficient political will that fail to incorporate sufficiently sustainable management of wetlands in land use policy (Mengistu, 2003). Currently, wetland resources are used beyond their regenerating capacity (EPA, 2004). Such overuse of the resources often affects not only the resource base in use but also associated resources, adversely affecting

integrity of resources' relation leading to the disruption of the ecosystem at large. According to Bezabih (2008), factors that adversely affecting wetland functions, values and services are grouped into natural, economic, institutional, policy and strategic factors.

Expansion of wetlands for agricultural activities may lead to increased extraction of water from wetlands and growing desiccation of these areas; increased erosion from degraded uplands, as a result of more intensive rainfall, will lead to increased sediment deposition in the wetlands burying the fertile soil. Together, these developments will reduce utility of wetlands for cropping and domestic water supply, and so undermine one of the key adaptive strategies of rural communities in the face of climate change. Wider implications of wetlands damage are loss of environmental functions of wetlands such as reduction in flood peaks, recharge of aquifers, and storage of carbon - mostly in permanent wetlands.

Although human-induced changes in Earth's terrestrial surface is not a recent phenomenon, present rate, extent and intensity of land use and subsequent changes to land cover are unprecedented (Ellis and Pontius, 2011). Land use and land cover changes are linked to climate change, biodiversity loss and pollution of water, soil and air (Waltert *et al.*, 2004; Ellis and Pontius, 2011). The land use change affects climate of an area which in turn affects natural resources such as water, wetlands and biodiversity (IPCC, 2001; Gibbard *et al.*, 2005).

Though Wetlands are important in global cycling of water and chemicals, including greenhouse gases and stabilize climate changes, wetlands and their biota are at risk from combined effects of land use changes (Sanz, 2002; Finlayson *et al.*, 2006). Thus, degradation of the environment, which negatively impact ecosystem processes and function, especially conversion of wetlands to irrigated lands, represent significant challenges to biodiversity (Sharsm *et al.*, 2007).

### 2.3 Sustainable wetlands management

Sustainable wetland management should ensure peoples continued access to resources in ways, which maintain both their livelihoods, and resources which they depend on. In other words, land use of resources for agriculture must be limited so that other benefits are not destroyed or seriously

reduced (Wood, 2003). In this way, wetlands conservation can be undertaken so that it enhances benefits that local populations derive from natural ecosystems while maintaining them. Sustainability of wetlands needs participatory participation of relevant stakeholders in planning and implementation process (Siraj, 2004).

### 2.4 Impacts of Land use changes on Socio-Economic Provisions of Wetland

It is widely recognized that wetlands provide several ecosystem services that contribute to human well-being. The major ecosystem services that wetlands provide includes: Provisioning Services (such as agricultural production and raw materials), Regulating Services (such as nutrient retention and flood water storage), Cultural Services (such as recreation and scenery) as well as supporting Services such as nutrient cycling and primary production (Posthumus *et al.,* 2010, Schagner *et al.,* 2013).

#### 2.4.1 Provisioning Services

The role of wetland resources in livelihoods of poor is important particularly in developing countries. For example, wetland activities at Pece Wetland in Uganda provides more than 50% of monthly income of dependent population (Opio *et al.*, 2011). Nearly 90% of East Godavari Delta population in Andhra Pradesh, India depends completely on mangrove wetland products for sustaining their livelihoods (Dahdouh-Guebas *et al.*, 2006). Bosma *et al.*, (2012) reported that livelihood of 40% of households in Mahakam Delta depends on resources from mangrove wetland ecosystems. In addition, this number is as high as 80% when pond-farming activities such as fish and shrimp cultivation are included. This show how important wetlands are not only to human beings but also to disaster management. The conversion of wetlands into other land use categories, primarily conversion of various vegetation cover into agricultural land has greatly impacted on water flow and biogeochemical cycle of most ecosystems in Kenya (Milad *et al.*, 2011). The effects of land use changes are perceived as the most important drivers of wetland loss not only in Kenya but also in most African Countries (Sala *et al.*, 2000).

### 2.4.2 Regulating Services

Wetlands are known to represent a key prerequisite for the functioning of an ecosystem and delivery of bundles of ecosystem services (MA, 2005, Groot *et al*., 2010). Land use change do undermine regulatory capacities of the ecosystem in terms of ability to avoid and minimize hazards such as flooding (Preston *et al.,* 2011). A number of risks initiated by land use changes or its consequences originates as a result of diminished land productivity, land degradation, disruption of water regime, water contamination and extra loss of biodiversity (Shao *et al*., 2005)

On the other hand, change in land use patterns in terms of desirable functional change of physical features of the landscape can be applied as an adaptation option to most of the risk such as disruption of water regime resulting in flood risk. This can as well be reduced by conservation and restoration of forests that would stabilize land slopes and regulate water flows or through the reinforcement of water storage capacity of upland wetlands by sustainable management (Wratten, 2013)

### 2.4.3 Supporting Services

Most of indirect benefits of wetlands are lost when wetlands are converted to cropland especially if the wetland is drained. Drained wetlands are less effective at regulating stream flow and purifying water since the drainage channels speed-up the movement of water through the wetland (Kyle, 2015). Drainage also increases danger of erosion as water flow is increased thus increasing erosive power of water. Hydrological changes which results from drainage have negative effects on soil (e.g. there is reduced organic matter and moist levels, and sometimes there is increased risk of underground fires and increased of acidity due to the oxidation of sulphides to produce sulphuric acid (Kyle, 2015).

Kyale (2015) stated that soil is disturbed when crops do not bind or cover soils as well as natural wetland vegetation. Thus, erosion is less effectively controlled due to lack of enough soil cover from planted crops. This becomes a very serious problem in areas with high erosion hazards especially in Saiwa Wetlands. Adding fertilizers and pesticides (which may leach into the water

system) thus leading to water pollution, further reduces effectiveness of wetlands in terms of water purification. The impacts of cultivation can be minimized if traditional cultivation practices are followed.

### 2.4.4 Cultural Services

Wetlands are important historical sites that comprise important components of Kenya's cultural heritage. Some communities use wetlands for cultural ceremonies. They play an important role in cultural identity of people, spiritual practices and beliefs. Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and a vital source of income for many countries. Previous survey conducted by BANCA (2014) in Moeyungyi Wetland- Myanmar, estimated that the overall annual recreation revenue from tourism was $74,000. Therefore, loss of wetlands means loss of habitat for various species, many of which are important to local activities and tourism.

## 2.5 Mapping of Land use and Ecosystem Services

The concept of Ecosystem Services (integrating approaches and aspects from different disciplines) (Braat and Groot, 2012) has gained attention in research, policy and society in recent years. Various strategies integrating both spatial and aspatial data have been used to map ecosystem services such as integration of remote sensing technologies into ecosystem services concepts. The process of mapping and assessing ecosystems and their services starts with mapping ecosystems themselves. Large-scale land cover maps produced using high-resolution satellite imagery, have proved valuable for this. They can be linked to habitats, and hence ecosystems (Maes *et al.*, 2014). Mostly, relationship between drivers and services are derived rather straight forward by Look-up tables and INVEST (Integrated Tool to Value Ecosystem Services and their trade-offs) which is an open access tool based on land cover maps for use with GIS (Geographic Information System) software. This is done in order to conceptualize and assesses ecosystems services values which can be incorporated in policy making, spatial planning and management.

## 2.6 Legislation and Policy Framework Governing Wetland Management

There are various policies and legislative frameworks that govern preservation, use and management of wetlands; such as the Ramsar Convention on Wetlands of 1971, the Kyoto Protocol of 1995, Convention on Biological Diversity, the Rio-De-Janeiro Conference and the Copenhagen Climate Meeting of 2009 which were results of the recognition that global and regional climate changes are a threat to the land resources on which human survival depends (Rebelo *et al.*, 2009). As a signatory to these instruments, Kenya has progressively designated a number of lakes and sites as "Ramsar sites"

### 2.6.1 Ramsar Convention on Wetlands of 1971

The Wetland or "Ramsar" Convention is one of the oldest global nature conservation treaties that deal with a particular ecosystem. It is an intergovernmental treaty that provides the framework for national action and international cooperation that instigates for the conservation and sustainable use of wetlands and their resources through local, regional and national action. The main goal of this convention is to protect and conserve a particular ecosystem and all species that depends on it. In relation to physical planning the Convention requires that planning must be carried out so as specifically to promote conservation of the Wetlands and generally to promote sustainability of wetlands.

### 2.6.2 Convention on Biological Diversity

This Convention was opened for signature in 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). It was inspired with growing commitment to sustainable development by the world communities. It represents a drastic step forward in conservation of biological diversity, the sustainable use of its components, and fair and equitable sharing of benefits arising from the use of genetic resources. The World Summit on Sustainable Development held in Johannesburg 2002 recommended partnership between governments, private sectors and the public at large to enhance management of wetlands. Its focus is also on sustainable development. Kenya being a signatory to these international treaties and conventions. Its therefore committed to implement recommendations from global initiatives on environmentally sustainable development, such as United Nations Summit held in 2000, where

nearly all world leaders endorsed a set of eight time bound and measurable goals, named “the Millennium Development Goals” so as to combat environmental degradation, among other global problems.

# CHAPTER THREE: METHODOLOGY

## 3.1 Study Area

### 3.1.1 Location, Size and Extent

The study was carried out in Cherengany Sub-County in Trans-Nzoia County. The Sub-County lies within latitude 1°1'8.72"N and longitude 35°0'8.3"E. It covers an area of 629.8 sqkm with a population density of 310 persons per square kilometer (KNBS, 2013). The Sub-County has a total population of 195,173 distributed into 39,119 households (KNBS, 2013). Saiwa wetland is located in the Trans-Nzoia County and a section of this wetland forms Saiwa Swamp National Park which was established in 1974 and is managed by Kenya Wildlife Service. It covers an area of 2.9 $km^2$

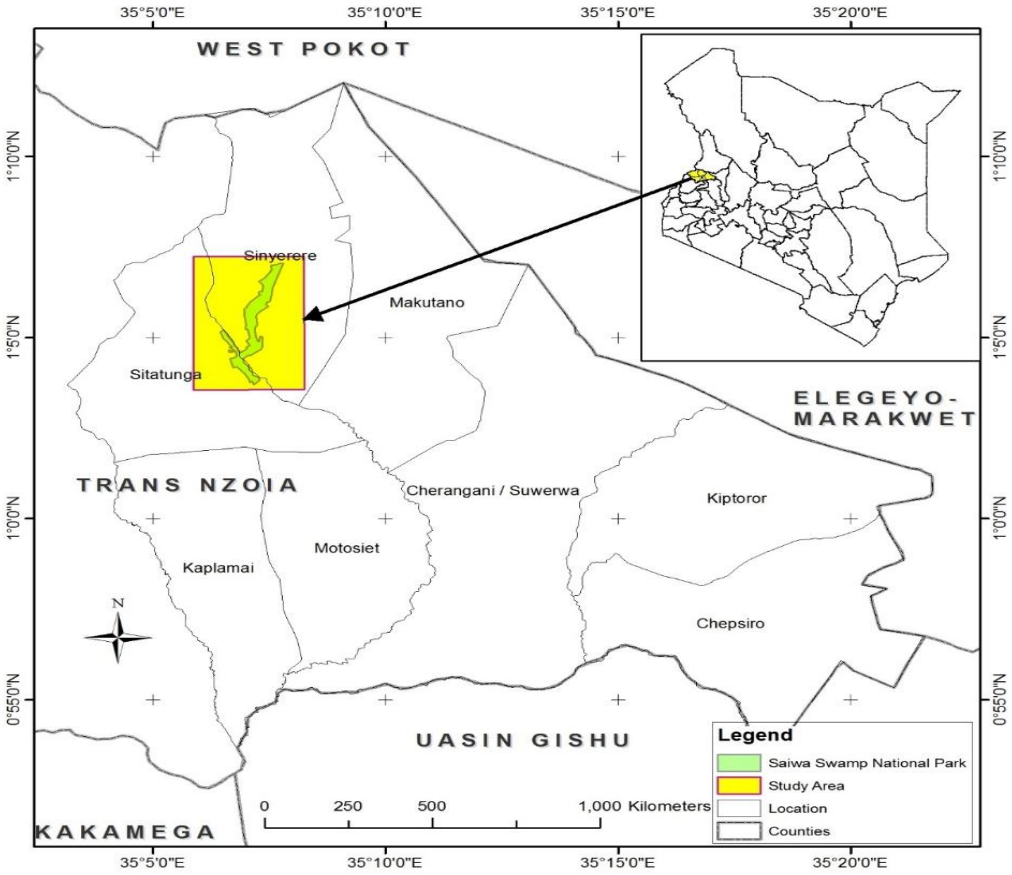


Figure 3.1: Location of Saiwa Swamp, Cherengany Sub-County, Trans Nzoia County

### 3.1.2 Topography, Geology and Soils

The altitude of the study area is about 1800 meters above sea level with several undulating hills such as Cherengany hills. The main rivers that flows through the swamp includes: River Kapenguria, Kipsaina and Sinyerere River which are the main rivers within the study area.

The study area is characterized by two types of rocks namely; metamorphic rocks of basement system and volcanic rocks. Soils in the area ranges from sandy to loamy and loam to sand depending on location in terms of relief as shown figure 3.2 below. However, red loam soils which under the prevailing rainfall conditions are very suitable for maize and other crops.

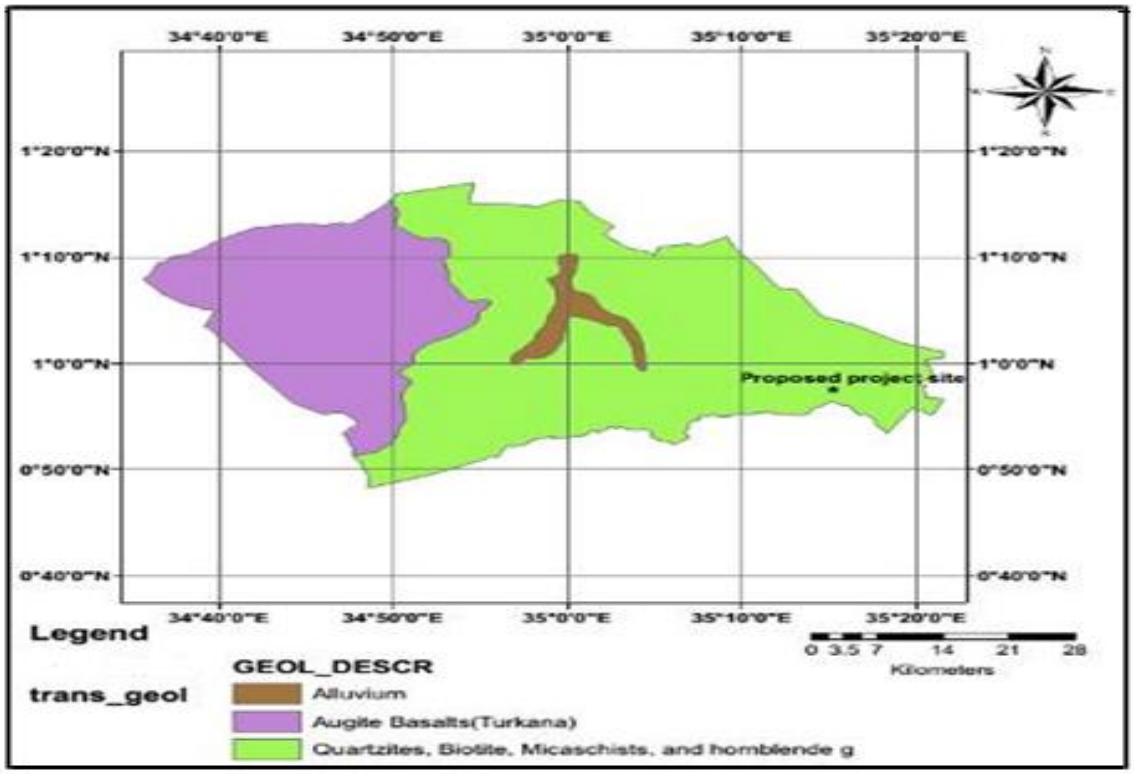


Figure 3.2: Saiwa Soil Map
Source: Survey of Kenya, 2016

### 3.1.3 Climate

The study area experiences highland equatorial climate, which is characterized by widely varying rainfall in relation to diverse relief. On average, the annual rainfall in the study area ranges from 1,000 to 2,000 mm. Rainfall distribution during the year is bimodal, with a first peak in April and a second in August. The long rains start in July and usually average more than 1000mm above the April short rains. The temperatures in the area range between 15-25 C, with coldest season being July-August season.

### 3.1.4 Land-use patterns

Land is demarcated and individually owned under freehold system of tenure. Due to increasing demand of change of land use as a result of population increment, there is encroachment along the two rivers (Sinyerere and Kapenguria) which drains into Saiwa swamp for agricultural purposes. Figure 3.3 below indicates various land use patterns that do exist within the study area.

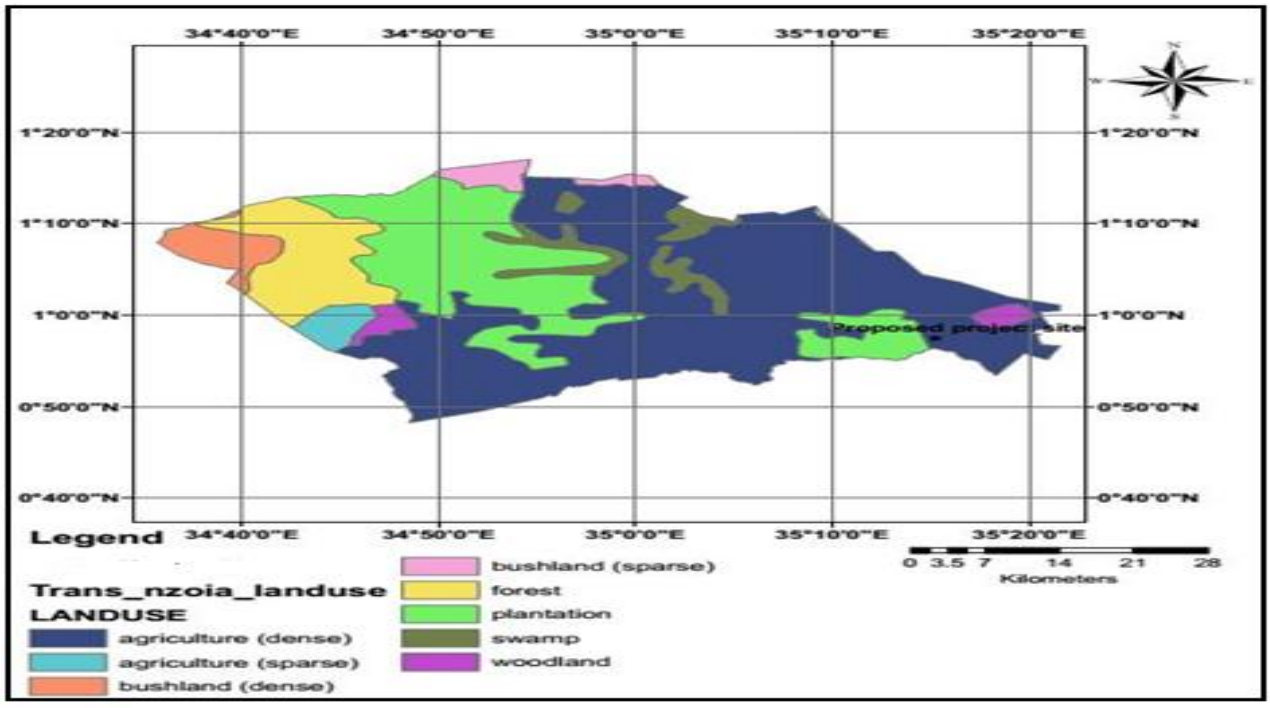


Figure 3.3: Land use map

Source: Trans Nzoia lands office, 2016

### 3.2 Research Design

The study adopted a diagnostic research design (determine the frequency with which something occurs or its association with something else) to provide an analysis of the policy framework governing the development of Saiwa wetland, impacts of land use changes on socio-economic services, land use patterns and recommendations on measures that can be adopted for sustainable development of Saiwa wetland (Thomas Gitau, 2008). The design is rigid hence make enough provisions for protection against bias and maximize reliability. This research targeted the population of Cherengany Sub-County with a population of 195,173.

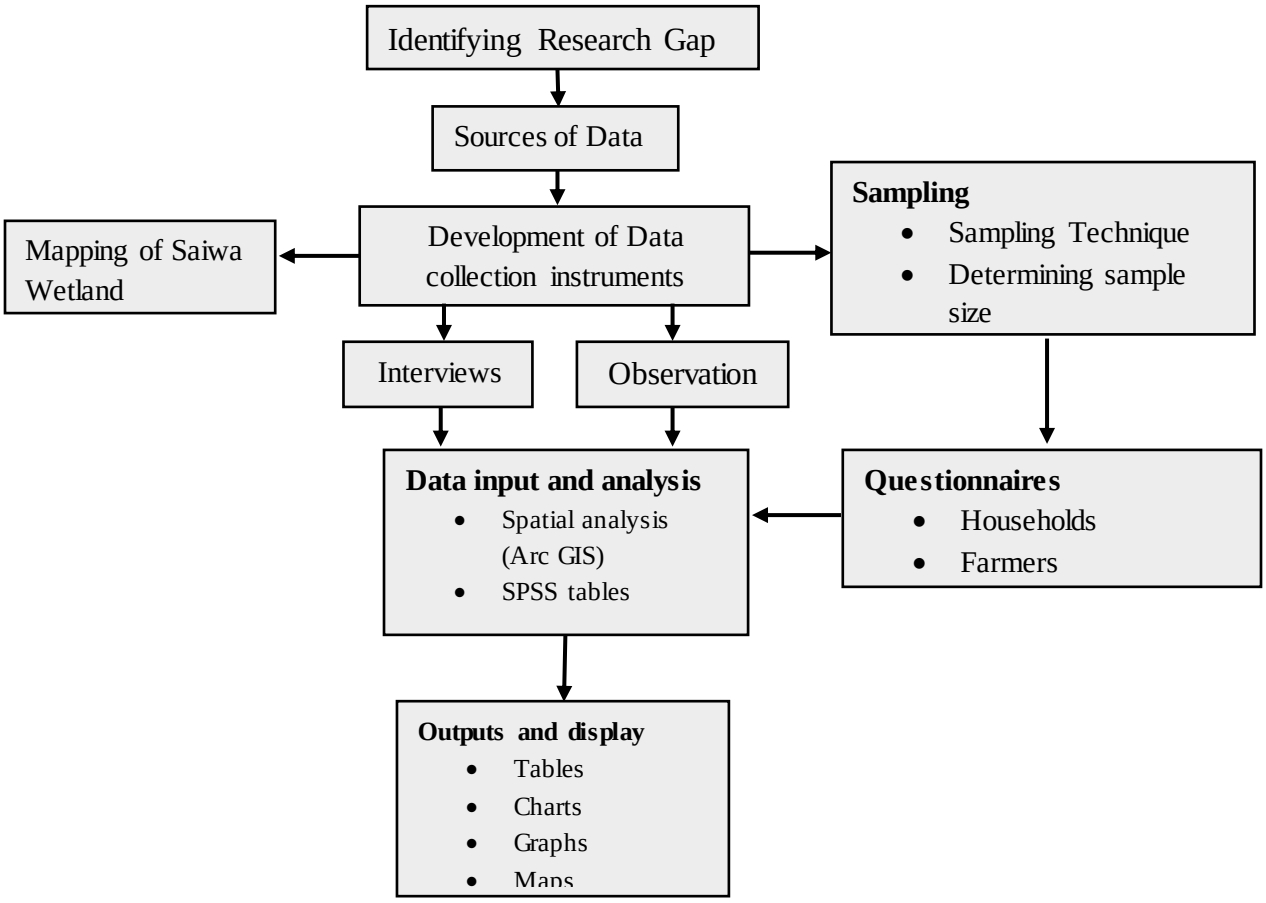


Figure 2.4: Summarized Research Design
Source: Author, 2017

### 3.3 Sample Procedure and Sample Size

This research study used two sampling techniques; purposive and simple random sampling. In addition, both qualitative and quantitative methods of data collection were adopted.

#### 3.3.1 Purposive sampling

This technique was used to sample various resource persons from relevant governmental and non-governmental institutions who have knowledge on the matter under study. Purposive sampling assisted researcher to get the opinion of the target population without necessarily interviewing every subgroup in the study area. The resource persons interviewed were as follows; Mr. Lala – County Director of NEMA, from ASDSP; Mr. Evans Mutangi (Environment), Mr. Oyato John (Monitoring and Evaluation), Ms. Esther Cherop – Warden Saiwa Swamp National Park and Mr. Morris Wanjala – Kipsaina Crane and Wetland Conservation Group.

#### 3.3.2 Simple Random Sampling

Simple random sampling technique was used to administer the household questionnaires. A sample of 100 households were randomly selected to represent proportionately the entire community of Cherengany sub-county population. The sampling frame (population) was household families living adjacent to the Saiwa Swamp National park and the two rivers (Sinyerere river and Kapenguria river) which feeds to Saiwa Wetland.

#### 3.3.3 Sampling Size

The sample size was determined using the formula recommended by Nassiuma (2000).

$$n = \frac{NC_V^2}{(C_V^2 + (N-1)e^2)}$$

Where n= Sample size

N= Population

Cv = Coefficient of variation (take 0.5)

e= Tolerance of desired level of confidence, take 0.05% at 95% confidence level

Since Cherengany Sub-County has a population of 195,173 as per 2009 national housing and population census, the formula applied was as follows:

$$n = \frac{195{,}173(0.5)^2}{0.5^2 + (195{,}173) \times 0.05^2}$$

$$n = 100$$

This gives 100 respondents as the sample size. This sample of 100 households living adjacent to Saiwa wetland was divided into halves; 50 household upstream and 50 households downstream. A simple random sampling method was used to administer questionnaires to heads of each household within a distance of 1km (since households were separated by farms) from Saiwa wetland in order to obtained the required information of the study.

### 3.4 Data Collection

Primary and secondary sources of data were used to provide data for this study. A sample of 100 Questionnaires (both structured and semi-structured) were used to collect data on information related to the study both from the households upstream and downstream. Interview schedules were used to collect data from key informants ranging from Environmental officers, KWS officers, Agricultural officers, CBOs among others. Secondary data on policy and regulatory framework was solicited from various wetland policy documents, journals, Reports among others.

#### 3.4.1 Questionnaires

A series of questionnaires with both open-ended and closed-ended questions were administered to obtained data on socio-economic provisions, existing legislation and policy framework that deals with management of Saiwa wetland.

### 3.4.2 Observation

Observation was used as a tool to purposefully and selectively watch and listen to verify respondents' information and information from secondary sources and have a feel of the impacts of land use changes on socio-economic provisioning services. In this notion, observation was used to examine land use trends and patterns and service provisions.

### 3.4.3 Electronic gadgets

Digital cameras were used to take pictures of current status of land uses, physical infrastructure status. GPS was used to collect Geographic Coordinates of various locations in the study area and remotely sensed maps were used to study the chronological trends and patterns of land uses and land use changes over the past 27 years.

### 3.4.4 In-depth Interviews

This involves a person to person interaction to gain relevant information through asking questions. This can be done mainly between a person to a group of people. This method was used to gather information from key resource persons; both governmental and non-governmental officials, Community based organizations.

## 3.5 Data analysis

Both qualitative and quantitative analyses techniques were used to analyzed the collected data. A GIS/ Remote sensing based desk study was done in order to assess the spatial and temporal changes in the areal extent of different land uses and land cover in order to assessed land use changes and modelling of socio-economic provisions of Saiwa wetland. This provided a quick comparison of variables using different sets of data. Data collected from research questionnaires was edited, coded and subjected to descriptive statistics for calculation of frequencies, means and percentages and the results presented in figures, tables, maps, graphs and charts. Qualitative data from in-depth interviews, questionnaires and observation were edited, organized descriptively into themes which are presented in discussions, narrative forms and citations through transcription (Burnas, 2000).

# CHAPTER FOUR: RESULTS AND DISCUSSIONS

## 4.0 Introduction

Findings and discussions of this study based on data collected from the field are discussed and presented as per the objectives. The first section provides analysis of the existing legislations and policy framework that deal with protection and conservation of wetlands. The second section is the analysis of mapping the extent and patterns of land use/ Land cover on Saiwa Wetland. The third section presents analysis of impacts of land use changes on the Socio-Economic provisions of Saiwa Wetland; consisting of income generation, employment creation, tourism, preservation of culture and tradition, main households' activities, among others.

## 4.1 Existing legislation and policy framework that deal with protection and conservation of Wetlands in Kenya

This section entails an analysis of the existing legislations and policy framework that's deals with the protection, conservation and management of natural resources; in this case, Saiwa wetland. The study aimed at reviewing existing policies, legislations and institutional frameworks that deals with the management of Saiwa wetland. The study assumed that there are existing legislation and policy frameworks for Saiwa wetland management. This study reviewed key environmental policies, legislation and institutional frameworks that deal with Saiwa wetland management.

### 4.1.1 The Constitution of Kenya, 2010

Chapter 5 part 1 section 60 (1) of the Constitution states that land in Kenya shall be held , used and managed in a manner that is equitable, efficient, productive and sustainable, and in principals of land use policy with equitable access to land, security of land rights, sustainable and productive management of land resources, transparent and cost effective administration of land, sound conservation and protection of ecologically sensitive areas, elimination of gender discrimination in law customs and practices related to land and property in land and encouragement of communities to settle land disputes through recognized local communities initiatives consistent with the constitution. The Constitution of Kenya has been able to deal with the past land injustices

where sectors dealing with land matters were established without consulting the local communities and their rights to access and utilize wetland resources (Barrow 2002).

Under section 42 of the Constitution of Kenya, 2010, everyone is entitled to clean and healthy environment which includes protecting the environment sustainably using various rules and regulations and other measures as they are listed under section 69 of the Kenyan Constitution. Article 70 provides some of duties everyone has to perform to sustainably manage environmental resources. As pertains to the implementation of land related policies, the constitution of Kenya Section 60 (2) leaves this mandate to the national land policy. As stated in Section 61 (1) all the land in Kenya belongs to all Kenyans either collectively, communal or individually. Section 61 (2) clearly classifies Kenyan land as either communal, public or private. Section 61 recognizes government wetlands while section 63 (3) states that any unregistered community land shall be held in trust by county government on behalf of community for which it is held. Parliament of Kenya is tasked with the role of coming up with rules and regulations to govern ownership of land and its use under Section 65 (4) of the Constitution of Kenya while Section 67 (1) creates the national land commission whose core mandate is to manage the Kenyan land on behalf of the national and government and recommend national land policy to the central government. Parliament is empowered under section 68 of the Constitution of Kenya to merge and rationalize existing, revise sectoral land use laws as per Constitution and enact rules and regulations to guide land access and use. The Constitution has succeeded in providing for enhanced transparency in the administration and management of land and land-based resources.

Section 69(1) of the Kenyan Constitution 2010, mandates the national government with responsibility of ensuring sustainable exploitation, utilization, management and conservation of land based natural resources and be able to equitably share the benefits arising from the resources. Additionally, the government should ensure protection of indigenous biodiversity and the genetic resources owned by communities; encourage involvement of local communities in management of land-based resources, Establish EIA and environmental audit and monitoring systems, prevent environmental activities dangerous to the environment and utilizing land based natural resources for the benefit of the people of Kenya. These provisions address the pledge by Barrow *et al.*, (2002) that greater roles for local communities, the rural and urban poor as well as the private sector in the management of wetlands is the only solution to maintain critical wetland services.

Section 70(1) of the Constitution of Kenya, 2010, provides that anyone who is denied the right to a clean and health environment to seek legal redress without demonstrating that any person has suffered loss or injury as highlighted in Section 70(3).

### 4.1.2 The Environmental Management and Coordination Act *(EMCA)* of 1999

Part 1 of this Act provides for co-operation of different sectors dealing with natural resources (wetlands) protection and conservation which should apply multi-sectoral approaches to conserve and manage natural resources in their natural habitats while coordinating all the subsectors that have a stake in environmental management. Like the draft, National Wetlands Conservation and Management Policy 2013, Wildlife Act (Cap 376), EMCA ,1999 recognizes the principles of sustainable environmental management.

Unfortunately, NEMA has continued to work alone because it has not been able to establish multi-sectoral coordination structures where different sectors can have their say on how to Conserve and protect different natural resources (such as Wetlands) found within the country. Consequently, this has accelerated institution conflicts between different institutions especially between KWS and KFS both of which have overlapping functions in the day-to-day management of Wildlife, Forests and Wetlands. Section 3 (3) of EMCA has highly welcomed Public participation in any major development decision on the environment where the public shall have a recourse to law. In addition, it has a provision where the public has to be listened to in issues related to land use changes that entails conversion of wetlands to other uses. Section 125 of EMCA, 1999, has also called for the establishment of tribunals to deal with environmental crimes. This has not been implemented since environmental matters were included in the Kenyan judicial system late thereby giving the Kenya's Judiciary limited capacity to deal with environmental issues.

Part V Section 42-57 of EMCA, 1999, deals with protection and management of wetlands, rivers and lakes, hilltops, hillsides, conservation of energy, biological diversity, mountain areas and forests among other natural resources. All these institutional frameworks, acknowledge the country's commitment to inter-sectoral development and sustainable use of resources under international conventions and other agreements to promote sustainable management, conservation and utilization of wetlands and biological diversity within a framework of sustainable livelihoods as proposed by Scoones, (1998)

Under Sections 29 (2) and (3), NEMA as an Institution develops Frameworks of the County Environment Committees. The County Director of Environment (Trans-Nzoia County) is the one in charge of environmental matters. Section 42 of the Act notes that only after approval should development activities on wetlands be carried out. Under Schedule 2 paragraph 8, there is need to do Environmental Impact Assessment (EIA) for agricultural activities. Farmers interviewed within the study area claimed that they were not aware of any permits needed in order for one to grow produce on or near the wetland. This wetland is considered as a very fertile area as it gave them economic independence. They also felt that the County Government of Trans-Nzoia and the National Government should intervene in situations of human-wildlife conflicts since wildlife from Saiwa wetland destroys their crops, animals and also injured humans.

### 4.1.3 The Agriculture Act, Cap 318

The Agriculture Act, Cap 318, Section 48 gives the minister for agriculture powers to come up with rules for land conservation as it promotes soil conservation, water conservation and prevents destruction of vegetation. These rules for land conservation include; prohibiting, regulating or controlling clearing of land for farming, destruction of vegetation and grazing or watering of livestock on the wetlands. However, this Act has not been implemented on the ground to protect and conserve the bigger part of Saiwa wetland which lies outside the fenced section (Saiwa Swamp National Park). Local communities living around Saiwa wetland are instead practicing farming, grazing their livestock on the wetland, encroachment of the wetland and sand harvesting from the wetland. As a result of poor farming methods, sand mining and grazing of livestock on upstream, there has been siltation of the upper side of the wetland and erosion on the lower side. The poor implementation of this Act has not only led to siltation of the wetland but also destruction of the wildlife habitat, and unacceptable land scape degradation due to poor implementation of sustainability principals.

Plate 4.1: Farming and Grazing on the Wetland

Plate 4.2: Sand mining on Sinyerere River

### 4.1.4 The National Land Policy Sessional Paper No. 3 of 2009

The Sessional Paper No.3 of 2009 on national land policy, section 3.4.3 entails principles of environmental management with section 128 indicating that, wildlife, forests, coastal resources, water, marine as well as soil erosion as the major environmental problems experienced in Kenya. Section 29 of the land policy, states that conservation and sustainable environmental management measures such as; urban areas management, ecosystem protection, environmental assessment and audit, shall be put in place in order to conserve and manage the environment. Sustainable management of land based natural resources (such as wetlands) is acknowledged in the Land Policy, specifically section 130. The policy further notes that sustainable management of land based natural resources depend on governance systems, which define the relationship between people and the resources. Section 31 states that in order for the management of land based natural resources to be inclusive and comprehensive, all regulations, laws and policies that deal with natural resources should be in lined with the framework established by EMCA 1999.

Section 31 of the land policy indicates that, to consider social economic and cultural values, involve local people living next to parks and ecologically sensitive areas in the management and protection of such areas, the government shall facilitate the preparation of participatory environmental action plan by people living near protected areas. By implementing the Land policy in Kenya, the control and command by government agencies will be stopped. This will ensure that local communities living near environmental sensitive areas are included as the central part of conservation, utilization and sharing of the benefits accruing from wetland conservation.

Kenya's diverse ecosystems which includes; wetlands, marine, forests and coastal ecosystems, national parks, arid and semi-arid areas (ASALs), watersheds, lakes and drainage basins are acknowledged in section 133 of the land policy. Section 33 of the policy indicates that there is a challenge in the management of the resources due to contracting uses and wide-ranging governance's structures resulting from the trans-boundary nature of resources hence unsustainable utilization of resources.

Section 33 of the policy indicates that government shall come up with measures for management and restoration of wetland resources, identification of traditional wetland management systems and benefit sharing with local people. Additionally, the policy encourages public participation to ensure sustainability in management of natural resources in collaboration with private and community stakeholders to ensure the protection of ecosystems and their sustainable management.

The government is tasked with ensuring that all land uses and practices are in conformity with land use plan and the principles of biodiversity protection, conservation and sustainable development under section 138 of the policy. However, there is no evidence of actual implementation of these good land policy provisions in Saiwa Wetland.

### 4.1.5 Water Policy and Water Act, 2002

The water policy entails guidelines that support integrated water resource management and development to assure sustainability with community participation and private sector playing the key roles in the process. The water Act 2002, promotes participatory participation of local communities in management of wetlands and other water catchment areas. Communities living around Saiwa wetland do recognize it as a water catchment because they use water from the wetland for domestic and livestock consumption. They are also aware that Saiwa wetland acts as a recharge to the wells surrounding the greater part of the park. Section 71 (1) of the Water Act, 2002 protects water catchments by licensing water users to enter into agreements for drainage of land, soil conservation, control of vegetation, effectively preserving purity and quality of water. In Saiwa wetland, there is no water user association to use water from the wetland but KWS have dug boreholes and wells around the wetland where the local communities can fetch water and reduce access into the wetland in search of water which give an excuse for committing illegal activities including hunting of the wildlife in the wetland and cutting down of trees.

### 4.1.6 National Water Master Plan 2030

This plan was launched on 26 March 2014 and brought all stakeholders from water sector; community-based organizations, Non-Governmental Organizations, County governments, Ministry of Environment, Water and Natural Resources and Development Partners. The plan aims at improving water and sanitation (availability and accessibility) to all, increase in agricultural area

under irrigation to 1.2 million hectares, to be a nation that has a clean, secure and sustainable environment and to generate more efficient energy by the year 2030. Protection of Kenya's water towers and Ecosystems would lead to a clean, secure and sustainable environment. It further notes that there is need to promote water resources development to the maximum for its sustainability. In order to manage water demands, there is need to introduce water savings, effective and efficient water use, recycling of water to meet the increasing demand. There is need to put forth Mitigation measures in areas adjacent to Saiwa wetland due to increasing agricultural activities.

Water abstractions in areas of Saiwa wetland lying outside the protected section primarily used for domestic and irrigation of small-scale farms needs to be checked to ensure its sustainability. At Saiwa trenches have been dug along the rivers feeding into the wetland to divert waters into the nearby farms. The plan should provide mechanisms of what needs to be done to achieve efficient use of water.

At Saiwa Kenya Wildlife Service (KWS) has dug boreholes and modern water pumps around the Saiwa Swamp National Park (protected area) which is part of the Saiwa wetland to enable the communities (farmers) adjacent to the park have equitable use of the resource. This scenario is different from upstream (Kapenguria river) and downstream (Sinyerere river) which lies outside the protected area and are vulnerable to degradation by the community people. The plan needs to be decentralized to the communities and also have a feedback from the members on its viability in application. Without community participation and information to the users there is no way of ensuring that the plan works. Communities can also be trained on water saving measures and programs such as drip irrigation as well as giving incentives for efficient use of water.

### 4.1.7 National Water Resources Management Strategy 2012-2017

The National Water Resources Management Strategy is provided for under Water Act, 2002, Sections 11(1) and 11(2). This strategy advocates for sustainable development of Kenya's Water Resources. Under this strategy it was revealed that management and use of water resources were planned and implemented in a fragmented, sectoral and sub-optimal manner. This led to encroachment and degradation of the water catchments and water resources. Situation analysis of

Kenya's economic sectors; agriculture, energy, livestock, fisheries, manufacturing, environment and tourism depicts their dependency on available water and sustainable environmental flows (NWRMS, 2009).

This Plan has proposed various strategies related to management of water under Environmental Planning and Governance such as; development of a policy framework to harmonize environmental laws and institutions, capacity promotion of collective enforcement of environmental standards, strengthening of institutional capacities of multi-sectoral planning, strengthening of linkages between institutions of planning and environmental management, and have water conservation measures strengthened to enhance water availability for environmental and other uses (NWRMS,2009). This can be attained at the Standards Enforcement and Review Committee. The committee would be advised on actions points to assist in the development of National Environment Action Plans as well as water and wetlands management plans that are all aimed towards the sustainable use and management of the resources.

### 4.2 Overlaps in Kenya's Wetlands Management

The review of institutions responsible for wetlands conservation showed that the Ministry of Environment and Mineral Resources, Ministry of Culture Gender and National Heritage, and Ministry of Forestry and Wildlife are responsible for the management and conservation of natural resources in Kenya. The Ministry of Forestry and Wildlife has three government agencies: KFS, KWS and KEFRI and the Ministry of Environment and Mineral Resources (MEMR) has NEMA. There is overlap in roles with KWS, KFS and KEFRI in terms of provisions of measures for environmental restoration; collection, storage, archive, analysis, update and dissemination of geospatial data on natural resources; promotion of rational wildlife and forestry resources utilization and promotion of education and environmental awareness.

The distinctive function of NEMA in Kenya is to coordinate all the environmental management matters. Other NEMA's roles do overlap with the roles of other institutions. Such overlapping roles Includes; formulation of environmental management policies, a role also performed by KFS, KWS and KEFRI, preparation and implementation of management plans, coming up with

measures for environmental management and development of regional committees which are also performed by KFS and KWS.

### 4.3 Key issues in legislation and Policy frameworks

It was clear from the findings of this study that there exist enabling policy and legislation framework that bring together different sectors in wetlands management; involving the relevant stakeholders and local communities as beneficiaries and partners. In addition, participation of local communities, policy recognition of collaborative wetlands management and creation of NGOs-government-local community partnership was sufficient.

All the legislation and policy documents reviewed including the Constitution of Kenya, 2010 and the National Land Policy 2009, has adequate provisions to ensure sustainable land utilization principles, sustainable conservation of land, environmental audit and assessment, productivity targets and guidelines which comply with EMCA, 2000 and ensuring public participation of local communities in the management of wetland natural resources as per EMCA, 1999. However, there is poor implementation of these policies and legislations. Participation of local people in wetland conservation and protection without financial backing was a continued violation of people's rights as they could not participate in wetland management due to lack of policy budgetary means to do so.

The study established that participatory Wetland management has not been implemented in Kenya and Saiwa wetland in particular as there are yet no participatory wetland management agreements between the local communities, KWS and KFS. The study further revealed that despite NEMA having been operational since 2002, there exists no significant collaboration between key government agencies. Additionally, institutional mandates were seriously overlapping with very little public participation in wetland management. Consequently, this led to a major sibling conflicts problem.

The study further established that there were no any national institutional coordination mechanisms under NEMA thus making NEMAs role as a coordinator remain unimplemented years

since EMCA, 1999 came into force. There was no sharing of research findings data between different institutions because of the lack of collaboration between the institutions. NEMA cannot be effective in managing wetlands without sharing the relevant wetland research data and findings by other institutions such as KFS and KWS that does biodiversity research that should guide protected areas management by the KWS. Without an inter–ministerial coordination structure and mechanism to bring together the ministries and their sectors it is unimaginable how collaborative actions among the agencies and the ministries can be coordinated. Given the overlapping mandates among the management departments it was imminent that coordination and collaborative mechanisms are inevitable otherwise the day to day management of natural resources was likely to be dominated by unnecessary institutional conflicts and rivalry.

### 4.4 Mapping the extent and patterns of land uses and land cover on Saiwa wetland in Trans Nzoia County

Mapping of the land use patterns formed the basis of this study where the wetland host important biodiversity even though is threatened by intensive agricultural activities that are carried out in the catchment area. The wetland was mapped out from the aerial image of the site which resulted in the base map containing a number of features such as different land uses, vegetation, rivers among others. In order for this to be achieved, ArcGIS 10.5 and ERDAS 15 were used to extract LULC information, analysis of land use patterns in multi-temporal approach.

#### 4.4.1 Landsat Data

According to Jenson (1986), he recommends that at least two-time period data sets be used when detecting land use and land cover changes over a given period of time. For the analysis of this objective, four-time Land sat imageries were used; Thematic Mapper (5TM), Enhanced Thematic Mapper Plus (7 ETM+) and one Land sat 8 images for the year 1988, 2000, 2010 and 2017 were analyzed respectively as shown in table 4.1

Table 4.1 Land sat Image Data information

| Reference year | Sensor | Date of Acquisition |
|---|---|---|
| 1988 | Landsat TM | 06/03/1988 |
| 2000 | Landsat TM | 14/02/2000 |
| 2010 | Landsat ETM+ | 09/02/2010 |
| 2017 | Landsat 8 | 21/01/2017 |

Source: Survey of Kenya, 2017

### 4.4.2 Landsat Imagery classification

In order to achieve the main objective of this study, land use patterns and land cover changes were generated from the satellite images through defined spectral classes. ENVI 4.8 was used to process a multi-temporal Landsat data and areas of interest were defined to extract important statistics for classification. The four periods Land sat imageries in table 4.1 were classified using the supervised classification method with a color composite band of 4, 3 and 2 respectively. This was done irrespective of classes corresponding to the selected areas of interest. In regard to Andersen (1998) classification guidelines, four (4) LULC classes were established as follows: water bodies, cropland, shrubs and forest. Description of these land use and land cover classes are presented in table 4.2

Table 4.2: Land cover classes in Saiwa wetland

| **Land Cover Classes** | **Description** |
|---|---|
| Agricultural | These class include; cultivated land and scattered settlements. |
| Forest | This class include; areas covered by woody vegetation |
| Swamp | This class include; the Saiwa swamp |
| Wetland | This class include; areas that are inundated or saturated by surface or ground waters |
| Shrub bland | Consists of various woody shrubs and brushy thickets |
| Grassland | This class include; areas covered by grasses |
| Settlement | This include; towns and market centers |

Source: Field data,2017

### 4.4.3 Land use Change Detection

Land use change detection was done by classifying land cover and land use over a given period of time. ENVI software (ESRI, 2009) was used for thematic change detection of different images from the year 1988 to the current year 2017.

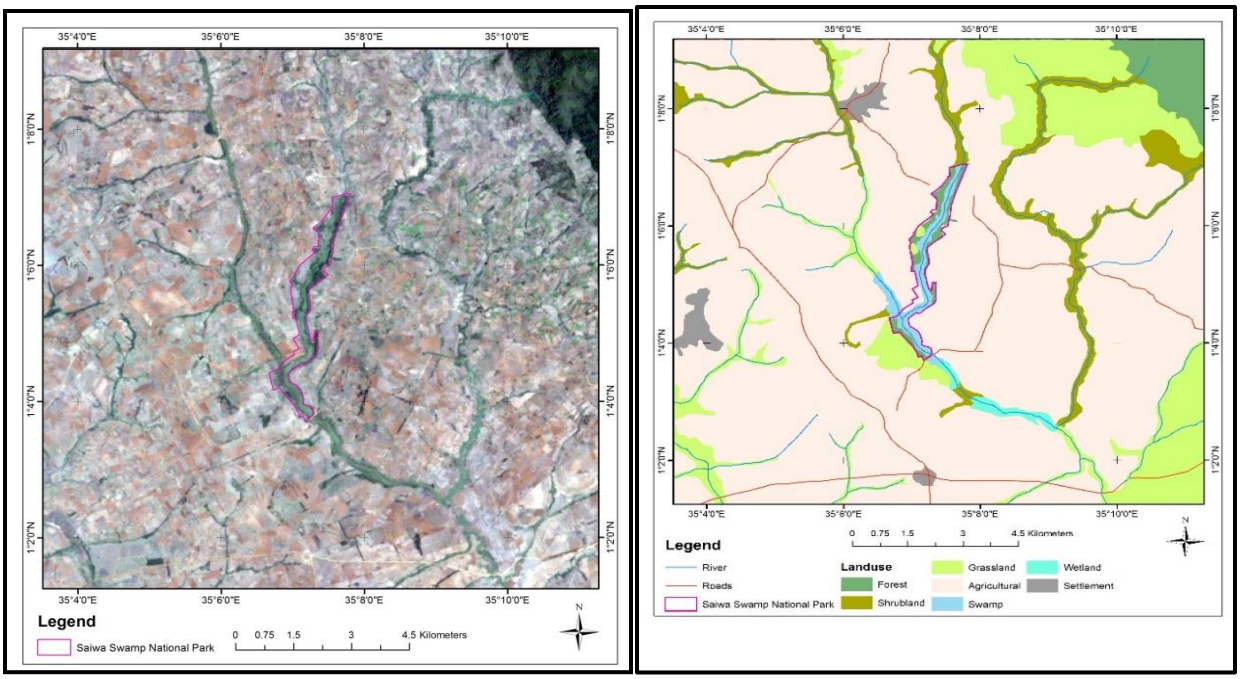


Figure 4.1: Saiwa Image and Land Use/Land Cover Map, 1988

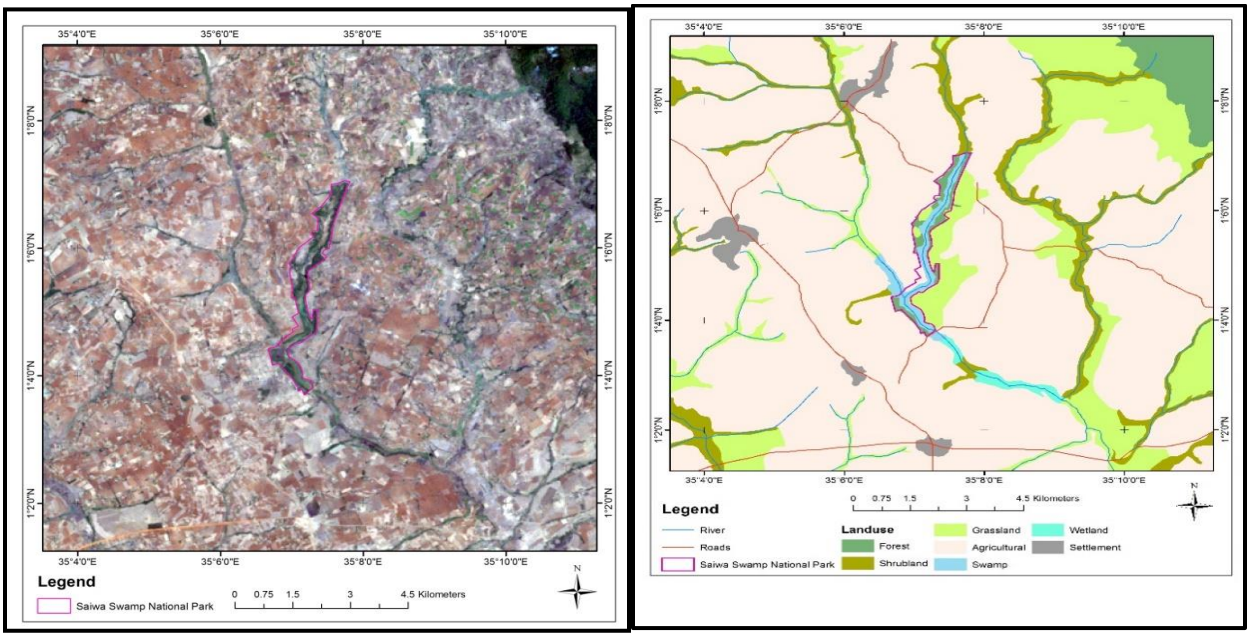


Figure 4.2: Saiwa Image and Land Use, Land Cover Map, 2000

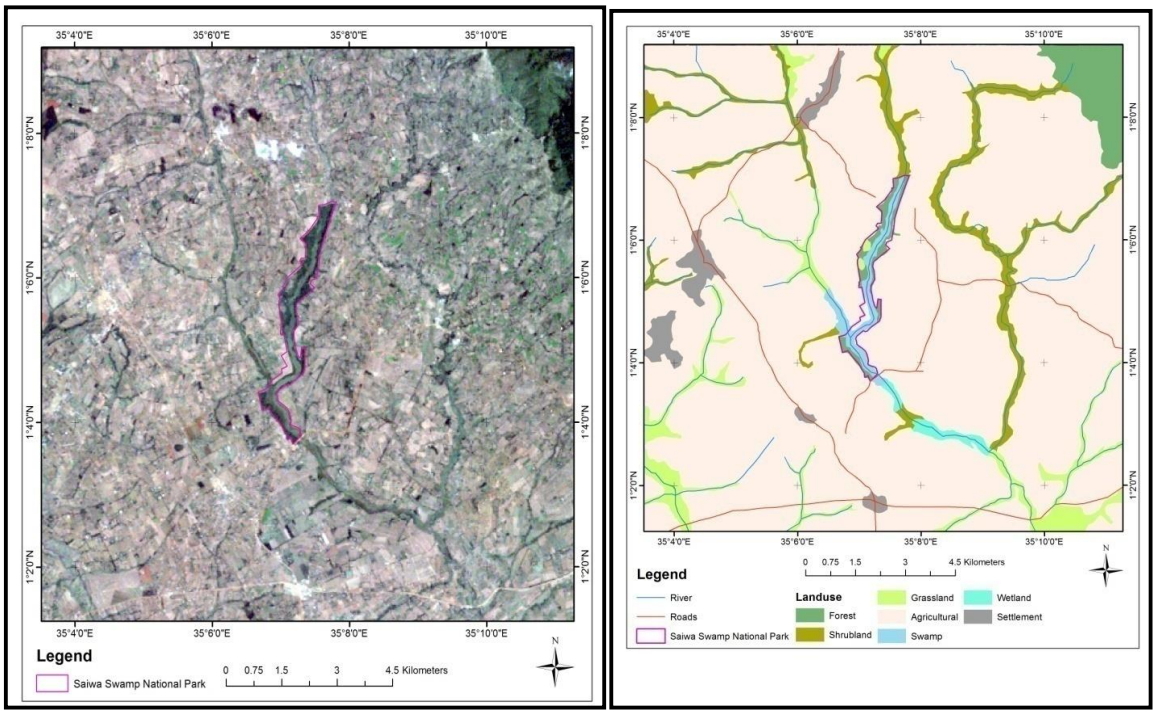


Figure 4.3: Saiwa Image and Land Use, Land Cover Map, 2010

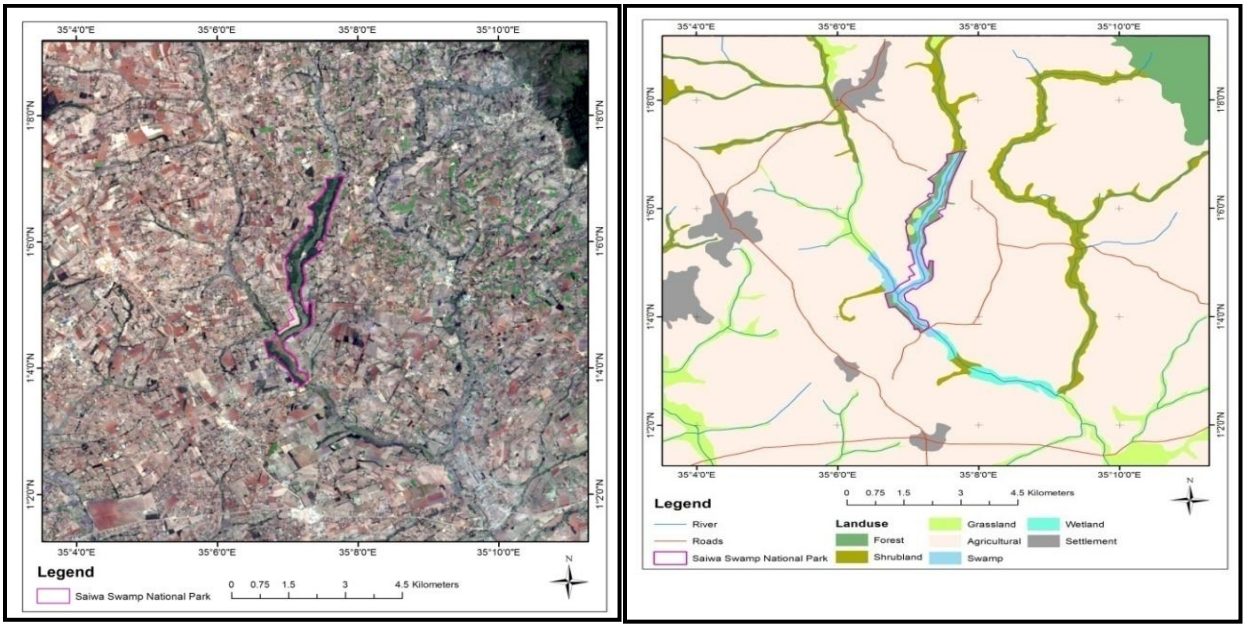


Figure 4.4: Saiwa Image and Land Use/Land Cover Map, 2017

Land use area per square meters for Saiwa area for the time period analyzed in table 4.3.

Table 4.3: Land use area per square meters

| **Land use** | **1988** | **2000** | **2010** | **2017** |
|---|---|---|---|---|
| | **Area (SQM)** | **Area (SQM)** | **Area SQM)** | **Area (SQM)** |
| Agricultural | 159337431 | 165993470 | 179298902 | 179974425 |
| Forest | 6727593 | 6648977 | 6140734 | 6130733 |
| Swamp | 1941624 | 1941624 | 1941624 | 1941624 |
| Wetland | 1003536 | 1003536 | 1003536 | 1003536 |
| Shrub land | 10619884 | 9503833 | 9494527 | 8853527 |
| Grassland | 28752898 | 22615976 | 8997589 | 7038590 |
| Settlement | 2494404 | 3169954 | 4000458 | 5934935 |
| **Total** | **210877370** | **210877370** | **210877370** | **210877370** |

Source: Field Survey, 2017

Table 4.4: Land use changes analysis for the study area

| Land use | 1988-2000 Change (SQM) | 2000-2010 Change (SQM) | 2010-2017 Change (SQM) |
|---|---|---|---|
| Agricultural | 6656039 | 13305432 | 675523 |
| Forest | -78616 | -508243 | -10001 |
| Swamp | 0 | 0 | 0 |
| Wetland | 0 | 0 | 0 |
| Shrub land | -1116051 | -9306 | -641000 |
| Grassland | -6136922 | -13618387 | -1958999 |
| Settlement | 675550 | 830504 | 1934477 |

Source: Field Survey, 2017

Table 4.5: Percentage change analysis for the study area

| Land use | 2000 % Change | 2010 % Change | 2017 % Change |
|---|---|---|---|
| Agricultural | 4.177322904 | 8.0156358 | 0.37675802 |
| Forest | -1.16856058 | -7.6439278 | -0.1628633 |
| Swamp | 0 | 0 | 0 |
| Wetland | 0 | 0 | 0 |
| Shrub land | -10.5090696 | -0.0979184 | -6.7512579 |
| Grassland | -21.3436642 | -60.215783 | -21.772488 |
| Settlement | 27.08262174 | 26.1992445 | 48.3563882 |

Source: Field Survey, 2017

As shown from Table 4.4 during the period of 1988-2017, forest decreased by 8.98%. This is due to increase in population, hence conversion or encroachment of forest for agricultural purposes. Grassland decreased by 103.33% and shrubland decreased by 17.36% respectively. This resulted from increased settlement and intensive agricultural activities which are a major threat to the wetland. People have settled in or near wetlands, and cultivate areas close to the riverbanks.

Settlements increased by 101.64% and agriculture increased by 12.57 % respectively over the same period of time. If these changes in Land uses are not controlled and managed in near future, the sustainability of Saiwa wetland would be in jeopardy.

### 4.5 Impact of land use changes on Socio-Economic provisions of Saiwa wetland.

#### 4.5.1 Education Levels of people living around Saiwa wetland

In order to get an understanding of level of education of the community living around Saiwa wetland, respondents were asked of their highest level of education attained. Most of the people have attained secondary level of education which is 59.1%, 8.1% respondents attained Tertiary Education, about 22.7% primary education and 10.1% of respondents didn't have any form of formal education. Their response as to why they could not further their education (to tertiary level) was that their families could not afford funds to further their education, and as a result of that they decided to work on their farms since farming doesn't require any specialized skills. Due to low literacy levels, communities residing around Saiwa wetland are not quite aware of the benefits of protecting and conserving the wetland and as a result, there has been an increased encroachment of the wetland section that lies outside the park which is a protected area by the locals for agricultural, grazing and settlement. This has also made the community living around the area to have difficulties in participating in management issues.

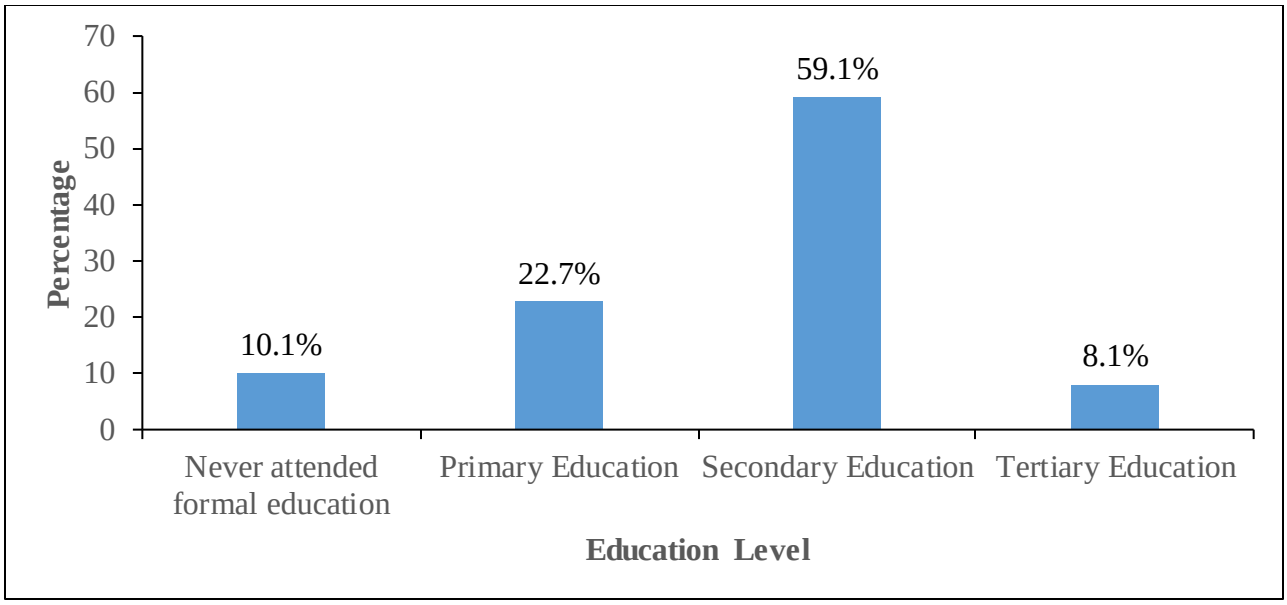


Figure 4.5: Education Level of the Respondents
Source: Field Data 2017

### 4.5.2 Main household Occupation

The study sought to know the main economic activities undertaken by various households living around Saiwa wetland. Majority of the households; 81.8% mentioned farming as their main economic activity. They majorly engaged in crop farming and livestock rearing. This has resulted increase in agricultural land between 1988 and 2017. The local communities have encroached forested areas, shrub lands, grasslands and in some sections of the wetland area (along Kapenguria river and Sinyerere) for farming activities since it is their main economic activity and a source of livelihood. About 9.1% of the respondents depended on formal employment, 4.5% of the respondents indicated small-scale businesses and another 4.5% of the respondents were involved in other small economic occupations such as casual laborers as shown in Figure 4.6. Only a small proportion of the 4.5% of the respondents were employed by KWS as casual laborers to perform different activities in the wetland.

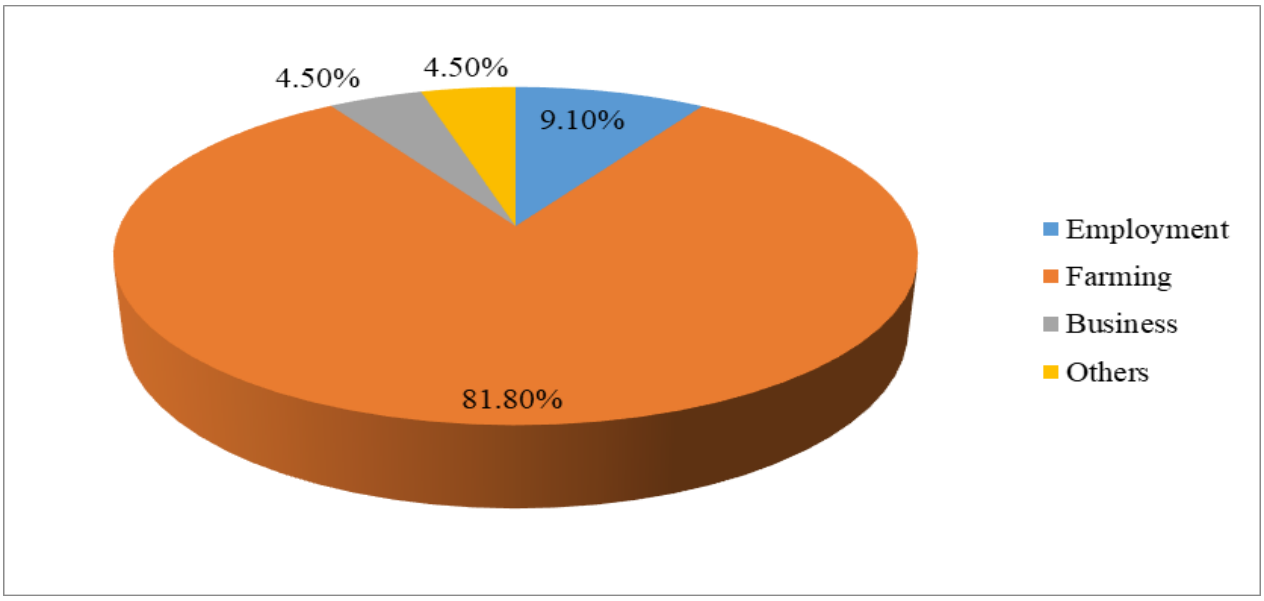


Figure 4.6: Household Occupation in Percentage
Source: Field Data 2017

### 4.5.3 Monthly Household Income

Figure 4.7 indicates that majority of the respondents (54.5%) earn below Ksh 10000 while the least number of respondents (4.5%) earn between 20001 to 30000, 30001 to 40000 and above 50000 per month respectively. About 38.1% of the respondents earn between Ksh 10001 to 20000.

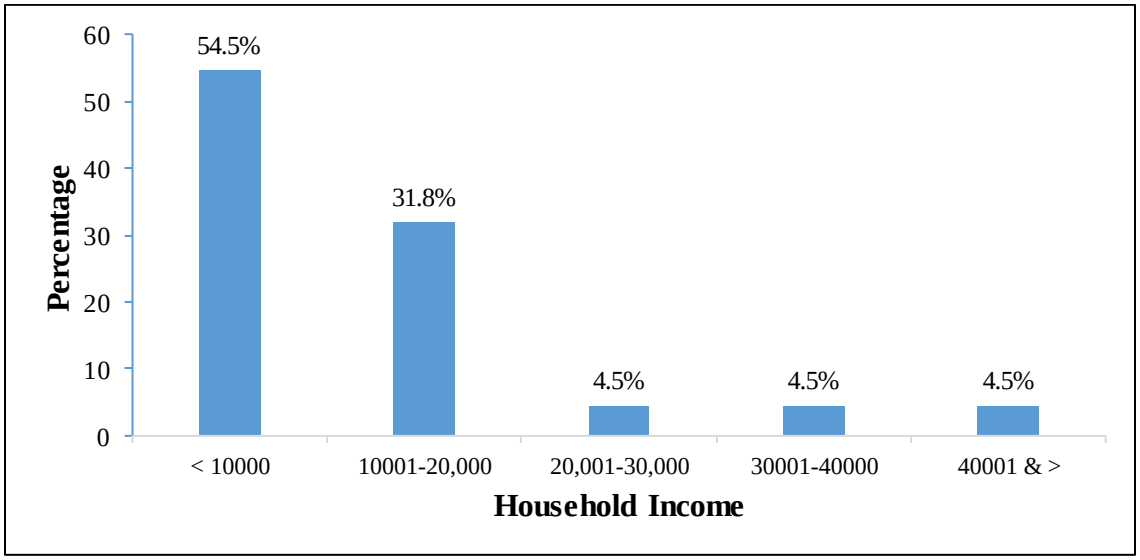


Figure 4.7: Monthly Household Income
Source: Field Data 2017

### 4.5.4 Years Lived around Saiwa wetland

The researcher also looked at the duration of stay by the community living within the study area. This was to support background information on the use of the wetland. Majority of the residents, 72.7%, have been living in the study area for more than 15 years (some were even born there), 9.1% of the respondents have been living in the study area for duration of 5 to 10 years. About 13.6% of the respondents have been living in the area for a duration of 11-15years while 4.5% were residents of the study area for a period of less than five years as shown in figure 4.8. This shows that most of the residents within the study area have either inherited the land from their families or bought it and settled in that area which has resulted to population increase in the study area. This is one of the main reasons as to why there are many settlements coming up and encroachment of the wetland, forests, shrub land and grasslands. This explains why there has been a decrease in forests, shrub lands and grasslands as from the year 1988 to 2017.

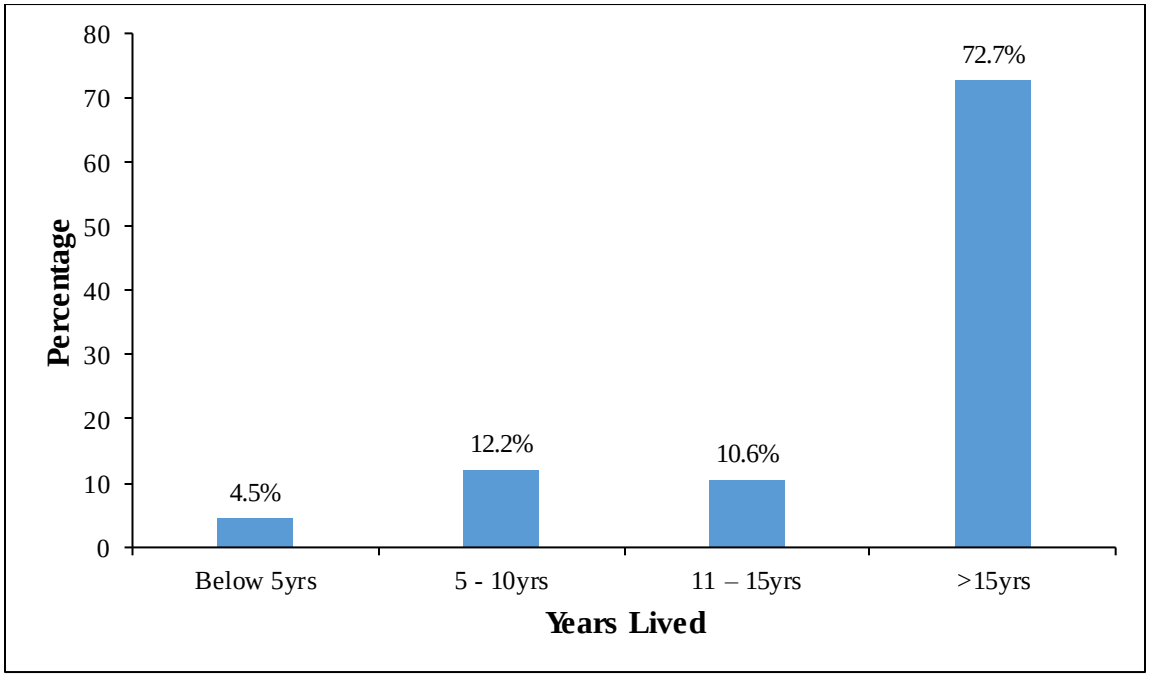


Figure 4.8: Years Lived around Saiwa Wetland
Source: Data 2017

Despite the fact that Saiwa wetland is of great importance to the communities living around it in terms of provisions of socio-economic services, it has undergone tremendous ecological changes. Agricultural malpractices around Saiwa Wetland have led to down wash of sediment loads into swamp causing high level of siltation suffocating the vulnerable swamp vegetation and affecting all the organisms in the water. Farming done at the banks of rivers; Sinyerere and Kapenguria which all flows into Saiwa Swamp has resulted in digging of trenches along the rivers to divert water from the rivers into the farms as shown in Plate 4.3. In return, the chemical fertilizers used in farms can easily get washed into the wetland which has led to introduction of foreign species such as; Lantana camara, Elephant grass and the Mauritius thorns into Saiwa Swamp, which have implication on the ecology and biodiversity of the wetland as shown in Plate 4.4. The invasive species such as elephant grass impedes the movement of aquatic Antelope; Sitatunga. Foot paths and footbridges built by KWS for communities to pass across the wetland within Saiwa Swamp National Park have also contributed to erosion and siltation of the wetland as shown in plate 4.6

**Plate: 4.3 Trenches Dug to divert Sinyerere river water into the nearby farms**
Source: Field Data

**Plate 4.4 Elephant Grass**
Source: Field Data

**Plate 4.5: Lantana camara species**
Source: Field Data

**Plate: 4.6 Erosion from Foot Path into Saiwa wetland**
Source: Field Data

### 4.5.6 Benefits derived from Saiwa wetland by the surrounding community and management

Saiwa wetland has both negative and positive impacts on people living around it. Apart from the negative effects such as wastage of food crops by wild animals, the wetland has many positive impacts to the surrounding community. Majority of the respondents, 41%, did not see any benefit from the wetland. They said that Saiwa Swamp National park is a habitat for different species of monkeys which destroyed their food crops on their farms and hence they did not see any benefit from Saiwa wetland. It could be also as a result of some sections of the wetland being a protected area hence could not access it with ease. About 23% of the respondents mentioned employment as another benefit. Saiwa wetland provides employment opportunities to members of the surrounding communities who are employed by KWS; to uproot and remove the invasive elephant grass from the wetland, clean up various pathways within Saiwa Swamp National Park which are used by Tourists, Rangers and members of the community to navigate around and a cross the wetland.

**Plate 4.7: Casual laborers from the community**
Source: Field Data

**Plate 4.8: Uprooting of Elephant Grass**
Source: Field Data

About 22% of the respondents indicated provision of water sources as another benefit they get from the wetland. In an effort to stop disturbance of the wetland by people coming to fetch water, KWS dug boreholes around Saiwa Swamp National park where the community people can fetch water without accessing the Wetland.

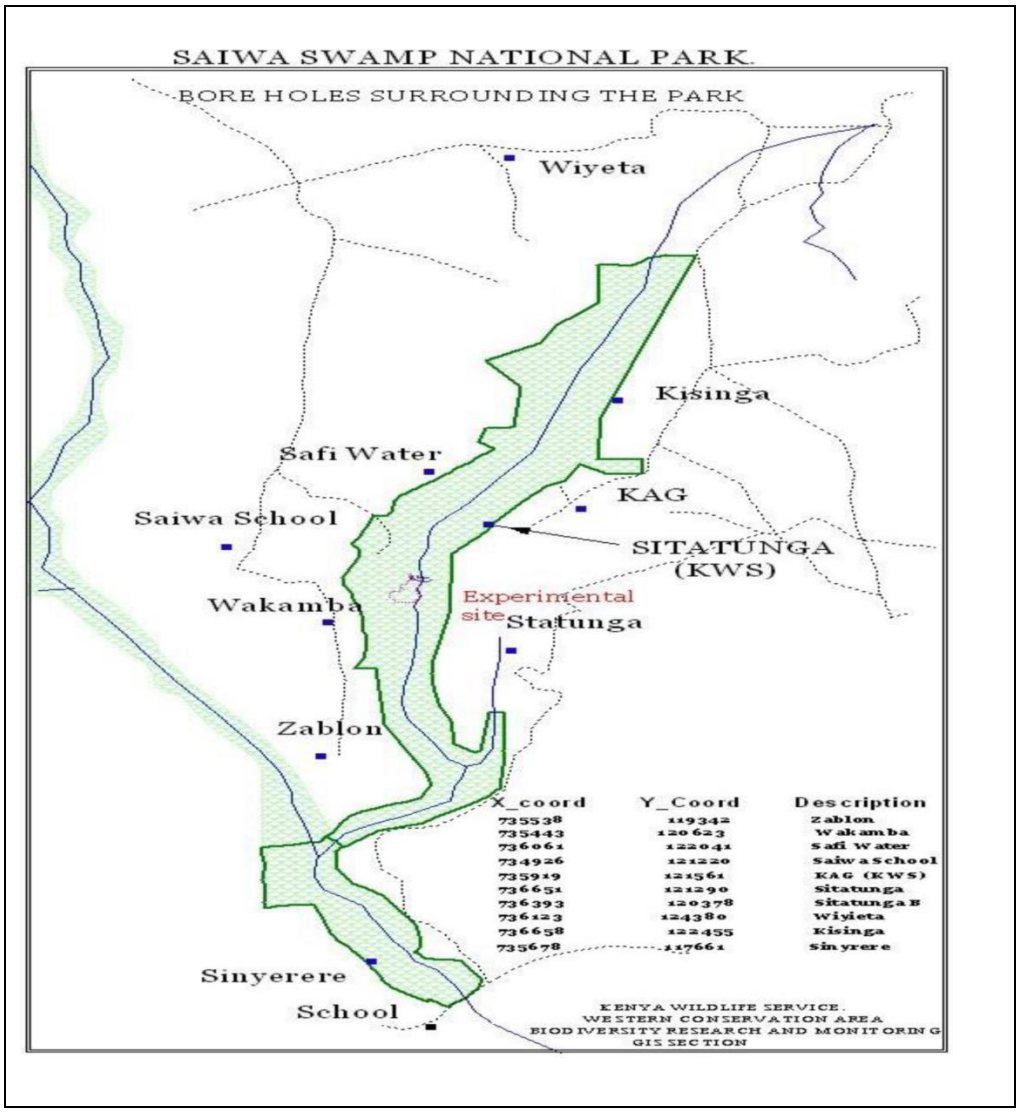


Figure 4.9: Boreholes surrounding Saiwa Wetland

Source: KWS, 2017

About 7% of the respondents mentioned tourism as an indirect benefit they obtained from Saiwa wetland. They pointed out that tourist who visited the wetland bought goods from them at good prices. They used the money to meet some of their basic needs. They also acknowledged that the higher the number of tourists who visited the wetland the higher the amount of money they get because the tourists tended to buy many good when they are more. Table 4.6 shows the number of tourists who visited Saiwa wetland from the year 2014 to 2016.

Table 4.6: Saiwa total visitors between the year 2014-2016

| | **2014** | **2015** | **2016** |
|---|---|---|---|
| **January** | 127 | 45 | 176 |
| **February** | 166 | 208 | 132 |
| **March** | 149 | 401 | 138 |
| **April** | 254 | 215 | 95 |
| **May** | 85 | 229 | 26 |
| **June** | 223 | 235 | 387 |
| **July** | 179 | 545 | 157 |
| **August** | 115 | 539 | 301 |
| **September** | 110 | 176 | 218 |
| **October** | 578 | 281 | 379 |
| **November** | 249 | 541 | 198 |
| **December** | 40 | 165 | 388 |

6% and 1% indicated climate regulation and recreation as other benefits they derive from the wetland respectively as shown in figure 4.11. Other benefits mentioned by the respondents includes improvement of school infrastructure through construction of classrooms and toilets, provision of through ways to different destinations to the surrounding communities and erosion

control. Community members were restricted from accessing the wetland and therefore, they could not derive forage, craft materials and construction materials from the wetland.

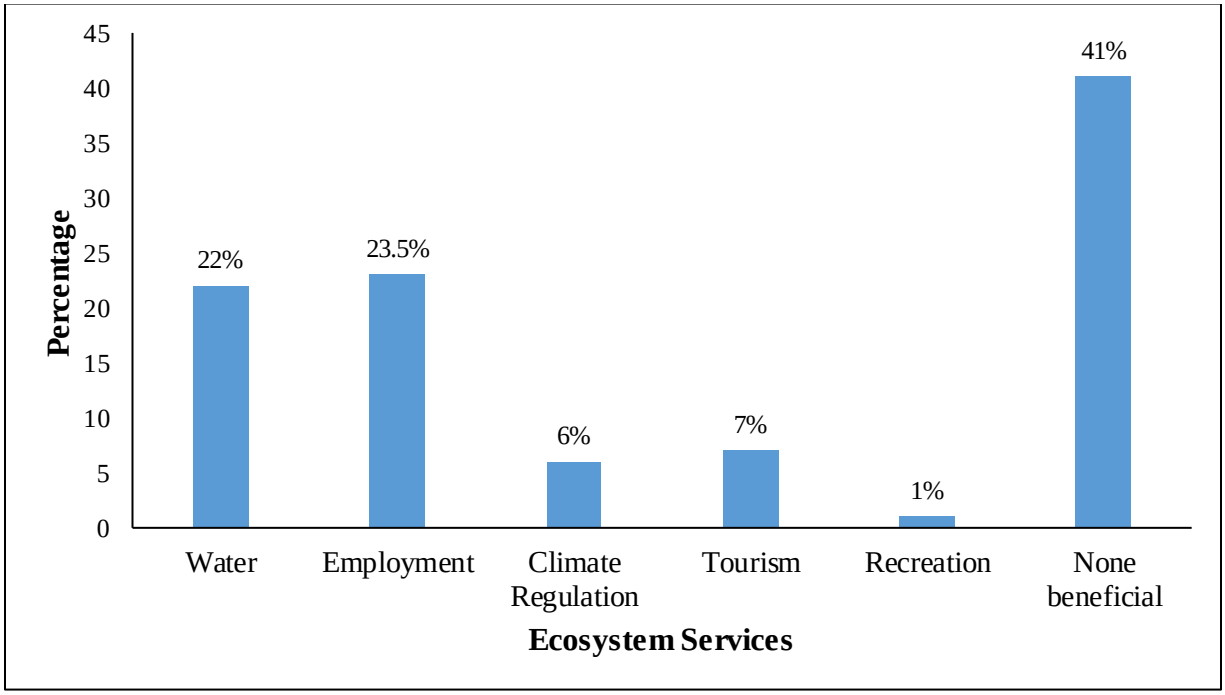


Figure 4.10: Ecosystem services derived from the wetland by surrounding communities
Source: Field Data, 2017

**Plate 4.9: Classrooms constructed by KWS**
Source: Field Data

**Plate 4.10: Tourists on Saiwa Wetland**
Source: Field Data

Figure 4.12 indicates that Saiwa wetland is also a source of income to the management (Kenya Wildlife Services). The data collected was from the year 2014 to 2016.

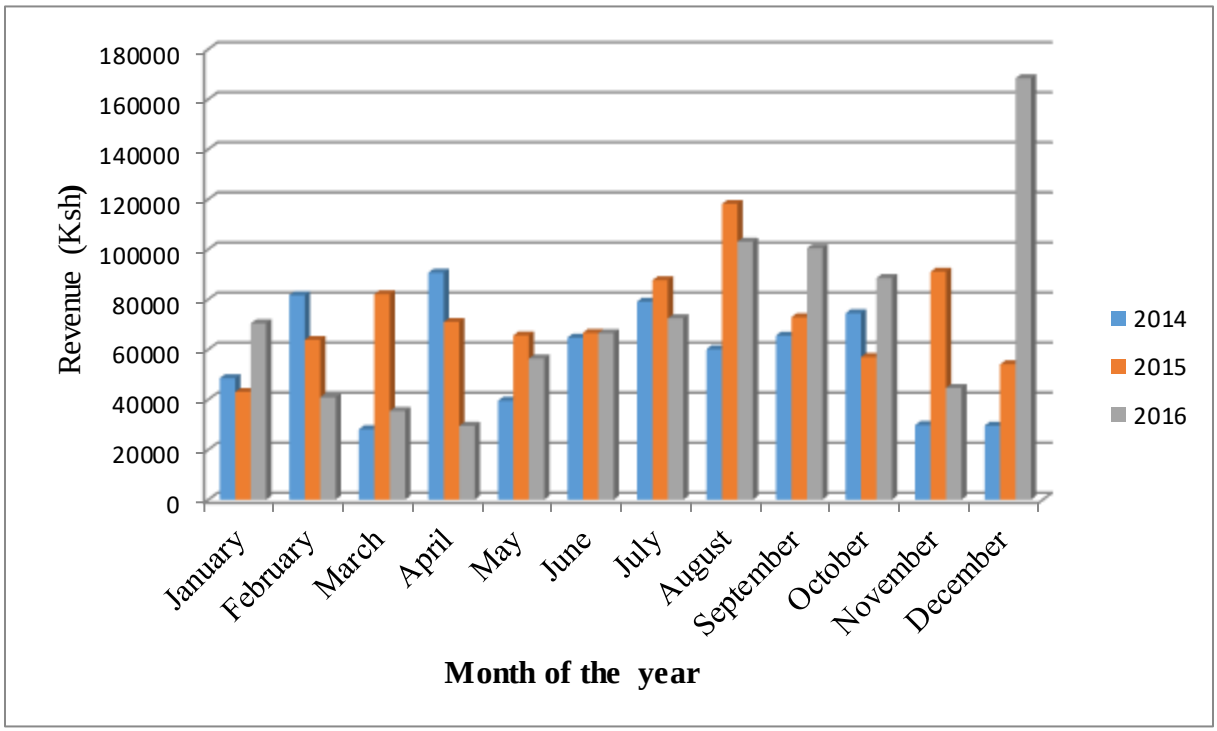


Figure 4.11: Revenue collected by KWS from 2014-2016

Source: Field Data, 2017

Table 4.7: Revenue collected by KWS from 2014-2016

| | **2014 (Ksh.)** | **2015 (Ksh.)** | **2016 (Ksh.)** |
|---|---|---|---|
| **January** | 48540 | 43040 | 70470 |
| **February** | 81720 | 63830 | 40850 |
| **March** | 28190 | 82140 | 35460 |
| **April** | 90690 | 71000 | 29520 |
| **May** | 39525 | 65640 | 56400 |
| **June** | 64760 | 66625 | 66520 |
| **July** | 79070 | 87670 | 72475 |
| **August** | 60140 | 118200 | 103110 |
| **September** | 65570 | 72960 | 100500 |
| **October** | 74500 | 57030 | 88550 |
| **November** | 29870 | 91060 | 44690 |
| **December** | 29590 | 54140 | 168440 |

All the revenue collected from tourism in Saiwa Swamp National Park by the Kenya Wildlife Service is all forwarded to the National Government and it's not directly invested in the management of the area. There for, it's a source of revenue to the Government of Kenya.

The findings of this study concur with findings of a study which was done by International Institute for Applied System Analysis (2002) on Land and Water Use of Wetlands in Africa specifically on the economic values of African wetlands. The results of their study indicated that provision of water, flood control, provision of wildlife habitats and provision of recreation sites are the main benefits local population derives from wetlands. The results further indicated that overuse of wetland resources by local communities may result to exhaustion of the wetlands hence no benefits will be derived from them.

The finding of this study supports the results of another study which was done by Cocozza (2009) on economic and environmental benefits of wetlands. In his study, he concluded that apart from Purification of water, wetlands also provide habitats for wildlife, recharges and discharges ground water, mitigates floods and are good sites for tourism and recreational activities. The findings of this study are also similar to findings of another study which was done by Horwitz *et al..*, (2012) on their review of wetlands and human health interactions. They noted that wetlands are good sources of income to the surrounding local communities. They further noted that; wetlands are sources of food to the local populations for examples rice; they conserve biodiversity and preserve social cultural traditions.

# CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

## 5.0 Chapter overview

This chapter entails three sections: Summary of the study in relation to objectives, Conclusion on the study findings and recommendation of measures that can be put in place to preserve and improve services provisions and sustainable management of Saiwa wetland in Trans-Nzoia County.

## 5.1 Summary of Findings

The findings of the study revealed that all policy documents including the Constitution of Kenya, 2010 and the National Land Policy 2009, has adequate provisions to ensure sustainable land utilization principles and sustainable conservation of land, environmental audit and assessment, productivity targets and guidelines which comply with EMCA, 2000 and ensuring public participation of local communities in the management of wetland natural resources as per EMCA, 1999. However, there is poor implementation of these policies and legislations to ensure sustainable management of existing wetlands in Kenya. Inadequacy in legal and policy framework governing wetland ecosystems remains a major challenge that contributions to degradation of Saiwa wetland. The implication being lack of clear land use planning. Lack of implementation of existing wetland policies has led to unregulated ecosystem resources use and no government or non-government agency has a clear mandate over the management of wetlands in the region.

Mapping of land uses and land cover patterns formed the basis of second objective. Various land uses and land covers were mapped out and the findings showed that during the period of 1988-2017 forest decreased by 8.97% which was as a result of increased in population that led to conversion or encroachment of forest for agricultural purposes. Grassland and Shrub land decreased by103.33% and 17.36% respectively. This was due to increased settlement and intensive agricultural activities which are the major threat to the wetland. Settlements increased by 101.64% due to the favorable settlement scheme in Trans-Nzoia County that attracted migration of people from other counties which led to population pressure hence needs for more housing. Agriculture

increased by 12.57% which was fueled by increased population that mainly depends on agriculture as a source of livelihood.

With this order of priority, it was noted that majority of the land cover conversions largely resulted from growth in human populations which has resulted in substantial impacts on Saiwa wetland, particularly increased demand for wetland resources. Common practices that affected wetland include sub-division of family farms and drainage of wetland. People have settled in or near wetland, and cultivated areas close to the riverbanks (the section of wetland lying outside the protected area). Wetland encroachment has resulted in riverbank erosion of the Sinyerere and Kipsaina Rivers in the study area.

Findings further indicated that Saiwa wetland attracts tourism which earns a country foreign exchange and recreational activities. The presence of Saiwa wetland has also led to other social benefits such as building of infrastructure, schools, alternative water sources, scientific education and employment of community's members. Misuse of Saiwa wetland resources by the local communities may therefore result to exhaustion of the wetland hence minimal benefits will be derived from it.

### 5.2: Conclusion

In conclusion, existing Kenya's policy and institutional framework that deals with wetland management are not aiding participatory and sustainable wetland management as policy development is delinked from its implementation. The shortfall of mechanisms to operationalize local community in Participatory wetland management was a major hindrance to realization of policy provisions. Many local households are conscious of benefits they obtained from wetlands and the costs they incur due to the wetlands. Even though they support wetland conservation objectives, the losses that result to their livelihoods due to wetlands; land subdivision, wetland biodiversity (animals such as de Brazza monkeys, porcupines destroy their crops, poultry) means that until the situation is reversed, wetlands will continue to lose invaluable wetland services due to imminent unsustainable extraction of wetland provisioning services.

Local institutions exist but their low capacity(financially) and inadequate engagement by the government agencies in true participatory Wetlands management mean that they will continue to

rely on civil society funding for them to engage in participatory wetlands management. Until the government is able to provide sustainable resources to support these institutions as supporters of wetland conservation, achieving participatory and sustainable wetland management goals would be faced with many challenges and may never be realized.

## 5.3 Recommendations

### a) Legal framework

In view of this study, the current land use practices around Saiwa wetland have not adhered to the wise use concept and management of wetlands, hence have led to numerous environmental impacts. This is due to unimplemented legal framework that is capable of supporting Saiwa wetland resources effectively. Though the wetland policy and the Constitution of Kenya 2010 have emphasized on a paradigm shift in the conservation and management of wetlands in the region, a comprehensive integrated wetland enforcement mechanism needs to be put in place to guarantee the sustainability of Saiwa wetland

In order to mainstream issues of sectoral management of wetlands, there is need to harmonize sectoral policies, laws and institutional framework. Wetlands Steering Committee can be established as part of institutional framework. (EMCA can provide the legal framework and the National Environmental Policy as the guiding policy). This Committee can plan on issues relating to wetlands, bringing together stakeholders and come fourth with National Wetlands Management Plan that would give general guidelines for management of wetlands. Inspection Division can be formed and decentralized to Regional Technical Support Units, to County Units that can be headed by Wetlands Officers (develops County Wetlands Action Plans), then to Sub-counties units that can implement Community Based Wetland Management Plans. The ultimate users of wetland(community) would be able to embraced participatory wetlands management in this units. They will carry out land uses that conforms with wetlands to ensure its sustainability and also benefits from educational drives, talks at local market days, gatherings of chiefs and other forums on the importance of sustainable use and management of the wetland.

**b) Mapping of Saiwa wetland**

Mapping, zoning and planning for Saiwa wetland needs to be done (Location, characteristics, size, land regimes that affects them). Without this knowledge, the sustainability of this wetland cannot be achieved. National Wetlands Inventory showing its location, size, functions, use, management and institutional frameworks can be done to give recognition to these critical environments.

**c) Formation of wetland Conservation Groups**

There is need to form a community-based organization whose primary role is to engage the youth in conservation activities in and around Saiwa wetland. The group should be formed in response to human pressure on the Saiwa ecosystem. The wetland and its surrounding ecosystems are threatened by activities in and around the conservation area including, over-grazing, agricultural activities, settlement. The group should try to change the local community's behaviors and attitudes towards wetland conservation by providing realistic alternatives for the services provided by the wetland and promoting conservation schemes in order to preserve the conserved ecosystem. This has to be done through tree planting, investing in wellbeing and raising awareness through training and seminars to persuade local communities not to graze and farm on and around the wetland. The group should also initiate the planting of elephant grass along the riverbanks as an alternative fodder for livestock in order to compensate for the loss of grazing areas within the wetland.

**d) Involvement of County Government and Non-government institutions in the management of Saiwa wetland**

It is important for the County government and Non-governmental institutions to be closely involved in wetland management. This is crucial because the current land use practices in the County have degraded the existing ecological ecosystems. This can be obtained through development of an integrated wetland management strategy that supports wetland management through capacity building at the local level, institutional support, funding of conservation activities, creation of awareness through seminars and stakeholder participation in wetland management.

## 5.4 Areas for further study

- Research should be carried out to identify the effect of agro-chemicals used for agricultural purpose to the aquatic ecosystem in Saiwa wetland
- Impacts of land use changes to existing wetlands is a major problem that exists not only to Saiwa Wetland but also to other wetlands in the County. Therefore, similar studies could be carried out on other wetlands in the county in order to come up with a concrete solution to this problem
- Enforcement and compliance with existing wetland laws to ensure sustainable wetland management of Saiwa wetland in Trans Nzoia County.

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## 5.0 APPENDICES

### Appendix 5.1: Household Questionnaire

**KENYATTA UNIVERSITY**

**DEPARTMENT OF ENVIRONMENTAL PLANNING & MANAGEMENT**

Name of the interviewer……

Date of the interviewee……

Name of the respondent (optional)……

**Household information**

1. For how long have you lived around Saiwa Wetland?
   (i) 0-5yrs [ ] (ii) 5-10yrs [ ] (iii) 10-15yrs [ ] (iv) 15yrs and above [ ]
2. What are your household characteristics? (Please fill in the table below)

| **Age** | **Gender** | **Education level** | **Main Occupation** | **Household income (Per Month)** | **Comment on sustainability of main source of income** |
|---|---|---|---|---|---|
| Under18 [ ]<br>ii18-35 [ ]<br>iii.36-55[ ]<br>iv. Above 55 | 1=M<br>2=F | 1.primary<br>2.Secondary<br>3. College<br>4. University<br>5. Never | 1.Employed<br>2.Farming (Crops)<br>3Business<br>4. Fishing<br>5. Livestock<br>6. Others | 1. 10000 and below<br>2. 10001-20000<br>3. 20001-30000<br>4. 30001-40000<br>5. 40001-49999<br>6. 50000 and Above | |

3. What's your household size? 1) Below 3 members, 2) 3-6members, 3) 7-10members 4) Above 10members

4. What are some of the activities taking place in and around Saiwa Wetland?

…..……

…..……

…..……

5. Are there any benefits you get from Saiwa wetland?

…..……

…..……

…..……

…..……

b). If yes for how long have you been enjoying the benefits? a) Below 5 yrs. b) 5-10yrs c) 11 – 15yrs d)16 – 20 yrs. e) above 20 yrs.

6. Please tick land ownership and size of land as indicated in the table

| Land Tenure | i. Leasehold | ii. Freehold | iii. Private | iv. Others (specify) |
|---|---|---|---|---|
| Size | | | | |

7. a) How does land ownership indicated in the table above influence your main occupation and other sources of livelihoods?

……

……...

8. Where does your water come from?

| **Sources** | | **Which of the sources do you use for each of your uses** | **Sources in Wet season** | **Sources in Dry Season** |
|---|---|---|---|---|
| Springs | | Irrigation of Crops | | |
| Wells | | Water for Livestock | | |
| Boreholes | | Domestic use (Drinking, cooking washing and Sanitation) | | |
| Pipes/Tap water | | Other uses (Please Specify) | | |
| Rainwater | | | | |
| River/Stream | | | | |
| Pond | | | | |
| Saiwa Wetland | | | | |

9.

| For each of the water sources mentioned above, How does the provision of water meet your demand on a month by month basis? Use the following keys: + more water than is needed – not enough water O about right | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| If your usual source of Water runs dry or becomes unavailable, what are the alternative sources of supply?<br>(State 'none' if this is the case)<br>Note: Refer to question 8<br>for regular sources of supply<br>in wet and dry season | **Main uses (tick all that apply)** | **Alternative sources (In wet season)** | **Alternative sources (In dry season)** |
| | Irrigation of crops | | |
| | Water for livestock | | |
| | Drinking | | |
| | Cooking and Washing | | |
| | Sanitation | | |
| | Other uses (please specify) | | |
| What is your most Important water supply source and what is it used for?<br>Note: Main reason is crucial. e.g. a source can be important because there is<br>no alternative supply | [Refer to list above and ask respondent to name one and its main reason] | | |
| Do you know how much water you use per month/day for each of the uses mentioned above? | YES / NO | | |
| How many buckets or Containers do you use per day (wet season)?<br>What size are these? | | | |

| | |
|---|---|
| If you have no water supply in your home, how much time do you spend collecting water each time<br>You draw some off/visit the source? | |

10. Do you ever get awareness on protection and conservation of wetlands?

a) Yes b). no

If yes by who?

……...……

……

11. Types and uses of products derived from wetlands?

| Products | Quantity<br>Produced (per season/year) | Market (Specify) | Unit price (At site) | Total income |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

12. Do you know any policy or regulation governing the conservation and protection of wetlands?

a). Yes b). No

If Yes which ones?

……...……

……..

…….

How effective are they?

1=very ineffective, 2= ineffective, 3= Neutral, 4= effective,5=being very effective

Give brief explanation for your answer above

……...……

…….

…….

13. In your own opinion what are some of the environmental impacts that arise from land use change within and around Saiwa Wetland?

……

……

……

14. What are the problems facing protection and conservation of wetlands in Trans Nzoia County?

……

...……

……

15. Based on the above problems facing the protection and conservation of wetlands what can be done to improve the situation?

……...

…….

## Appendix 5.2: Institutional Questionnaire

**KENYATTA UNIVERSITY**

**DEPARTMENT OF ENVIRONMENTAL PLANNING & MANAGEMENT**

Name of interviewer……. Date…….

| | |
|---|---|
| Name of the institution | |
| Name of the officer | |
| Designation | |
| Duration of stay in the institution | |

**1.** Gender: a) Male b) Female

**2.** Age: a) 20-25 Yrs. b) 26-30 Yrs. c) 30-35 Yrs. d) 36-40 Yrs. e) 40-45 Yrs. f) 46-50 Yrs. g) 50 Yrs. and above

**3.** Level of education

a) Primary education b) Secondary education c) Tertiary education d) none

**4.** What are the existing policies, strategies and legal framework for the protection and conservation of Wetlands and how effective are they in a ratio of 1-5 (1=very ineffective, 2= ineffective, 3= Neutral, 4= effective,5=being very effective)?

| | Specify the framework/ strategy | Level of effectiveness |
|---|---|---|
| **Policies** | 1. | |
| | 2. | |
| | 3. | |
| | 4. | |
| | 5. | |
| | 6. | |
| **Strategies** | 1. | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |
| **Legal Framework** | 1. | |
| | 2. | |
| | 3. | |
| | 4. | |
| | 5. | |

**5.** What are the positive and negative impacts of land use changes at Saiwa on

a). Agriculture?

…..……

b). Livestock?

…..……

c) Water?

…..……

d) Global climate regulation?

…..……

e) Disaster Risk reduction?

…..……

f) Tourism?

…..……

g) Recreation?

…..……

h) Harvested wild goods?

…..……

**6.** What socio-economic impacts have you experienced as a result of land use change in and around Saiwa wetland?

a) Positive

…..……

…..……

b) Negative

…..……

…..……

**7.** In your own opinion what are some of the environmental impacts that arise from land use change within Saiwa Wetland?

……

……

……

**8.** Is Saiwa wetland used for

a) Tourism and Recreation Yes, No

If yes explain briefly (statistics if any)

……
……
……

**9.** What are the problems facing protection and conservation of wetlands in Trans Nzoia County?

……
....……
……
....……
……
....……

**10.** Based on the above problems facing the protection and conservation of wetlands, what can be done to improve the situation?

……....
……
……

**11.** What has your organization done to ensure that there is protection and conservation of Saiwa wetland?

……
....……
……

**12.** What do you think the government should do to enhance protection and conservation of wetlands in Kenya?

……
....……
……