EFFECT OF ANTHROPOGENIC ACTIVITIES ON TERRESTRIAL FLORA AND FAUNA SPECIES IN RACHUONYO SOUTH SUB COUNTY, HOMABAY COUNTY KENYA

BY

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DECLARATION

Declaration by student

I declare that this thesis is my original work which has never been presented or duplicated for award of any degree or academic work in this University or elsewhere.

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DEDICATION

I dedicate this piece of work to my lovely husband Castro Odhiambo, my beloved children Catherine Debora Castro, Castro Fidel Castro and Catherine Florence Castro for their constant prayers, understanding, patience and encouragement which brought a constant inspiration in me to continue working hard to achieve my dream in life. May the Almighty God bless them abundantly.

ABSTRACT

Globally, terrestrial flora and fauna species are at the brink of extinction yearly due to the increase in human population. Yearly, species reduce at 34% globally and 68% in Kenya as result of increased anthropogenic activities. The current rapid population growth has led to increased anthropogenic activities and population pressure on the land posing threats to the survival of terrestrial flora and fauna species. In Kenya, Rachuonyo South Sub County is characterized by rising population growth evidenced by a population density of 511 persons/Km^2 which was far above the national population density of 82 persons/$Km^{2.}$ This poses a threat to existing flora and fauna species in the region. However, there is less documentation on specific anthropogenic activities and the type and number of flora and fauna species affected by these activities. About 74% and 97% of population in Rachuonyo depends on agriculture and wood fuel respectively. Notably, hunting and gathering and vegetation clearance are anthropogenic activities taking place in Rachuonyo, and yet it is not well documented on how these activities are threatening terrestrial flora and fauna species. Therefore, the purpose of this study was to examine the effect of anthropogenic activities on terrestrial flora and fauna species. The objectives of this study were to: identify the terrestrial flora and fauna species threatened by anthropogenic activities, explain the effect of hunting and gathering on terrestrial flora and fauna species and determine the effect of vegetation clearance on terrestrial flora and fauna species. The study was guided by ecological theory. A cross-sectional descriptive research design was used. A minimum sample size of 379 household heads was taken out of a target population of 30,990. Purposive sampling was used to get 10 key informants. Primary data were collected through questionnaires, key informant interviews, photography and field observation, while secondary data were obtained from published and unpublished reports. Expert judgement was used to determine validity while Cronbach Alpha was used to ascertain reliability of the instruments. Qualitative data was examined through content analysis and quantitative data was analyzed using frequencies, percentages, mean and standard deviation. The study revealed that there are 80 and 25 threatened terrestrial flora and fauna species respectively in Rachuonyo South Sub-County. The study revealed that daily and weekly hunting were found significant and negatively correlated with the number of animals hunted down r (377 = -.587., p = .04 and r (377 = -.465, p = 02. Daily gathering was significant and negatively correlated to the amount of vegetation gathered r (377 = -.778., p = .05 (Table 24). Both once a year and twice a year vegetation clearance were found significant and negatively correlated with the number of animals hunted down r (377 = -.543., p = .04 and r (377 = -.455, p = 02 respectively. Both once a year and twice a year vegetation clearance was found significant and negatively correlated with the number of flora species r (377 = -.527., p = .04 and r (377 = -.345, p = 02 respectively. The study concluded that Rachuonyo South Sub County is endowed with a variety of terrestrial flora and fauna species with hunting and gathering and vegetation clearance threatening the survival of these species. The study recommends on sensitization of the local community on the importance of terrestrial flora and fauna species. There is need for enhancement of conservation measures so as to ensure protection and conservation of these species for increased biodiversity in the region and country at large.

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LIST OF ACRONYMNS AND ABBREVIATIONS

AWF	Africa Wildlife Foundation
CBD	Convention on Biological Diversity
IAAKST	International Assessment of agriculture Knowledge Science and Technology for Development
IPBES	International Science- Policy Platform on Biodiversity and Ecosystem Services
IDRC	International Development Research Centre
IUCN	International Conservation of Nature
KWS	Kenya Wildlife Service
KNBS	Kenya National Bureau of Statistics
LPI	Living Planet Index
MEA	Millennium Ecosystem Assessment
NEMA	National Environment Management Authority
SD	Standard Deviation
UN	United Nations
UNEP	United Nations Environment Program
WAF	World Animal Foundation
WRI	World Resource Institute
WWF	World Wide Fund for Nature

WORKING DEFINITIONS OF TERMS

Anthropogenic Activities: This refers to human activities undertaken by human beings on the environment and they include farming, charcoal burning, hunting, firewood collection and harvesting resources like reeds, grass and medicinal herbs.

Changes in habitat: This refers to the alteration of the original environment of animal and plant species. The indicators include; habitat loss, habitat fragmentation, animal mobility, abundance of animal and plant species. This will be determined by usage of Google Earth and reports from relevant conservationists.

Ecosystem: It refers to a set of relationship between living resources, habitat and residents of the area and they include animals, trees, plants and people.

Farming: It refers to the encroachment of the habitat due to growing of crops and rearing of animals. This will be determined by the measure of extension area for crop growth and animal rearing.

Gathering: It refers to collection or picking of game hunted, firewood, herbs, grass and reeds. In this study gathering will be determined through analysis of the presence of gathering of the above flora and fauna species.

Hunting: Refers to ensnaring and killing of wild animals for personal benefit such bush meat, skin and hair for traditional costumes in an area. This will be determined by the presence of hunting activity in the study area.

Settlement: It refers to the encroachment of habitat due to establishment of buildings for habitation. This will be determined by settlement density of the study area.

Species abundance: The commonness or rareness of species compared to others in a community. It will be determined by reports from relevant conservationists.

Species Diversity: The relative abundance of a species compared to other species in a particular area. This will be determined by reports from relevant conservationists.

Terrestrial flora and fauna species conservation: This refers to the preservation, protection and restoration of plant and animal species in an area. The indicators include; habitat loss, habitat fragmentation, animal migration, abundance of plant and animal species. The measurement will be done through Google earth and report from relevant conservationists.

Terrestrial flora species: These are plant species in an area including herbs, grass, bushes. These plants possess advanced characteristic such as flowering plants, having xylem, tissues and phloem.

Terrestrial fauna species: These are animal species living in an environment that are commonly hunted for game. They include mammals and other vertebrates considered to have developed an advanced characteristic.

Threatened species: This refers to any species whose environment has been altered or tampered with leading to a relocation, reduction or even death of species.

Endangered species: These are species which are at the brink of disappearing within the study area due to the alteration of their habitat.

Species richness: This the list of terrestrial flora and fauna species inhabiting a given habitat.

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter covers the background of the study, statement of the problem, research objectives, research questions, significance, scope and delimitations, theoretical and conceptual framework.

1.2 Background of the Study

By the rise of Iron Age in 1000 BC, a dramatic growth in human population of 72million was experienced. Since then the human population has grown by 100 times, thereby increasing anthropogenic activities for livelihood (Klein, Beusen & Janshen, 2010). This is a fundamental cause to the ongoing global mass extinctions of terrestrial flora and fauna species (Eldredge, 2000). Anthropogenic activities are socio-economic duties carried out by human beings on an environment such as farming, hunting, grazing, charcoal burning, firewood collection, and brick making. The Convention of Biological Diversity state that there are both indirect and direct anthropogenic factors of species extinction. The direct human factors are habitat loss, spread of invasive species, over harvesting, pollution, and climate change (Allister, Braat, VanderWindt, Rademaekers, Eichler & Turner (2009). A study done by Redford (1995) as cited by (Muluneh, 2021) noted that a third to half of earth surface have been greatly altered by direct human factors.

According to World Wide Fund, the greatest threat to terrestrial flora and fauna species is seemingly habitat loss and out of all species described in the IUCN's Red List 85% are threatened by habitat loss (WWF, 2020). Other studies such as (Odetta 2014; Vilà, Espinar, Hejda, Hulme, Jarošík, Maron, & Pyšek, 2011; Pejchar & Mooney, 2009) have greatly talked about how spread of invasive species, habitat loss, climate change, pollution and over harvesting threatens flora and fauna species. However, these studies occurred elsewhere and

not in Rachuonyo. At the same time there was no documental evidence identifying the threatened terrestrial flora and fauna species in Rachuonyo South. The analysis of the above studies indicated that rapid population growth has led to increased anthropogenic activities and population pressure on the land thus posing threats to the survival of terrestrial flora and fauna species. This was replicated in Rachuonyo South whose population growth was rising as evidenced by 2019 Kenya population and demographic census which reported a population density of 511 persons/Km^2 in the sub-county which was far above the national population density of 82 persons/Km^2.

The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) indicates the global increase in the loss and rapid in decline of terrestrial flora and fauna species since 2010, with an increased risk of extinction in mass of species in the coming decades if no urgent global measures are undertaken. They further project that extinction threatens an estimated 1million species of fauna and flora, (IPBES 2019a). Similarly, recent scientific knowledge such as the IUCN (2019 & 2021) and FAO (2021), acknowledge that yearly, there is global decline of species at a rate of 34% of flora and 25% of fauna and yet these species are greatly beneficial to human wellbeing through the numerous ecosystem services they support such as soil formation and protection, food and medicines. Studies by United Nations Environment Program (2019) and CBD (2019) are in agreement with Redford (1995) and asserted that habitat loss and degradation greatly threatened species with extinction. The rate of the threat is estimated at 1000 times background rates. These studies have concentrated on the importance of species diversity and the effect of its decline to humanity, however, these species were still declining and this has weakened livelihoods, health, food security, and quality of life world over. Therefore, a better understanding on the available species of flora and fauna was still crucial and how these anthropogenic activities have threatened terrestrial flora and fauna

species. The present study bridged these two identified knowledge gaps by identifying terrestrial flora and fauna species threatened by anthropogenic activities.

Numerous studies indicated that globally, terrestrial flora and fauna species are undergoing the fastest rate of extinction known in geological history and hold the opinion that the earth has reached its sixth mass of extinction. For instance, out of 391,000 flora species known globally, 21% are threatened with extinction (UNEP report, 2010b; Mongabay, 2016). In addition, Cresswell and Murphy (2016) estimated that globally, 15 billion flora species are threatened with extinction yearly. These researchers affirmed that 90% of flora species have been removed in the United States and 480 fauna species have been recorded as extinct in Australia. Further, a study acknowledged that human activities and influences are greatly enhancing the extinction rate of species and yet their existence is not known (Camilo, Derek, Sina, Alastair, Simpson & Boris 2011). Further, Camilo et al. (2011) indicated that about 86% of all terrestrial flora and fauna species are yet to be discovered, described and catalogued. Additionally, they also indicated that out of 7.77 million faunae and 298,000 species of flora only 953,434 and 215,644 species respectively have been described and catalogued. These studies have noted that terrestrial flora and fauna species were being threatened and yet these species were not documented globally, regionally and locally. Hence there was need to examine the current status of these species. Therefore, the present study aimed at identifying threatened terrestrial flora and fauna species in the study area.

The challenge of terrestrial flora and fauna species decline is a universal phenomenon that includes African continent (Darwall, Smith, & Allen 2011). Studies done by Lindsey, Romañach, Tambling, & Chartier (2011) and Plumer (2019) indicated that in Zimbabwe within a span of four years about 1400 large mammals had decayed in traps, similarly, in between the year 2009 and 2011, 7000 elephants had been killed by hunters in Mozambique. A study stated

that hunting as an anthropogenic activity greatly endangers animal species and that in the red data book of species recorded by IUCN out of 9000 species listed, 72% are threatened by hunting (Sean, Watson and Fuller 2016). This finding compared well with FAO (2015) findings which stipulated that wildlife in the majority of countries within savanna environment are greatly threatened by hunting. However, FAO further indicated that the sum of bush meat hunted is not tracked anywhere. These studies (Lindsey et al 2011; Plumer 2019; Sean, Watson and Fuller 2016; and FAO 2015) concurred that hunting as an anthropogenic activity has threatened animal species to extinction. However, these studies majorly focused on hunting as an anthropogenic activity at the expense of gathering aspect, similarly, they did not analyze how hunting affected plant species and yet both fauna and flora species were being threatened by this activity. Therefore, the current study described how hunting and gathering threatened terrestrial flora and fauna species.

According to IUCN (2014), 3,148 flora species were listed to have faced extinction due to habitat loss being enhanced by vegetation clearance. In support to this, studies done by Neldner, Neihus, Wilson, McDonald, Ford & Accad (2017); Taylor, Eber& Toni, (2014) affirmed that habitat loss propagated by vegetation clearance is a great threat to terrestrial flora and fauna species whose intensity increases from no impact to above 95% loss of species richness. Convention on Biological Diversity (2016), on the other hand noted that in as much as a lot of measures have been put in place to reduce the decline of species in Africa, however, seemingly the continent is still experiencing a high rate of extinction. For instance, approximately 140,000 and 372,000 hectares of natural vegetation are lost yearly in Nigeria and Tanzania respectively (Nguon & Kulakowski, 2013; Sangedas & Maleko, 2018). In as much as these studies clearly outlined the decline of flora species due to loss of habitat. However, these studies did not analyze how habitat loss due to vegetation clearance was affecting fauna species and yet these species are essential for human livelihood. Due to this gap there was need to determine how

terrestrial species were threatened by vegetation clearance. Hence, the present study bridged this knowledge gap by determining how vegetation clearance threatened terrestrial flora and fauna species.

Kenya is endowed with over 35,000 terrestrial flora and fauna species. Some of these species do not exist in other parts of the globe making Kenya to be traditionally known as a mega bio diverse country (Lusweti, 2011). A study conducted by Convention on Biological Diversity acknowledged the fact that these species in Kenya have remained highly protected. However, on the contrary, the study also pointed out that many areas still remained unprotected (CBD, 2019). According to Ogutu, Piepho, Said, Ojwang, Njino, Kifugo & Wargute, (2016), 69% flora and 68% fauna are being depleted annually due to habitat destruction enhanced by rapid growth in human population. Similarly, Masumi (2020) noted that the survival of terrestrial species in Kenya as was evaluated using the IUCN Red List Index (RLI) projected a negative trend from between 1993 and 2020. The CBD (2019) finding measured up with the outcomes by Lusweti (2011) and FAO (2019), which acknowledged that habitat destruction greatly fuels the decline of species essential for human wellbeing. Further, Lusweti (2011) noted that destruction of habitat may cause modification of habitat due to fragmentation thus barring stability and continuity of the habitat making species to be isolated thus enhancing species extinction. NEMA (2019), noted that the government has not been able to attain the aim of reducing species diversity decline by 2010 due to destruction of habitat.

Studies done by Akama, (2003) and Mungai, (2004) asserted that the population around protected regions in Kenya kill a number of wild animals for their consumption especially in dry season. Further, Mungai (2004) noted that illegal bush meat in the tune of about 2tons get harvested in yearly in Africa, 0.3M tons are approximated to be consumed in Kenya. Hunting has been pointed out as an activity that poses both human livelihood and conservation

challenges (Bennett, Robinson, Wilkie and, Eves, 2002; Milner, Bennett and Gulland 2002; Brown, 2003;).Further, a study conducted by DFID (2002) affirmed that hunting leads to the decline of fauna species in rain forest (DFID, 2002). According to Ariya (2015), sales of dry bush meat are done to small hotels within Homabay, Mbita, Sori and Ndhiwa. These bush meats are acquired through illegal hunting that is occurring in Homabay County. These studies Akama, (2003); Mungai, (2004) and Ariya (2015) agreed that hunting was a great threat to survival of animal species and greatly led to their decline. However, these studies did not factor how hunting threatens various plants species. This study therefore bridged this gap by describing how hunting and gathering threatened terrestrial flora and fauna species.

Rachuonyo South Sub County receives an average annual rainfall of 700-800mm, which is scanty and unreliable, it has a well-drained and fertile soil supporting a range of vegetation including trees, herbs, and shrubs (GoK Report, 2013 and James, 2017). A study conducted by Appiah & Pappinen, (2010) indicated that the dominant occupant of the region is Luo speaking community who are mainly farmers cultivating maize, sorghum, cassava, beans and bananas, coupled up with animal rearing. GoK Report (2013) further asserted that in addition to farming the community are also involved in residential and commercial settlement, sand harvesting, and brick making. Vegetation cover has constantly been disturbed due to over reliance on agriculture, vegetation clearance and continuous herbs collection for food and medicinal purpose (GoK Report, 2018). A study entitled “Prospects of Farm Forestry among communities in Rachuonyo District, Kenya” by Pappinen and Appiah (2010), reported that tree product is a major contributor to the household cash income of about 32%. Farmers therefore amalgamate smallholder cropping, livestock and multipurpose trees but highly favours exotic tree species for cash income, fuel and shade.

The Sub County is dominated by a Luo community known as Rachuonyo. Historically, the Rachuonyo people were renowned hunters and gatherers, a skill they inherited from their ancestor Rachuonyo who was an excellent hunter and made a big hunt for his master, Chien (Ayot, 1978). According to studies by Boyd, Richerson & Henrich (2011); Laland (2004) and Hewlett, Fouts, Boyette & Hewlett (2011) Multiple cultural knowledge are uniquely passed down through generations by mankind and that mostly children at tender age go along with their parents particularly mothers on foraging expedition where they observe subsistence activities. This can be replicated in the study area. Though this study by Ayot (1978) does not give a clear indication of the depletion of flora and fauna species, it can be used to justify the fact that there is a lot of hunting and gathering happening in the study area. A study by Ariya (2015) further acknowledged that hunters in Homabay tend to ensnare wild animal species through galvanized steel, sisal ropes and copper. This study by Ariya (2015) was good because it provided a direction on how hunting threatened fauna species. However, these studies did not analyze the effect of hunting and gathering on plant species. Therefore, the present study bridged this gap by describing the effect of hunting and gathering on terrestrial plant and animal species.

According to the findings of Homabay County Integrated Development Plan (2018), thousands of species are threatened to extinction in Homabay where Rachuonyo South is located. This is due to high population growth and poverty level which increases human activities on the habitat within the county. Further, HCIDP (2018), noted that high rate of fertility within the County which stand at 5.2 offspring/woman which is greater than 4.6 offspring/woman which is the national rate while counties such as Siaya and Migori whose fertility rate stood at 3.2 and 4.2 children respectively. For instance, by 2009, the sub county was a home to 113,118 people, currently according to 2019 census, the population rose to 130,814 people and a population density of 511 persons/Km^2 in the sub-county which is far above the national population

density of 82 persons/Km^2 and some surrounding counties such as Siaya and Migori whose densities are 393 and 430 persons per square kilometer SCIDP (2018) and MCIDP (2018). Meanwhile, Homabay county where Rachuonyo is situated is also experiencing a steady rise in her rate of population growth for instance in the census of 1999, the county had 751,332 people this rose to 963,794 in 2009 and in the 2019 census the county has a population 1,131,950. The county has an annual population change of 1.6% between the year 2009 and 2019 (Brinkhoff, 2020). This has greatly posed a great threat to the species.

According to (GoK 2018), activities such as Intensive agriculture, wildlife poaching, vegetation clearance has exacerbated environmental degradation and that bush and forest clearing, charcoal within the region has led to the loss of vegetation. Further GoK (2018), noted that these activities often lead to decline on plant species and animal habitat and yet forest is a home to over 80% of animal species such as Topi antelope, buffaloes, hyenas, hare and other snake species. In as much as measures such as reforestation, ecotourism, seed banks, nature preserves and government's legislation have been emphasized in the region unfortunately the decline is still high due to acceleration of these anthropogenic activities on habitats by densely human populated region. For instance, 74% of population is employed in agriculture, and at least 97% of the households use wood fuel for cooking, (GoK Report, 2018). However, these activities were threatening the survival of various species of plants and causing a relocation of animal species and yet these species were not documented. Hence, this study assessed the effect of the anthropogenic activities on terrestrial flora and fauna species in Rachuonyo Sub-County.

1.3 Statement of the Problem

Globally, terrestrial flora and fauna species are threatened majorly by rapid human population growth, increased human activities geared toward reducing poverty levels and cultural activities. In Kenya, particularly in Rachuonyo South, human population growth was found to

be alarming hence human activities escalating. According to Kenya population and demographic census of 2019, a population density of 511persons per Km^2 was reported in the sub-county which was far above the population densities of some surrounding counties such as Siaya and Migori whose densities are 393 and 430 persons per square kilometer respectively while national population density is 82 persons per km^2. The fertility rate of the Sub County stood at 5.2 children per woman greater than the national rate of 4.6 children per woman and of counties such as Siaya and Migori whose fertility rate stood at 3.2 and 4.2 children respectively. Thus it is worth noting that human population growth in the sub county has accelerated human activities on the habitat posing a great threat to flora and fauna species.

Historically, Rachuonyo community are renowned hunters and gatherers a skill acquired from their ancestral link to Rachuonyo who was one of the greatest and excellent hunters in Luo community. This activity threatens game found within the study area. However, most of the reviewed studies have focused on the mega- terrestrial fauna species as being threatened leaving the aspect of other species such as small game while some studies majorly focused on hunting as an anthropogenic activity at the expense of gathering aspect. The present study therefore, assessed the threats to both mega and small fauna species in the study area. Considering the global and local threats to terrestrial flora and fauna species coupled with the deficiency of the reviewed pieces of literature, the present study focused on examining the effect of anthropogenic activities (hunting, gathering and vegetation clearance) on terrestrial flora and fauna species in Rachuonyo South Sub County, Homabay County.

1.4 Objective of the Study

The main objective of this study was to examine the effect of anthropogenic activities on terrestrial flora and fauna species in Rachuonyo South Sub County, Homabay County.

The specific objectives of the study were to:

1. Describe the terrestrial flora and fauna species threatened by anthropogenic activities in Rachuonyo South Sub County.
2. Explain the effect of hunting and gathering on terrestrial flora and fauna species in Rachuonyo South Sub County.
3. Determine the effect of vegetation clearance on terrestrial flora and fauna species in Rachuonyo South Sub County.

1.5 Research Questions

1. Which are the threatened species of terrestrial flora and fauna?
2. What is the effect of hunting and gathering on terrestrial flora and fauna species?
3. What is the effect of vegetation clearance on terrestrial flora and fauna species?

1.6 Significance of the Study

The exploration on effect of anthropogenic activities on flora and fauna species conservation focused on Rachuonyo South Sub County in Homabay County. This study was to benefit various individuals, institutions, governmental and non-governmental organizations in different ways. To the local conservationist, the findings was to help in identifying the endangered species which require protection. To local community in Rachuonyo, the findings was to educate them on the need for conserving the local species for sustainable development. To the Kenyan Wildlife Service, the findings was to help in developing campaigns and other mitigating measures for conserving flora and fauna species. The NEMA was to use the findings to develop various policies for environmental conservation in Kenya and Rachuonyo. To NGOs involved in conservation in Rachuonyo, the findings was to help them improving on their conservation programs. To the Kenya forest Service, the findings was to help them to protecting the endangered indigenous species of trees. The Kenyan Government through the ministry of planning was to use the findings for natural resource mapping for economic

development. Finally, the findings of this study was to create awareness and informed policy on the relationship between anthropogenic activities and sustainable natural resource utilization in regard to terrestrial plants and animal species and to add to the existing body of knowledge on the importance of species diversity that will help other potential geographical researchers for further inquiry.

1.7 Scope and Delimitation of the Study

The survey was confined in Rachuonyo South Sub County. The county is characterized by a rapidly growing population that depended highly on the environment for their livelihood. About 74% of population is involved in agriculture, and at least 97% of the households use wood fuel for cooking. Herbal plants within the study area are also used as a source of food and medicine and hunting is done for bush meat these activities threatened the existence of terrestrial flora and fauna species and yet these species are greatly essential for the wellbeing of humanity (GoK 2018 and FAO 2021). The exploration was narrowed to Rachuonyo South Sub County focusing on the effect of anthropogenic activities such as hunting and gathering and vegetation clearance on terrestrial flora and fauna species in Rachuonyo South Sub County. The study assumed all other factors affecting terrestrial flora and fauna species such as invasive species, pollution, climate and interaction of species in the ecosystem since their effect is long term. The study further controlled the effect of climate by freezing the effect of weather (the measure of climate change) on the response of the items in the questionnaire. The respondents were asked questions on the assumption that weather was favorable. The study focused on identifying the terrestrial plant and mammal species located on the earth surface not beneath in Rachuonyo South Sub County.

1.8 Theoretical Framework

This study was directed by the ecological theory developed by Urie Bronfenbrenner in 1979. According to (Loreau & Andrew, 2007), ecological theory is a theoretical framework that has the following tenets: the study of the origin of species, the relationship between organism and environment and how they interact at micro, meso exo and macro levels of ecosystem. This theory prints a clear picture on different conditions under which various species are most likely to decrease and know the suitable way of protecting these species from decline. It is essential in the explanation of ecosystems and their response to human activity. All species are equally affected by habitat loss and have an identical risk of extinction (Montoya, 2008). With the human population passing 7 billion, activities like farming, and settlements are altering the natural habitats at a rate unprecedented in human history, thus causing disappearance at an approximate rate of 1,000 times the background rates (Plummer, 2019, UNEP, 2019b). In as much as various experts often disagree about the ethical reasons for conservation, nevertheless there is a policy consensus in the conservation community, to save species threatened by human activities (Minteer & Collins 2012).

Ecological theory maintains that even though human activities may or may not have visibly altered total region for major vegetation types, the composition of plant and animal species within them are significantly changed by such activities such as farming, wood fuel harvesting, hunting and gathering. In this study, the ecological theory is useful in the following ways: first, it is used to identify the variables of the study, secondly it is used to formulate the study objectives and finally to show the relationship between the study variables. Therefore, in this study, the researcher considered some of the anthropogenic activities such as vegetation clearance, hunting and gathering. The specific focus of this study was on the effect of anthropogenic activities on terrestrial flora and fauna species. This involved on how vegetation

clearance, hunting and gathering affect terrestrial flora and fauna species in Rachuonyo South Sub County.

1.9 Conceptual Framework

The conceptual framework as applied in the present study was useful in showing the interrelatedness of the key study variables. The key study variables were: Anthropogenic activities (independent Variable), terrestrial flora and fauna species conservation (dependent variable) and prevailing weather conditions (intervening variable). The three study variables are linked as follows; human activities are related to terrestrial flora and fauna species conservation in that an accelerated rate of these activities may lead to the devastation of the conservation of the terrestrial species. On the other hand, if terrestrial flora and fauna species conservation is enhanced, human activities would selectively be carried out. When weather condition is favorable human dependency on what is naturally provided would be reduced while unfavorable weather condition causes high dependency on what is naturally available hence posing a serious threat to the conservation of terrestrial flora and fauna species. The conceptual framework was as shown in Figure 1.

Anthropogenic Activities Affecting flora and fauna Species Conservation

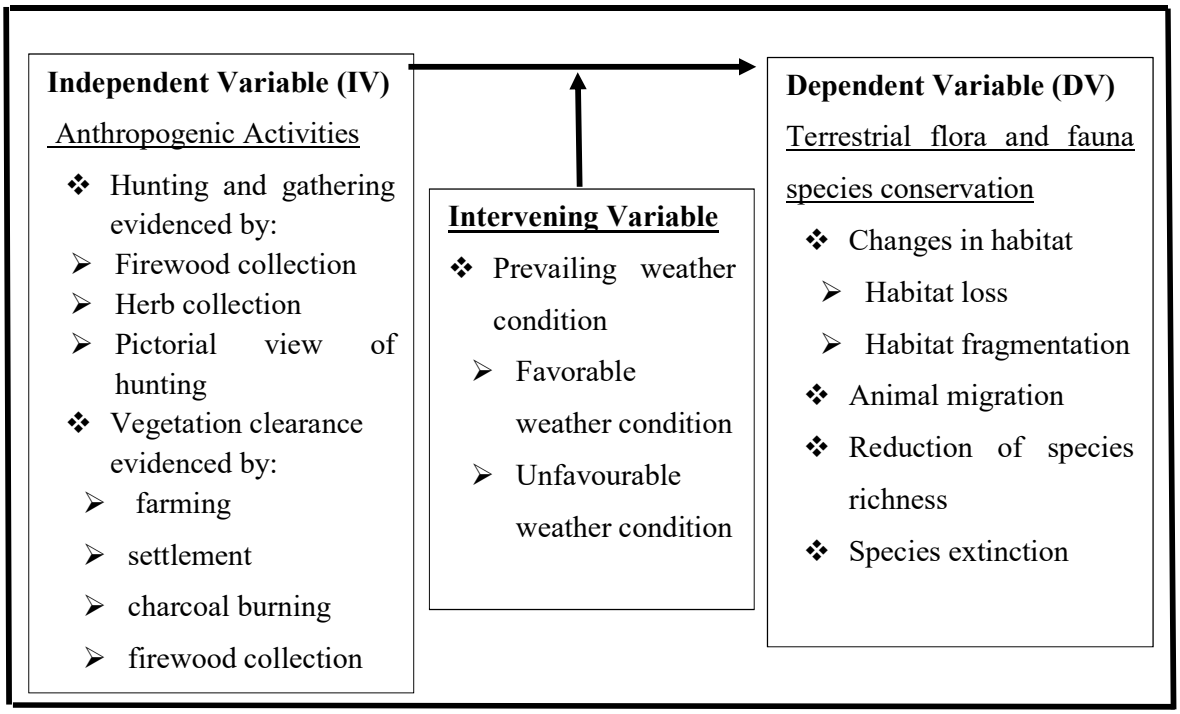

Figure 1: Conceptual Framework of Human Activities on Terrestrial Flora and Fauna Conservation.

Source (The Researcher, 2021).

The study variables were measured using questionnaires and interview schedules loaded with questions carrying various indicators. The variable indicators for anthropogenic activities were hunting, gathering, and vegetation clearance for farming, settlement, charcoal burning and firewood collection. The variable indicators for terrestrial flora and fauna species conservation were; changes in habitat, (habitat loss, habitat fragmentation), animal migration, reduction of species richness. The variable indicators for prevailing weather condition was indicated by favorable weather condition and unfavorable weather condition. The key concepts in the conceptual framework: Anthropogenic activities, terrestrial flora and fauna species conservation and prevailing weather conditions also formed key tenets of ecological theory. Ecological theory majorly focuses on the relationship between environment and species diversity, the key study variables also form an integral part of environmental activities and species diversity. This interrelatedness between the study variables and the tenets of the

ecological theory form a strong basis for justification of the choice of ecological theory in the present study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents reviewed literature based on the main themes in the research questions of the study.

2.2 Flora and Fauna Species Diversity

Globally terrestrial flora and fauna species are approximated to be ranging between 10 to 30 million. Only 1.4 million species are well known and roughly are well known and roughly 1.75 million species have been scientifically described (CBD report, 2010). However, the global living planet index reveals that there has been a constant decline in fauna population over the past 40 years (WWF report, 2014). Further, WWF, (2014) showed that between 1970 and 2012 experienced a decline of 52% of all fauna species population. A study noted that about 99.9% of species that have ever lived have become extinct (WWF report, 2019). The International Union for Conservation of Nature noted that many fauna species are threatened with extinction, and in their (2019) Red List; around 25% of fauna, 34% of flora are threatened with extinction (IUCN report, 2019). These studies greatly analyzed the rate at which these species were threatened, however, they did not analyze the specific human activities and how these activities affected them. This study therefore capitalized on this to assess the effect of anthropogenic activities affecting terrestrial flora and fauna species conservation.

World Wide Fund for Nature postulated that by 2050 roughly 30-50% of the current species could be extinct. The study acknowledged that 99% of this species threatened to extinction is due to anthropogenic activities (WWF, 2019). IUCN (2019) inserted that more than 28,000 species out of the 105,700 species assessed in the IUCN red list in 2018 are threatened with extinction. The decline rate of terrestrial species has been approximated to be 100 to 1000 times more than what is considered normal. However, currently the rate of extinction has been

accelerated and ranges between 1,000 and 10, 000 times above the natural extinction rate. Thus forming the basis of belief that the planet earth has reached the sixth mass of extinction (WWF, 2019). In as much as these studies have given detailed information about the status of species diversity globally, these species were still declining and this caused reduction of various species of flora and fauna.

The continent of Africa is enormously endowed with varied assembly of flora and fauna species (WB, 2019). Most experts believe that some parts of Africa have a soaring number endemic species. For instance, 55% of mammals, 63% of birds, 49% of reptiles and 40% of amphibians are found to be endemic in East Africa. However, the findings of these research also indicated that the endemism in North Africa is comparatively low and that out of 222 species of mammals found in Ghana 16 are endangered (UNEP/GRID-Arendal, 2002; World Resources Institute, 2003; Furman & Guertin, 2021). The results of Furman (2003) agrees with the above belief and noted that most flora and fauna species known globally are hosted in Savannah and they include the wide assemblage of large mammals such as elephants, buffalo, rhinoceros, giraffes, lions, leopards, and Oryx. Similarly, a study conducted by African Wildlife Foundation noted that beyond 22000 native flora species from about 230 varied flora species are hosted in South Africa. In addition, the study also recorded that a vast diversity of mammals including the endangered riverine rabbit exist in the region (AWF, 2017). In as much as these studies embraced that the continent of Africa is enriched with numerous terrestrial flora and fauna species, however, these large and diverse biological heritage was at risk of extinction. Moreover, thousands of species were not yet scientifically described and yet facing extinction without any proper documentation, beside, these species are essential for life. Therefore, this study sought to identify specific terrestrial flora and fauna species threatened by anthropogenic activities found in the study area.

According to National Environmental Management Authority 25,000 fauna species and 7000 flora species have been recorded in Kenya (NEMA 2009). A study noted that a number of ecosystem stretching from mountains, marine, tropical dry lands, forests and arid lands support the diverse species in Kenya (Mutavi &Long'ora, 2010). In the contrast IUCN acknowledged that anthropogenic activities have greatly destroyed these ecosystem leading to habitat loss, for instance, in the 2008 list of flora species assessed by IUCN threat criteria in Kenya, 103 out of 146 assessed species are categorized to threatened (IUCN 2009). Despite the fact that these studies have identified that flora and fauna species were threatened by anthropogenic activities, however, due to population explosions, anthropogenic activities have been intensified on the habitat, creating a great threat to species which may have not been documented. It was against this missing gap that the current study sought to examine how human activity affects the species diversity in the study area.

2.3 Effect of Hunting and Gathering on Terrestrial Flora and Fauna Species

Globally, terrestrial flora is experiencing a massive collapse in their population size (Ripple 2016). Worldwide ecologists asserted that humans are responsible for the extinctions of flora, they estimated that 24 species a day, go extinct due to hunting and gathering (Turtenwald, 2018). Hunting is the seeking, pursuance and capture or destruction of game and wild animals for subsistence, profit or sport (FAO report, 2018). Kirby (2012) stated that 301 out of the 4,500 terrestrial mammal species listed by the IUCN threatened with extinction is due to hunting. Further, FAO report, (2018) reported that; USA alone is annually losing 175 million fauna including; 24,000 bear, 55,000 caribou, 67,000 moose, 84,000 antelope, and million rabbits among others. The above studies showed that hunting was a source of decline for terrestrial fauna species globally, however, these studies did not clearly show how gathering affects flora and fauna species. There was a need for more studies to link hunting and gathering to species decline. The current study, therefore found this a missing knowledge gap and

therefore addressed the effect of hunting and gathering on the threatened terrestrial flora and fauna species.

African continent is currently faced with the local extirpation of many larger terrestrial mammals (Jimoh, Ikyaagba, Alarape, Adeyemi, & Waltert 2012; Maisels, 2013), such as Miss Waldron's red colobus monkey in Ghana, decimation of game herds in Botswana, wild bear and warthog in Muslim Countries (FAO, 2018; Rinkesh, 2019). Besides, between 2014 and 2017 Africa lost more than 100,000 elephants (Actman, 2019), in Central Africa 178 species are estimated to be currently hunted and out of these 97 species are greatly threatened and are at the verge of extinction due to hunting (Taylor, 2012; IUCN, 2012). Sadly, hunting is still on the increase in Africa, being fueled by the rising human populations, improved weaponry and overseas demand for exotic bush meat. The above studies have agreed that hunting was a dangerous activity especially to flora species, however, neither of them focused on the effect it brought on the plant species and yet hunters affected flora species as they accessed the habitat in search for the prey. This therefore gave this study a leeway to broaden the knowledge scope on effect of hunting and gathering on flora and fauna species.

In Uganda more than 1,400 pangolins were killed in between 2012–2016 due to illegal hunting (Rossi, 2018). On the other hand, over 1,000 rhinos were illegally hunted in 2017 in South Africa (AWF, 2017). Researcher noted that on average, hunting leads to 83% reduction fauna species within 25 miles of hunter access point like roads and towns (Justin 2017). Some experts have noted that Tanzania is experiencing illegal hunting making large mammals like elephants, eland and giraffe to be extremely rare and others to be locally extinct (Alex, Foley, Foley, De Luca, Msuha, Tim, Davenport & Sarah 2014). Despite these interesting insight concerning the effect of hunting to fauna species, none of these researchers clearly documented on the species which were highly threatened. The current study bridged this gap by identifying fauna species threatened by hunting.

A study carried out in Kenya by Gilbert (2019) pointed out that, about 300,000 tons of bush meat is consumed yearly. Meanwhile AWF, (2014), noted that; high demand for wildlife trophies like rhino horn and ivory has accelerated the rhino and elephant illegal killings. Ogutu (2016) asserted that; species declines rate had substantially inter-country variations with all counties posting very negative results. Further, Ogutu (2016), noted that, most common species of fauna in Kenya declined between 1977-1980 from 1,809,605 to 607,233 in 2011-2013 though the decline rate actual rate varied within the species. Greatest decline of (64-88%) was recorded among warthog, wildebeest, giraffe, Grant's gazelle, gerenuk, lesser kudu, and others. It was clear from the above studies that terrestrial fauna species were lost due to hunting. None of the above researches have clearly listed the species that were highly threatened and to what extent they were threatened. The listing of these species helps in identifying the threatened species.

2.4 Effect of Vegetation Clearance on Terrestrial Flora and Fauna Species

Globally, as a result of alteration of habitat for human consumption, a number terrestrial flora and fauna species have been on the decrease consistently (UNEP, 2014). Most experts believe that globally terrestrial species are threatened to extinction and that in the next few decades, 1 million species of flora and fauna species are at threat of being lost (AWF, 2015; UNEP, 2019a). This declining trend is attributed to the destruction of habitat due to vegetation clearance. Vegetation clearance is any activity causing destruction on local vegetation including cutting and removal of plant and trees burning, poisoning, slashing of understory, and removal of branches and shrubs (Native 2015). The findings of Neldner et al. (2017) agrees with the results of (AWF, 2015) and (UNEP, 2019a) that terrestrial species are at the verge of extinction due to habitat loss. The study noted that 233 florae and 33 faunae have been listed as near threatened meanwhile others are extinct. These studies did not analyze how vegetation clearing caused the decline of these species and yet species were declining at alarming rate.

Besides, there was a possibility of many flora and fauna species dying at the time of clearing, meanwhile faunae that managed to escape during the clearing process died from stress, starvation or predation. There was therefore need to assess if these outcomes were true.

The destruction of the natural habitat of terrestrial species for human settlement and transport infrastructure has immensely threatened numerous flora and fauna species (McDonald, Marcotullio & Giineralp, 2013; Bennie, Davies, Cruse, Gaston, 2016). A researcher affirmed this by asserting that the survival of numerous flora and fauna species are critically threatened by an ever growing and urbanizing human population (Giincralp, 2013). Additionally, some researchers forecasted that between 2010 and 2050 there will be an increase of 60% in the stretch of roads and railway and that by 2050 urban centres will host 6.3 billion residents (United Nations, 2015; Dulac, 2013), unfortunately, the regions that have a soaring terrestrial flora and fauna species is where most human settlement occur (Luck & Smallbon, 2010). This is a threat indicator to terrestrial species whose habitat are being destroyed for settlement. In support to this, Giincralp (2013) further inserted that due to urban growth above 25% of all species that have been listed as endangered or critically endangered.

The Counties enclosed by urbanized areas in the United Kingdom have greatly experienced species extinction. For instance, 35% of flora became extinct due to expansion of urban development in the region (Hardman 2011). A researcher confirmed this and acknowledged in the study done by the National Wildlife Federation that most of the American local flora and fauna species are significantly threatened due to transformation of their habitat for human settlement (Ewing and Kostyack 2016), further, the National Wildlife Federation noted that on an hourly basis 20 flora and 20 fauna species becomes extinct (Effects of overpopulation 2013). Additionally, a researcher acknowledged that the fragmentation of the original habitat for the establishment of roads and houses has immensely enhanced the decline of terrestrial species (Cane, Minckley, Kervin, Roulston & Williams, 2006). In as much as these studies keenly

observed that terrestrial flora and fauna species are being affected by clearance of vegetation for settlement and infrastructure however, these studies did not analyze how this action affected specific flora and fauna species and yet the expansion of settlement was a serious threat to the integrity of habitat. The practice denied the habitat crucial natural interconnectedness, thus reducing the movement of species between habitats. Consequently, this led to migration and death due to starvation and predation. Hence this study found this a missing gap and examined it.

African continent is experiencing a high population growth rate. This is greatly witnessed in most of her rural population in countries such as Benin, Burundi, Eritrea, Burkina Faso and Uganda (WB, 2013). Thus more land for agriculture and settlement is required which eventually causes a decline in species diversity due to habitat loss. In a similar manner, the IUCN indicated that due to agriculture, habitat is largely altered especially in West African countries (Nigeria, Cameroon, Gabon and Congo), threatening some species like Red-capped Mangabey (Cercocebus torquatus. The over harvesting Fleurydora felicis (shrub) for medicinal purposes, and wood fuel in Guinea has seriously endangered this particular species and in Madagascar, 90% of rosewood and palissander (Dalbergia) are highly utilized (IUCN, 2019). Despite the great insight aired by these studies on the decline of flora species due to agriculture and wood fuel, regionally increasing population growth rate was still exerting a lot of pressure on habitat. This study therefore emphasized on this to address the effect of anthropogenic activities on terrestrial flora and fauna species.

In Kenya there is high dependency of wood fuel as a source of energy especially among the urban and rural population. Yearly, 2.4 million tons are approximated to be consumed inform of firewood and charcoal used by rural and urban population at a rate of 90% and 82% respectively (KES, 2018). The National Environmental Complaints Committee indicated that terrestrial flora and fauna species are at the brink of disappearance due to charcoal burning.

This causes flora and fauna species to disappear at a rate of 1 to 10 annually (NECC, 2018). In as much as the above studies have correctly indicated that wood fuel harvesting was a major threat to terrestrial species in Kenya, the dependence of most Kenyan population on wood fuel was still high and this posed a lot of threats to terrestrial flora and fauna species as their habitat were destroyed causing fauna species to relocate in search of new habitat and breeding points. This study addressed this gap. This research was essential because the assessment of this activity will help in regulating the rate at which species are declining.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides methods that were used by the researcher in executing the study. This section contains research design, the area of study, target population, sampling procedure and sample size. The data collection instruments comprising of the questionnaire and interview schedules. The validity and reliability of the research instruments, piloting, data analysis techniques and ethical considerations.

3.2 Location

Rachuonyo South Sub County is in Homabay County. It is bordered by Rachuonyo North Sub County to the North, Rachuonyo East Sub County to the North East, Rangwe Sub County to the West and Kisii County to the South. Rachuonyo South Sub County lies between longitudes 34^{o} $14^{'}$ E and 35^{o} 1'E and latitude 0^{o} 23' S and 0^{o} 36' S (figure). It has a total area of 259 square kilometres. Rachuonyo South Sub County is divided into five wards namely; West Kasipul, East Kamagak, Central Kasipul, West Kamagak, and North Kamagak, these wards are further sub divide into twenty-five sub locations which had a specific boundary (Government of Kenya 2018).

3.2.1 Study Area

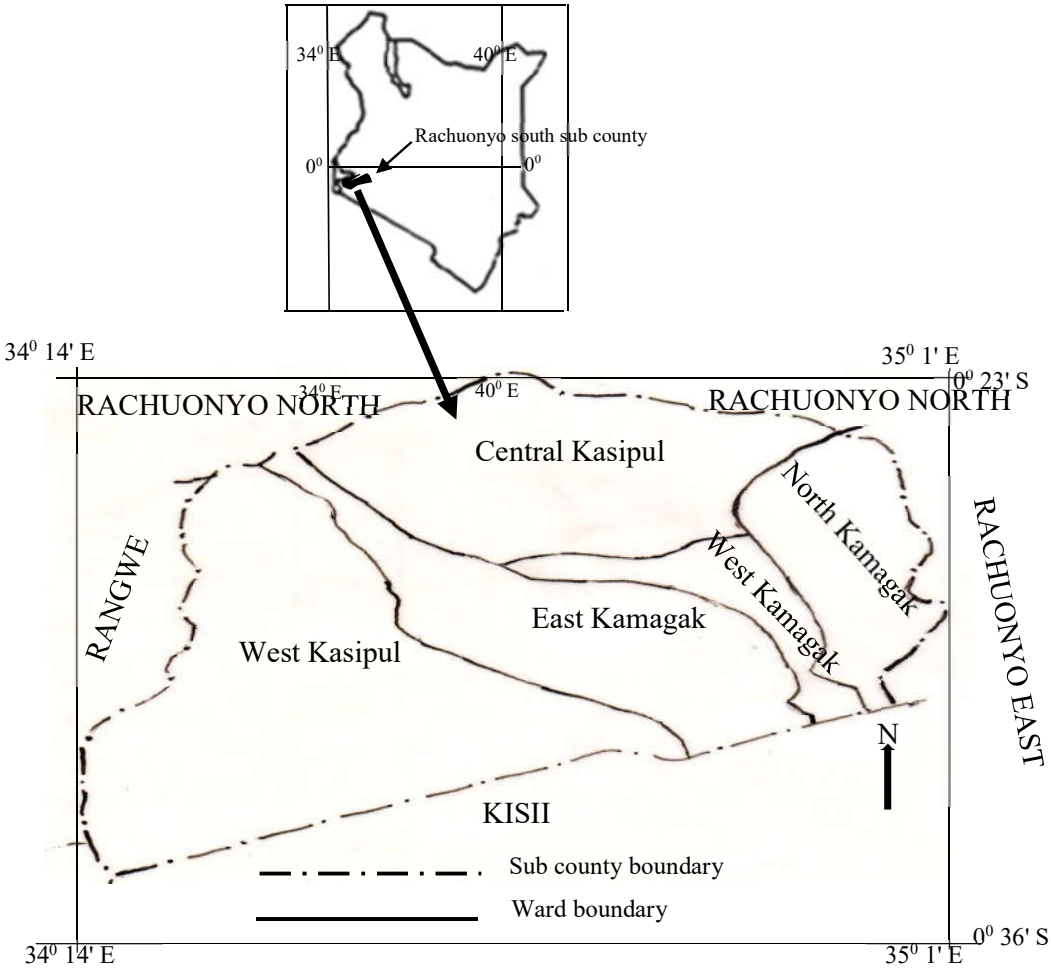

Figure 2:Map of Kenya Showing Wards of Rachuonyo South Sub County

Source: Researcher (2022)

3.2.2 Climate

Rachuonyo South Sub County has an inland equatorial climate type which is modified by the altitude effects and being adjacent to lake Vctoria and this lowers the temperatures than the equatorial climate. The rainy seasons are two from March to June being the long rains season and August to November being the short rains season. Annually the average rainfall ranges from 700 to 800mm. The averages altitude is between 1180m and 1900m above sea level, it is composed of deep, well drained relatively fertile soils (GoK, 2013 and GoK, 2018).

3.2.3 Land Use

The activities on the land in the sub county consist of residential and commercial settlement, sand harvesting, hunting, gathering, charcoal burning, brick making and continuous crop farming of both cash crops like banana, coffee, groundnuts, and sweet potatoes and subsistence production of maize, beans, sorghum and kales (GoK 2013). These activities have led to the clearance of the habitats (GoK 2018).

3.3 Research Design

The study employed a cross-sectional descriptive research design because data was collected at one point at a time from the study area and described to depict the effect of human activities on terrestrial flora and fauna species conservation. Descriptive research is described by Mugenda & Mugenda, (2003), as a process of collecting data to answer questions about the current situation which involves a one-time interaction with group of people. McCombes (2019), asserted that descriptive research design is a survey design used to investigate one or more variables, assess opinions and preference in environmental issues and problems and is the most appropriate method to determine opinions attitudes, and beliefs in a natural environment through use of interviews schedules and questionnaires. Sampling units were households while household heads were the unit of analysis, both male and female heads were used as respondents.

3.4 Study Population and Sampling

According to Kothari (2015), study population is that population to which a researcher wants to generalize the results of a study. The target population is household heads in Rachuonyo south sub county. This Sub County is inhabited predominantly by the Luo community and has five wards namely; West Kasipul, East Kamagak, Central Kasipul, West Kamagak, and North Kamagak and twenty-five sub locations which had a specific boundary. According to Kenya

National Bureau of Statistics (2019) the sub county had a population of 130,814, based on the area of 259 square kilometre and an average population density of 511 per square kilometer, and it has a total of 30,990 households upon which the sample unit was taken (KNBS, 2019). An inclusion and exclusion criteria was used to determine the household heads to be picked for sampling. Khan (2015) defines inclusion criteria as characteristics that the prospective subjects must have if they are to be included, meanwhile, exclusion criteria are the characteristics that disqualifies prospective subjects from inclusion in the study. In this study therefore, factors like age and gender was considered. Hence, only household heads either male or female of age 31 and above was considered. Table1 shows the Name of Wards, Sub-Locations, and total population in Rachuonyo South Sub County.

Table 1: Name of Wards, Sub-Locations, and Total Population in Rachuonyo South Sub-County
Source: Field Data (2022)

Name of the Ward	Number of Sub Location	Total Population
West Kasipul	Kodera North, kamyawa, Kasire Kogelo, Kopiyo Karanding, Kodera South, Kamigido, Karabach, Kokech,Kasimba, Kawino, Konuonga, Kotieno Kochich, Kotieno Konuonga, Kowidi, Kanyango, Kokal	53,239
East Kamagak	Kachieng, Oyugis town and Sino Kogola	34,316
Central Kasipul	Kachien North and Kachien South	10,339
West Kamagak	Kamuma and Obisa	14,604
North Kamagak	Kawere East, Kawere West and Nyalenda	18,316
5	25	130,814

Source: Field Data (2022)

Thus the study involved five wards composed of 25 sub location giving a total population of 130, 814 persons for Rachuonyo South Sub County.

3.4.1 Sampling Procedure and Sample Size

The total population of Rachuonyo South Sub county was 130, 814. A stratified random sampling technique was employed to select respondents from five wards in the study area. The Relief mobile application software 2018 was used to compute the sample size. The relief Mobile phone application is designed based on the Cochran's sample size formulas:

$$n = \frac{t^2(\%\ \text{prevalence})\ (1-\%\text{prevalence})}{e^2}$$

Where: n = is the sample size for infinite population, t is coefficient for confidence level (z-score of 1.96), % prevalence is prevalence rate (0.5) while e is the precision rate (0.05).

Since the study population is finite at N=30990 household heads, then the sample size formula is

$$n_0 = \frac{n}{1+(\frac{n-1}{N})}$$

Where n_0 is the sample size for finite population, n is the sample size of infinite population and N is the population. (Relief Mobile Phone Application, 2018).

Therefore, illustrating sample size of the respondents obtained from the Relief sample size calculator:

$$n = \frac{(1.96)^2 \times (0.5 \times 0.5)}{(0.05)^2} = 384$$

$$n_0 = \frac{384}{1+(\frac{384-1}{30990})} = 379$$

Hence, the minimum sample size of the study was 379 indicating that questionnaires were administered to 379 household heads. The unit of analysis were household heads composed of either adult male or female in the study area who provided key information concerning human activities that were greatly threatening the existence of species in Rachuonyo South Sub County.

The sample size per ward used in the study was attained by dividing the total number of households from each ward by the total households of the entire sub county and then multiplied by total sample size as shown in Table 2 column 5.

Table 2: Sampling Matrix of Respondents

No.	Name of Ward (Strata)	Sampling Method	Number of Households (N)	Sample Size (n)
1.	West Kasipul	Stratified Random Sampling	12,148	$\frac{12148 \times 379}{30990} = 149$
2.	East Kamagak		8582	$\frac{8582 \times 379}{30990} = 101$
3.	Central Kasipul		2352	$\frac{2352 \times 379}{30990} = 29$
4.	West Kamagak		3496	$\frac{3,496 \times 379}{30990} = 43$
5.	North Kamagak		4412	$\frac{4,412 \times 379}{30990} = 54$
Total	5		30,990	379

Source: Modified from (KNBS 2019)

To get individual household heads from the sample size for each ward, stratified random sampling was employed by considering the wards as strata. The five wards namely East Kasipul, Central Kasipul, North Kamagak, East Kamagak and West Kamagak were considered as strata. The list of all household names was obtained from the Ward executive officer, to get the sampling frame after which the respondents were randomly picked by assigning a number to every subject of the accessible population by using computer. Data was entered in computer per ward using the sampling frame for each individual ward. A sample size of 379 households out of 30990 was generated randomly by random number generator in M.S Excel. The structured questionnaires were therefore, administered to the 379 household heads to collect data (Appendix B)

3.4.2 Purposive Sampling

Purposive sampling was used to identify 10 key informants to give a holistic and representative information on the community about anthropogenic activities and terrestrial flora and fauna species conservation. The response from the respondents indicated that terrestrial flora and fauna species in the region were highly threatened and that anthropogenic activities such as hunting, gathering and vegetation clearance were highly prevalent and were greatly threatening terrestrial flora and fauna species in the study area. The key informants included: five chiefs (one per ward), one hunter, one herbalist, two forest officers from Wire Forest and Kodera Forest, and two environment conservation officer. According to Mugenda and Mugenda (2003) purposive sampling technique helps the researcher to interview people believed to be expert in their field. This enabled the researcher to obtain information required based on the objectives of the study. Thus forest officers provided information on the various activities taking place in the forest, various types of plant and animal species, the herbalist, on types of plant species used, hunter on various species being hunted and chiefs on the various human activities occurring on their area of jurisdiction.

3.5 Data Collection Methods

Once the permit was granted, the researcher pre-visited the study area for a day for familiarization with the respondent's environment. The researcher appointed a research assistant for each ward and trained them on the administration of questionnaires. They helped in the administration of these instruments to the household heads upon filling the consent form (see Appendix C). The administration of questionnaires took a period of two weeks. Upon the completion of the exercise, the researcher then trained the research assistant on how to conduct interviews. Key informants such as chiefs, herbalist, hunter, forest officers and environment officer were interviewed and conversation noted down on interview schedule form. In this

study both primary and secondary data sources was consulted for the study to collect qualitative and quantitative data.

3.5.1 Primary Data

Primary data on terrestrial flora and fauna species in the region, flora species gathered, fauna species hunted, and vegetation clearance was collected from household heads and key informants through questionnaires and interview schedule respectively. Key informants served as confirmation and proof to the information collected from household heads. Both questionnaires and interview schedule was used in this study because they provided a reliable and valid basis for data collection.

3.5.2 Questionnaires

Questionnaire was a major tool for collecting data. Structured questions with both closed and open ended questions on various plant and animal species, species of animal hunted, species of plants gathered in the region, various types of vegetation cleared, the purpose of their clearance and conservation measures in the region was administered to household heads who were adult male and female of age 31 years and above (see Appendix D). The researcher with help of research assistant administered questionnaires to the respondents to clarify to the respondents on questions that they could not easily understand. This method was appropriate because it allowed this study to understand and capture the respondents' point of view through probing of incidental information, reaching out a large number of respondents within a short time, give the respondents adequate time to respond to the items, it offer sense of anonymity to the respondents and it is an objective method hence no bias resulting from the personal characteristics.

3.5.3 Key Informant Interview

The interview schedule was administered to ten Key informants in the study area (Appendix C). They included four chiefs one per ward, one herbalist, two forest officers from Wire Forest and Kodera Forest, one hunter and two environment officer. The interview was done based on their experience attained on their area of work that caused them to have deep knowledge on the various plant and animal species threatened, the species richness, their uses, and various human activities threatening species in the region. The interview sought their opinions on the effect of human activities on plant and animals in the region.

3.5.4 Observation and Photography

The researcher employed a non-participant observation technique to observe various types of vegetation in the region such as forests, shrubs and grasses (Appendix E). Some of the human activities in the area such as plant gathering, crop farming, hunting was also observed. Photographs was taken to represent the relevant physical attributes related to study and to enhance the quality of the study.

3.5.5 Secondary Data Collection

Relevant information on anthropogenic activities and terrestrial flora and fauna species was considered from both unpublished and published sources. This was obtained from relevant sources like publications, journals, newspapers, internet, text books, websites, government reports (published and unpublished reports). In addition to this, thesis, and dissertations with relevant topics from Maseno University library, Government documentation center's in Homabay and Forestry Department in Rachuonyo, International center for Research in Agroforestry (ICRAF) and internet. This was sought to bring an insight into the study thereby facilitating comparisons on various studies on anthropogenic activities on terrestrial flora and

fauna species and at the same time, it greatly enhanced information received from household heads. This assist the researcher to identify the existing knowledge gaps.

3.5.6 Flora and Fauna Species Identification

Different types of flora and fauna species were listed by respondents during the survey. These species were listed in their local names (Luo) while Kokwaro (1993) was used to give scientific name of some medicinal plants given in local names by the respondents in the study area. Common or English name of flora and fauna species found in the study area were identified using the Luo Biological Dictionary (Kokwaro and Timothy 1998). Information on other species of terrestrial flora and fauna were provided by key informants from Kenya forestry Department in Rachuonyo South Sub County and Kenya Wildlife Service.

3.6 Data Analysis and Results Presentation

Data on the main objective of this study was to examine the effect of anthropogenic activities on terrestrial flora and fauna species conservation, were sorted, ordered, coded and entered in an appropriate output form. Data was then processed in Microsoft excel and analyzed using SPSS version 22. Spearman Rank Correlation Analysis was used in assessing the effect size. The descriptive statistics included mean and standard deviations.

Table 3: Quantitative Data Analysis Matrix

Research Objectives	Independent Variable	Dependent Variable	Data Analysis Procedure
1. Identify terrestrial flora and fauna species threatened by the anthropogenic activities in Rachuonyo South Sub County.	Anthropogenic activities	Flora and Fauna species conservation	Percentages, Frequencies and Content Analysis

2.	Describe the influence of hunting and gathering on terrestrial flora and fauna species conservation in Rachuonyo South Sub County	Hunting and Gathering	Flora and Fauna species conservation	Spearman Rank Correlation Analysis, Means and Standard, Deviation
3.	Determine the influence of vegetation clearance on terrestrial flora and fauna species conservation	Vegetation Clearance	Flora and Fauna Species Conservation	Spearman Rank Correlation Analysis, Frequencies and percentages

Source: Researcher (2022)

3.6.1 Measurement of Variables

The dependent variable is terrestrial flora and fauna species that depended on the independent variable which is anthropogenic activities. They were measured by asking the stakeholders questions whose response printed a clear picture of the real situation on the ground. Secondary data were read and interpreted to support the responses.

3.6.2 Data Processing

To get the result of the study both quantitative and qualitative data analysis were employed. The data were arranged according to research objectives and analyzed quantitatively by descriptive statistical techniques and qualitatively through content analysis. The processing of the quantitative data was done through the usage of Statistical Package for the Social Sciences (SPSS) version 22 by computing frequencies, percentages, standard deviation and means. The data was presented through tables and figures.

3.6.3 Results Presentation

The presentation and discussion of the findings were done in form of summarized Tables, Charts, Plates, and Discussions. The findings were expected to create awareness on the effect of anthropogenic activities on terrestrial flora and fauna species in Rachuonyo South Sub-county.

3.7 Reliability and Validity

The correctness of the data collection procedure greatly determines the quality of research study. The information obtained through the various techniques of data used were correct and relevant to the research questions or objectives. This made validity and reliability to be measures of relevance (Babbie & Mouton, 2010).

3.7.1 Reliability of the Instruments

Reliability is a measure of the degree to which a research instrument applied repeatedly to the same object yields the same result each time (Babbie, 2010). According to Krosnick & Stanley (2009) pre-testing is the best way to minimize ambiguity, enhance clarity and ascertain responses to the style and content of the questions. Therefore, reliability was determined by the data collected from pilot study. The pilot study was conducted at Obisa Sub Location in West Kamagak ward which was chosen purposively. Instruments were administered to a sample size of 10% (38 respondents) as stipulated by Mugenda and Mugenda (2003) and Wuensch (2012). The pilot study helped in streamlining the instrument. This therefore made the outcome from the field to be a real representation of the situation on the ground. The data collected was fed into statistical package for the social sciences (SPSS) version 22, to generate Cronbach Alpha.

According to (Rovai, Baker & Ponton 2014) Cronbach Alpha is a model of internal consistency reliability based on the average inter-item correlation of an instrument. Gliem and Gliem, (2003), asserted that Cronbach Alpha is a measure used to assess the strength of internal

consistency. It is the average value of the reliability coefficients one would obtain for all possible combinations of items when split into two half-tests. The case processing summary of the reliability analysis on anthropogenic activities and terrestrial flora and fauna species conservation questionnaires was reported as shown in Table 4. A total of 38 respondents (100% of the cases) was used in the reliability analysis.

Table 4:Pretested Questionnaires

		N	%
Cases	Valid	38	100.0
	Excluded[a]	0	0.0
	Total	38	100.0

a. List wise deletion based on all variables in the procedure.

Internal consistency reliability was employed through computation of Cronbach Alpha. The reliability statistics are displayed in Table 4.

Table 5: Reliability Statistics

Cronbach's Alpha	Number of Items
0.709	11

From the reliability statistics, a Cronbach Alpha of 0.709 was generated. This indicated a strong internal consistency of the items in the questionnaire. Rovai et al (2014) noted that reliability tests resulting in an alpha of .7 are generally accepted as having high reliability and appropriate for any study. Therefore, the questionnaire was reliable to be used in the study.

3.7.2 Validity of the Instruments

According to Robson (2011), Validity is the extent to which the instrument measures what it is designed to measure. In other words, validity is the degree to which the results obtained from the analysis of the data are truthfully representing the phenomena under study. In this study

both face and content validity was considered. Face validity refers to researchers own evaluation of the presentation and the applicability of measuring instrument to see to it that they are relevant, reasonable, unambiguous, and clear (Oluwatayo, 2012). Content Validity as described by Bollen (1989) and cited by Drost (2011), is a qualitative type of validity where the domain of the concept is made clear and the researcher judges whether the measures fully represent the domain. Therefore, the determination of face and content validity of the research instrument in this study guaranteed accuracy and connection among the questions asked and variables measured. For instance, the items in the research instrument in this study were based on themes listed under literature review.

The validity of the instruments was also reflected on the items which were structured in simple English language, which the respondents found easy to understand. The research instrument was further analyzed by restructuring the question items to meet the objectivity of the research hence validity. The instruments were subjected to validation by experts in the area of study. This was according to Mugenda and Mugenda, (2003) who noted that validity is judgement made better by a group of professionals and experts in the field of study. Therefore, the researcher sought the judgement of experts in the field from School of Arts and Social Sciences, Maseno University to assess the ease of use, clarity, readability and the concept to be measured by the instrument in relation to the objectives of the study.

3.7.3 Pilot Study

According to Mugenda and Mugenda (2003), a sample of a tenth of the total sample with homogenous characteristics is appropriate for the pilot study. Thus sample size of approximately 10% (38 respondents) of the total sample size of the targeted household was used Wuensch (2012). Pilot testing was a crucial step in research process as it estimates the reliability of the instruments by revealing vague questions and unclear instructions. It enabled the researcher to test out, establish the ease of administration and the errors that could be in

numbering and interpretation of the items on the research instruments. It also captured important comments and suggestions from the respondents that enabled the researcher to improve on the efficiency of the research instrument. Any challenges that were observed during the pilot study in terms of clarity of items on the research instruments were used to improve the instruments as a way of enhancing validity of the data that were obtained using the instrument. The pilot study was used to determine the suitability of the methods of data collection and analysis. The pilot study was conducted at Obisa Sub Location in West Kamagak ward which was chosen purposively. The portion of population used in the pilot study was excluded in the main study.

3.8 Ethical Considerations

Ethical issues were considered based on levels of the study as articulated by (Creswell, 2014). The levels of study included; prior to the study, beginning of the study, data collection, data analysis and reporting, sharing and storage of data.

Prior to the study, professional association standards were examined through consulting the code of ethics for professional association. The researcher sought approval from the school of graduate Studies Board as well as the Ethics Review Committee of Maseno University. Upon approval of the proposal, the researcher conducted a pre-visit to the study area and obtain relevant permission to carry out the study. The site without vested interest in outcome of study was chosen by selecting sites that did not raise power issues with researchers.

At the beginning of the study, the researcher identified research problem that benefit participants by conducting needs assessment or informal conversation with participants about their needs. The purpose of the study was disclosed by contacting participants, and informing them of the general purpose of the study. The participants were not pressurized into signing consent forms by telling them that they do not have to sign form. The norms and charters of

indigenous societies were respected by finding out about cultural, religious, gender, and other differences that need to be respected.

During the data collection, the researcher minimized any form of disruption through building trust, and conveying extent of anticipated disruption in gaining Collecting data. All participants received equal treatment by making certain that all participants received the same treatment. The principle of veracity was upheld by avoiding deception of the participants. Potential power imbalances and exploitation of participants (e.g., interviewing, observing) was avoided. The collection of harmful and irrelevant data was avoided by: Putting into place wait list provisions for treatment and controls, discussing the purpose of the study and how data was to be used, avoided leading questions, withheld of sharing personal impressions, avoided the disclosure of sensitive information, involved participants as collaborators and strictly observed questions stated in an interview protocol.

During data analysis, the researcher avoided siding with participants (going native) by reporting multiple perspectives. Disclosing only positive results was avoided by reporting contrary findings. The privacy and anonymity of participants was respected by assigning fictitious names or aliases and developing composite profiles of participants.

During reporting, sharing, and storing of data, the researcher avoided falsifying authorship, evidence, data, findings, and conclusions by reporting honestly. Plagiarism was avoided by reading APA (2010) guidelines for permissions needed to reprint or adapt work of others. The information that would harm participants was not disclosed by using composite stories so that individuals cannot be identified. The language of communication was clear, straightforward and appropriate by using unbiased language appropriate for audiences of the research. Data was shared with others through providing copies of report to participants and stakeholders. Raw data and other materials (e.g., details of procedures and instruments) was kept through

considering website distribution. Duplication or piecemeal publications was avoided through publishing in different languages. The ownership of the data was stated by giving credit for ownership to researcher, participants, and advisers. The data was to be stored for a period of five years in line with (APA, 2010) guidelines.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

"This chapter consist of data analysis and presentation of findings of the study. This is done based on the three objectives of the study namely: To Identify the terrestrial flora and fauna species threatened by anthropogenic activities in Rachuonyo South Sub County; to explain the effect of hunting and gathering on terrestrial flora and fauna species conservation in Rachuonyo South Sub County and to determine the effect of vegetation clearance on terrestrial flora and fauna species conservation in Rachuonyo South Sub County.

4.1.1 Respondent's Response Rate

The United State Government Accountability Office (2017), defined response rate as the percentage of the eligible sampled elements of the target population who provided usable data for the analysis. According to GAO Internal Guidance Resource (2017) the computation of the response rate can be done using the following formula;

$$\text{Response rate} = \left[\frac{\text{Usable Responses}}{\text{Eligible sampled element}}\right] \times 100\%$$

The present study adopted this formula to compute the respondents' response rate as shown in Table 6.

Table 6:Respondents Response Rate Summary

Respondents	Eligible Sampled Element	Usable Response	Rate (%)
Household heads	379	365	96 %
Chiefs	5	4	80%
Environmental officers	2	2	100%
Herbalist &Hunter	2	2	100%
Forest Officers	2	2	100%

The respondents' response rate (household heads =96%, chiefs =80%, environmental officers =100%, herbalist and hunter =100%, forest officers =100%) as shown in Table 6 for this study were sufficient as they were far above the 50% bench mark rate proposed by the United State

Government Accountability Office (2017). This high response rate enhanced the reliability and validity of the study.

4.1.2 Socio-Demographic Characteristic of the Respondents

Connelly (2013) asserted that demographic characteristics of participants are essential in informing the readers of the research about what population outcome may generalize. In this study, the data collected focused on gender, age, household size, education, main occupation, period lived in the study area, approximate size of land and approximate income per month of the household heads as summarized in Table 7 below.

Table 7:Socio-Demographic Characteristic of the Respondents

Demographic Characteristics		**Response Categories**				
Variable	**Indicator**	**Household Heads**	**Chiefs**	**Environment Officer**	**Hunter/ Herbalist**	**Forest Officer**
Gender	Male	149 (41%)	3(75%)	1 (50%)	1(50%)	1(50%)
	Female	216 (59%)	1(25%)	1 (50%)	1(50%)	1(50%)
Age bracket	31- 40yrs	17 (5%)				
	41-50 years	112 (31%)				
	51-60 years	149 (40%)				
	Above 60 years	87 (24%)				
Level of Education	Primary	185 (51%)				
	Secondary	100 (27%)				
	Certificate	49 (13%)				
	Tertiary	31 (9%)				
Period of Residence	5-9 years	3 (1%)				
	10-14 years	16 (4%)				
	15-19 years	112 (31%)				
	20 and above	234 (64%)				
Main Occupation	Formal Employment	53 (15%)				
	Casual Employment	25(7%)				
	Business	60 (16%)				
	Farming	227 (62%)				
Approximate land size	1-3 acres	259 (71%)				
	4-6 acres	90 (25%)				
	Above 7acres	16 (4%)				

Approximate Income	Ksh. 0-5000	103 (28%)				
	Ksh. 5001-10000	183 (50%)				
	Ksh. 10001-15,000	28 (8%)				
	Above Ksh. 15,000	51 (14%)				
Years of Service	Below 5yrs		1(25%)	0(00%)	0(0%)	0(0%)
	Above 5yrs		3(75%)	2(100%)	2(100%)	2(100%)

Source: Field Data 2022

The result in Table 7 indicate that the current study was balanced with both male and female respondents (Household: Male= 41%, Female=59%, Chief: male=75%, female=25%; Environment officer: male=50%, female=50%, herbalist: female=50%; hunter: male=50%, forest officer: male=50%, female=50%). This implied that for their livelihood, both male and female were actively engaged on anthropogenic activities which threatened the terrestrial flora and fauna species. UNEP, (2017) conform to the finding of this study that both men and women in the world are actively involved in anthropogenic activities that threatens biodiversity. Further, UNEP, (2017) noted that biodiversity is seen to be closely connected to development, access to resources, income-generating activities and essential household products. Therefore, on a daily routine both men and women collect, utilize, sell plant and animal products.

Age bracket in the current study (Table 7) depicted maturity and experience of respondents. It was included because it is a determinant of people carrying out various anthropogenic activities having the history of the occurrence of these activities and how these activities have affected terrestrial flora and fauna species within Rachuonyo South Sub County. From the results, it was evident that most (40%) of the respondents were in age bracket of 51 to 60. This implied that mature and experienced indigenous respondents were considered to give history of terrestrial flora and fauna species that were indigenous and how the anthropogenic activities have affected them.

Level of education indicates the ability of a respondent to articulate issues regarding terrestrial flora and fauna species conservation, anthropogenic activities threatening species and the involvement of the respondent in these activities. In the present study, the level of education was distributed as: Primary (51%), Secondary (27%), Certificate (13%) and Tertiary (9%). From the result, majority (78%) of the respondents had basic education which empowered them to provide the information relevant to the current study, at the same time, this analysis indicated the level of involvement of the respondents to the activities that threatens the survival of species. This implied that in as much as the respondents could articulate issues regarding species, majority (78%) of the respondents that had education below tertiary level were greatly involved in the anthropogenic activities. UNESCO, (2015) support this finding by indicating that, by enhancing knowledge, fostering beliefs, instilling values, and changing attitudes, through education, there is a great potential to influence individuals reconsider lifestyles that are environmentally unsustainable. Further, UNESCO, (2015) pointed out that 25% of people had not more than secondary school education worry more about environment as opposed to 46% with tertiary education and above.

Period of residence and years of service in a given area may be commensurate with knowledge of area under study. It was included to help ascertain that respondents were majorly residents of the study area and that made them understand and have a deeper knowledge of the area where the investigation was taking place. In the study, majority (64%) of the respondents had stayed in the study area for 20 years and above. This had the implication that majority (64%) of the respondents had adequate knowledge of the area and hence could identify the terrestrial flora and fauna species, anthropogenic activities threatening these species and conservation measures in the study area. Studies done by Omari, 2006 and Babatunde & Qaim, 2009 supported this finding that when people stay in a particular area for a longer duration, they get experience on the conditions of their locality, get to know very well plants and animals they

utilize for food, shelter and other utilities and therefore able to give very relevant information to the study investigator.

Occupation and an approximate monthly income of the respondents gives light on the resource utilization within the study area. In this study, the formally employed, casually employed, business oriented and farming oriented respondents accounted for 15%, 7%, 16% and 62% respectively and majority of respondents' monthly income fell in the range between Ksh. 5001 to Ksh. 10,000 which accounted for 50%. This implied that most respondents heavily depended on the available natural resources such as land and species for their livelihood. The analysis depicted that a greater (62%) percentage of respondents depend on farming activity that threatens the survival of species as a result of vegetation clearance at the same time majority (50%) of the respondents had a low income of Ksh. 5001 to Ksh. 10,000. This implies that majority of the residents are poor making them to rely on activities such as farming, hunting and gathering that threatens the survival of terrestrial flora and fauna species. Gok, (2018), reported that 74% and 97% of the household heads within Homabay County are employed in agriculture, and use wood fuel for cooking and that the region is characterized by high level of poverty.

Approximate land size in the study area depicted the level of land fragmentation due to high population. According to the study, the land was distributed as: 1-3 acres (71%), 4-6 acres (25%) and above 7acres (4%). Majority (71%) of the respondents indicated that had average sized farms of 1 to 3 acres while 25% had average sized farms of 4 to 6acres. This implied that the respondents depended highly on land and that due to high population, the land is highly fragmented. Similar findings by Gok (2018), reported that the study area is known to be a rapidly population growing zone and high population pressure and density and decreasing food production potential putting pressure on the available resources.

Years of service of the key informants reflected their professional experience. In the current study, the key informants which included; Chiefs, Environment Officers, Herbalist, Hunter and Forest Officer had served for a period of above five years. This implied that the key informants had requisite experience. Cossham & Johanson, (2019); Marshall (1996), opined that key informants are individuals who are highly knowledgeable, who have a role in the community and contributes to research phenomena or understanding of the phenomenon and so they have the potential to furnish the researcher with the right information they are seeking. Further, Marshall, (1996) indicated that information sought from them are expertly given as the have inter-personal skills, or ranks in the society that make them be at a vintage position with deeper insight of what is happening within their reach and knowledge.

4.2 Terrestrial Flora and Fauna Species Threatened by Anthropogenic Activities in Rachuonyo South Sub County

The current study aimed at identifying the terrestrial flora and fauna species being threatened within Rachuonyo South Sub County. Result in Table 8 below reveal the threatened terrestrial flora species in the study area. The summary includes the local name, botanic name, classification whether indigenous or exotic, uses and anthropogenic activities threatening the species.

Table8: Threatened Terrestrial Flora Species, Classification, Uses and the Threatening Anthropogenic Activities

Threatened Terrestrial Flora Species		Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Local Name	**Botanical Name**			
Anyuka	*Vangueria Madagascariensis*	Indigenous	Fruit, Firewood	Gathering Vegetation Clearance
Achak	*Euphorbia Inaequilatera*	Indigenous	Vegetables	Gathering Vegetation Clearance

Threatened Species	Terrestrial Flora	Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Local Name	**Botanical Name**			
Adugo,	*Combretum Molle*	Indigenous	Wood Fuel	Gathering Vegetation Clearance
Akech	*Chameecrista Hildebrandtii*	Indigenous	Medicinal	Gathering Vegetation Clearance
Alii,	*Acacia Seyal*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Ang'we	*Kedrostis Foetidissima*	Indigenous	Medicinal	Gathering Vegetation Clearance
Pilipili	*Capsicum Frutescens*	Indigenous	Spice, Medicinal	Gathering Vegetation Clearance
Apuoyo	*Chloris Gayana*	Indigenous	Fodder, Thatch	Gathering Vegetation Clearance
Apoth	*Corchorus Trilocularis*	Indigenous	Vegetables, Medicinal	Gathering Vegetation Clearance
Arumbe,	*Acacia Hockii*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Arupiny	*Commiphora Africana*	Indigenous	Medicinal, Firewood	Gathering Vegetation Clearance
Atego,	*Keetia Gueinzii*	Indigenous	Fruit	Gathering Vegetation Clearance
Atipa	*Asytasia Gangetica*	Indigenous	Vegetables	Gathering Vegetation Clearance
Ayiergweng,	*Boscia Angustifolia*	Indigenous	Wood Fuel	Gathering Vegetation Clearance
Bongu,	*Fiscu Sur*	Indigenous	Wood Fuel	Gathering Vegetation Clearance
Bondo	*Euphorbia Candelabrum*	Indigenous	Glue	Gathering Vegetation Clearance
Chwaa	*Tamarindus Indica*	Indigenous	Fruit, Medicinal, Wood Fuel	Gathering Vegetation Clearance

Threatened Species Local Name	Terrestrial Flora Botanical Name	Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Deg Akeyo	*Cleome Gynandra*	Indigenous	Vegetables, Medicinal	Gathering Vegetation Clearance
Det,	*Ormocarpum Trichocarpum*	Indigenous	Medicinal	Gathering Vegetation Clearance
Dwelle	*Melia Azeradarch*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Huyandawa	*Withania Somnifera*	Indigenous	Firewood, Medicinal	Gathering Vegetation Clearance
Kagna	*Vaungueria Apiculate*	Indigenous	Fruit, Firewood	Gathering Vegetation Clearance
Keyo,	*Combretum Molle*	Indigenous	Wood Fuel	Gathering Vegetation Clearance
Madhare,	*Ozoroa Insignis*	Indigenous	Medicinal	Gathering Vegetation Clearance
Milo	*Mucana Pruriens*	Indigenous	Medicinal	Gathering Vegetation Clearance
Minya	*Cissus Quadrangularis*	Indigenous	Medicinal	Gathering Vegetation Clearance
Nderma	*Basella Alba*	Indigenous	Vegetables, Medicinal	Gathering Vegetation Clearance
Nduga	*Acacia Drepanolobium*	Indigenous	Firewood, Medicinal	Gathering Vegetation Clearance
Ng'owo	*Ficus Wakefieldii*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Nyabend-Winy	*Lantana Camara*	Indigenous	Firewood, Medicinal	Gathering Vegetation Clearance
Nyajuok-Olaw	*Acmella Caulirhiza*	Indigenous	Medicinal	Gathering Vegetation Clearance
Nyanyiek Mon	*Bidens Pilosa*	Indigenous	Medicinal	Gathering Vegetation Clearance

Threatened Species	Terrestrial Flora	Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Local Name	**Botanical Name**			
Nyayado,	*Senna Occidentalis*	Indigenous	Medicinal	Gathering Vegetation Clearance
Obala-Ndagwa,	*Ricinus Communis*	Indigenous	Medicinal	Gathering Vegetation Clearance
Ober	*Albizia Coriaria*	Indigenous	Medicinal, Wood Fuel	Gathering Vegetation Clearance
Obino,	*Senna Didymobotrya*	Indigenous	Medicinal	Gathering Vegetation Clearance
Obokeran	*Psychotria Peduncularis*	Indigenous	Brick Making,	Gathering Vegetation Clearance
Obolobolo	*Annona Senegalensis*	Indigenous	Medicinal, Firewood	Gathering Vegetation Clearance
Obong	*Cajanus Cajan*	Indigenous	Vegetables	Gathering Vegetation Clearance
Ochok,	*Solanum Incanum*	Indigenous	Fodder, Brick Making	Gathering Vegetation Clearance
Ochol	*Lepisanthes Senegalensis*	Indigenous	Medicinal, Wood Fuel,	Gathering Vegetation Clearance
Odielo	*Commelina Africana*	Indigenous	Vegetables	Gathering Vegetation Clearance
Okita,	*Plectranthus Barbatus*	Indigenous	Medicinal	Vegetation Clearance
Okuro	*Alternantherapungens*	Indigenous	Weed	Vegetation Clearance
Okworo	*Clerodendrum Myricoides*	Indigenous	Medicinal	Gathering Vegetation Clearance
Olando	*Indigofera Arrecta*	Indigenous	Basketry Medicinal	Gathering Vegetation Clearance
Olemo	*Ximenia Americana*	Indigenous	Fruit, Firewood, Medicinal	Gathering Vegetation Clearance
Oludh-Koun	*Allophylus Africanus*	Indigenous	Firewood,	Gathering Vegetation Clearance

Threatened Species	Terrestrial Flora	Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Local Name	**Botanical Name**			
Ombasa,	*Tylosema Fassoglense*	Indigenous	Medicinal, Food	Gathering Vegetation Clearance
Omen	*Hibiscus Aponeurus*	Indigenous	Medicinal	Gathering Vegetation Clearance
Omieny	*Lippia Javanica*	Indigenous	Medicinal	Gathering Vegetation Clearance
Ondati,	*Teclea Nobilis*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Onera	*Terminalia Brownie*	Indigenous	Construction, Wood Fuel, Medicinal	Gathering Vegetation Clearance
Ongodi	*Sida Acuta*	Indigenous	Wood Fuel, Medicinal	Gathering Vegetation Clearance
Ong'ono,	*Sclerocarya Birrea*	Indigenous	Fruit, Medicinal	Gathering Vegetation Clearance
Onunga	*Morus Nigra*	Indigenous	Wood Fuel, Fruits	Gathering Vegetation Clearance
Oseno,	*Cordia Monoica*	Indigenous	Firewood	Gathering vegetation clearance
Osiri	*Acacia Brevispica*	Indigenous	Medicinal	Gathering vegetation clearance
Osiri,	*Scotia Myrtina*	Indigenous	Fruit, Medicinal	Gathering vegetation clearance
Otho	*Balanites Aegyptiaca*	Indigenous	Wood Fuel, Fruit	Gathering vegetation clearance
Pedo	*Harrisonia Abyssinica*	Indigenous	Firewood, Fodder,	Gathering vegetation clearance
Pocho	*Ficus Thonningii*	Indigenous	Medicinal, Sacred	Gathering vegetation clearance
Powo	*Grewia Bicolor*	Indigenous	Construction, Wood Fuel, Basketry	Gathering vegetation clearance
Roko	*Zanthoxylum Chalybeum*	Indigenous	Medicinal	Gathering vegetation clearance
Siala	*Markhamia Lutea*	Indigenous	Construction, Wood Fuel, Medicinal	Gathering vegetation clearance

Threatened Species	Terrestrial Flora	Classification (Indigenous Exotic)	Uses	Threatening Anthropogenic Activities
Local Name	**Botanical Name**			
Sangla	*Rhus Natalensis*	Indigenous	Medicinal, Wood Fuel	Gathering vegetation clearance
Yago	*Kigelia Africana*	Indigenous	Wood Fuel, Medicinal	Gathering vegetation clearance
Yiendalusi	*Rhynchosia Alegans*	Indigenous	Medicinal	Gathering vegetation clearance

Source: Field Data 2022

Result from Table 8 shows that a total of 80 flora species were identified as threatened and most of the threatened flora species identified were indigenous apart from Ndap Nyaluo (*nicotiana tabacum*) which is exotic. Some of the indigenous flora species threatened included; Anyuka (*Vangueria madagascariensis*), Achak (*Euphorbia inaequilatera*), Osiri, (*Scotia myrtina),* Adugo, (*Combretum molle*), Akech (*Chameecrista hildebrandtii*), Alii, (*Acacia seyal*), Ang'we (*Kedrostis foetidissima*), Pilipili (*Capsicum frutescens*), Otho (*Balanites aegyptiaca),* Pedo (*Harrisonia abyssinica),* Pocho (*Ficus thonningii),* Powo (*Grewia bicolor),* Roko (*Zanthoxylum chalybeum),* Siala (*Markhamia lutea),* Sangla (*Rhus natalensis*), Yago (*Kigelia Africana) and* Yiendalusi (*Rhynchosia alegans)* among others.

The uses of the identified terrestrial flora species were established to be wood fuel, fruits, vegetables, fodder, construction, timber, brick making, for basketry and medicinal purposes. These uses led to anthropogenic activities such as vegetation clearance, and gathering which posed a great threat to the identified flora species. This implies that Rachuonyo South is endowed with various terrestrial flora species which support their livelihood in areas such as food, wood fuel, medicinal and construction among others and that the local community majorly depend on indigenous species at the expense of exotic species this has posed heavy threats to the existing indigenous species leading to extinction of some species. An interview with a key informant revealed:

> Initially, Rachuonyo South Sub County was heavily forested with indigenous trees, thick bushes and shrubs, but currently due to increased human activities such as charcoal burning, brick making, rural access roads and crop farming most species have reduced in number and specific species used for herbal medicine have become rare forcing the herbalist to take a long duration in gathering herbs. (Female herbalist from Kotieno Sub location in West Kasipul – December 2022).

Another key informant also revealed:

> As a result of increased human activities such as charcoal burning, firewood collection and brick making accelerated by rapid population growth and poverty in the sub county most indigenous terrestrial flora species such as yago (*Kigelia Africana), siala (Markhamia lutea),* alii *(Acacia seyal),* konga (*Agave sisalama)* kuogo*(Lannea schweinfurthii)*, ng'owo (*Ficus wakefieldii*), ober (*Albizia coriaria)*, onera (*Terminalia brownie)* and otho (*Balanites aegyptiaca*) have been greatly threatened and that some species such as *oseno (Cordia monoica),* keyo (*Combretum molle), roko (Zanthoxylum chalybeum) and* dwele (*Melia azeradarch)* have become extinct within the study area (Forest Warden at Kodera Forest– December 2022).

This implies that flora species are greatly essential to the livelihood of the local community. However, how these species were being used due to increased human activities enhanced by rapid population growth and high poverty level within the study region had threatened them. Hence, more species will be driven to extinction in the next few decades within the study area if the poverty level and rapid growth of human population is not controlled. This high growth rate and poverty was also noted by Homabay County Integrated Plan (2018).

A similar study to the current findings (Table 8) by Backeus, Pettersson, Stromquist & Ruffo, (2006) in semi-arid areas of Ihombwa region in Tanzania enumerated 86 species of trees. Other studies by Luoga (2000) and Giliba et al. (2011), enumerated 79 and 110 species of trees in Kitulanghalo and Bereku forest reserves respectively. Kamal et al. (2009), recorded a total of 85 wild plant species in semi-arid areas of Dhading District in Nepal out of which 61 species (72%) had multiple functions as food, medicine, or cultural and economic importance. However, the above studies (Backaus et al., 2006; Luoga 2000; Giliba et al., 2011 and Kamal et al., 2009) only identified the number of plants species in the 72 studied ecosystems, providing their general uses. The current study has focused on the effect of anthropogenic

activities on terrestrial on terrestrial flora and fauna species conservation concluding that Rachuonyo South Sub County is endowed with 80 terrestrial flora species which are greatly threatened by human activities.

The study further established the current status of terrestrial flora species as to whether increasing or decreasing the result are summarized in Table 9.

Table 9:The Current Status of Flora Species

Current Status of Flora Species	Number of Respondents	Percentages (%)
Increasing	51	14
Decreasing	281	77
No change	33	9
Total	365	100

Mean 1.96, Standard Deviation 0.487

Source: Field data, 2022

Table 9 shows that majority (77%) of the respondents noted a decrease in the number of terrestrial flora species, they further identified the reasons for the decrease which were found to be linked to the uses of terrestrial flora species (Table 8). About 14% of the respondents indicated an increase in terrestrial flora species basing their argument on tree planting, agroforestry, planting of vegetables for consumption, usage of modern technology of cooking and building while 10% indicated no change in terrestrial flora species. This finding shows that the distribution of the response from household heads leaned highly toward “Decreasing” (mean=1.96 and SD = 0.487) as presented in Table 9. This implies that the study area is endowed with various terrestrial flora species as indicated on Table 8. However, as a result of

overdependence on naturally provided resources the number of flora species within the study are is on a declining trend, thus threatening their survival.

This quantitative decline in species was explained by the qualitative data resulting from the summary on the uses of the terrestrial flora species (Table8). Additionally, an interview with a key informant revealed:

> Most of the indigenous community are greatly involved in activities such as crop farming, settlement of new homes, charcoal burning, firewood collection and brick making and these activities have posed threats to terrestrial flora species as no replacement is done for the species cut at the same time once an area has been cleared for crop farming and settlement it is permanently left for that activity leaving no room for regrowth of the species. Further, due to population pressure more habitat are constantly encroached this has made terrestrial flora species to decrease in number thus habitat loss. (Administrative Chief from East Kamagak – December 2022).

This explains the fact that terrestrial flora species are greatly essential for the livelihood of the residents of Rachuonyo South Sub County. However, rapid growth of human population has accelerated human activities within the study region that exerts a lot of pressure on the available flora species thus threatening them. These human activities (uses of the species) are also important to the local community, some of them such as crop farming, charcoal burning and brick making among others are sources of earning a living within the study area. It is evident, therefore, that the uses of these species are linked to the anthropogenic activities (vegetation clearance, and gathering). This eventually led to loss and fragmentation of habitat that caused fauna species to relocate to safer and larger habitat and even those that would remain would eventually die due to competition for food. Further there was a clear indication that the residents were ignorant of the various species conservation measures put in place within the study area as evidenced by the responses of the 14% respondents. It barred the residents from managing habitat by practicing activities which prevented degradation and thereby enhancing the quality of vegetation.

The findings of IUCN (2019), noted that increase in human population has led to the release of anthropogenic activities that lead to loss and fragmentation of habitat which threatens species to extinction. Similarly, Carrington (2020) asserted that the key reasons for the loss of plant species is the clearance of wild habitat to create farmland, overharvesting of wild plants for herbal medicines that has threatened 723 species with extinction. These findings from IUCN (2019) and Carrington (2020) are consistent with the findings of the present study. However, IUCN studied population density, diversity and abundance of antelope species in a Lake National park while Carrington (2020) on the other hand focused on the race against time to save plants and fungi. These studies did not document on specific human activities such as vegetation clearance, hunting and gathering and how these activities are affecting terrestrial flora and fauna species conservation an area studied by the current study.

The study further established the threatened terrestrial fauna species in Rachuonyo South Sub County. The result is summarized in Table 10 below. The summary includes the local name, botanic name, classification whether indigenous or exotic, uses and anthropogenic activities threatening the species.

Table10:Threatened Terrestrial Fauna Species, Classification, Uses and Threatening Anthropogenic Activities

Threatened Terrestrial Fauna Species		**Classification (Indigenous/ Exotic**	**Uses**	**The Threatening Anthropogenic Activities**
Local Name	**English Name**			
Abur	*Bohar reedbuck*	Indigenous	Meat	Hunting, Vegetation Clearance
Aidha	*African giant squirrel*	Indigenous	Meat	Hunting, Vegetation Clearance
Apool	*Common water buck*	Indigenous	Meat	Hunting, Vegetation Clearance
Apwoyo	*Scrub hare*	Indigenous	Meat	Hunting, Vegetation Clearance
Bim	*Baboon*	Indigenous	Not Specified	Vegetation Clearance
Chiewu	*Brush tailed porcupine*	Indigenous	Meat	Hunting, Vegetation Clearance
Dwe	*Sitatunga*	Indigenous	Meat	Hunting, Vegetation Clearance

Threatened Terrestrial Fauna Species		Classification (Indigenous/ Exotic	Uses	The Threatening Anthropogenic Activities
Local Name	**English Name**			
Fuko	*Root rat*	Indigenous	Meat	Hunting, Vegetation Clearance
Gwothim	*Hunting dog*	Indigenous	Not Identified	Vegetation Clearance
Jowi	*African buffalo*	Indigenous	Meat, Horns	Hunting, Vegetation Clearance
Kibwe	*Black backed jackal*	Indigenous	Not Identified	Vegetation Clearance
Mbeche	*Bush pig*	Indigenous	Meat	Hunting, Vegetation Clearance
Mwanda	*Klipspringer*	Indigenou	Meat	Hunting, Vegetation Clearance
Mwok	*Antbear*	Indigenous	Meat, Skin	Hunting, Vegetation Clearance
Ngau	*Common duiker*	Indigenous	Meat, Horn, Skin	Hunting, Vegetation Clearance
Njiri	*Warthog*	Indigenous	Not Identified	Vegetation Clearance
Nyakech	*Impala*	Indigenous	Meat	Hunting, Vegetation Clearance
Ogwang Kibikibi	*Honey badger*	Indigenous	Not Identified	Vegetation Clearance
Ogwang-Oluwo-Bondo	*Tree civet*	Indigenous	Not Identified	Vegetation Clearance
Omoro	*Roan antelope*	Indigenous	Skin	Hunting, Vegetation Clearance
Ondiek	*Spotted hyena*	Indigenous	Not Identified	Vegetation Clearance
Ong'er	*Vervet monkey*	Indigenous	Not Identified	Vegetation Clearance
Oyieyo	*Bush rat*	Indigenous	Not Identified	Vegetation Clearance
Riwo	*Wildebeest*	Indigenous	Meat	Hunting, Vegetation Clearance

Source: Field Data 2022

The findings from Table 10 revealed that a total of 24 fauna species were identified as threatened. All the fauna species identified were indigenous and they included Abur (*Bohar reedbuck),* Aidha **(***African giant squirrel),* Apool (*Common water buck),* Apwoyo **(***Scrub hare),* Chiewu (*Brush tailed porcupine),* Dwe (*Sitatunga)* Fuko (*Root rat***),** Jowi (*African*

Buffalo), Mbeche (*Bush pig*), Mwanda (*Klipspringer*), Mwok (*Antbear*), Ngau (*Common duiker),* Nyakech (*Impala),* Omoro (*Roan antelop),* Riwo (*Wildebeest).*

The study established that fauna species were used for meat, horn and skin and that these uses resulted in anthropogenic activity (hunting and gathering) which was found to be a threat to species conservation (Table 10). An interview with key informant revealed:

> Rachuonyo South Sub County was once sparsely populated with human, having few patches of bare land for crop farming while the rest of the land was covered by thick vegetation and various animal species were roaming in groups, currently the region has high human population, scattered shrubs and reduced fauna species while other such as riwo, nyakech, ngau, and jowi becoming extinct (Administrative Chief from North Kamagak – December 2022).

This implies that Rachuonyo South is endowed with various terrestrial fauna species which are greatly used by the local community as a source of game meat to replace beef which are costly and so most of them cannot afford, while other species are hunted for their horns which are used for making musical instrument known as "abuu" and for their skin which is used for making traditional drums for various local churches and traditional regalia worn by council of elders during special ceremonies and functions. This indicate that the community heavily depend on these species for their survival however the overdependence on them have threatened some of the species to relocate or migrate and the community is ignorant about the threat caused to the species due to overdependence. The study further established the current status of terrestrial fauna species as to whether increasing or decreasing the result are summarized in Table 11.

Table 11: The Current Status Flora Species

Current status of flora species	Number of Respondents	Percentages (%)
Increasing	45	12
Decreasing	287	79
No change	33	9
Total	365	100

Mean 1.97, Standard Deviation 0.462

Source: Field Data, 2022

The findings on Table 11 revealed that; most (79%) of the respondents indicated a decrease in fauna species due to the uses of species as shown in Table 10. About 12% of the respondents noted that the terrestrial fauna species increasing due to rearing of domestic animals and keeping poultry for consumption and usage of modern instruments in various churches. while 9% recorded no change. This finding showed that the distribution of the response from household heads leaned highly toward "decreasing" (mean=1.97 and SD = 0.462) as presented in Table 11. This quantitative decline in species richness was explained by the qualitative data resulting from the summary on the uses of the terrestrial fauna species (Table 10). Further, the uses of these species were also observed to be connected to the anthropogenic activities (vegetation clearance, hunting and gathering). It is evident that despite the threat the local community was causing to terrestrial fauna species most of them were still engaged on the same activities. These activities are however key to their livelihood. There is therefore need to create awareness to the local community on the importance of species to ecosystem, effects of their destruction and further engaging them on activities such as poultry rearing to help them find other sources of protein.

This finding is in agreement with a report by WWF (2014), which recorded that there has been a constant decline in fauna population over the past 40 years and that a period between 1970 and 2012 experienced a decline of 52% of all fauna species population. Further, WWF, (2019), affirmed that about 99.9% of species that have ever lived have become extinct. In as much as this study indicated the quantitative rate of decline of fauna species, it did not list fauna species threatened and specific reasons for their threat. The current study has listed specific fauna species threatened and the factors that pose threat to them.

The identification of the threatened terrestrial flora and fauna species within the study area was enhanced by the help of the pre-existing literature of the threatened species in Kenya as stipulated by Kenya Wildlife Service. The study noted the various terrestrial flora and fauna

species identified as threatened in Kenya Wildlife Service which included African elephant, African lion, African wild dog, Barbour's vlei rat, Black rhinoceros, Blue whale, Cheetah, Coalfish whale, Eastern bongo, Eastern red colobus, Giant thicket rat, Golden-rumped elephant shrew, Grevy's zebra, Hirola, Lelwel hartebeest, Leopard, Mount Elgon vlei rat, Roan antelope, Rothschild's giraffe, Sable antelope, Sitatunga, Striped hyaena, Tana crested mangabey and White rhino while the flora species included Camphor, East African sandalwood, Meru oak, Parasol tree, Rat aloe, Red stinkwood, Tana river poplar and Voi cycad (KWS 2021). The identified fauna species were different from the species identified by the current study apart from Sitatunga. This therefore enabled the present study to fill the first gap by identifying some fauna and flora species threatened within the study area.

Therefore, it is a clear indication that both terrestrial flora and fauna species identified within the study area were facing drastic decline due to anthropogenic activities such as vegetation clearance, hunting and gathering. These findings were consistent with those of (Butchart, 2010; Hoffmann, 2010) who noted that as mankind is increasingly using the natural resources and modifying the environment, the terrestrial species is in decline and that much of the decline were due to habitat loss and transformation. However, these studies focused on timing and direction of trend inflections as well as estimating the trend in which species population changed over time. Furthermore, Hoffmann (2010) coded each species according to IUCN threats, conservation actions and utilization action classification scheme. The current study however, studied specific anthropogenic activities actually threatening terrestrial flora and fauna species conservation in Rachuonyo South.

4.3 Effect of Hunting and Gathering on Terrestrial Flora and Fauna Species Conservation in Rachuonyo South Sub County

The second objective sought to explain hunting and gathering as an anthropogenic activity that threatens terrestrial flora and fauna species identified in objective one. The results are presented in Table 12.

Table 12: Hunting and Gathering Activity

Questions	Scales (frequency and percentages)		Statistics	
	Yes	No	Mean	SD
Is hunting and gathering activity taking place in this region?	360(99%)	5(1%)	1.01	0.116
Do you or any member of your household engage in gathering activity?	257(70%)	108(30%)	1.30	0.457
In your opinion, is hunting and gathering activity affecting plants and animal species in this area?	285(78%)	80(22%)	1.22	0.414

Source: Field Data, 2022

The findings on Table 12 indicated that most (99%) of the respondents acknowledged the occurrence of hunting and gathering activity in the study area. At the same time, majority (70%) of the respondents also accepted their involvement in the said activity. These findings indicated that the distribution of the response leaned highly toward "Yes" (mean=1.01 and SD 0.116 and mean of 1.30 and SD of 0.457) respectively. It implies therefore that hunting and gathering as human activity was prevalent within the study area and most respondents were heavily involved in the activity as a source of acquiring food (from both game meat and traditional vegetables), medicine and firewood among others for their livelihood. However, in as much as this activity is crucial for the survival of the local community, it is greatly endangering the indigenous species causing some to migrate or relocate. An interview with key informant revealed:

> Majority of the local inhabitants have no proper source of income for their livelihood apart from agriculture and small scale business therefore they are highly depending on flora species for local vegetable (such as achak, apoth, atipa, obong, odielo and ododo among others); for medicinal purposes, firewood, charcoal burning (for sale and personal use), construction, basketry (for sale) and fauna species are hunted for game meat, skin and horn. This activity is

on an increasing trend due to increase of human population making each house hold to have a larger population being fed and later on settled hence posing a lot of pressure to the naturally available resources.

This implies that hunting and gathering was prevalent within the study area as majority of the respondents were actively involved in the activity as a means of food procurement, construction, basketry and medication among others. This activity was accelerated by their low economic power justified by their approximate income per month that ranges between Ksh.5001 to Ksh.10000 (Table7). This therefore, resulted in unsustainable use of flora and fauna species which was a threat to their conservation.

Through observation, the study further established the presence of hunting activity within the study area as shown in plate 1(a) where Hare (Apwoyo) has been successfully hunted down in Nyalenda Sub Location and (b) where hunting in progress in the shrubs and bare land which was formerly indigenous forests cleared for crop farming in Sino Kogola Sub Location. This implies that the local residents heavily depend on naturally available resources for their livelihood.

The presence of hunting and gathering as human activity occurring in Nyalenda and Sino Kogola sub Locations was justified by plate 1a and b.

Plate 1(a) **Plate 1(b)**

Plate 1(a and b):Hunting and Gathering Activity in Nyalenda and Sino Kogola respectively.
Source: Field data 2022

The above findings were supported by the results from the previous studies carried out by (Andy, Milner-Gulland, Ingram & Aidan, 2019) and (Nasi, Brown, Wilkie, Bennett, Tutin, Van Tol & Christophersen, 2008) which asserted that time taken by individual in hunting depends entirely on their economic power and that in times of hardship hunting act as economic guard. In as much as the outcome of these studies supported the findings of the present study, however, these studies focused on hunting for consumption on tropics and tropical forest respectively further, Andy et, al. (2019), studied on influences of hunting methods and effort on the types of animals caught in the Tropics. They did not document on how hunting and gathering as an anthropogenic activity affects both flora and fauna species. This gap was bridged by this present study.

A research carried out in Latin America, Asia and Africa by (Nielsen *etal*. 2018), on the Importance of Wild Meat in the Global South: noted that once a year, 39% of household out of

the 7978 household interviewed hunted wildlife for meat and that reliance on wild meat is highest among the poorest households. A study in West Africa by (Schulte-Herbrüggen, Marcus, Katherine, Laura Charlotte & Guy, 2013) noted that conservation and rural livelihood of many who depends entirely on bush meat for income and food are greatly threatened by unsustainable hunting. It is noted that these studies concentrated on the economic importance of wild meat to rural population, patterns of hunting, wildlife depletion, and the integration of hunting into agricultural livelihoods. Also, the study was done in an intensively managed farm forest (protected area). The current study however, was conducted in an unprotected area, and did not consider economic importance of hunting and gathering activity rather, it concentrated on effect of hunting and gathering activity on species conservation.

The study further established that several Terrestrial Flora and Fauna Species were being hunted and gathered. Table 13 shows the Terrestrial Flora and Fauna Species were being hunted and gathered and reasons.

Table 13: Terrestrial Flora Species Gathered and Fauna Species Hunted and Reasons.

Flora Gathered	**Botanical Name**	**Reasons**	**Fauna Hunted**	**English Name**	**Reasons**
Anyuka	*Vangueria madagascariensis*	Fruit, firewood	Abur	*Bohar reedbuck*	Meat
Achak	*Euphorbia inaequilatera*	Vegetables	Aidha	*African giant squirrel*	Meat
Adugo,	*Combretum molle*	Wood fuel	Apool	*Common water buck*	Meat
Akech	*Chameecrista hildebrandtii*	Medicinal	Apwoyo	*Scrub hare*	Meat
Alii,	*Acacia seyal*	Wood fuel, Medicinal	Chiewu	*Brush tailed porcupine*	Meat
Ang'we	*Kedrostis foetidissima*	Medicinal	Dwe	*Sitatunga*	Meat
Pilipili	*Capsicum frutescens*	Spices, medicinal.	Fuko	*Root rat*	Meat

Flora Gathered	Botanical Name	Reasons	Fauna Hunted	Botanical Name	Reasons
Apuoyo	*Chloris gayana*	Fodder ,construction	Jowi	*African Buffalo*	Meat, horns
Apoth	*Corchorus trilocularis*	Vegetable, medicinal	Mbeche	*Bush pig*	Meat,
Arumbe,	*Acacia hockii*	Wood fuel, Medicinal	Mwanda	*Klipspringer*	Meat
Arupiny	*Commiphora Africana*	Medicinal, firewood	Mwok	*Antbear*	Meat, skin
Atego,	*Keetia gueinzii*	Fruit	Ngau	*Common duiker*	Meat, skin, horn
Atilili	*Psiadia punctulata*	Medicinal	Nyakech	*Impala*	Meat,
Atipa	*Asytasia gangetica*	Vegetables	Omoro	*Roan antelop*	Skin
Ayiergweng,	*Boscia angustifolia*	Wood fuel	Riwo	*Wildebeest*	Meat
Bongu,	*Fiscu sur*	Wood fuel			
Bondo	*Euphorbia candelabrum*	Glue			
Chwaa	*Tamarindus indica*	Fruit, medicinal, wood fuel			
Deg akeyo	*Cleome gynandra*	Vegetables, medicinal			
Det,	*Ormocarpum trichocarpum*	Medicinal			
Dwelle	*Melia azeradarch*	Wood fuel, Medicinal			
Huyandawa	*Withania somnifera*	firewood, medicinal			
Kagna	*Vaungueria apiculate*	Fruit, firewood			
Keyo,	*Combretum molle*	Wood fuel			
Konga	*Agave sisalama*	firewood, construction,			
Koth-kiyombi	*Datura stramonium*	Medicinal			
Kuogo,	*Lannea schweinfurthi i*	Medicinal, wood fuel			
Madhare,	*Ozoroa insignis*	Medicinal			
Milo	*Mucana pruriens*	Medicinal			
Minya	*Cissus quadrangula ris*	Medicinal			

Flora Gathered	Botanical Name	Reasons	Fauna Hunted	Botanical Name	Reasons
Ndap-nyaluo	*Nicotiana tabacum*	Smoking			
Nderma	*Basella alba*	Vegetables, medicinal			
Nduga	*Acacia drepanolobium*	firewood, medicinal,			
Ng'owo	*Ficus wakefieldii*	Wood fuel, Medicinal			
Nyabend-winy	*Lantana camara*	Firewood, medicinal			
Nyajuok-olaw	*Acmella caulirhiza*	Medicinal			
Nyanyiek mon	*Bidens pilosa*	Medicinal			
Nyayado,	*Senna occidentalis*	Medicinal			
Obala-ndagwa,	*Ricinus communis*	Medicinal			
Ober	*Albizia coriaria*	Medicinal, wood fuel			
Obino,	*Senna didymobotrya*	Medicinal			
Obokeran	*Psychotria peduncularis*	Brick making,			
Obolobolo	*Annona senegalensis*	Medicinal, firewood			
Obong	*Cajanus cajan*	Vegetables			
Ochok,	*Solanum incanum*	fodder, brick making			
Ochol	*Lepisanthes senegalensis*	Medicinal, wood fuel,			
Ochuoga	*Carissa spinarum*	Fruit, medicinal, fire wood			
Odielo	*Commelina Africana*	Vegetables			
Ododo	*Amaranthus hybridus*	Vegetables, medicinal			
Okita,	*Plectranthus barbatus*	Medicinal			
Okworo	*Clerodendrum myricoides*	Medicinal			
Olando	*Indigofera arrecta*	Basketry ,medicinal			
Olemo	*Ximenia Americana*	Fruit, firewood, medicinal			

Flora Gathered	Botanical Name	Reasons	Fauna Hunted	Botanical Name	Reasons
Oludh-kuon	*Allophylus africanus*	firewood,			
Ombasa,	*Tylosema fassoglense*	Medicinal, fruit			
Omen	*Hibiscus aponeurus*	Medicinal			
Omieny	*Lippia javanica*	Medicinal			
Ondati,	*Teclea nobilis*	Wood fuel, Medicinal			
Onera	*Terminalia brownie*	Pole, wood-fuel, medicinal			
Ongodi	*Sida acuta*	Wood fuel, Medicinal			
Ong'ono,	*Sclerocarya birrea*	Fruit, medicinal			
Onunga	*Morus nigra*	Wood fuel, fruits			
Onuong'o	*Hygrophila schulli*	Medicinal			
Ohoho	*Phytolacca dodecandra*	Medicinal			
Osani	*Leptochloa obtusiflora*	Fodder			
Oseno,	*Cordia monoica*	Firewood			
Osiri	*Acacia brevispica*	Medicinal			
Osiri,	*Scotia myrtina*	Fruit, medicinal			
Otho	*Balanites aegyptiaca*	Wood fuel, fruit			
Pedo	*Harrisonia abyssinica*	Firewood, fodder,			
Pocho	*Ficus thonningii*	Medicinal, sacred			
Roko	*Zanthoxylum chalybeum*	Medicinal			
Siala	*Markhamia lutea*	construction, wood fuel medicinal			
Sangla	*Rhus natalensis*	Medicinal, wood fuel			
Yago	*Kigelia Africana*	Wood fuel, Medicinal			
Yiendalusi	*Rhynchosia alegans*	Medicinal			

Source: Field Data, 2022

The findings presented on Table 13 indicated that flora and fauna species are being gathered and hunted respectively. There are 79 flora species gathered for medicinal purposes, fruit, basketry, wood fuel, construction, vegetable among other uses while 15 fauna species are hunted and gathered for the purpose of meat, skin and horn. Some of the flora species being gathered include; Achak (*Euphorbia inaequilatera*), Osiri, (*Scotia myrtina),* Adugo, (*Combretum molle*), Akech (*Chameecrista hildebrandtii*), Alii, (*Acacia seyal*), Ang'we (*Kedrostis foetidissima*), Pilipili (*Capsicum frutescens*), Otho (*Balanites aegyptiaca),*Pedo (*Harrisonia abyssinica),* Pocho (*Ficus thonningii),* Powo (*Grewia bicolor),* Roko (*Zanthoxylum chalybeum),* Siala (*Markhamia lutea),* among others and some fauna species being hunted include; Abur (*Bohar reedbuck*), Aidha (*African giant squirrel*), Apool (*Common water buck*), Apwoyo (*Scrub hare*), Dwe (*Sitatunga*), Jowi (*African Buffalo*), Mbeche (*Bush pig*), Mwanda (*Klipspringer*), Mwok (*Antbear*), Ngau (*Common duiker*), Nyakech (*Impala*), Omoro (*Roan antelop*), Riwo (*Wildebeest*).

It is evident therefore that flora species are more threatened than fauna species in Rachuonyo South Sub County. This is because from Table 13, the uses of flora species are more than the purposes for which fauna are hunted and gathered. Majority of the community heavily depended on flora species for herbal medicine, vegetables, fruits, basketry. About 97% of the population use wood fuel as a source of energy. This has led to the clearance of vegetation as seen in Plate 1(a) and (b) causing the destruction of fauna habitat (especially for large mammal) leading to migration, reduction and relocation of species as seen in Plate 1(a) and (b). Further, this clearance has caused hunters to trek over a long distance on an open field in search for fauna species a clear indicator of migration, reduction and relocation of fauna species within the study area. These findings are consistent with (IUCN report, 2019) stating that yearly depletion rate of flora and fauna species were 34% and 25% respectively. Meanwhile in Kenya

according to (Ogutu, Piepho, Said, Ojwang, Njino, Kifugo & Wargute, 2016), the rate of depletion of flora and fauna were 69% and 68% respectively.

In addition, the current study aimed at establishing whether hunting and gathering affected terrestrial flora and fauna species and in which way. The results are presented in Tables 14 and 15 respectively.

Table 14: Whether Hunting and Gathering Affects Terrestrial Flora and Fauna Species

Is Hunting and Gathering affecting Terrestrial Flora and Fauna Species	Number of Respondents	Percentage (%)
Yes	285	78
No	80	22
Total	365	100

Mean 1.22 and Standard deviation 0.414

Source: Field Data, 2022

The result presented on Table 14 showed that 78% of respondents indicated "Yes" while 22% noted "No". The distribution of the response towards this question was moderately spread however, it was still leaning toward "Yes" (mean=1.22, SD 0.414). this implies that fauna and flora species are affected by hunting and gathering. Further, the study established ways in which terrestrial flora and fauna species are affected as shown in Table 15.

Table 15: Ways in Which Terrestrial Flora and Fauna Species are Affected by Hunting and Gathering

In which way are flora and fauna species affected	No of Respondents	Percentages (%)
Relocation of fauna species	314	86%
Reduction of flora and fauna species richness	347	95%
Habitat loss,	336	92%
Fragmentation of the habitat	296	81%

Source: Field Data 2022

The study revealed that 86% of terrestrial fauna species were affected by relocation, 95% by reduction of species number, 92% by Habitat loss, and 81% fragmentation of habitat (Table 15). An interview with some key informants revealed;

> Hunting and gathering has led to relocation of fauna species, reduction of flora and fauna species, and migration of terrestrial fauna species such as nyakech (*Impala*) (that used to walk in group of fifties), jowi (*African Buffalo*), njiri (warthog), and bim (*baboon*), habitat loss, fragmentation of the habitat, adaptation to new feeds in fauna species, decline in predators, increase of the prey and imbalance in the biomass (A male hunter at Nyalenda Sub location and female herbalist at Kamuma Sub Location –December 2022).

This implies that terrestrial flora and fauna species were highly affected by hunting and gathering activity as indicated by the responses above, majority of the respondents noted a decline in species as a result of the uses of the species and over dependence for instance 95% and 73% of the respondents noted reduction and relocation of species respectively. Some of the species were noted to have migrated such as Bim (Baboon) Jowi (African Buffalo), Nyakech (Impala) among others. This decline and migration of species has led to imbalance on the ecosystem. At the same time 92% and 81% of the respondents indicated loss and fragmentation of habitat this has exposed the land to agents of erosion rendering the soil unable to support the growth of more flora due to depletion of nutrient. Hence the survival of the species within the study area was threatened.

These findings are justified by Mazor *etal*. (2018) who reported that the global diversity is highly threatened by hunting of wild animals and that 20% of species in the IUCN Red list are directly threatened by hunting. Similarly, Ripple et al., (2015) also indicated that over 300 mammal species are threatened by hunting. In as much as these findings conforms to the present findings, however, these studies focused on how drivers of biodiversity loss can be realigned to match the predicted severity for an informed policy goals and threats of large herbivores of body mass equal to or greater than 100kg and over looked ecosystem effects respectively. The present study however did not examine how to realign drivers of biodiversity loss with the predicted severity rather concentrated how plants and animals are threatened by hunting and gathering.

Further, studies by Lusweti, (2011); Ariya, (2015); Justin, (2017); and Turtenwald, (2018) asserted that hunting leads to extinction of species, 83% reduction fauna species and modification of habitat due to fragmentation thus barring stability and continuity of the habitat making species to be isolated thus enhancing species extinction. In addition, Andy, Milner-Gulland, Ingram & Aidan (2019) noted that hunting in the tropics are at unprecedented rate. Even though the outcome of the above studies conquered with the current study, these studies did not consider hunting and gathering as an anthropogenic activity threatening both flora and fauna species. For instance, Andy *etal.* (2019), discussed on how hunting methods influences the types of animals caught, the harvest efficiency and the sustainability implications of these factors. Meanwhile, Lusweti (2011) studied relevance, importance and status of biodiversity in Kenya, while Ariya (2015) focused on establishing the level of wildlife utilization, types and sources of wildlife snaring materials in Ruma National Park. Above studies did not document on the effect of hunting and gathering on both flora and fauna species, a gap which was bridged by the present study.

The current study further established the frequency of occurrence of hunting and gathering and the results were summarized in Table 16.

Table 16: Frequency of the Occurrence of Hunting and Gathering

Frequency of Hunting and Gathering	Number of respondents	Percentage (%)	Cumulative Percentage (%)
Daily	117	32	32
Weekly	168	46	78
Monthly	44	12	90
Yearly	7	2	92
Not at all	29	8	100
Total	365	100	

Mean 2.08 and Standard Deviation 1.109

Source: Field Data, 2022

The finding presented on Table 16 showed that 46% of respondents stated weekly occurrence, 32% recorded daily, 12% recorded monthly, 8% stated non-involvement while 2% stated yearly occurrence. The response was not evenly spread within the scale but greatly leaned

toward weekly and daily. This indicated that the frequency of hunting and gathering was very high (mean=2.08, SD = 1.109), making the cumulative annual hunting and gathering rate in the study at 90% (Daily 32%, weekly 46%, monthly 12% totaling to 90%. This result implied that hunting and gathering activity was on an increasing trend within the study area. The implication of these data is that the increasing trend has caused threat to terrestrial species leading to a decline and migration or relocation of some flora and fauna, migration and loss of habitat. If the activity is not curtailed, then in the near future the region shall have lost a greater percentage of species.

Further, Spearman Rank Correlation Analysis was done on hunting and terrestrial fauna species in Rachuonyo South to measure the strength and direction of association that exist between the two variables and to establish whether association is really significant as shown in Table 17

Table 17 : Hunting Frequency and Number of Fauna (N =379)

			daily hunt	**weekly hunt**	**monthly hunt**	**yearly hunt**	**approximate number of Fauna**
Spearman's rho	daily hunt	Correlation Coefficient	1.000	-.045	.261	-.360	-.577
		Sig. (2-tailed)	.	.930	.548	.361	.04
		N	379	379	379	379	379
	weekly hunt	Correlation Coefficient	-.037	1.000	-.096	-.262	-.445
		Sig. (2-tailed)	.930	.	.820	.530	.02
		N	379	379	379	379	379
	monthly hunt	Correlation Coefficient	.233	-.096	1.000	-.217	.515
		Sig. (2-tailed)	.578	.820	.	.606	.192
		N	379	379	379	379	379
	yearly hunt	Correlation	-.360	-.262	-.217	1.000	-.194

		Coefficient					
		Sig. (2-tailed)	.381	.530	.606	.	.645
		N	379	379	379	379	379
	approximate number of Fauna	Correlation Coefficient	-.577	-.445	.515	-.194	1.000
		Sig. (2-tailed)	.04	.02	.192	.645	.
		N	379	379	379	379	379

Source: Field Data (2022)

The study established that both daily and weekly hunting was found significant and negatively correlated with the number of animals hunted down r (377 = -.577., p = .04 and r (377 = -.445, p = 02 respectively (Table 17). This outcome supported the findings on Table 12 which indicated that most (99%) of the respondents acknowledged the occurrence of hunting and gathering activity in the study area. At the same time, majority (70%) of the respondents also accepted their involvement in the said activity. It implies therefore that hunting and gathering as human activity was prevalent within the study area and most respondents were heavily involved in the activity as a source of acquiring food (from both game meat and traditional vegetables), medicine and firewood among others for their livelihood. However, in as much as this activity is crucial for the survival of the local community, it is greatly endangering the indigenous species causing some to migrate or relocate.

Additionally, Spearman Rank Correlation Analysis was done on the frequency of gathering and flora count in Rachuonyo South to measure the strength and direction of association that exist between the two variables and to establish whether association is really significant as shown in Table 18

Table 18: Gathering Frequency and Flora Count (N =379)

			daily Gathering	weekly Gathering	monthly Gathering	yearly Gathering	approximate vegetation count
Spearman's rho	daily Gathering	Correlation Coefficient	1.000	-.037	.233	-.360	-.678
		Sig. (2-tailed)	.	.930	.578	.381	.05
		N	379	379	379	379	379
	weekly Gathering	Correlation Coefficient	-.037	1.000	-.096	-.262	-.345
		Sig. (2-tailed)	.930	.	.820	.530	.402
		N	379	379	379	379	379
	monthly Gathering	Correlation Coefficient	.233	-.096	1.000	-.217	.515
		Sig. (2-tailed)	.578	.820	.	.606	.192
		N	379	379	379	379	379
	yearly Gathering	Correlation Coefficient	-.360	-.262	-.217	1.000	-.194
		Sig. (2-tailed)	.381	.530	.606	.	.645
		N	379	379	379	379	379
	approximate vegetation count	Correlation Coefficient	-.678	-.345	.515	-.194	1.000
		Sig. (2-tailed)	.05	.402	.192	.645	.
		N	379	379	379	379	379

Source: Field Data (2022)

The study found out that daily gathering was significant and negatively correlated to the amount of flora gathered r (377 = -.678., p = .05 (Table 24). Similarly, the weekly gathering showed a likelihood a negative relationship, even so, it was insignificant. Both the monthly and yearly gathering had no effect on vegetation. A similar result was presented on Table 13 which

indicated that flora and fauna species are being gathered and hunted respectively. This implies that gathering was threatening the survival of plant species and causing reduction to some plant species.

These findings are justified by Schulze, Knights & Coad (2018) in their study on assessment of threats to protected terrestrial areas suggested that collection of terrestrial animals and unsustainable hunting was favored by the majority (61%), then recreational activities impacts at (55%), fire or its suppression at (49%), then alien invasive species (48%), and terrestrial plants gathering (48%). Critique of the above study revealed the study focused on assessing threats to terrestrial species in protected areas. The current study however, was carried out in an unprotected area and did not consider threats to terrestrial species rather effects of specific human activities such as hunting and gathering and vegetation clearance to terrestrial flora and fauna species conservation. It is evident from the above analysis that hunting and gathering as an anthropogenic activity is prevalent within Rachuonyo South Sub County and this may be attributed to lack of public awareness on the importance of terrestrial species to the ecosystem and the effect of their decline to the livelihood of the community. This has posed a great threat to terrestrial flora and fauna species conservation.

4.4 Effect of Vegetation Clearance on Terrestrial Flora and Fauna Species Conservation in Rachuonyo South Sub County

The current study further sought to determine the effect of vegetation clearance as an anthropogenic activity that threatened terrestrial flora and fauna species conservation. The study identified types of vegetation, whether vegetation clearance was occurring and reasons for clearance within Rachuonyo South Sub County. It also determined how vegetation clearance affected terrestrial flora and fauna species conservation. The response on types of vegetation and reasons why they are cleared are summarized in Table 19.

Table 19: Types of Vegetation Cleared and Reasons for their Clearance

Types of Vegetation	Reason for Clearance (Uses)	Number Respondents	Percentage (%)
Forest	Crop farming	270	98
	Establishing of homes	292	80
	Wood fuel	354	97
	Hunting and gathering	219	60
	Road construction and expansion	146	40
	Brick making	296	81
	Urban settlement	256	70
Grassland	Crop farming	329	90
	Establishing of homes	310	85
	Overgrazing	318	87
	Brick making	347	95
	Urban settlement	110	30
Shrub land	Crop farming	339	93
	Establishing of homes	259	71
	Overgrazing	234	64
	Hunting and gathering	325	89
	Road construction and expansion	274	75
	Brick making	303	83
	Urban settlement	193	53

Source: Field Data 2022

The results presented on Table 19 shows that the area had three common types of vegetation being cleared which included forest, grassland and shrub land. The current study established that about 98%, 97%, 81%, 80%, 70%, 60% and 40% of the respondents noted that forest clearance is due to crop farming, wood fuel, brick making, establishment of homes, urban settlement, hunting and gathering and road construction respectively. Further the study noted that about 95%, 90%, 87%, 85%, 30%, 30% and 20% of the respondents acknowledged that grassland is greatly cleared due to brick making, crop farming, overgrazing, establishment of

homes hunting and gathering, urban settlement and road construction respectively. Additionally, the current study established the main reasons why shrub land is cleared to be crop farming (93%), hunting and Gathering (89%), brick making (83%) and road construction and expansion (75%) among others as indicated on Table 19. Key informant interviewed reported:

> Initially Rachuonyo South had vegetation which was very thick and covering a larger area before rise in human population that accelerated exploitation of vegetation. Increase in human population has accelerated human activities on habitat. This has led to the clearance of most vegetation for human settlement, crop farming, road construction, brick making and an uncontrolled lumbering. (Environment Officer December 2022)

This implies that the study area was endowed with great vegetation cover as had been indicated by key informant. However, the increase of human activities enhanced by high rate of population growth has altered the ecosystem that the entire community depended on reducing it to scrubs, grassland and isolated forests (kodera and Wire forests). These activities on the other hand were also crucial to local humanity for their livelihood, despite their usefulness, they have led to destruction of vegetation leading to loss and fragmentation of habitat which eventually resulted to the migration and reduction of fauna species within the study area causing an imbalance to the ecosystem that the community heavily depended upon.

Through observation, (Plate 2) the study established that vegetation clearance occurs as a result of the excavation of land for marram for road construction and expansion and brick making. A key informant reported:

> In most cases forest, shrub land and grassland are always cleared to pave room for construction and expansion of new and rural access roads, brick making, overgrazing especially during dry spell when most livestock heavily depend on plant leaves and branches and encroachment of the forest for home establishment due to increase in human population. (Forest Officer Wire Forest- December 2022)

Plate 2:Marram Excavated Land at Wire Hills for Construction of Rural Access Roads and Oyugis Kendu Bay Road.

Source: Field Data 2022

Similar studies to the current findings (Table 19) by McDonald, Marcotullio & Giineralp, 2013; Bennie, Davies, Cruse & Gaston, (2016) enumerated that the destruction of the natural habitat of terrestrial species for human settlement and transport infrastructure has immensely threatened numerous flora and fauna species. other studies Giincralp, (2013) and Neldner et al. (2017) asserted that the survival of numerous flora and fauna species are critically threatened by an ever growing and urbanizing human population and that about 233 flora and 33 fauna species have been listed as near threatened meanwhile others are extinct. Although the finding of these studies McDonald, Marcotullio & Giineralp, (2013), Bennie, Davies, Cruse & Gaston, (2016) are in agreement with the findings of the present study, however, these studies focused on Urbanization and trends in biodiversity and ecosystem services and ecological effects of artificial light at night on wild plants respectively. The current study focused on the effect of vegetation clearance of terrestrial flora and fauna species.

The current study established whether vegetation clearance is occurring in the study area and how it was affecting terrestrial flora and fauna species. The results are summarized on Table 20 and Table 21 respectively.

Table 20: The Occurrence of Vegetation Clearance and How it Affects Species

Occurrence of vegetation clearance	Number of respondents	Percentage (%)
Yes	326	89
No	39	11
Total	365	100

Mean 1.11 Standard Deviation 0.309

Source: Field Data 2022

The result presented on Table 20 showed that 89% of respondents indicated "Yes" to the occurrence vegetation clearance within the study while 11% noted "No. This response implies that majority of the residents are involved in the activity. Further, the study established whether vegetation clearance was affecting terrestrial flora and fauna species as indicated on Table 21.

Table 21: Whether Vegetation Clearance is Affecting Terrestrial Flora and Fauna Species

Occurrence of vegetation clearance	Number of respondents	Percentage (%)
Yes	326	89
No	95	26
Total	365	100

Mean 1.26 Standard Deviation 0.439

Source: Field Data 2022

The findings on Table 21 noted that about 74% of the respondents acknowledged that terrestrial flora and fauna species listed on Table 8 and Table 10 were greatly affected by the vegetation clearance while 26% of the respondents recorded that species were not affected. These findings inclined toward "Yes" as depicted by means of 1.11 and SD of 0.309 and means of 1.26 and SD of 0.439 respectively (Table20 and Table 21). The result revealed that the activity was prevalent and had highly affected terrestrial flora and fauna species. This implies that these species were highly threatened by vegetation clearance due to crop farming, construction of rural access roads, brick making among others. This activity has caused areas that were initially covered by indigenous trees to be bare as seen in Plate 2 hence loss of habitat which is a major threat to the survival of fauna species. It has also reduced the number of large fauna species

causing some like Jowi (*African Buffalo*) and Riwo (*Wildebeest*) to migrate, further, the interaction between species have been restricted especially due to habitat fragmentation caused by the construction of rural access roads as indicated in Plate 2.

The results of the present study are in agreement with the outcome of studies by Ewing and Kostyack (2016), Effects of overpopulation (2013) and Cane, Minckley, Kervin, Roulston & Williams (2006) which pointed out that flora and fauna species are significantly affected due to transformation of their habitat for human settlement, establishment of roads and houses leading to fragmentation of the original habitat and that on an hourly basis 20 flora and 20 fauna species becomes extinct. However, these studies by Ewing and Kostyack (2016), Effects of overpopulation (2013) and Cane, Minckley, Kervin, Roulston & Williams (2006) did not focus on whether terrestrial flora and fauna species are being affected by vegetation clearance a gap filled by the present study, instead they majored on Wildlife and habitat Destruction and Complex Responses Within a Desert Bee Guild (Hymenoptera: Apiformes) to Urban Habitat Fragmentation.

Further, the study established ways in which vegetation clearance has affected terrestrial flora and fauna species. The results are as presented in Table 22.

Table 22: How Flora and Fauna Species are Affected by Vegetation Clearance

How flora and fauna species are affected	Number of respondents	Percentages (%)
Relocation of fauna	314	86
Reduction of fauna species	285	78
Habitat loss	356	98
Fragmentation of the habitat	296	81
Reduction of flora species richness	347	95

Source: Field Data 2022

The findings on Table 22 indicated that vegetation clearance has greatly affected terrestrial flora and fauna species. About 86% of the respondents noted relocation of some species, 95%

reduction of flora and fauna species, 98% habitat loss, 81% fragmentation of the habitat, while 78% indicated decline in predators. An interview with a key informant revealed:

> Vegetation clearance has affected terrestrial fauna species through relocation of some of the species such as Bim(Baboon), abur(*redunca redunca*) Abur (Bohar reedbuck), Jowi (*African Buffalo*), Mwanda (*Klipspringer*), Nyakech (*Impala*), and some flora species such as oseno (*Cordia monoica),* yago (*Kigelia Africana)*, reduction of terrestrial species, fragmentation of habitat, loss of habitat, change in eating habit of predators and relocation of fauna species due to reduced size of their habitat (A male forest officer from Wire forest- December 2022).

This outcome confirms that vegetation clearance was a threat to terrestrial flora and fauna species conservation. It is evident that vegetation clearance has adversely affected terrestrial flora and fauna species through their uses as shown in Table 19. Most of flora and fauna species have relocated, reduced in number or migrated (fauna). In as much as this species are heavily threatened, the local community are still subjecting them to more threat. It is therefore evident that most of the local inhabitants are ignorant of the importance of these species and the effect caused by the decline of species to their livelihood hence a need to conserve the threatened species.

The above findings were justified by studies conducted by (Travis et al. 2013; Reside et al. 2012 and Neldner *etal*. 2017) in Australia which asserted that at the point of land clearance numerous plants and animal species are killed, and those that escaped die soon due to stress, starvation or predation, the species' ability to adapt and move is decreased. Even though the findings of these studies conformed to the outcome of the present study, nevertheless, they differ on their key objectives and area of study. For instance, study by Neldner *etal*. (2017) gave a general information on species threatened without listing specific species being threatened, a gap knowledge filed in the present study by listing species threatened. Similarly, Reside et al. (2012) in Australia did not document on effect of vegetation clearance on terrestrial flora and fauna species but focused on Australian tropical savanna birds distribution changes under climate change. In addition, Travis et al. (2013) studied the inability of species

to adapt and move due to vegetation disturbance but did not document on effect of vegetation clearance on terrestrial species rather focused on Dispersal and species' responses to climate change. The above studies were conducted in Australia while the present study was however conducted in an African rural set up characterized by high poverty level and rapid growth of human population.

Also, the current study established the current status, the reasons and frequency of vegetation clearance in the study area. The results were as shown in Table 23, Table 24 and Table 25.

Table 23: Current Status of Vegetation Clearance

Current Status of Vegetation Clearance	Number of Respondents	Percentage (%)
Increasing	293	80
Decreasing	72	20
Total	365	100

Mean 1.20 Standard Deviation 0.398

Source: Field Data, 2022

The finding on Table 23 showed that majority (80%) of the respondents noted an increase in the rate of vegetation clearance. The responses were skewed toward "Yes" as indicated by a mean of 1.20 and SD of 0.398. The study further, assessed the frequency of vegetation clearance within the study area as shown in Table 24.

Table 24: Frequency of Vegetation Clearance as an Anthropogenic Activity

Frequency of Hunting and Gathering	Number of respondents	Percentage (%)	Cumulative Percentage (%)
Weekly	39	11	11
Monthly	72	20	31
Twice a year	150	41	72
Once a year	92	25	97
Not at all	12	3	100
Total	365	100	

Mean 2.08 and Standard Deviation 1.109

Source: Field Data, 2022

The results in Table 24 indicates that about 41% of the respondents recorded twice a year occurrence, 25% stated once a year, 20%, noted monthly, 11% stated weekly occurrence while 3% noted non-involvement. The distribution of findings on the response depicted a mean of

3.06 and SD of 1.079 which indicated a yearly vegetation clearance. This suggested that the cumulative annual rate of vegetation clearance in the study was at 72% (weekly 11%, monthly 20%, twice a year 41% Table 24). The above analysis indicated that cumulatively annual rate of vegetation clearance was at 72%. Additionally, the study established the reasons for the increase in vegetation clearance as indicated on Table 25.

Table 25: Reasons for the Increase in Vegetation Clearance

Reasons for the Increase in Vegetation Clearance	Number of Respondents	Percentage (%)
Crop farming	357	98
Human settlement	347	95
Urban settlement	219	60
Rural access roads	256	70
Brick making	293	82
Wood fuel	350	96
Hunting	285	78
Uncontrolled lumbering	256	70
Overstocking	303	83

Source: Field Data, 2022

The finding in Table 25 indicated that about 98% of the respondents reported increase in vegetation clearance due to crop farming, 95% reported on human settlement, 60% indicated urban settlement, 82% recorded on brick making, 96% indicated on wood fuel, 78% recorded on hunting, 70% reported on uncontrolled lumbering while 83% recorded overstocking. Further an interview with key informant revealed:

> The scattered trees and shrubs are a clear indicator that vegetation clearance is on the increasing trend as opposed to the ancient days when the region was heavily forested. Most species such as otho, Alii, ober, oseno, ondati, yago, keyo that are used for wood fuel and medicinal purposes are very rare some have become extinct due to their uses. Currently human and urban settlement and rural access road networks are becoming more pronounced as more people are establishing their homes in areas which were once forested. (Herbalist- December 2022)

This implies that the purposes for vegetation clearance were the key reasons why there was an increase in vegetation clearance within Rachuonyo South. It is also evident that terrestrial fauna species were greatly threatened due to loss of habitat which they heavily depend on for their interaction, predation, feeding, safe movement across the landscape and rest. This threat

eventually causes loss of some flora, migration of some fauna species while other fauna migrates to other safer regions thus reducing the species number within the study area. However, the local residents were still heavily involved in clearing vegetation for their wellbeing. Therefore, if no attention is given to this worrying declining trend of vegetation then in the near future more species shall have become extinct. This declining trend of vegetation also prints a clear picture that majority of the respondents are not aware of the conservation measures that can be used to preserve and protect species from depletion therefore were heavily threatening the existence of terrestrial flora and fauna species.

Further, Spearman Rank Correlation Analysis was done on vegetation clearance frequency and number of fauna species in Rachuonyo South to measure the strength and direction of association that exist between the two variables and to establish whether association is really significant as shown in Table 26.

Table 26: Vegetation Clearance Frequency and Number of Fauna species (N =379)

			Twice a year Clearance	Once a year Clearance	Monthly Clearance	Weekly Clearance	approximate number of Fauna specie
Spearman's rho	Twice a year Clearance	Correlation Coefficient	1.000	-.052	.272	-.360	-.577
		Sig. (2-tailed)	.	.930	.548	.361	.04
		N	379	379	379	379	379
	Once a year Clearance	Correlation Coefficient	-.037	1.000	-.096	-.262	-.445
		Sig. (2-tailed)	.930	.	.820	.530	.02
		N	379	379	379	379	379
	Monthly Clearance	Correlation Coefficient	.233	-.096	1.000	-.217	.515
		Sig. (2-tailed)	.578	.820	.	.606	.192

	Weekly Clearance	N	379	379	379	379	379
		Correlation Coefficient	-.360	-.262	-.217	1.000	-.194
		Sig. (2-tailed)	.381	.530	.606	.	.645
	approximate number of animal specie	N	379	379	379	379	379
		Correlation Coefficient	-.577	-.445	.515	-.194	1.000
		Sig. (2-tailed)	.04	.02	.192	.645	.
		N	379	379	379	379	379

Source: Field Data 2022

The study established that both twice a year and once a year vegetation clearance was significant and negatively correlated with the number of animals threatened r (377 = -.57., p = .04 and r (377 = -.445, p = 02 respectively (Table 26). This outcome supported the findings on Table 24 which indicated that about 41% of the respondents recorded twice a year occurrence, 25% stated once a year, 20%, noted monthly, 11% stated weekly occurrence. This implies that terrestrial fauna species are being threatened within the study area due to habitat destruction for human settlement, road construction and farming causing some species to relocate and some to die.

Similarly, Spearman Rank Correlation Analysis was done on vegetation clearance frequency and number of flora species in Rachuonyo South to measure the strength and direction of association that exist between the two variables and to establish whether association is really significant as shown in Table 27.

Table 27: Vegetation Clearance Frequency and Number of Flora Species (N =379)

			Twice a year Clearance	Once a year Clearance	Monthly Clearance	Weekly Clearance	approximate number of Flora specie
Spearman's rho	Twice a year Clearance	Correlation Coefficient	1.000	-.062	.341	-.371	-.577
		Sig. (2-tailed)	.	.930	.548	.361	.04
		N	379	379	379	379	379
	Once a year Clearance	Correlation Coefficient	-.037	1.000	-.096	-.262	-.445
		Sig. (2-tailed)	.930	.	.820	.530	.02
		N	379	379	379	379	379
	monthly Clearance	Correlation Coefficient	.233	-.096	1.000	-.217	.515
		Sig. (2-tailed)	.578	.820	.	.606	.192
		N	379	379	379	379	379
	Weekly Clearance	Correlation Coefficient	-.360	-.262	-.217	1.000	-.194
		Sig. (2-tailed)	.381	.530	.606	.	.645
		N	379	379	379	379	379
	approximate number of Flora specie	Correlation Coefficient	-.577	-.445	.515	-.194	1.000
		Sig. (2-tailed)	.04	.02	.192	.645	.
		N	379	379	379	379	379

Source: Field Data (2022)

The study found out that both twice a year and once a year vegetation clearance was found significant and negatively correlated with the number of flora threatened r (377 = -.577., p = .04 and r (377 = -.445, p = 02 respectively (Table 27). A similar result was indicated on Table 24 with twice and once a year vegetation clearance on terrestrial flora. This implies that flora

species are threatened by this activity causing the species to reduce in number some are completely and permanently cleared making this places for settlement and farming.

The findings of the current study conformed to the outcome of studies conducted by (Cane et al. 2016; McDonald, Marcotullio & Giineralp, 2013; Bennie, 2016; KES, 2018; IUCN, 2019) which reported that the destruction of the natural habitat of terrestrial species for human settlement, transport infrastructure, the fragmentation of the original habitat for the establishment of roads and houses, alteration of habitat for agriculture, over harvesting Fleurydora felicis (shrub) for medicinal purposes, and wood fuel. High dependency of wood fuel as a source of energy especially among the rural population due to ever growing and urbanizing human population has critically threatened the survival of numerous terrestrial flora and fauna species. Even though the findings of these studies are in line with the outcome of the current study, these studies did not document on how terrestrial flora and fauna species were affected by vegetation clearance as an anthropogenic activity. For instance, (Cane et al. 2016), projected on complex responses within a desert bee guild to urban habitat fragmentation; Bennie et al, (2016) focused on ecological effects of artificial light at night on wild plants and did not document on effect of anthropogenic activities on terrestrial flora and fauna an area studied by the present study.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter entails the summary of key findings based on the study objectives, conclusion, recommendation and suggestion for further study.

5.2 Summary of Findings

In the first objective, the study aimed at identifying the terrestrial flora and fauna species threatened by anthropogenic activities in Rachuonyo South Sub County. The results indicated that Rachuonyo South Sub-County had 80 terrestrial flora species and 24 terrestrial fauna species threatened by anthropogenic activities. Some of the threatened flora species were: Anyuka (*Vangueria madagascariensis*), Achak (*Euphorbia inaequilatera*), Adugo, (*Combretum molle*), Akech (*Chameecrista hildebrandtii*), Alii, (*Acacia seyal*), Osiri, (*Scotia myrtina),* Ang'we (*Kedrostis foetidissima*), Pilipili (*Capsicum frutescens*), Otho (*Balanites aegyptiaca),*Pedo(*Harrisonia abyssinica),* Pocho (*Ficus thonningii),* Powo (*Grewia bicolor),* Roko (*Zanthoxylum chalybeum),* Siala (*Markhamia lutea),* Sangla (*Rhus natalensis*), Yago (*Kigelia Africana) and* Yiendalusi (*Rhynchosia alegans) (*Table 8).

Some of fauna species included Abur (*Bohar reedbuck*), Aidha (*African giant squirrel*), Apool (*Common water buck*), Apwoyo (*Scrub hare*), Dwe (*Sitatunga*), Jowi (*African Buffalo*), Mbeche (*Bush pig*), Mwanda (*Klipspringer*), Mwok (*Antbear*), Ngau (*Common duiker*), Nyakech (*Impala*), Omoro (*Roan antelop*), Riwo (*Wildebeest*)Table 9.

It was found out that both terrestrial flora and fauna species richness were both threatened and on a declining trend (mean= 1.96, SD = 0.487 and mean= 1.97, SD = 0.462) respectively due to anthropogenic activities such as hunting, gathering and vegetation clearance (for wood fuel, brick making and crop farming, road creation and expansion, urban and rural settlement). This therefore implies that terrestrial flora and fauna species are greatly essential for the livelihood

of the local community in Rachuonyo South Sub County, however, the rate at which they are being used is leading to their decline.

The second objective aimed at describing the effect of hunting and gathering on terrestrial flora and fauna species in the study area. The outcome of the study showed that hunting and gathering was prevalent within the study area with 99% of the respondents indicating the presence of the activity (mean=1.01 and SD =0.116) (Table 12), about 70% of the household heads noted that they were engaged in hunting and gathering (mean=1.3, SD=0.457) (Table 12). Consequently, 78% of the respondents confirmed that hunting and gathering was affecting terrestrial flora and fauna species within the study area (mean=1.22, SD=0.414) (Table 14). Both daily and weekly hunting was found significant and negatively correlated with the number of animals hunted down r (377 = -.587., p = .04 and r (377 = -.465, p = 02 respectively. Daily gathering was significant and negatively related to the amount of vegetation gathered r (377 = -.778., p = .05 (Table 24). Similarly, the weekly gathering showed a likelihood a negative relationship, even so, it was insignificant. Both the monthly and yearly gathering had no effect on vegetation.

The aim of the third objective was to determine the effect of vegetation clearance on terrestrial flora and fauna species. The study found out that 89% of the respondents noted the prevalence of vegetation clearance within the study area (mean=1.11 and SD=0.309) as shown in Table 18. About 74% of the respondents recorded that vegetation clearance was highly affecting terrestrial flora and fauna species (mean=1.26, SD=0.439) indicated in Table 18. The frequency of vegetation clearance was indicated to be very high (mean=3.06, SD= 1.079) this is illustrated in Table 21. This suggested that the cumulative annual rate of vegetation clearance in the study was at 89%. With 80% of the respondents indicating an increasing in trend of the rate of vegetation clearance within the area of study (mean= 1.20, SD= 0.398) (Table 20). Both once a year and twice a year vegetation clearance was found significant and negatively correlated

with the number of animals threatened r (377 = -.543., p = .04 and r (377 = -.455, p = 02 respectively. Both once a year and twice a year vegetation clearance was found significant and negatively correlated with the number of plants threatened r (377 = -.527., p = .04 and r (377 = -.345, p = 02 respectively

5.3 Conclusion

The study found out that in Rachuonyo South sub county is endowed with variety of both indigenous and exotic terrestrial flora and fauna species. however, these species were found to be threatened due to anthropogenic activities such as hunting, gathering and vegetation clearance which were highly connected to uses of species such as wood fuel, brick making, logging for lumbering, road creation and expansion, crop farming and over stocking.

Hunting and gathering as an anthropogenic activity was found to be prevalent within the study area threatening the existence of terrestrial flora and fauna species.

Lastly on the effect of vegetation clearance, this anthropogenic activity was found out to be prevailing within the study area and greatly essential for the wellbeing of the local community. However, the study concluded that vegetation clearance is highly affecting the survival of terrestrial flora and fauna species since it is connected to activities such as crop farming, brick making, wood fuel among others which are related to anthropogenic activities.

5.4 Recommendation

There is need to create awareness on the importance of terrestrial species to the ecosystem services that the community is enjoying and the dangers that would be faced by the community due to the destruction of the species. This should be done by encouraging the residents to employ proper utilization of naturally available resources for sustainable development.

Vegetation clearance, hunting and gathering have led to the relocation and reduction of terrestrial species due to destruction of habitat. Therefore, the local residents should be aware

on how various terrestrial species are threatened by various anthropogenic activities in order to control them.

5.5 Areas Suggested for Further Research

The following areas were not covered in the present study and may be deemed essential for forming a good basis for further inquiry:

i. Effect of culture on the acceleration of the anthropogenic activities and conservation of local species.

ii. The rate at which terrestrial flora and fauna species conservation are affected by anthropogenic activities.

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APPENDICES

Appendix A: Respondents Consent Form

CHRISTINE ATIENO JUMA

MASENO UNIVERISITY

Dear Respondent

RE: PARTICIPANT CONSENT FORM

You are kindly requested to be a participant in a research study on ‘effect of anthropogenic activities on terrestrial flora and fauna species conservation in Rachuonyo South Sub County, Homabay County Kenya. The objectives of the study are to: Identify the terrestrial flora and fauna species threatened by anthropogenic activities, describe the effect of hunting and gathering on terrestrial flora and fauna species conservation and to determine the effect of vegetation clearance on terrestrial flora and fauna species conservation in Rachuonyo South Sub County. The study is for academic purposes only. By choosing to participate in the study, please not that there will be no infringement in your basic rights neither will you subjected to any form of prejudice

I have been made to understood the information the study is seeking and I therefore undertake to freely participate in the study without coercion

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

Appendix B: Questionnaires

TITLE: EFFECT OF HUMAN ACTIVITIES ON TERRESTRIAL PLANT AND ANIMAL SPECIES CONSERVATION IN RACHUONYO SUB COUNTY

WARD…… LOCATION……SUB LOCATION…….

The questionnaire seeks information from you on the Effect of Human Activities on Plant and Animal Species Conservation. Maximum confidentiality will be observed for all your responses and the outcome of this study is basically for academic purposes only. Attempt all sections by marking appropriately as provided

Section A (Socio-Demographic Characteristic of the Respondent's)

Personal details;

a) Gender

Male ☐ Female ☐

b) Age in Years

Below 30 ☐ 30 – 40☐ 40 – 50 ☐ Over ☐

c)**Household size……**

d) Level of education

Tertiary ☐ Certificate ☐ Secondary ☐ Primary ☐

e) Period lived in Rachuonyo Sub county.
i) 5-9years ☐ (ii) 10-14 years ☐ (iii)15-19 years ☐ (iv)20 years and above ☐

f) Main occupation:

i) Formal employment ☐ (ii) Casual labuorer ☐ (iii) Business ☐ (iv) Farming ☐ (v) Others (specify)……

g)Approximate size of Land
i) 1-3Ha ☐ (ii) 4-6 Ha ☐ (iii) Above 7 Ha ☐ (iv) Others specify……..

i) Approximate income per month:

i) 0-5000☐ (ii) 5001-10,000☐ (iii) 10,001-15,000☐ (iv) Above 15,000☐

Section B: Identify terrestrial plant and animal species threatened by human activities

a) Fill the table below

	Plant species	If Indigenous (put a tick)	If Exotic (put a tick)	Uses	Human Activities threatening the species
1.					
2.					
3.					

Table 1

i) From the information in the table 1 above tick the current status of plant species in the area.

☐ increasing ☐ decreasing ☐ No change

ii) If increasing give reasons for:

Indigenous species

……

Exotic species

……

iii) If decreasing state reasons for:

Indigenous species

……...……..

Exotic species

…….

b) Fill in the table below

	Animal species	If Indigenous (put a tick)	If Exotic (put a tick)	Uses	Human Activities threatening the species
1.					
2.					
3.					

Table 2

a) From the information in the table 2 above tick the current status of animal species in the area. ☐ increasing ☐ decreasing ☐ No change

i) If increasing give reasons for:

Indigenous species

……

ii) If decreasing state reasons for:

Indigenous species ……

c) In your opinion state how terrestrial plant and animal species conservation can be enhanced in this region ……..…

Section C: Describe the effect of hunting and gathering on plant and animal species conservation

3. a) Is hunting and gathering activity taking place in this region? ☐ Yes ☐ No

i) If yes, kindly fill table below

ii. Do you or any member of your household engage in gathering activity? Yes ☐ No ☐

	Animals hunted	Uses	Plants gathered	Uses
1				
2				

If YES give reasons ……

iii) How frequently do you do the activity mentioned above?

☐ Daily ☐ Weekly ☐ Monthly ☐ After one month

In your opinion, is hunting and gathering activity affecting plants and animal species in this area? Yes☐ No ☐

If YES

i) State how hunting has affected:

Plant species…..……

Animal species……

ii) State how gathering has affected:

Plant species……

Animal species……..

c) In your opinion, state how hunting and gathering activity can be controlled. …….

d) Are there some conservation measures taking place in this region to conserve plant and animal species? Yes☐ No ☐

If YES state them ……

Section D: Determine the effect of vegetation clearance on plant and animal species conservation

a) Is vegetation clearance taking place in this area? Yes☐ No ☐

If YES, kindly fill the table below

	Types of Vegetation	Reasons for Clearance
1.		
2.		

i) From the information in the table 4 above tick the current status of vegetation clearance in this area. ☐ increasing ☐ decreasing

If increasing give reasons: ……..

If decreasing state reason: ……..……

b) How frequently is vegetation clearance taking place in this region?

Weekly☐ Monthly☐ Once a year ☐ Twice a year☐

Does vegetation clearance affect plant and animal species in this region? Yes ☐ No ☐

If YES, state how it has affected

Plant Species.……..……

Animal Species…..……..

d) In your opinion, state how vegetation clearance can be controlled in this region.

……

Appendix C: Key Informant Interview Guide

TITLE: EFFECT OF HUMAN ACTIVITIES ON TERRESTRIAL PLANT AND ANIMAL SPECIES CONSERVATION IN RACHUONYO SUB COUNTY

Ward…….. Location……Sub location……

Date…… Gender of Respondent……..

Period Lived in the area……Main Occupation……

List types of terrestrial plant and animal species found in this region.

	Plant species	Animal species
1.		
2.		
3.		

Initially, what was the status of flora and fauna species in this region?

……

State the current status of plant and animal species in this region.

……

In which way has population growth affected terrestrial flora and fauna species and vegetation cover in this region?

……

List the human activities threatening terrestrial plant and animal species in this region.

……
……

Explain the status of hunting and gathering activity in this region.

…….

List the plant and animal species hunted and gathered in this region.

	Plant species	Animal species
1.		
2.		
3.		

Explain how hunting and gathering has affected plant and animal species in this region.

……

In your opinion, explain how hunting and gathering activity can be controlled in this region.

..……

Explain the status of vegetation clearance in this region.

……

List the type of vegetation being cleared in this region and give reasons for their clearance.

	Plant species	Reasons
1.		
2.		

Explain how vegetation clearance has affected plant and animal species in this region.

……

In your opinion, explain how vegetation clearance can be controlled in this region.

……

List the conservation measures taking place in this region.

……

In your opinion, state how these conservation measures can be enhanced.

……

Appendix D: Observation Schedule

TITLE: EFFECT OF HUMAN ACTIVITIES ON TERRESTRIAL PLANT AND ANIMAL SPECIES CONSERVATION IN RACHUONYO SUB COUNTY

Ward…….. Location…… Sub location……

Date…… Gender of Respondent……..

Period Lived in the area…… Main Occupation……

1. List the various plants and animal species threatened.
2. List the various activities threatening plants and animal species such as hunting, and gathering.
3. Identify the common vegetation types being cleared in Rachuonyo South
4. List the various observable activities that lead to the clearance of vegetation such as farming, charcoal burning, firewood collection.

Appendix E: MUERC

MASENO UNIVERSITY SCIENTIFIC AND ETHICS REVIEW COMMITTEE

Tel: +254 057 351 622 Ext: 3050
Fax: +254 057 351 221

Private Bag – 40105, Maseno, Kenya
Email: muerc-secretariate@maseno.ac.ke

REF: MSU/DRPI/MUERC/01065/22 **Date**: 4th November, 2022

TO: Christine Atieno Juma
PG/MA/NS/00085/2018
Department of Geography and Natural Resource Management
School of Arts and Social Sciences
Maseno University
P.O. Box Private Bag, Maseno, Kenya

Dear Madam,

RE: Effect of Anthropogenic Activities on Terrestrial Flora and Fauna Species Conservation in Rachuonyo South Sub County

This is to inform you that **Maseno University Scientific and Ethics Review Committee (MUSERC)** has reviewed and approved your above research proposal. Your application approval number is MUERC/01065/22.The approval period is 4th November, 2022 – 3rd November, 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by Maseno University Scientific and Ethics Review Committee (MUSERC).
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to Maseno University Scientific and Ethics Review Committee (MUSERC) within 24 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to Maseno University Scientific and Ethics Review Committee (MUSERC).

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Prof. Philip O. Owuor, PhD, FAAS, FKNAS
Chairman, MUSERC

MASENO UNIVERSITY ETHICS REVIEW COMMITTEE 04 NOV 2022 PRIVATE BAG MASENO

Appendix E: Research Permit

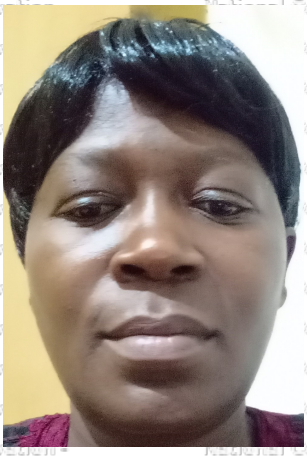
REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **665267**

Date of Issue: **06/December/2022**

RESEARCH LICENSE



This is to Certify that Ms.. CHRISTINE ATIENO JUMAH of Maseno University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Homabay on the topic: EFFECT OF ANTHROPOGENIC ACTIVITIES ON TERRESTRIAL FLORA AND FAUNA SPECIES CONSERVATION IN RACHUONYO SOUTH SUB COUNTY, KENYA for the period ending : 06/December/2023.

License No: **NACOSTI/P/22/22380**

665267

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
    i. Endanger national security
    ii. Adversely affect the lives of Kenyans
    iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
    iv. Result in exploitation of intellectual property rights of communities in Kenya
    v. Adversely affect the environment
    vi. Adversely affect the rights of communities
    vii. Endanger public safety and national cohesion
    viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
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