THE STATUS OF POACHING, ITS IMPACTS AND FOOD SECURITY AS A CONTRIBUTING FACTOR IN LAKE CHILWA BIOSPHERE RESERVE, MALAWI.

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A Thesis Submitted to the Graduate School in Partial Fulfillment for the Requirements of the Master of Science Degree in Environmental Science of Egerton University

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DECLARATION AND RECOMMENDATIONS

Declaration

I declare that this thesis is my original work and has not been presented for the award of a degree at any other University.

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Recommendation

This thesis has been submitted to the Graduate School with our approval as University supervisors.

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DEDICATION

I dedicate this thesis to my parents Mr and Mrs B.K. Phiri, wife Mercy, son Chisomo, brothers and sisters for their support and endurance during my absence. God bless you for your support.

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ABSTRACT

The pressure on the wildlife in Lake Chilwa Biosphere Reserve (LCBR) has been increasing due to increase in population, illegal and unsustainable hunting practices. This has become a threat to sustainability of fish, birds and other wildlife species in LCBR. The broad objective of this study was to assess the status of poaching, its impacts and food security as one of the key drivers in LCBR in Malawi. The study employed a social survey research design. One hundred households were sampled using systematic random sampling from the area within LCBR. The households were 45 from Zomba, 21 and 34 Phalombe and Machinga districts respectively. Questionaires and focused group discussions were used to collect primary data. Secondary data was collected from Fisheries and Agriculture departments and Biosphere reserve manager. Descriptive statistics, trends and regression were used to analyse the data. The results from the study indicate that poaching in LCBR exist and its level is high as indicated by 61.3% of respondents and <5% of tools licensed annually. The main drivers of poaching are poverty as indicated by 35.4% of the respondents, food insecurity 32.1%, population growth 17.5% and low level of education and unemployment 2.5% and 1.7% respectively. Poaching is causing the decline in fish catches, reduction in composition of both birds and fish species and size of fish caught. There is also reduction in peoples' income in the area as well as increase in malnutrition cases due to lack of cheap protein sources. The anti-poaching strategies currently in place include patrols, intelligence led operations, participatory resource management and policy based management. The results also indicate that people perceive conservation as important for sustenance of fish production and income base for the community, avoid species extinction and attract tourists. It is therefore recommended that LCBR`s core zone be further gazetted as a protected area to ensure that the current threats from poaching are minimized. The Malawi government should put up policy framework that will create a good environment for small businesses to thrive to improve the livelihoods to divert communities focus from extraction of resources from the biosphere reserve and a deliberate policy framework must be enacted to provide for sustainable alternatives protein sources.

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LIST OF ABBREVIATIONS AND ACRONYMS

AfriMAB	African Network of Biosphere Reserves under UNESCO MAB program
AWF	African Wildlife Foundation
BfN	(German acronym) Germany Federal Agency for Nature Conservation
BRAPA	Biosphere Reserves as Model Regions for Ant-Poaching in Africa.
BVC	Beach Village Committee
CBD	Convention on Biological Diversity
CBNRM	Community Based Natural Resource Management
CITES	Convention on International Trade in Endangered Species
DC	District Commissioner
DNA	Deoxyribonucleic Acid
DNPW	Department of National Parks and Wildlife
DoF	Department of Fisheries
DPSIR	Drivers, Pressures, State, Impact, Response
DNPW	Department of National Parks and Wildlife
EAD	Environmental Affairs Department
EMA	Environmental Management Act
FAO	Food and Agriculture Organization
FISH	Fisheries Integration Societies and Habitat
FMC	Forest Management Committees
GPS	Geographical Positioning Systems
GWP	Global Wildlife Program
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
LCBR	Lake Chilwa Biosphere Reserve
MAB	Man and Biosphere
NEP	National Environmental Policy
NSO	National Statistics Office
UNESCO	United Nations Education Scientific and Cultural Organization
USAID	United State Agency for International Development
SDGs	Sustainable Development Goals

CHAPTER ONE
INTRODUCTION

1.1 Background Information

Poaching is a term that many people have defined in different ways depending on the context. In common terms, for convenience and consistency Carter *et al*. (2017), adopted the term poaching as the illegal killing or taking of wildlife. In this context it refers to hunting without license or permit, in protected areas (National parks, game reserves), using illegal equipment or tools and any other hunting practices which are against legal provision of any institution or country. Poaching is a problem where wildlife is valued as a source of both income and protein (meat) (Wilfred and Maccoll, 2015). Wildlife meat is any non-domesticated terrestrial mammals, birds, reptiles and amphibians harvested for consumption (Nasi *et al.*, 2008). Brashares *et al*. (2004) reported that in Africa the intensity of hunting is usually inversely related to time spent on farming activities. Thus, the presence and importance of factors behind wildlife exploitation may differ from place to place and the strategies employed to address problems related to poaching cannot be universal.

Human pressure on wildlife in protected areas is increasing. This is partly because wildlife is concentrated in such areas having been driven off from other habitats due to conversion of land use activities to agriculture and settlements. Illegal wildlife use is usually related to distances from human settlements to protected areas. For example in Serengeti Tanzania, both wildlife meat poaching and consumption rates are quite high among the villages near protected areas (Hofer *et al.*, 1996).

Biosphere reserves are places that seek to reconcile both cultural and natural heritage preservation with the people´s sustainable development (Sonali, 2017). These reserves include representative and unique areas of the world's biomes and the selection of the reserves has been greatly facilitated by a thorough knowledge of the important biotic communities. According to Ratika (2013), biosphere reserves conserve genetic resources, species, ecosystems and landscapes without uprooting inhabitants. Instead, the traditional life style and traditional resources of the local people are maintained. In addition, biosphere reserve helps to rebuild any damage caused to ecosystems and habitats thereby ensuring sustainable economic, cultural, social and ecological development. Biosphere reserve are a model for co-existence between nature and human, besides, biosphere reserve provides a lot of scientific information for specific scientific studies and research and this is one reason why this study was carried out.

Lake Chilwa Biosphere Reserve in Malawi, has a variety of bird, fish and small animal species which are used for food by a large proportion of the local community (Bhima, 2006). In the area, poaching is combined with other livelihood activities into the socio-economic framework of people's livelihood. Population increase, poverty and food insecurity are some of the factors that can influence poaching levels. The level of food in a particular community may have a role in influencing wildlife poaching. It must therefore, be assumed that communities may be more involved in wildlife poaching when they don't have enough food.

The study sought to assess the status of poaching, drivers, its impacts and its relationship with food security level among local communities within Lake Chilwa biosphere reserve. The findings will generate information and knowledge that can be incorporated in policy making and management of the LCBR resources by the relevant authorities.

1.2 Statement of the Problem

Poaching of birds and fish in Lake Chilwa Biosphere Reserve in Malawi have existed for a long time and has developed into a significant socio-economic activity. Wildlife such as birds and fish support a variety of groups of people for their subsistence and livelihoods. Over the past few years, the pressure on the wildlife has been increasing due to increase in population, illegal and unsustainable hunting practices. This has become a threat to sustainability of fish, birds and other wildlife species in this unique ecosystem. Even though poaching has existed within Lake Chilwa Biosphere Reserve, there is paucity of data on status of poaching within the biosphere reserves' zones, the drivers for poaching and what measures are in place to control it. Such information is crucial for decision making considering that LCBR has no legal protection status despite being a wetland of national importance. Besides, the biosphere reserve is managed under three administrative councils of Zomba, Machinga and Phalombe districts where population has been steadily increasing over the years thereby putting pressure on the limited natural resources.

1.3 Objectives of the Study

1.3.1 Broad Objective

The broad objective of this study was to contribute to the sustainable use and management of birds and fisheries resources of Lake Chilwa Biosphere Reserve in Malawi.

1.3.2 Specific Objectives

I. To establish the status of poaching in Lake Chilwa Biosphere Reserve.
II. To determine the drivers of poaching in Lake Chilwa Biosphere Reserve.
III. To determine the impacts of poaching to people, birds and fish within the Lake Chilwa Biosphere Reserve
IV. To document the anti-poaching strategies and determine their effectiveness in the Lake Biosphere Reserve
V. To evaluate the communities' perception of wildlife conservation in the Lake Chilwa Biosphere Reserve

1.4 Research Questions

I. What is the status of Poaching in LCBR?
II. What are the driving factors to poaching in the LCBR?
III. What are the impacts of poaching people, birds and fish in LCBR?
IV. What anti-poaching technics/ strategies are employed by the government towards conservation of birds and fish in LCBR?
V. Which anti-poaching strategies are effective in counter poaching in the LCBR?
VI. What is the perception of the communities towards wildlife conservation around LCBR?

1.5 Justification and Significance of the Study

The Malawi National Wildlife Policy of 2000 aims to ensure proper conservation and management of wildlife in order to provide for: sustainable utilization; equitable access to the resources; and fair sharing of the benefits from the resources for both present and future Malawians. The goal of the National Fisheries and Aquaculture Policy of 2017 is to promote sustainable Fisheries resource utilization and aquaculture development in order to contribute to food and nutrition security and economic growth of the country. The Sustainable Development Goals (SDGs) goals advocate for conservation and sustainable use of the water resources for sustainable development. They also aim at protecting, restoring and promoting

sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

This study sought to generate data on status of poaching and their impact on people, birds and fish and identify factors which influence or deter poaching in LCBR. Such information is important in coming up with policies that take into account human-wildlife interactions in conservation of natural resources. This study is also significant as it is in line with several such similar policies. Assessment of the drivers that play a role in wildlife poaching could assist in increasing an understanding of the relationships between wildlife as a natural resource, and people as the resource users, through gaining knowledge of relevant issues to create a complete picture.

1.6 Scope of the Study

The study focused mainly on poaching of birds and fish species found in the Lake Chilwa Biosphere Reserve. Information on fish was from 2008 to 2017, birds from 2009 to 2014, this is because the data base from institutions where the data was acquired had well consolidated information within the specified years. This study was restricted to community members within the Lake Chilwa Biosphere reserve in Malawi including Machinga, Phalombe and Zomba Districts which form the core, buffer and transition zone.

1.7 Limitations of the Study

Some respondents were not familiar with scientific names of some fish and species, so reliance was made on Fisheries officers who were familiar with both local names and scientific names to get reliable information from the respondent. Field guides and pictures of bird and fish species were also used to get correct responses on which species are targeted for poaching. It was also not easy to meet some officers from government departments because they were engaged with routine activities. A visit was first made and schedule interview programs on date they deemed would be free from other time demanding activities.

1.8 Assumptions of the Study

Given the sensitive nature of the research, it was assumed that the respondents and key informants provided accurate information to the best of their knowledge.

1.9 Operational Definition of Terms

Biosphere reserve: A national or international ecosystem with plants and animals of unusual scientific and natural interest designated for conservation by the UNESCO-MAB program. UNESCO Biosphere Reserves are ideal learning sites for nature conservation and sustainable development.

Driving Forces: The factors that cause changes in a system. They can be social, economic or ecological and can have positive or negative influences.

Fishing: Catching fish, either for food or as a sport using any equipment.

Fishing gear: The equipment used by fishermen when fishing.

Impacts: The effects on human health and/or ecosystems produced by a pressure. E.g. reduction in abundance or biodiversity.

Poaching: The illegal taking of wildlife, in violation of laws. In this study this has been used to refer to illegal capturing of fish and birds.

Pressure: Human activities that directly affect the system and are generated by the driving forces.

State: The condition of the system at a specific time and is represented by a set of descriptors of system attributes that are affected by different factors.

Response: The efforts made by society as result of the changes manifested in the impacts. As directed actions, responses typically take the form of program activities, such as the number of inspections done.

CHAPTER TWO
LITERATURE REVIEW

2.1 Global Poaching Levels

In the global perspective wildlife is being threatened to extinction due to poaching practices and in some instances wildlife populations have been reduced significantly. Leopards, rhinoceros, elephants, lions, turtles, zebras, pangolins and tigers are among such wildlife species facing a significant threat from poaching.

South Africa experienced a reduction in poaching around the 1990s, but later rose steadily and resulted into illegal wildlife trade thus contributing to the global $20 billion from the wildlife trade industry (Andrews, 2013). McGrath, 2013, reported that 668 rhinos were killed in 2012, and most rhino species are now critically endangered, as some animals are left fatally injured when their horns are removed for sale. The driving force behind it all is a growing economy around the world and beliefs in the healing powers of rhino horns in traditional medicine especially in Asia and China (Graham-Rowe 2011). However, with advances in modern technology, scientists have been able to test the medicinal capabilities of rhino horns and have come up with conflicting information which has made the medicinal healing capacity of horns unreliable (Laburn and Mitchell, 1997; But, *et al*., 1991). It is reported that since 2006, 95% of all rhino deaths occurred in Zimbabwe and South Africa, of which the majority were through poaching, destined for illegal export to Asia (Milliken *et al.*, 2009).

Poaching is also reducing African elephant's population. It is reported that African elephant populations dropped by 64% between 1979 and 1987 from an estimated 1.3 million to 472,000 (Scriber, 2014). According to The Great Elephant Census, it was estimated that African elephant populations also dropped by 30% between 2007 and 2014 (Scriber, 2014).

Leopards have not been spared either. According to the International Union for the Conservation of Nature (IUCN) 2016, leopard's status declined to vulnerable in the list of threatened species. It was reported that the leopard became extinct in 23 of its 85 original range countries in Africa and Asia (Global Wildlife Program (GWP), 2017). Leopards are poached for their skins and other body parts.

2.2 Poaching in Malawi

Poaching in Malawi is at subsistence level where small game, fish & birds are collected for home consumption and the surplus sold as a source of income. This is mainly because of low animal numbers and difficulty in hunting them. Poaching in protected areas e.g. national parks and game reserves is usually by communities that surround them. The problem is compounded if the national park is trans-boundary considering that Malawi is a landlocked country bordering Tanzania to the north, Mozambique to the east & south and Zambia to the west. Most of the poachers of big game e.g. elephants tend to be foreign.

Lake Chilwa Wetland was declared Malawi's first Ramsar site in 1997 due to a large proportion of migratory birds that overwinter in the wetland. The lake and its associated wetland supports about 164 bird species, 43 of which are seasonal and long term changes in lake level have major impacts on floodplain inundation and consequently on water bird populations (Chiotha, 1996). Bird hunting around Lake Chilwa is among major economic activities with over 1.2 million birds killed annually (Lunduka, 2013). This though permitted by license, illegal bird hunting is one of the challenges within the wetland despite its international importance. The practice is unsustainable because the birds are trapped even during the nesting season thus affecting future generations. One of the reasons for poaching within the wetland is lack of legal protection.

It was well known that poaching existed in LCBR, however there is no research that focused on establishing its status. Most of the researches conducted have focused on effects of climate change and adaptation, variation in physiochemical parameters of the water and management measures used in LCBR.

2.3 Types of Poaching

Poaching may be categorized as subsistence, commercial and a blend of the two (Duffy and St John, 2013). Subsistence poachers typically target small game and hunt to meet food needs. Fischer *et al*. (2013) reported that subsistence poaching is characterized by low technology, for example use of traps and snares which tends to have a minimal impact on wildlife. However, most of these methods are nonselective hunting technologies which can be detrimental to species that are both of conservation concern and critical to nature based tourism (Becker *et al*., 2013). Commercial poachers usually target big game which are commercially valuable species such as elephants and some do it to collect dead animals as trophies. Commercial poachers are usually organized and typically use more advanced technologies

including firearms, GPS and mobile phones to track wildlife. This can have a devastating impact on wildlife populations if it is not regulated.

Tackling poaching requires an understanding of human decision making. The decision to poach or not is decided by an individual, but is shaped by the social, political and economic context in which those individuals find themselves (Duffy and St John, 2013). It has been reported that poachers tend to be motivated by commercial gain, household consumption, recreational satisfaction, trophy poaching, thrill killing, protection of self and property, poaching as rebellion, poaching as traditional right or use, disagreement with specific regulations, and gamesmanship. Others are motivated by the ease of poaching due to little to no regulation of the law while others are simply unaware of the law (Senko *et al.,* 2011). Understanding the drivers and deterrents associated with poaching is most important in biodiversity hotspots especially if it has endemic species and there are threats related to habitat loss.

The type of poaching prevalent in Malawi is of the subsistence even though there have been reports recently of commercial poaching in some protected areas such as Lengwe National Park mainly due to its proximity to Mozambique.

2.4 Drivers and Causes of Poaching

The illegal harvesting of natural resources is a major threat to biodiversity in terms of both plants and animals globally. Increase in human population causes an increase in demand for natural resources and the ecosystems on which they rely will continue to be overused. Countries around the world have enacted legislation to limit what is extracted from natural systems to make them profitable and sustainable. But legislation alone cannot completely get rid of the demand of important resources on which people depend for necessities and because of varying drivers.

According to Bashari. (2014), family consumption, fur, horn and other by-products, pet and live trade, and retaliation killing are the most important drivers of wildlife poaching in Afghanistan. Lindsey *et al.* (2015), outline drivers of poaching as demand for bush-meat in both rural and urban areas and human encroachment of wildlife areas. Other drivers of poaching include lack of alternative livelihoods, lack of alternative food sources especially proteins, inadequate penal systems and lack of enforcement, lack of clear rights over wildlife or land, and/or inadequate benefits from wildlife, political instability and poor governance,

demand for wildlife body parts for traditional medicine and cultural ceremonies and abundant material for making snares.

In Uganda it was found out that wildlife crime is driven by subsistence need, desire for commercial gain, cultural traditions, perceived injustice in the distribution of costs and benefits of conservation and politics (Harrison *et al.*, 2015). Poaching is therefore driven by similar factors in the different regions only that their intensity and presentation differ depending on the kind of poaching present.

Knowledge of factors that influence poaching on wildlife for food may help curb wildlife poaching and related crimes by formulating relevant policies. Generating information on drivers of poaching may help managers and government on appropriate approaches to be implemented and relevant policy framework to be considered to help remove them.

2.5 Impacts of Poaching on Wildlife and Livelihood

Hundreds of millions of individual animals belonging to hundreds of species are the targets of illegal harvesting and trade (USAID, 2017). Poaching as a form of wildlife crime not only threatens the survival of focal species, but significantly alter ecosystem functions and stability when species are substantially depleted or even made extinct (USAID, 2017).

Poachers create insecurity in rural communities and sometimes enforcement officers, hurting morale and recruitment of such staff and reducing tourism and associated revenue needed for conservation and community development. In developing countries, loss of revenue from trade, taxes, and tourism can be significant and particularly damaging (Rosen & Smith 2010). The illegal trade in wildlife can also introduce and spread pathogens (Gómez & Aguirre 2008), posing major risks to human and livestock health, with implications for food security, commerce, and labor productivity. Despite focused efforts often lasting several decades, wildlife crime still remains a global threat (Broad & Damania 2010, Sharma *et al.,* 2014).

Wildlife poaching poses threats that affect local communities, wildlife populations and subsequently the environment (Obour *et al.*, 2016). A community that relies on its wildlife to attract tourists is at great risk for economic hardship if the prevalence of poaching is high (Estrada, 2014). Tourist may boycott an area if the wildlife is no longer available and this could have a detrimental effect on a community's economy since social amenities e.g. restaurants, hotels, rentals, and other attractions may be affected. Extinction is the greatest threat to animals that are victims of wildlife poaching. In 2011, the International Union for the Conservation of

Nature (IUCN) declared the western black rhinoceros extinct which was poached due to the belief in the healing properties of its horn. Poaching is also dangerous to the environment as it reduces the natural populations of some species in the ecosystem, reduction in population causes imbalance in the food chain (Rinkesh, 2009). Energy balance and different cycles e.g. nitrogen, carbon and water within the ecosystem are dependent on several biotic and abiotic factors. An imbalance in any of the factors impacts on the integrity of the ecosystem making it imperative to control negative activities because ecosystems are sensitive in nature. Considering that humankind depends on natural resources for sustenance, it implies that poaching does have far reaching direct and indirect effects on livelihoods within a community. In extreme cases, poaching may lead to the extinction of a species which can have a negative economic effect on a country. For example, it has been reported that Sri Lanka lost over US$ 750 million of its annual sea food export due to poaching by illegal fishermen from India (Hettiarachchi, 2007).

The information generated from the research will assist resource users, managers and policy makers to understand the severity of the problem. This will help in implementation of conservation measures and strengthening the existing regulatory frameworks through enforcement.

2.6 Anti-poaching Strategies

Poaching and wildlife trade have been some of the major issues for conservation in the world. There are different strategies and practices that have been in use to curb poaching and illegal wildlife trade. These methods are there to reduce actual killing of wildlife and the trade that result. Some of the strategies in use include, intensive monitoring and patrolling, intelligence network mobilization, community based anti-poaching, enforcement of legislations, participatory wildlife management, involvement of non-government organization in management of natural resources, devolution of power to communities, sharing of the benefits of conservation with the communities that surround protected areas. Other methods that have been implemented to counter poaching and illegal wildlife trade include: Poisoning and use of indelible ink in the horn of the live rhino. This renders the horn useless and ink can be identified by scanners; Dehorning, although it has been found to be expensive and also reported to reduce the survival of the dehorned animals as evidenced in Zimbabwe where it was observed that there was a 29.1 % chance of survival of dehorned rhinos as compared to horned rhinos (Mukwazvure and Magadza, 2014).

Remotely Piloted Aircraft systems or drones are also used to curb poaching. Drones use cameras, sensors and GPS in the gathering of information on poaching. In Nepal use of drones showed to be an effective anti-poaching method (Merchant, 2012). In addition to drones Anti-Poaching Heat Sensing Planes have also been used in South Africa at Kruger National Park (Mukwazvure and Magadza, 2014). Deoxyribonucleic acid (DNA) mapping is also one of the methods that are used to determine possible location of an animal`s origin. According to Mukwazvure and Magadza (2014), DNA mapping was used in 2002 by Singapore officials to trace back a container of ivory to Zambia.

In this study, documentation of anti-poaching strategies was done as presented and discussed in chapter 4 section 4.5. Results on which strategies works better have been reported. This is important because, the strategies that work better will be communicated to the government and policy makers so that such strategies are strengthened and more resources allocated.

2.7 Wildlife and Conservation in Malawi

Global human land use has led to natural landscape fragmentation on a considerable scale, and at a considerable speed. These changes represent major threats to biodiversity and the ecosystem services that depend upon it, and are reflected in wildlife population reductions and extinctions (Mellink *et al.*, 2017). In Malawi the need for protecting and ensuring sustenance of wildlife under growing human impact has been approached through the establishment of protected areas such as national parks, game reserves, sanctuaries, designation of some important ecosystems to international treaties recognition e.g. wetlands and biosphere reserves, setting recommended buffer zones for farming and settlements to some sensitive natural landscapes such as wetlands, rivers, lakes mountains and designated protected forest areas. However these initiatives are now recognized as lacking the capacity to conserve wildlife populations both in Malawi and globally.

In trying to conserve the natural resources including wildlife, conservation policies are in place. These policies addresses conservation and management of wildlife resources in protected wildlife areas, forest reserves, public lands, customary and private lands. The policies also advocate for community extension and environmental education, co-operation with national and international partners. In addition, they also advocate for wildlife utilisation, management approaches and species protection and law enforcement.

In Malawi protected areas cover about 11.6% of the total land area (Department of National Parks and Wildlife (DNPW, 2000). These include National Parks, Wildlife Reserves, Nature Sanctuaries and Forest Reserves. These protected areas have high concentration of wild animals than unprotected areas. This is largely due to increasing human population pressure, poverty and inadequate appreciation of the resources benefits which often lead to habitat loss, poaching and unsustainable use. In terms of fauna, the country has a wide diversity of animal species ranging from mammal, bird, reptile, amphibians and fish. In Malawi utilization of wildlife is allowed through the following legal forms: bird hunting license, game hunting license, animal captivity license, game farming, game ranching, fishing permit/ license and resource use by surrounding communities on a permit.

Challenges experienced in wildlife conservation include poaching both for subsistence and commercial use. There has been trafficking of wildlife products due to low risk but high returns. Increase in human pressure, inadequate field resources, weak legislation and sometimes failure to use multiple legislation during prosecution of offenders, encroachments due to demand for farming land and tenure system, human-wildlife conflicts which negates attitudes towards wildlife and inadequate effective community participation.

An assessment of the perception of the communities to conservation was done to have knowledge of whether the people would be willing to be engaged in conservation activities. Prior knowledge of the perceptions on conservation help create appropriate entry points for dissemination of messages and implementation of various conservation programs.

2.8 Policies Guiding Conservation of Wildlife in Malawi

Malawi has a variety of terrestrial and aquatic wildlife which is governed by a number of policies and acts to ensure sustainable utilization and conservation. The country is signatory to a number of international treaties and conventions that have played a role in formulation of some of national policies intended for management of wildlife and natural resources. These include the Convention on Biological Diversity (CBD) in 1992 which promotes both in situ and ex situ conservation of natural resources; the Ramsar Convention of 1971 which provides for the protection of biological diversity in wetlands and wise use of wetlands as well as the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) of 1973, whose objective is to control and regulate international trade in wildlife species through species classification and the use of permits (DNPW, 2000).

The Malawi National Environmental Policy (NEP, 2004) was adopted in order to promote sustainable social and economic development through sound management of the environment (EAD 2004). It provides an overall framework against which relevant sectoral environmental policies can be developed and revised to ensure that these are consistent with the principle of sustainable development. The NEP is backed by the Environment Management Act (EMA), which was enacted in 1996 in order to remove the lack of an overarching statute providing general environmental protection (EAD, 2005). Of particular relevance to poaching, the Fisheries Conservation and Management Act (1997) promotes community participation in the protection of fish and provides for the establishment and operation of aquaculture. The establishment of aquaculture is an important step in order to reduce pressure on natural Fisheries (DoF, 1997; DoF, 2017). One of the principal priorities of the Wildlife Division in Malawi is to deal comprehensively with poaching and illegal fishing activities in wildlife reserves, water bodies and other sensitive areas. The National Wildlife Policy (2000) ensures proper conservation and management of wildlife resources in order to provide for sustainable utilization and equitable access to the resources and fair sharing of the benefits for both present and future generations of Malawi (DNPW, 2000).

2.9 Bird Diversity in LCBR

Lake Chilwa hosts a variety of bird species of which some are migratory. The lake and its associated wetlands support about 164 bird species, 43 of which are seasonal (Chiotha, 1996). The lake is home to many bird species which include glossy ibis, *Plegadis falcinellus*, *Dendrocygna bicolor* (fulvous whistling-duck), *Amaurornis flavirostris*, (black crake) *Gallinule* and *Porphyrio alleni*, lesser moorhen, *Gallinula angulata*, *Larus cirrocephalus* (grey-headed gull) and *Gallinapo media* (great snipe) (Fishpool and Evans 2001; Dowsett-Lemaire & Dowsett 2006). *Rynchops flavirostris*, a wetland-dependent bird species of global concern occurs regularly in significant numbers in the wetland (Birdlife International, 2002).

Bird killing constitutes a major threat to migratory birds in the region. The birds are hunted for food or sale. The hunting season coincides with the closed season of the fishery (November to February) and the period when most households experience seasonal food shortages (Wilson 1999). Van Zegeren and Wilson (1997) reported that an estimated 1.2 million birds are trapped annually by at least 460 trappers with an estimated economic value of US$215,000.

2.10 Fisheries in LCBR

It has been reported that fish provide 60 – 70% of animal protein in Malawi but fish supply per capita has steadily fallen from 12.9 kg/yr in 1976 to 6.4 kg/yr in 2003 due to high population growth, growing demand, and declining production caused by over-fishing and illegal fishing (FAO, 2007). Artisanal Fisheries located mainly in rivers and inshore areas of the lakes dominate the fishery sector and it is extremely important to the national economy for the sector provides employment, food and income. It provides direct employment and indirectly provides a livelihood to people through fish processing, marketing, boat building and engine repairs. Poaching is in the form of non-sustainable and illegal fishing methods including use of nets with small mesh size and mosquito netting, fish traps at river outlets, fishing by blocking rivers and netting in breeding grounds, and during breeding seasons. However, over-fishing and the use of illegal fishing methods cause a reduction in size and age of catch, altering the species composition and biodiversity of the stock. Existing Fisheries regulations are rarely respected and the destruction of breeding grounds has significantly reduced production capacity. Lake Chilwa contributes about 20% of the total annual catch of fish in Malawi (Njaya, 2001) and like the rest of the aquatic resources, has not been spared the effects of poaching. Overfishing has led to a reduction in catches partly because Lake Chilwa undergoes cyclic drying episodes that have been compounded by adverse effects of climate change e.g. drought.

This study was undertaken to assess the status and impact of poaching on the birds and fish species. The data generated will inform policy guidelines and amendments in the control of poaching.

2.11 Theoretical Model

This study was conceptualized based on the Driving Force, Pressure, State, Impact and Response (DPSIR) Framework. In this study, driving forces constituted economic factors (income levels, poverty, and lack of employment), cultural factors (traditions, dietary practices and education) and social factors (lack of food). Pressures included the activities that people are engaged in response to the driving forces. These activities include illegal fishing, bird hunting, unsustainable farming practices which can modify the state of environment. The modifications can be presented in the form of resulting impacts such as reduction of species diversity and provisioning capacity of the environment. The measures employed to deal with the driving forces, pressures, state and impacts are the responses, this include policies, community planning, environmental monitoring and others.

Table 2. 1: DPSIR model pertaining to activities around Lake Chilwa Biosphere Reserve

Driving forces	**Pressures**	**State**	**Impacts**	**Responses**
Population	Illegal fishing	Migratory species	Loss of biodiversity	Fisheries policies
Cultural factors	Bird hunting	Endemic birds and fish species	Loss of Migratory bird species	Wildlife policies
Lack of income	Poor farming practices	Breeding potential of bird and fish species	Loss of recreation value and ecotourism	Community planning
Lack of food	Destruction of habitat		Reduction in provisioning capacity	Environmental monitoring and restoration
Availability of markets				Ecosystem service valuation
Governance				Human well-being index

2. 12 Conceptual Framework

The connection between social economic and socio-cultural factors and natural resource use exist. The conceptual framework in Figure 2.1, shows the connection/relationships between socio-economic and socio-cultural factors to poaching. In this study poaching constituted the dependent variable, while the socio-economic and socio-cultural factors represented the independent variables. Intervening variables included, policies, migratory behavior of the wildlife, climate variability, pollution and the perception of local communities to conservation. Socio-economic variables considered in this study include poverty (in terms of income levels), food security level and population increase. Socio-cultural factors include education and dietary practices.

In Figure 2.1, independent variables (socio-economic and socio-cultural factors represented) directly influence individuals to poach fish and bird species. This is the case when their presentation is on the extreme low side. When households have low income (living in poverty) they are forced to look for alternatives, these alternatives are usually natural resources which are easily accessible. The same is applicable when the household lack enough food (food insecure). Population increase result in competition for resources, when the population is higher than the resources can support, the resource may lack regenerative capacity as a result its production declines, and beyond that point resources may disappear (extinction). The result is that even people who depend on such resources for livelihood may suffer in terms of reduction in income, food and other benefits from such resources.

Beside the independent variables, there are intervening variables (migratory behaviour, policies, pollution, climate variability, perception on conservation) which can also affect the status of natural resources in a particular ecosystem. Migratory behaviour of some species can cause seasonal variation in abundance, good policies can increase abundance and production than bad ones, pollution always degrade the environment and makes it unsuitable for some species and perception on conservation influence individual decision on whether to conserve natural resources or not.

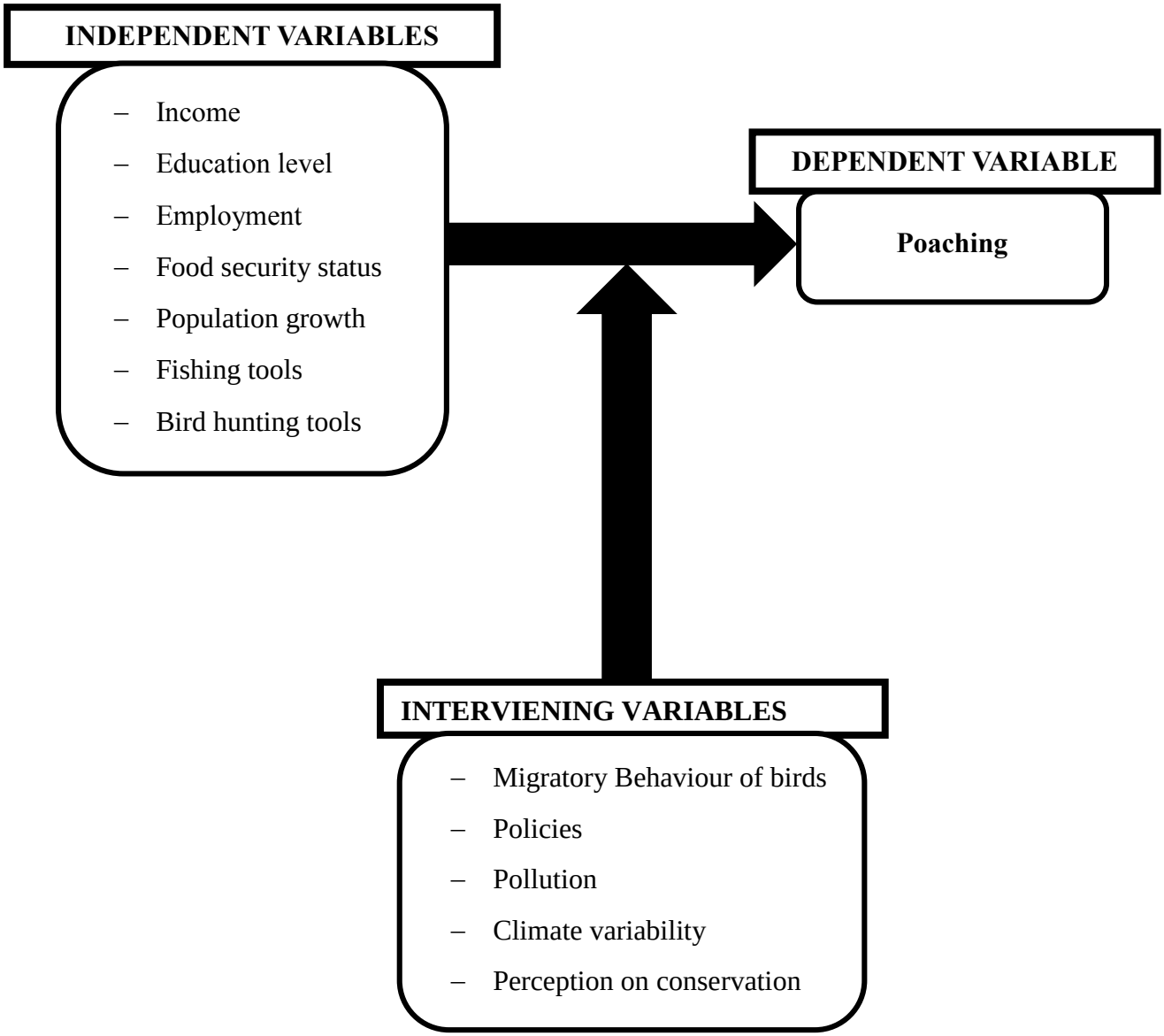

Figure 2. 1: Conceptual Framework showing Independent, Dependent and Intervening Variables

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter gives an account of the methodology that was used to achieve the research objectives and statistically test the relationships between the variables of the study. The chapter discusses the Study Area, research design, population, sampling procedures and sample size, instrumentation, data collection procedures and data analysis.

3.2 The Study Area

The study was conducted in Lake Chilwa Biosphere Reserve. Lake Chilwa wetland ecosystem was designated by UNESCO –MAB as a Biosphere Reserve in 2006. The wetland is also a designated Ramsar site because of its international importance as a waterfowl habitat. Lake Chilwa Biosphere Reserve and its wetland ecosystem lies in three districts namely; Machinga, Zomba and Phalombe, it also lies between two countries, Malawi and Mozambique.

Lake Chilwa Biosphere Reserve is located in the Southern region of the Republic of Malawi on the country's eastern border with Mozambique between latitude 15°00'S and 15°30'S and between longitude 35°30′E and 35°55′E. The entire wetland is approximately 40 km from east to west and 60 km from north to south with a total area of about 2,310 km^2 (EAD, 2001). The water level of the lake is at an altitude of 627 meters above sea level. There is no outflow from the lake, which consequently varies considerably in size and salinity depending on precipitation in the catchment area. The catchment is 8,349 km^2 of which 68% is in Malawi and 32% in Mozambique (EAD, 2001). A small increase in water level results in a large increase in the lakes surface area. Lake Chilwa is very shallow, averaging 1-2 *m* in depth with a maximum depth of only just over 2.5 *m*.

The biosphere reserve comprises the lake, typha swamps, marshes and seasonally inundated grassland floodplain where the transition, buffer and core zones are located. Unlike other biospheres where the core is the innermost protected area, all three zones within LCBR are easy to access and hence prone to poaching. The wetland in the biosphere reserve has a history of cyclic drying and filling. The hydrology of the wetland is an important control on the ecology of the biosphere reserve, determining not only the water chemistry and physical properties, but also the composition of the vegetation and soil characteristics (Howard and Walker, 1974).

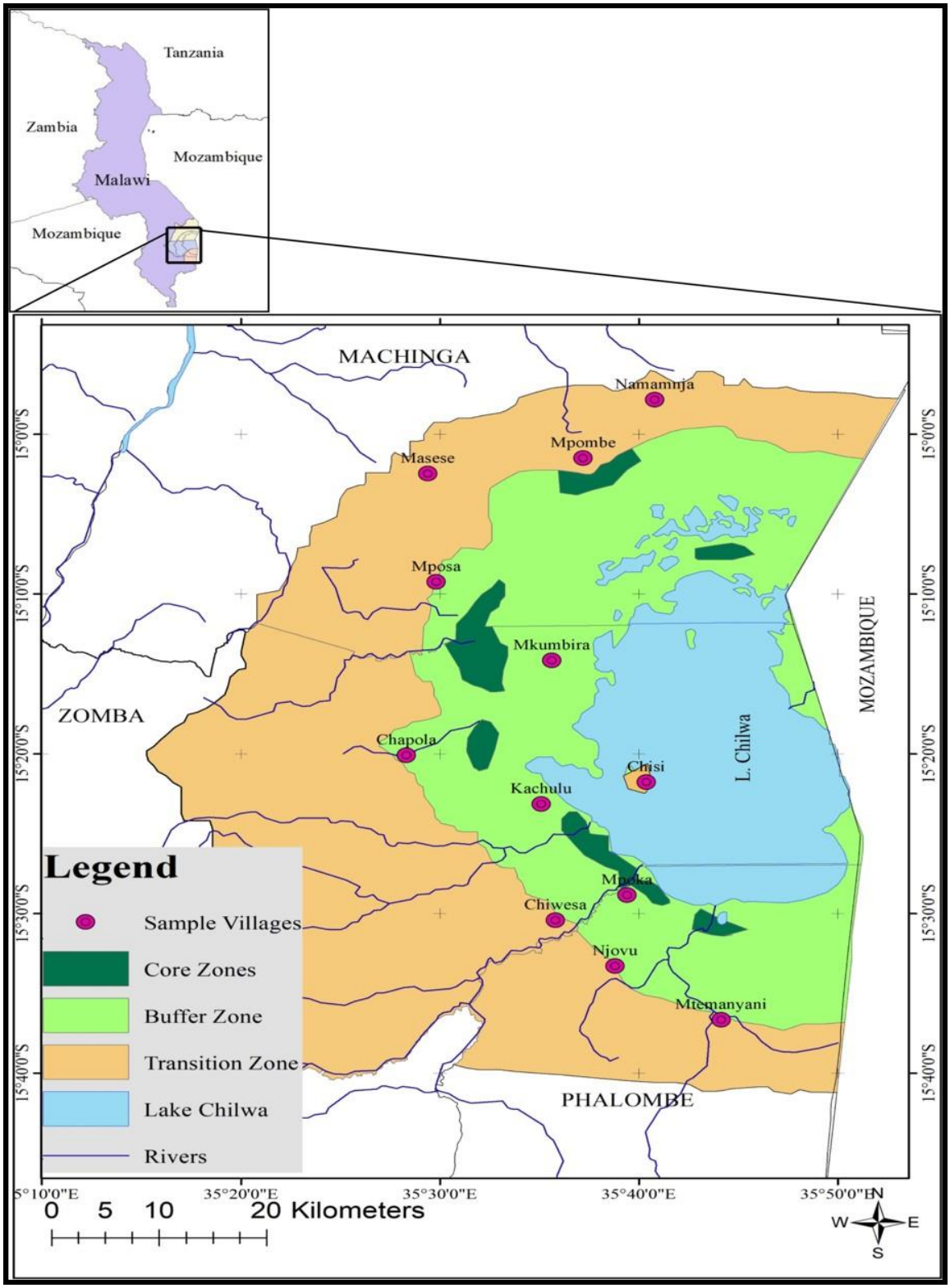

Figure 3. 1: Map of the Study Area showing the study sites

***Source*: Modified from LCBR UNESCO-MAB Nomination form (2004).**

The area has a tropical climate which is relatively dry and strongly seasonal (British Geological Survey, 2004). It constitutes the warm-wet season from November to April, cool dry season

from May to August and hot dry season from September to October. The temperatures are highest on average in November, at around 24.2 °C. The lowest average temperatures in the year occur in July, at around 17.0 °C. The average annual rainfall is 1282 mm (EAD, 2001).

The Lake Chilwa Biosphere Reserve has a high population with a density of 164/ km^2 and 1, 700,452 in the entire Lake Chilwa basin (EAD, 2001). The estimated number of households in the area was 347,300 by 2008 (National Statistics Office (NSO), 2008). The nearest major towns are Machinga, Phalombe and Zomba. The economy within the area is dominated by agriculture, where individual maize production accounts for the main activity, while tobacco is cultivated as the main cash crop. Other crops produced include rice, cassava, sweet potato, groundnuts, beans and pigeon peas. Livestock husbandry is still under developed; nevertheless cattle, poultry, goats, sheep, pigs and rabbits are raised for meat production, with poultry being the most common. Fish farming is also practiced in earthen fish ponds. In addition, Lake Chilwa continues to be the main source of fish in the area, with an annual catch of more than 5,000 tons. Small and medium-scale businesses dominate the area's non agro-based economy, with general retail accounting for the gross of sales (Ludaka, 1991).

Lake Chilwa Biosphere Reserve hosts a variety of bird species of which some are migratory (Bhima, 2006). It is estimated that 164 bird species are associated with the area of which 41 are Palearctic and 14 intra-African. Bird killing constitutes a major threat to migratory birds in the region. The lake contains 14 species of fish of which *Clarias gariepinus*, *Barbus paludinosus* and *Oreochromis shiranus Chilwae* are dominant (Lunduka, 2013). Fishing is also a major activity among the rural communities in the area around LCBR, to some significant extent the Fisheries sector is also affected by illegal fishing, leading to decline in fish production and catch in the region (Njaya, 2001). LCBR was chosen for the study because of its unique characteristics in terms of wildlife and the provision function it plays to the communities around it. These characteristics make the area suitable for studies pertaining to natural resource use, conservation and factors leading to unsustainable exploitation.

3.3 Research Design

Burns and Grove (2009), define research design as the blue print for conducting a study with maximum control over factors that may interfere with the validity and reliability of the findings. This study employed a social survey research design where semi-structured questionnaires were used to interview sampled households in communities around Lake Chilwa and key informants in different government sectors. A social survey involves obtaining information in a standardized form from large groups of people. Normally it involves the

random selection of a sample which is representative of the population of interest. The social survey helps in collecting both quantitative and qualitative information in a relatively short period of time.

3.4 Sampling Frame

The target population for this study was the households of the community members living within the transition zone of LCBR. This area is within Machinga, Phalombe and Zomba Districts. The community members comprised of 347,300 households.

3.5 Sampling Procedure and Sample Size

Multistage sampling technique was used in this study. In this technique large populations are divided into stages to make the sampling process more practical. It uses combination of stratified sampling or cluster sampling and simple random sampling. In this study, the target population was sampled purposively from the three districts i.e. Zomba, Machinga and Phalombe. Each district was treated as a stratum. A list of villages around the biosphere reserve was obtained from District Commissioner's offices and a simple random sampling criteria was used to select villages and respondents. The respondents constituted household heads of community members in transition zone of the LCBR reserve. Members of Bird Hunting Committees (BHCs) and Beach Village Committees (BVCs) were chosen to participate in focused group discussions. Key informants included managers from Fisheries and agriculture and wildlife in each district.

3.5.1 Sample Size Determination

The sampling unit for this study was a household. The formula by Nassiuma (2000) was used to determine the appropriate number of households that were sampled from the communities around Lake Chilwa Biosphere Reserve. The sample was calculated as follows;

$$n = \frac{NC^2}{C^2+(N-1)e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

In the formula above; n represent sample size; N represent the population size which was 347,300 households; C represent coefficient of variation which is ≤ 30%; *e* represent margin of error which is fixed between 2-5%. The sample was calculated at 30% coefficient of variation and 3% margin of error.

$$n = \frac{347300 \times 30^2}{30^2 + (347300 - 1)3^2} = 99.97 \approx 100$$

The calculation resulted into a total of 100 households for a sample. This sample was then divided proportionally depending on the total number of households to the districts where the study was conducted.

Table 3. 1: Total number of households and sample for each district

District	Target Households	Sample Household Heads
Machinga	113,683	34
Zomba	158,563	45
Phalombe	75,054	21
Total	**347,300**	**100**

Source (NSO, 2008)

3.6 Data Collection

Two types of data were collected: primary and secondary. Primary or field data was collected through administration of questionnaires, observation schedules and Focused Group Discussion (Appendix I, II, III, IV & V). The questionnaires consisted of information on number of fishers and hunters, tools used in bird hunting and fishing activities, crops and fish production, indigenous knowledge about birds and knowledge about policies for the protection of birds and Fisheries resources and other socio-economic aspects. Secondary data was collected from documented information in government offices and from documentation centers. The departments which included Fisheries, agriculture and wildlife provided information by responding to the key informant questionnaires.

3.7 Instrumentation

The study used both researcher-administered questionnaire and a self-administered questionnaire. The researcher-administered questionnaire was used to collect information on demographic, socio-economic, hunting tools, perception on level and impacts of poaching, reasons and perception on conservation, perception on level and drivers of poaching. A copy of the researcher-administered questionnaire used in the study is attached as Appendix I.

The self-administered questionnaires were used to collect data on birds and fish catch trends. These questionnaires also helped in getting information on anti-poaching strategies and

their effectiveness from technical personnel of fisheries and wildlife department and biosphere reserve manager. Copies of self-administered questionnaires are attached as Appendix II, III and IV of this thesis.

3.8 Validity and Reliability

The instruments used in this study were adequately reviewed and scrutinized for construct, content and face forms of validity.

Reliability tests help in identifying and minimizing random errors which arise from a number of factors such as researcher bias, fatigue (in both the researcher and respondent), poor test construction, inaccurate coding and inadequate clarity of instrument`s items (Mugenda & Mugenda, 2003). The use of different instruments and sources in data collection ensure that data collected is reliable. According Denzin and Lincoln (2005), triangulation which refers to the use of multiple and different sources, methods, investigators and theories for getting information ensure credibility of the findings. A pilot study was also conducted to test the respondents` understanding of the data instruments. The respondents of the pilot study were sampled from 3 villages which were not included in the main study. The sample size for the pilot study was 15 Household heads which represented 15 % of the sample for the parent study. Connelly (2008), suggests that a pilot study sample should be 10% of the sample projected for the larger parent study; Isaac and Michael (1995), suggested 10 to 30 participants.

3.9 Ethical Consideration

A clearance letter was obtained from the Board of Post Graduate Studies of Egerton University (Appendix VI). This letter was later presented to the Ministry of Local Government through the District Commissioners (DC) for Machinga, Phalombe and Zomba Districts for the authorization of the study. Introduction letter was also presented before the heads of the following departments; Fisheries, Agriculture and LCBR Manager.

3.10 Data Analysis

Data were edited and coded accordingly to ensure consistency and uniformity where responses were similar. The data was then entered and analyzed using Statistical Package for Social Sciences (SPSS) Software Version 25. Descriptive statistics was used to organize data on knowledge of poaching and levels, number of licensed fishing tools, perceived drivers, knowledge on existing impacts of poaching and perception and reasons for conservation (See Table 3.2). The computed descriptive results were organized in percentages tables, pie charts, and bar graphs, chi-square tests were performed on income levels, food security status and education level to determine their association with poaching. Trend and regression analyses were performed on number fishers, fishing tools, fish catches and birds trapped over the years. Anti-poaching strategies and their effectiveness were summarized and described accordingly.

Table 3. 2: Data Analysis Matrix

Specific Objective	Independent Variables	Dependent Variable	Statistical tools
To establish the status of poaching in Lake Chilwa Biosphere Reserve.	• Knowledge on poaching • Number of fisher folks • Number of tools • Number of licensed tools	Poaching	Descriptive statistics Trend Analysis
To determine the drivers of poaching in Lake Chilwa Biosphere Reserve.	• Perceived drivers • Income levels • Food security status • Education levels	Poaching	Descriptive statistics – Chi square test
To determine the impacts of poaching to people, fish and birds within the Lake Chilwa Biosphere Reserve	• Knowledge on existing impacts • Fish catch trends • Birds trapping trends	Perceive impact of poaching	Descriptive statistics Trend Analysis Regression
To document the anti-poaching strategies and their effectiveness in the Biosphere Reserve	• Anti-poaching strategies • Knowledge of effectiveness	Anti-poaching strategies in use	Descriptive statistics
To evaluate the communities' perception of wildlife conservation in the Lake Chilwa Biosphere Reserve	• Willingness to conserve resources in LCBR	Perception on and reasons for conservation	Descriptive statistics

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This section presents and discusses the main findings of the study conducted in Lake Chilwa Biosphere Reserve. The findings from semi-structured interviews, focus group discussions with community members and findings from key informants will be presented in this section. The findings from workshop organised by AWF that focus on LCBR will also be presented.

4.2 The Status of Poaching in the Lake Chilwa Biosphere Reserve

The status of poaching was determined through responses from respondents pertaining levels of poaching. Information from 2008 to 2016 on the annual trends licensed fishing tools, total annual recorded fishing tools and number of fishers was obtained from Fisheries department. The existence of poaching in LCBR is supported by 88% of respondents who acknowledged presence of poaching whereas 12% did not have any knowledge of poaching within the reserve. The percentage responses on the level of poaching are presented in Figure 4.1.

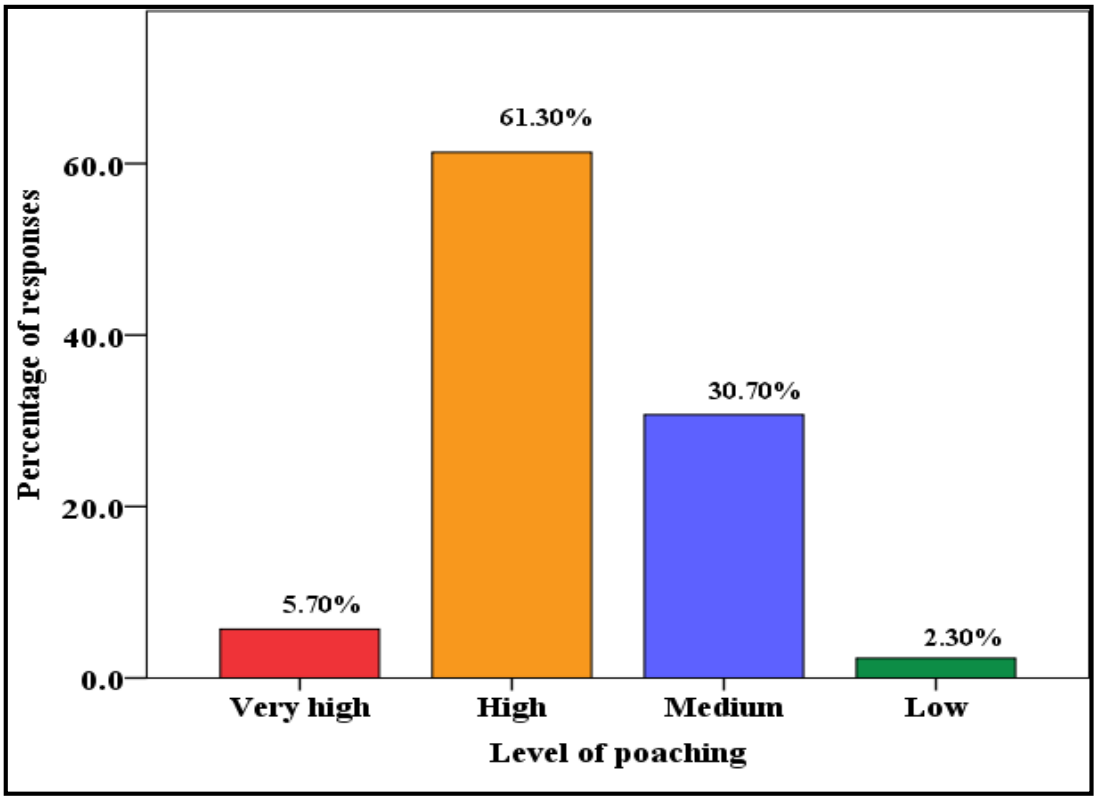

Figure 4. 1: Perceptions on level of poaching in Lake Chilwa Biosphere Reserve

The results in Figure 4.1, show that among the respondents with knowledge of existence of poaching activities, 5.7% indicated that poaching levels were very high, 61.3% indicated that poaching was high, 30.7% classified it as being of medium intensity whilst only 2.3 % indicated that there were low levels of poaching. It is important to note that 58% of the respondents indicated that poaching occurs at higher levels on Fisheries resources than birds.

The results in Figure 4.1 can be explained by two reasons. Firstly, it is due to easy access to the buffer and core zones of LCBR. Secondly, the increase in number of people in the area resulting into corresponding increase in number of people joining the fishing and hunting sectors in the biosphere reserve. This scenario could also result from the fact that the communities drive their livelihoods from fishing which is the second source of livelihood after farming in the area. Fish is the main source of protein because it is relatively cheaper to obtain in comparison to other livestock such as goats, poultry and cattle. Bird hunting is mostly intensified when fish catches no longer meet demand but otherwise only a few people in the community depend on birds for income and as a protein source. An assessment on the status of biodiversity and threats in Malawi by Millington and Kaferawanthu (2005), revealed that hunting of wildfowl in LCBR has been practiced for some time but its exploitation increased in 1996 following the drying up of the lake and the decline of the fishery in 1995.

4.2.1 Indicators of poaching in Lake Chilwa Biosphere Reserve

4.2.1.1 Fishing tool licensing levels

In this study, an assessment on the number of fishing tools licensed on annual basis in Table 4.1 and Figure 4 from 2014 to 2017 indicate that less than 5% of the fishing tools are licensed annually. In 2014, only 48 fishing tools were licensed representing 0.06% of the total number of tools. In 2015, only 192 were licensed representing 0.23% and in 2016, only 742 were licensed representing 1.95% of the total number of fishing gears. This information is clearly indicative of the high incidences of poaching in the Lake Chilwa Biosphere Reserve.

Table 4. 1: Total estimated and licensed fishing tools from 2014 to 2017

Year	2014	2015	2016	2017
Estimated tools	74078	82393	37950	-
Licensed tools	48	192	742	23
Percentage licensed	**0.06**	**0.23**	**1.95**	**-**

4.2.1.2 Number of people involved in fishing activities over time

The results in Figure 4.2 show an overall increase in trend of the number of people engaged in fishing over the years ($r^2 = 0.0711$; $y = 140x + 4357$). The reduction in numbers of fishermen between 2011 & 2012 coincide with the period when Lake Chilwa dried up and the fishery collapsed. The general increase in the trend indicate the possibility of an increase in poaching on Fisheries resources.

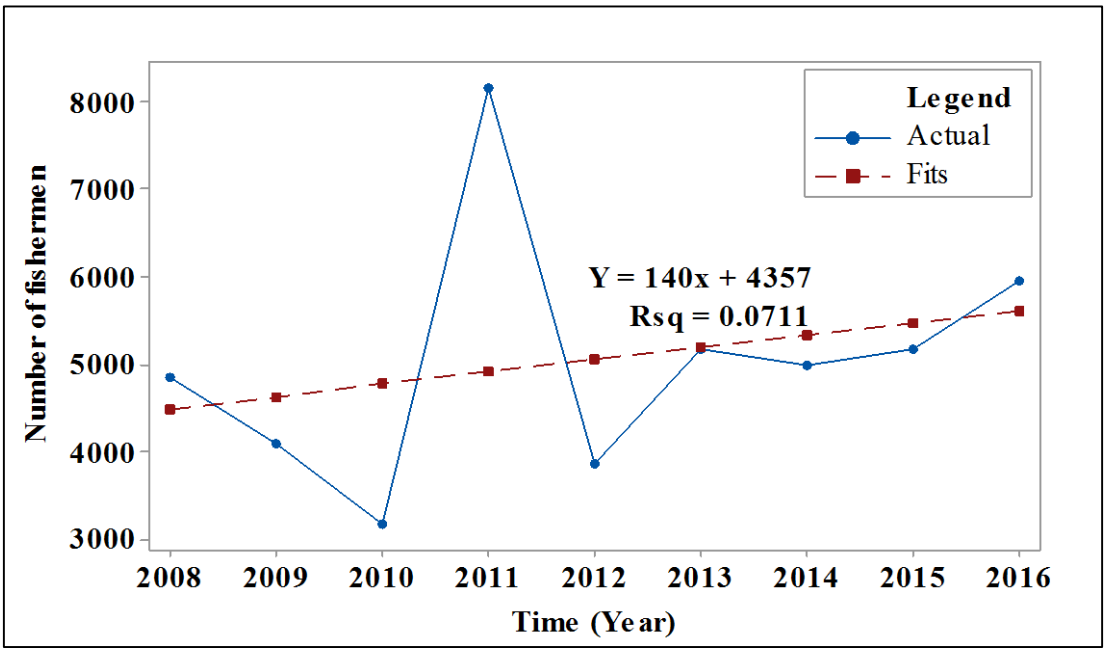

Figure 4. 2: Trends in numbers of fishermen from 2008 to 2016

4.2.1.3 Number of fishing tools over time

In the LCBR different tools are used for fishing and include: gillnets, fish traps, sein nets and lines and hooks. Many of these tools are modified in contravention of government`s prescribed regulations (e.g. mesh size and net material). Figures 4.3 show that there has been a general increase in the number of different fishing tools over the years which are rarely licensed as per the government requirements as observed already in Table 4.1.

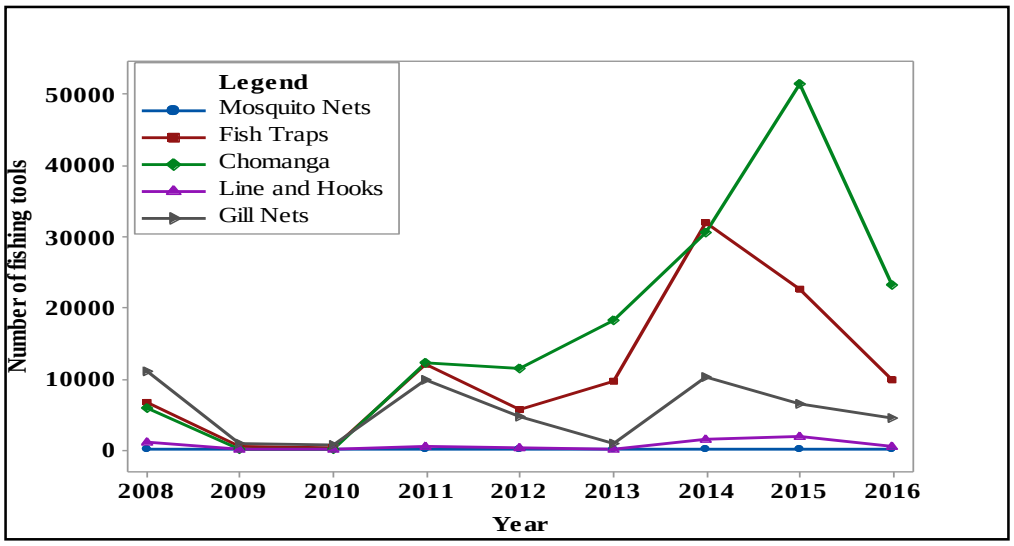

Figure 4. 3: Type and number of major fishing tools in Lake Chilwa from 2008 to 2016

The results In Figure 4.4 show the overall trend in number of fishing tool over time. The trend show a general increase in the number fishing tools over the years and the increase is significant ($r^2 = 0.4972$; $y = 7253x - 2111$; $p < 0.05$).

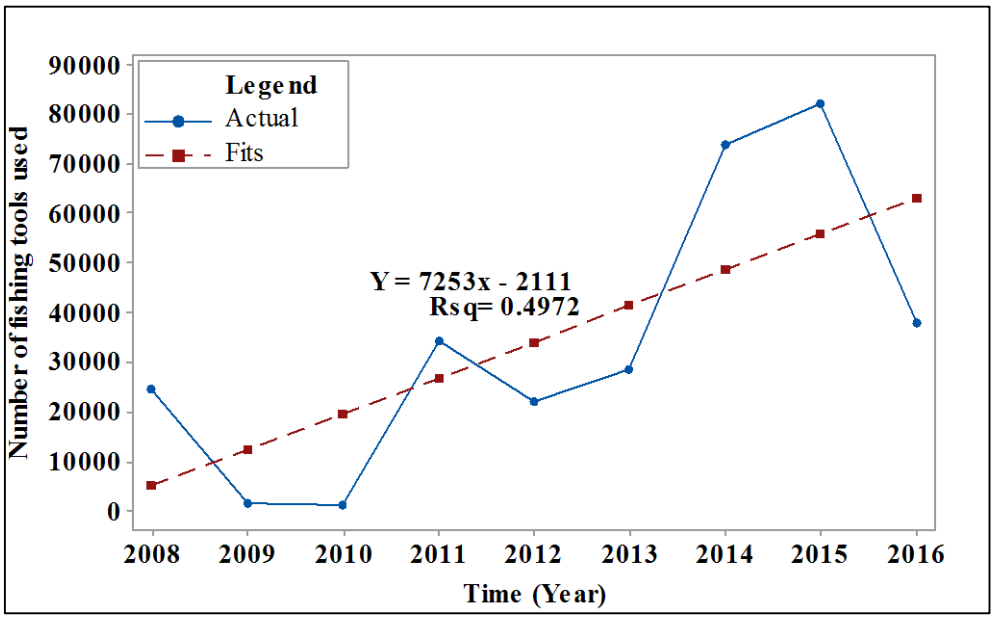

Figure 4. 4: Trend of annual total number of fishing tools in LCBR from 2008 to 2016

The fishing tools are rarely licensed as per the government requirements as observed in Table 4.1. This further explains that most of the people involved in fishing activities do that illegally as they do not have permits to do so. This proves the increase in poaching activities especially on Fisheries resources. In addition, some fishermen clear vegetation like the *Typha dominguensis* (*mjedza*) and *Aeschynomene pfundii* in the lake to make it easy for them to catch

fish as a result they destroy habitat for both fish and bird species. This vegetation provides a natural sanctuary, breeding and hiding site for fish, also serves as sites for bird nests. This practice is also illegal as per Fisheries regulations.

4.3 Reasons and drivers for poaching in LCBR

4.3.1 Reasons for poaching

Respondents were requested to provide information on reasons that motivate them to be involved in poaching. Figure 4.5 present results on reasons indicated for engaging in poaching.

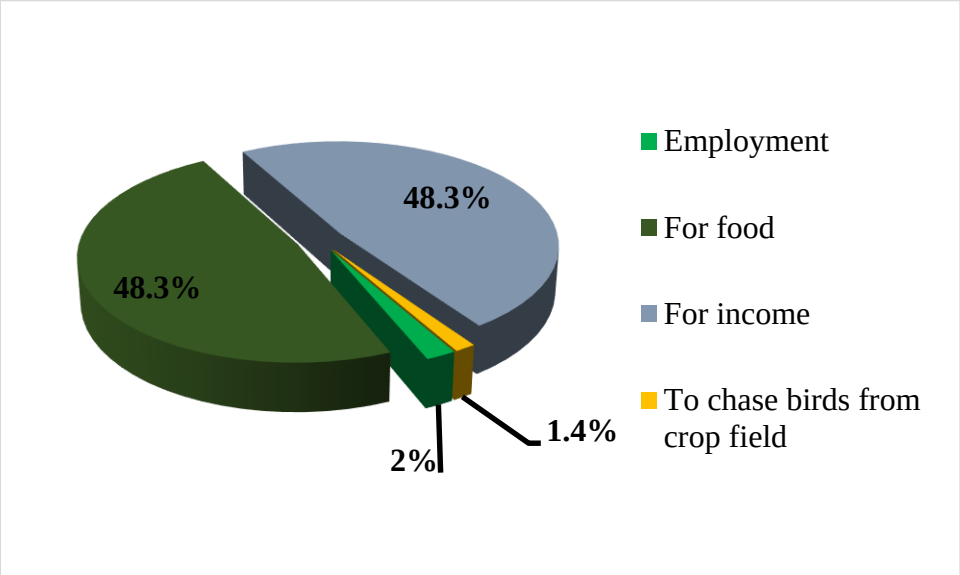

Figure 4. 5: Reasons for poaching in LCBR

The need to obtain food and to earn income were the leading reasons for poaching (Figure 4.5). Employment and the need to chase birds from crop field were the least mentioned motivating factors. As indicated by results community members are mostly engaged in the practice for food and income.

4.3.2 Drivers of poaching

A probe on levels of income, food security and education was made in order to determine if these factors influence involvement in bird hunting and fishing in LCBR. In addition to the above information on their perception and observation on what they perceive as drivers of poaching was made. Figure 4.6 present percentage responses on perceived drivers of poaching in LCBR.

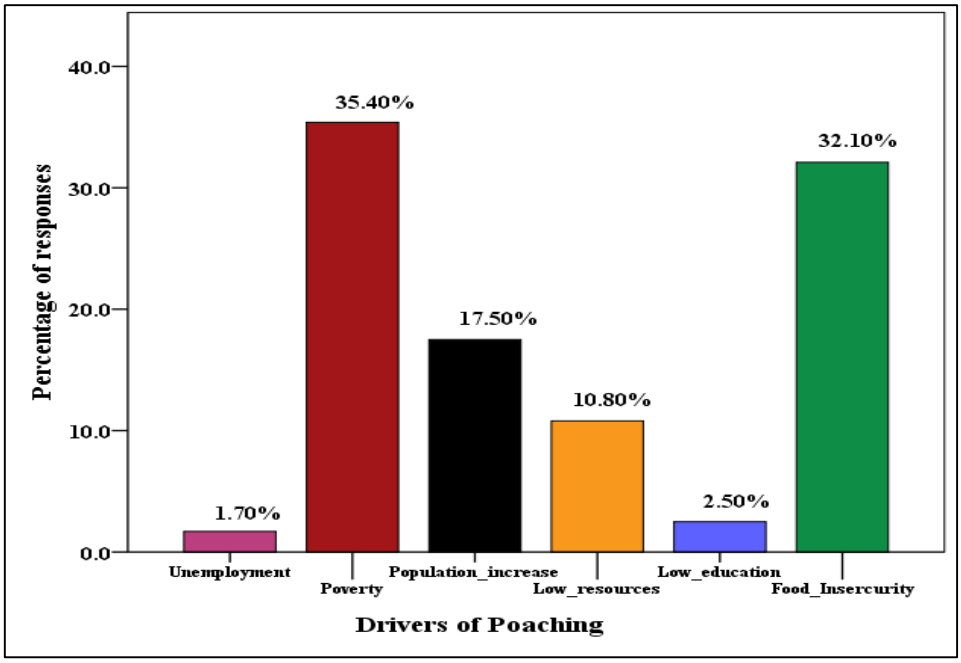

Figure 4. 6: Drivers of poaching in Lake Chilwa Biosphere Reserve

Poverty, food insecurity, population increase and insufficient resources for enforcement of regulations were perceived as the major drivers of poaching (Figure 4.6). It was also indicated that poaching to some extent is influenced by low levels of education of community members and unemployment. Price (2017) describe governance related issues as enabling conditions for poaching to take place. In this study limited resources for enforcement by enforcing agencies faced in LCBR is a governance issue that motivate people not to abide to regulations put in place.

Malawi is classified as one of the poorest countries in the world with 50.7 percent of the population living below the poverty line (IMF, 2017). The population within Lake Chilwa wetland is no different and people depend on fishing to earn income. World Bank classifies extreme poverty as living at a consumption (or income) level below 1.90 $ per day (Roser and Ortiz-Ospina, 2018). The report by CITES Secretariat *et al*. (2013), discloses that sites whose communities have higher levels of poverty experience higher levels of poaching. However, in

their review, Duffy and St John's (2013) found that while poverty may motivate people to poach, people from poor communities would not engage in the poaching of commercially valuable species unless there was demand from wealthier communities. Individuals in LCBR mostly practice subsistence type of poaching where food is the primary purpose as indicated in Figure 8 above and which in the process gives birth to local trade because not all the people can be fisher folks.

The proportion of Households below poverty line and above poverty line as a function of involvement in poaching is shown in Table 4.2. The households whose income level is below poverty line were more involved in poaching than those above.

Table 4. 2: Result on level of income and involvement in poaching in LCBR

Description	**Poaching**		**Overall (%)**	χ^2
	Not involved **(%)**	Directly involved **(%)**		
Below 1.90 USD /day	66.7	67.3	67	0.005
Above 1.90 USD/day	33.3	32.7	33	
Total	**100**	**100**	**100**	

Note: χ^2 denotes Chi-square.

Though the household heads perceived poverty as one of the drivers of poaching (Figure 9), the results (Table 4.2), indicate that there is no association between income level and involvement in poaching (χ^2 (1, N=100) = 0.005, p = 0.946). This is because even the rich would still be involved in poaching as such people have the capacity to procure efficient fishing and hunting tools as opposed to the poor who are only be able to use traditional fishing and hunting methods.

Table 4. 3: Result on level of education and involvement in poaching in LCBR

Education Level	**Poaching**		**Overall (%)**	χ^2
	Not involved (%)	Directly involved (%)		
Primary	41.02	65.6	56	6.099*
Secondary	53.85	32.8	41	
Tertiary	5.13	1.6	3	
Total	**100**	**100**	**100**	

Note: χ^2 denotes Chi-square and ***** indicate significance level at 5% respectively

The results in Table 4.3, show that 56% of the respondent only attained primary education, thus giving a reflection that most individuals in the biosphere reserve are not highly

educated and lacking the capacity to be employed the formal sector. The results also show that 65.6% and 32.8% of those directly involved in poaching attained primary and secondary education respectively and only 1.6% attained tertiary level. These results show a significant association between level of education and direct involvement in poaching in LCBR (χ^2 (2, N= 100) = 6.099, $p < 0.05$). In Malawi unemployment rate is very high especially the Southern region in which the study area is located and is coupled with lack of formal education by the rural communities (NSO, 2014 and IMF, 2017). Therefore, many people remain idle because of lack of skills required for skilled labor force. According to Lindsey *et al*. (2015), unemployment also provides individuals with ample time to spend hunting illegally and correspondingly, rates of hunting and household bush meat consumption decline sharply during times of peak agricultural activity. Poaching and its related activities often enriches local people, and illegal hunting and provides an opportunity for quick cash income for people with few alternative livelihood options (Lindsey *et al.*, 2015).

Lack of resources for enforcement of regulation create a conducive environment for individuals to practice illegal hunting activities because they know that law enforcers will not be able to intercept them. Many government institutions in Malawi mandated to safeguard natural resources do not receive enough finances for operations, this also applies to the fisheries and wildlife sectors. With limited financial and human resources, regulatory institutions are not able to carry their duties efficiently making it porous for illegal entry in the natural resource harvesting by individuals. Population in the LCBR has been increasing leading to increase in number of people involvement in poaching. The population in the area has been growing at 3% annually according to National Statistical Office (NSO, 2008), hence increasing the pressure on already dwindling resources.

4.4 The role of food security to poaching

In this study the role of food security was determined by using food security status of the respondents which was split at two levels (households being food secure and household being food insecure). This was arrived at by asking whether the household harvest was enough till the next harvesting season. In addition, respondents were asked to mention coping mechanisms during time of food deficit and also to mention the major sources of animal protein. This was done to further asses the role of food security to poaching. Table 4.4, present results on level of association between food security status and involvement in poaching activities.

The proportion of food insecure households and food secure households as a function of involvement in poaching is presented in Table 4.4. The results show that the involvement of food insecure households in poaching of is higher than that of food secure households and the difference is significant (χ^2 (1, N =100) = 5.923, p < 0.05).

Table 4. 4: Results on food security and involvement in poaching

Food security status	**Poaching**		**Overall (%)**	χ^2
	Not involved (%)	Directly involved (%)		
Food Insecure HH	46.2	70.5	61	5.923*****
Food Secure HH	53.8	29.5	39	
Total	**100**	**100**	**100**	

Note: χ^2 denotes Chi-square, HH indicate Household and ***** indicate significance level at 5%

In Figure 9 food insecurity has been shown to be one of the drivers of poaching. According to World Summit on Food Security 1996, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. In recent years, adverse effects of climate change e.g. drought have led to loss of yields thereby forcing people to seek alternative sources of food. Natural resources such as fish and birds are prone to exploitation when they are open access, the case with LCBR resources. These findings are in agreement with what Kafumbata *et al.* (2014) reported, they found out that African inland lakes such as Lake Chilwa contribute significantly to food security and livelihoods through direct exploitation of Fisheries resources. However, they stated that ecosystem services provided are under significant stress mainly owing to high demand by increasing populations, negative anthropogenic impacts on lake catchments and high levels of poverty which result in unsustainable use.

With increase in population within the area, farming land is becoming smaller with time resulting in low food production. GOM and World Bank (2006), established that the average landholding size per household in Malawi is 1.2 hectares while the average land per capita is 0.33 hectares, thus leading to low agriculture production whilst the population keeps increasing. The report by CITES Secretariat *et al*. (2013), reveals that poaching levels decrease as food security increases.

4.4.1 Coping mechanisms in times of food shortage

Figure 4.7 shows fishing as one of the major coping mechanisms used by people in times of food shortage.

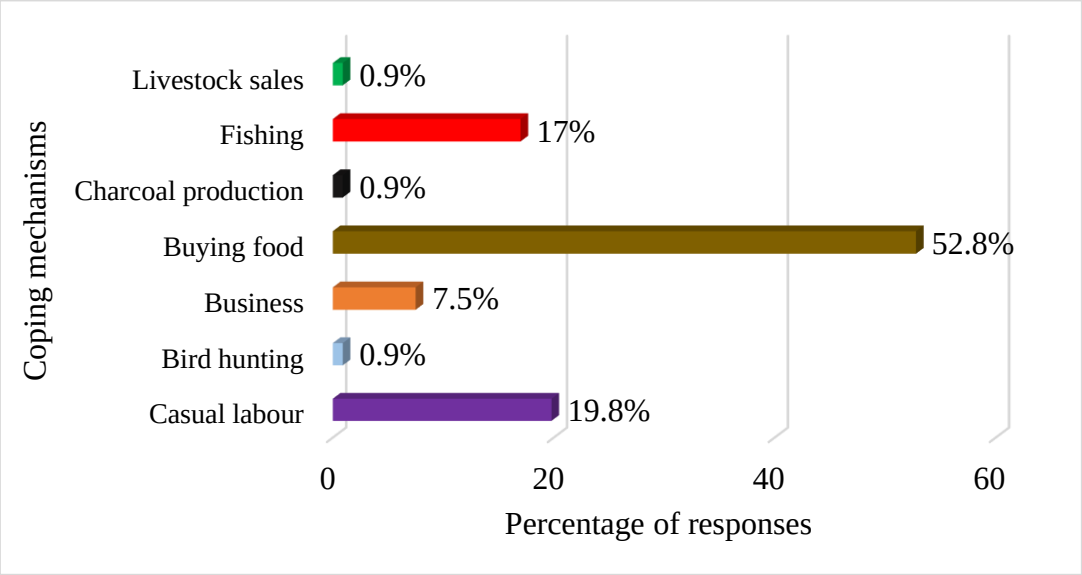

Figure 4. 7: Coping mechanisms during food shortage

This is a clear indication that some people are driven into fishing activities because of lack of food. It has also been shown that fishing and birds hunting are some of the economic activities that enable people get money for their families. This money actually form part of finances used for the purchase of food products.

4.4.2 Protein sources for the Households in LCBR

Figure 4.8 shows fish to be one of the major protein sources to the people in the LCBR as indicated by 31.2% of respondents.

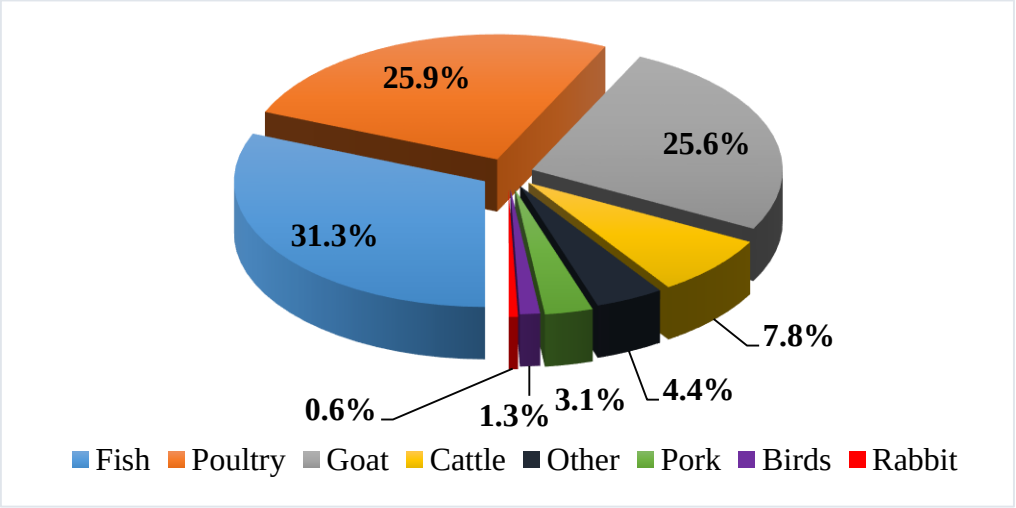

Figure 4. 8: Protein sources for Households in LCBR

This is because it is cheaper than other animal protein sources. Lake Chilwa is an open access resource easily accessible by everyone (Mvula and Haller, 2009), making poaching an easy option for people during times of food scarcity. Many people depend on natural resources for food during difficult times. In their study Chiotha *et al.* (2017), reported that bird hunting intensifies from November to February in LCBR, this is the period when most households experience seasonal food shortages and hence a coping mechanism. These indicators show the link between food security status and increase in poaching levels in the LCBR. According to Fa (2000), intensive farming of livestock and other forms of domestic protein is the only way to provide a sustainable source of food. However, Brown and Williams (2003) argues that the capital for livestock rearing are too prohibitive for small-holder farmers. Therefore, this condition makes it difficult for most individuals to stop relying on natural resources for food and other amenities because most of them are open access and simple and inexpensive tool are used to kill them, resulting into high return from little investment.

4.5 The impacts of poaching on species and people's livelihood within LCBR

To determine the impacts of poaching, respondents were asked to provide information on impacts observed over the years. Information on annual fish catches and bird trapping was obtained from the Fisheries department and biosphere reserve managers and trends were assessed. Figure 4.9 gives some insights on observed impacts resulting from birds and fish poaching in LCBR.

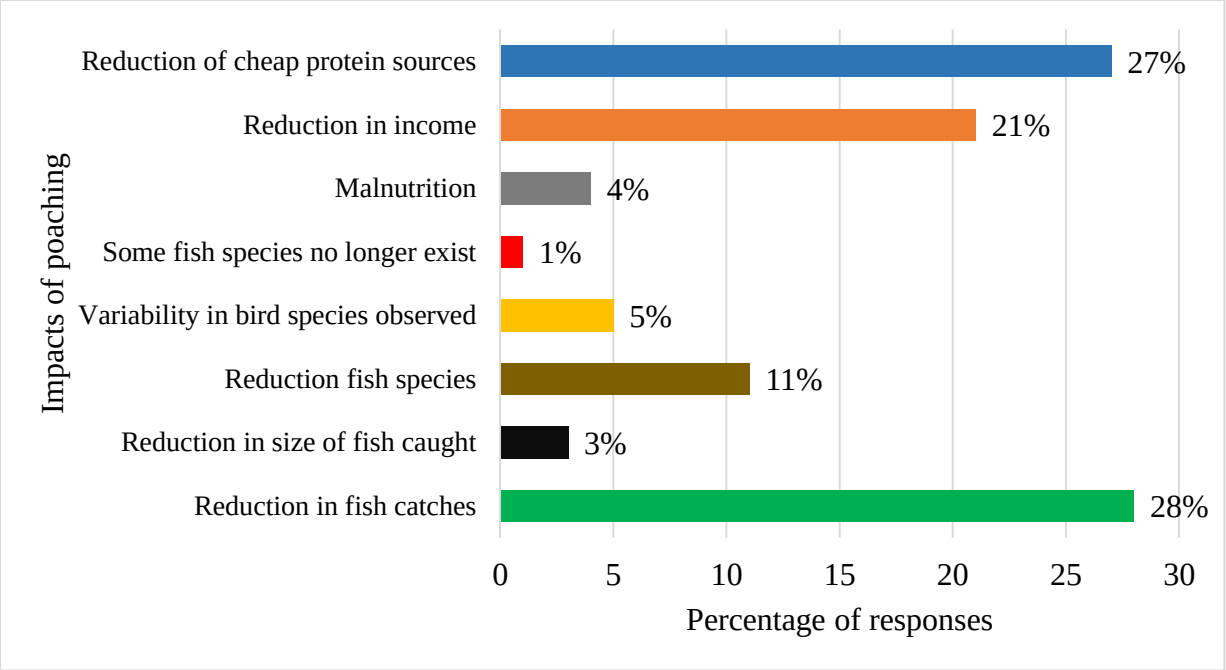

Figure 4. 9: Perceived Impacts of Poaching

The results show that poaching has been causing devastating impacts to both the biosphere resources (fish and birds species) and people's livelihood in Lake Chilwa Biosphere Reserve. The most noticed impacts included reduction in fish catches, cheap protein sources, people`s income and fish species caught over time (Figure 4.9). Variability of bird species observed over time, increased malnutrition cases, reduction in sizes of fish at catch and non-existence of some fish species were other observed impacts but to a smaller extent.

The impact of poaching in the biosphere reserve on species is manifested through reduction in amount of fish catches. It is reported that in the past, the lake used to have a variety of fish species but in recent times only a few species are found in the biosphere reserve i.e. catfish (*Clarias gariepinus*), tilapia (*Oreochromis shiranus chilwae)* and barbus species (*Barbus paludinosus*) (Njaya, 2001). This informs that the number of fish species being caught in the past few years are less than what used to be in the years before. Figure 4.10 shows how

fish catch of different species have been fairing from 2008 to 2017, the trend shows actual reduction in most of the species. The trend in Figure 4.11, shows that there has been a general reduction of total catches of all fish species over time (r^2 = 0.1576, y = -484x + 9173).

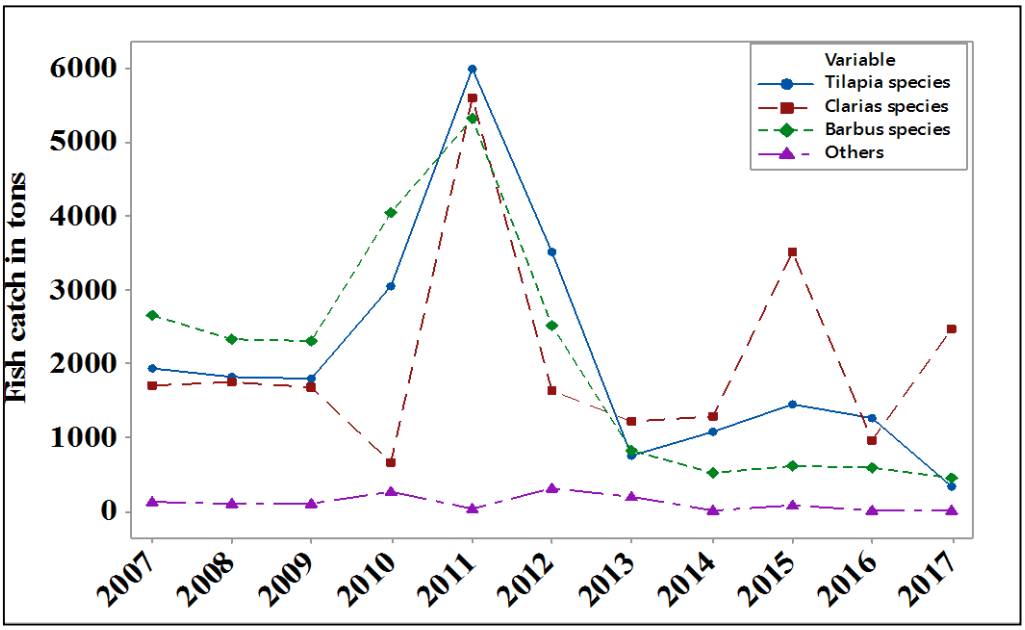

Figure 4. 10: Trend of fish catches in Lake Chilwa Biosphere reserve from 2008 to 2017

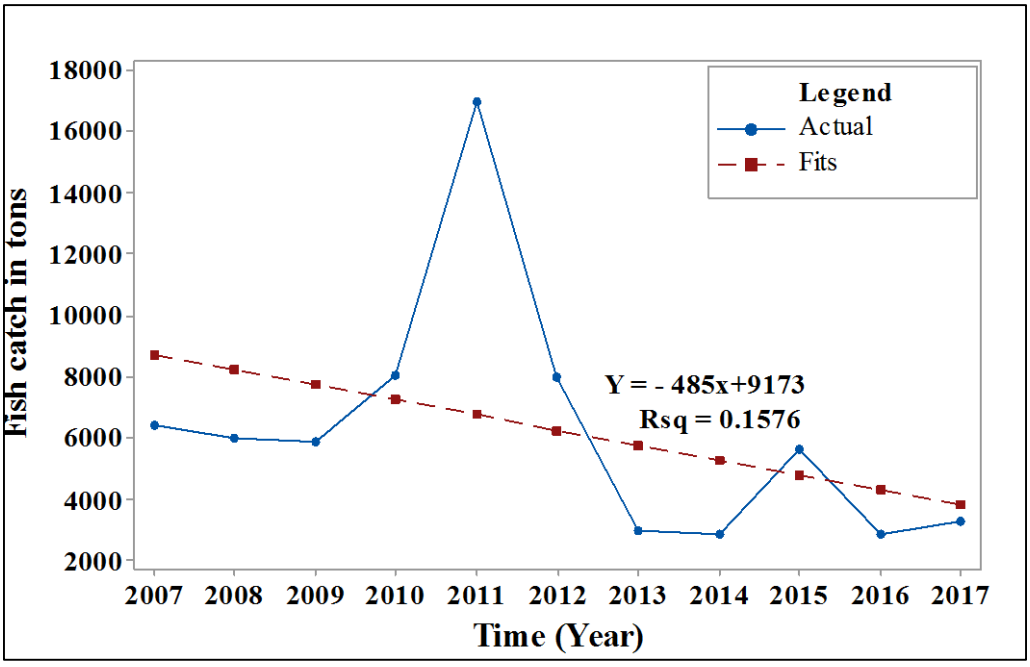

Figure 4. 11: Total yearly fish catches in LCBR from 2007 to 2017

In Figure 4.12, the total yearly number of birds killed/ trapped over the years shows a general increase between 2009 and 2012 which then declined between 2012 and 2013. This

shows the trend is somehow dynamic. The trends line shows a gentle increase in number of birds killed/ trapped though not significant (r^2=0.0088, y = 10.3x + 321).

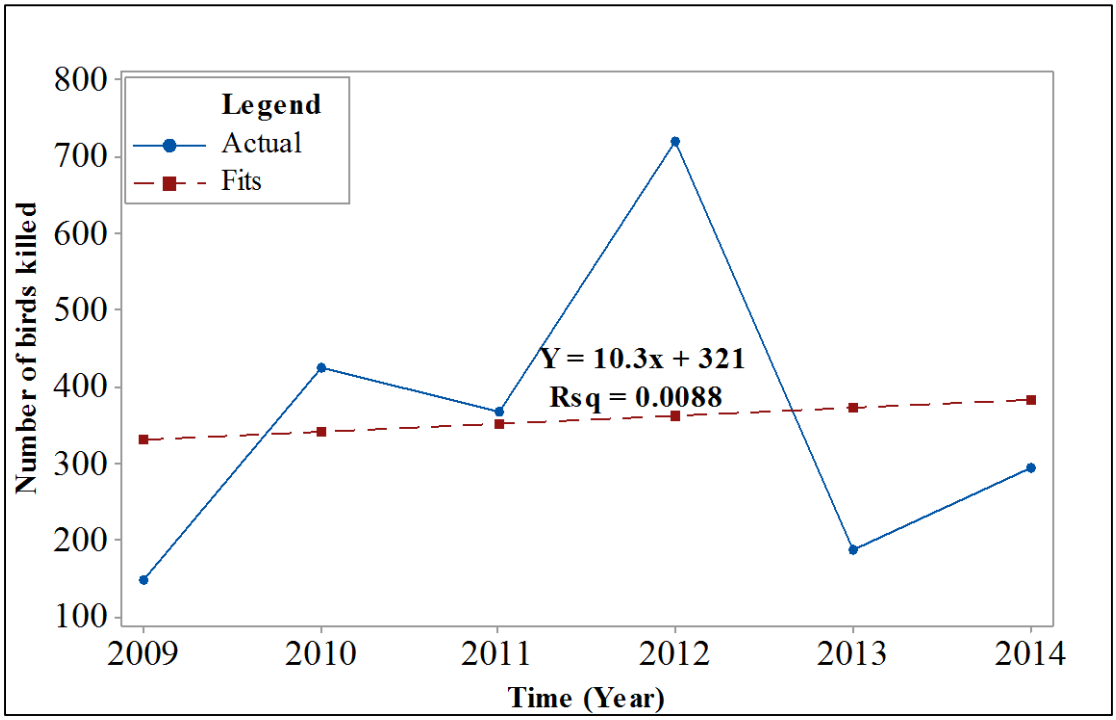

Figure 4. 12: Trend of birds trapped between 2009 and 2014

The changes in number of birds trapped could be attributed to actual reduction due to poaching and reduction in birds migrating to the biosphere reserve due to changes in climatic conditions. Birds are poached for both home consumption and as a source of income. The collapse of the fishery due to overfishing and frequent lake recessions results in killing of many bird species which is considered an alternative source of livelihood to fishing and farming. The major bird species mostly targeted included Fulvous whistling ducks (*Dendrocygna bicolor*), white-faced whistling ducks (*Dendrocygna viduata),* Lesser Moorhen (*Gallinula angulata),* Lesser Gallinula (*Gallinula alleni*), Crested francolin (*Dendroperdix sephaena*), Lesser masked weaver (*Ploceus intermedius*) and Spur-winged goose (*Plectropterus gambensis)* (Wilson and van Zegeren, 1998). However, there is paucity of data indicating the number of birds killed for each species and amount of birds that have been caught in the past because of lack of documentation.

In this study poaching has been shown to be the main cause of reduction in fish catches and size of individual fish caught over time, reduction in variety of fish species caught, seasonal variability in birds species observed and trapped and non-existence of some fish species. The respondents also indicated that these changes would not be entirely attributed to poaching alone

but also the effects of climate change, poor farming practices and destruction of habitats. In another study it was established that the effects of climate change, poor farming practices and destruction of habitats by the rural masses living in the area around LCBR are greatest threats to biodiversity (FISH, 2015). Climate change in the area has been evidenced by fluctuating water levels in the lake, reaching a point of drying up in some years. This affects availability of water in the lake thereby affecting breeding and habitat of fish and bird species. Climate change is also affecting crop production in the area, leading to poor harvests for the community members thereby driving people to rely much on the natural resources within the biosphere reserve both for food and income. It was reported that some people solely depend on the resources from LCBR for livelihood.

Poor farming practices are also blamed for the dwindling fish catches in the LCBR. Some people cultivate in sensitive areas which erode easily during the rainy season as a result, the lake has been accumulating silt thus reducing the water level further. Destruction of habitats by some extractive practices also contribute to loss of important breeding areas for the fish and nesting sites for the birds. People in the area remove vegetation growing in the lake to clear the area for easy movement of the fishing equipment, in the process they destroy hiding place for both the fish and birds. Typha swamps are sometimes used to construct floating islands by fishermen, and some of the vegetation is harvested for thatching of dwelling units.

4.6 Anti-poaching strategies currently in place in LCBR

In this study anti-poaching strategies being used in the biosphere reserve were documented by using focused group discussion where participants mentioned the strategies in place and how they use them. Information was also obtained from Fisheries department and biosphere reserve manager on the anti-poaching strategies in use. In addition a workshop on anti-poaching in biosphere reserves provided some insights on which anti-poaching strategies work better in LCBR. Table 8, present results on anti-poaching strategies and approaches in LCBR.

Table 4. 5: Anti-Poaching strategies and approaches in LCBR

Anti-poaching strategy	Approaches
Enforcement patrols	Vehicle, Motorbike, bicycles and boat patrols
Intelligence led operations	Community informants and deployment of patrols, awareness campaigns and meetings and posters in public places.
Participatory resource management	Community policing, Community participation in resource management.
Policy based management	Licensing of hunting equipment, Closed season observance, Fishing tools specification and Maximum bag allowance

The illegal harvesting of natural resources is a major threat to both animals and plants globally. The increase in human population continue putting pressure on natural resources and the ecosystems services. Globally, regulations have been put in place to optimize utilization of natural resources and their regeneration for sustainability. Malawi being a signatory to international and regional treaties like the CBD, SDGs, Ramsar and others, enacted several policies to guide utilization of natural resources. The results in Table 8 show enforcement patrols, intelligence led operations, participatory approaches and resource management approaches as strategies and approaches in use to counter poaching activities in Lake Chilwa Biosphere Reserve.

Enforcement patrols in LCBR are conducted using motor vehicles, motorbikes, bicycles and boats. The Fisheries department conducts these patrols because extraction of Fisheries resources is intensive than other resources. However, there is lack of documentation on the number of enforcement patrols and arrests made in previous years. District Fisheries offices of Machinga, Phalombe and Zomba conduct patrols depending on the availability of finances. These offices are mostly poorly funded. As a result enforcement is compromised leading to increased incidences of illegal activities in the biosphere reserve. According to Dobson and Lynes (2008) the results from the long-term study in the Serengeti indicate that funds spent on anti-poaching patrols lead to dramatic declines in poaching. Therefore, well-funded institutions can effectively reduce illegal poaching activities.

Intelligence led operations include use of community informants, awareness campaign and posters in public places. Community informants are whistleblowers who work hand in hand with government institution such as Fisheries and local authorities to report non- complying individuals. They work for free and might get an honorarium as an incentive. Awareness campaigns are conducted to remind the communities of existing and emerging regulation pertaining use of resources within LCBR. Posters are also placed in public places such as hospital, markets, along roads and school to communicate important information to the community.

In the LCBR participatory strategies such as community policing and Community Based Natural Resource Management (CBNRM) are used. Community support is crucial for effective law enforcement and essential for developing policies that encourage compliance to regulations. Malawi adopted the bottom – top approach to natural resources management when it was observed that most community based projects were not sustainable due to lack of ownership. The idea led to formation of community management committees by government authorities and projects such as Bird Hunters Association (BHA), Beach Village Committees (BVCs) and Forest Management Committees (FMC) in LCBR. These committees work with government departments and donor funded projects in the management of resources. Existence of the committees complement government effort especially when the mandated departments are unable to execute their duties due to lack of resources. These committees also formulate by-laws in line with government goals to control the hunting of water birds and illegal fishing and they assume the responsibility of enforcing these regulations.

Policy based management strategies such as hunting tool licensing, closed season observance fishing tool specifications and maximum bag allowance for birds hunting are also used to counter poaching in LCBR. Permits are issued by Fisheries and Wildlife Departments to enable people to fish and hunt legally within the reserve. The poachers tend to have no licenses, so with poor enforcement these people still end up participating in hunting and fishing activities. Lake Chilwa is officially closed by Fisheries department between October and January to enable fish spawn. This ensures that the juveniles have a chance of developing into adults for next generations. The government prescribes recommended mesh sizes for fishing tools and prohibit use of tools with differing specifications. This ensures that juveniles are spared but there have been recorded instances of non-compliance and if such culprits are caught, the equipment e.g. fishing gear has been confiscated. However, the offices did not have a data base for information on fishing gears confiscated in the past.

4.6.1 Effectiveness of anti-poaching techniques employed in LCBR

Generally key respondents rated patrols to be more efficient in counter poaching, this was followed by participatory resource management, policy based management strategies and lastly intelligence led operations. Lack of personnel and suitable equipment hamper the enforcement of laws and regulations that govern use of resources within the reserve. However, the major problem is that LCBR does not have a legal status as a protected area despite its international importance. There is no institution solely dedicated to management of the biosphere reserve. Inevitably, resources within the reserve are open access and prone to exploitation and poaching.

4.7 Perception of respondents towards conservation on fish and birds within LCBR

Conservation is key to ensuring continued availability of the resources over time and helps to remove the threat of extinction of important species. Respondents were asked to express their views on whether they think conservation is important and also to give the reasons for conservation. Figure 4.13 present percentage responses on reasons for conservation.

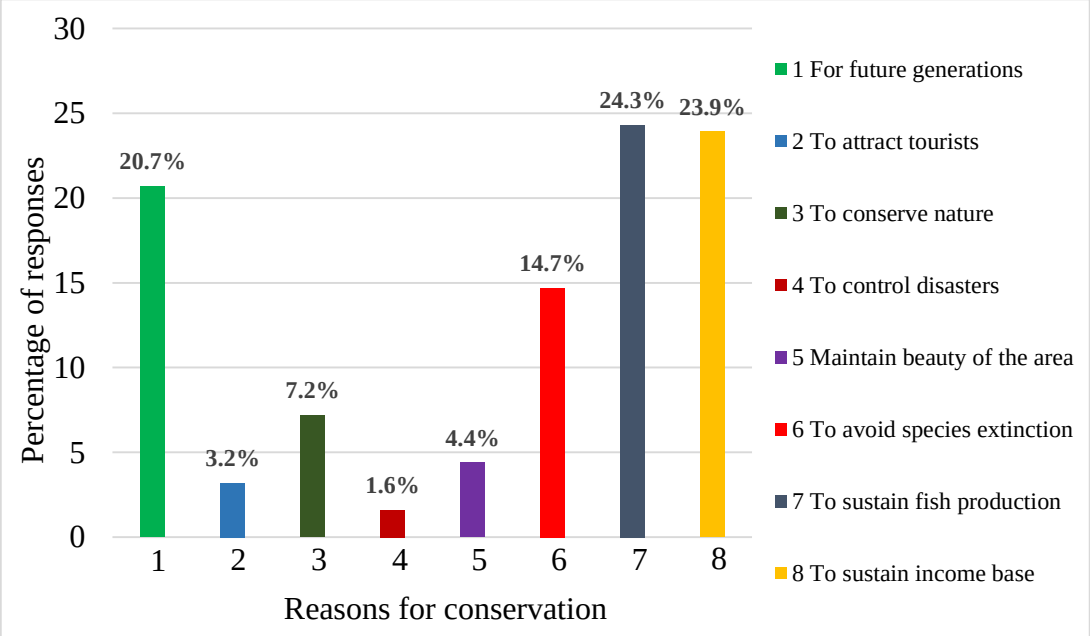

Figure 4. 13: Reasons for conservation in LCBR

All respondents were of the opinion that conservation of wildlife specifically fish and bird species in the Lake Chilwa Biosphere Reserve is a must. House hold heads indicated a number of reasons for need to conserve, which covered the environment holistically but those related to fish and birds were to sustain fish production, income base for the community, for future generations and avoid extinction of species. Conservation of nature, maintenance of

beauty of the area and tourist attraction and controlling disasters were other reasons mentioned for the need to conserve the LCBR. It was indicated that apart from food and income people are more attached to the Biosphere reserve because they also benefit from natural resources such as timber (building materials), farming land, fuel wood, settlement land and water which is used for irrigation and transport. In addition to natural resources, the biosphere reserve is a source of employment especially in the Fisheries sector where people are involved in fish processing, trading and boat building; Further, it is an area of tourism potential because of its aesthetic value.

Report by Chiotha *et al*. (2017) shows that people in the biosphere reserve are involved in several conservation activities which show their commitment to protect the resources at their disposal. Such initiatives include afforestation, conservation agriculture, and use of energy efficient fish smoking kilns. The current results show that despite involvement in illegal hunting activities, people in the Lake Chilwa Biosphere Reserve would want to protect or conserve the resources for the current and future generations. In another study, Elhalawan (2016) found out that many bird hunters in Egypt are interested in some level of regulation of bird hunting activities in order to help sustain birds for future generations, while others are not concerned about the future and believed that God is responsible for the future and will protect and secure birds for the coming generations.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

In this study, an assessment of poaching, drivers and its impacts were assessed, and of special interest was an assessment of the role of food security levels to poaching in the Lake Chilwa Biosphere Reserve. Given the results of the assessment, it was found there is high level of poaching in the LCBR as indicated by the low number of licensed fishing tools and non for bird hunting, increase in number of people joining the fishery and total number of fishing tools overtime.

Socio-economic factors such as education, income and food security level of household influence poaching. Low education levels influence individual involvement in poaching activities because their chances of being employed in the formal sector is very low. They thus opt to engage in poaching to earn income for their households. Food insecure households are more involved in poaching than food secure households. Food insecurity of households also influence poaching. Reduction in food production results in an increase in the number of people joining the fishery and bird hunting sectors. Poaching is also a key coping mechanisms during food shortages. Income level of individuals were also found to influence poaching levels but it has been observed that both the poor and the rich are involved in poaching. In addition to the above, population increase and inadequate resources for enforcement also encourage poaching.

Poaching in the LCBR has leads to a reduction of fish catches despite the resource being renewable. There is also a reduction of fish in sizes at catch, fish species observed and non-existence of some fish species which used to be there before and variability in birds seen and caught over time. Reduction in the catches has also presented an impact on the livelihood of the community around LCBR, indicated by reduction in people`s income, source of cheap protein and increased malnutrition.

There are some efforts by the government and other institution to reduce the poaching problem in the biosphere reserve. Enforcement patrols, participatory management, management strategies (fishing tools licensing, closed season observance, fishing tools specification) and intelligence led operations are the strategies used to reduce the incidences of poaching. And it was indicated that patrols are the most efficient strategies followed by participatory resource management. The study results also show that people would want conserve the resources of the biosphere reserve for their own benefit and that of the future

generations. The biosphere reserve is the income base as well as source of food for the community.

5.2 Conclusions

I. The study found that there is high level of poaching in the LCBR as indicated by the low number of licensed fishing tools and non for bird hunting.

II. Socio-economic factors such as education and food security level of household play a greater role in influence poaching. In addition, population increase and inadequate resources for enforcement also encourage poaching.

III. Poaching in the LCBR has led to a decline in fish catches, reduction of fish in sizes at catch, fish species observed and non-existence of some fish species which used to be there before and variability in birds seen and caught over time. There is also reduction in people`s income, source of cheap protein and increased malnutrition.

IV. Enforcement patrols, participatory management and management strategies and intelligence led operations are the strategies used to reduce the incidences of poaching.

V. The people in LCBR would want conserve the resources of the biosphere reserve for sustenance and for future.

5.3 Recommendations

5.3.1 Recommendations for policy and practice

I. This study found out that enforcement of regulation is hampered by limited resources given to enforcing agencies. There is need therefore for the government of Malawi to increase financial, human and material resources to agencies responsible for management of Fisheries and bird resources in LCBR. These would ensure enforcement patrols on regular basis to ensure that offenders are afraid and unable to access the biosphere reserve.

II. The communities around LCBR are characterized by low levels of education as observed in the findings. There is need for education on functions and benefits of biosphere reserves and awareness campaigns among communities.

III. LCBR does not have legal protection status like that accorded to National parks and Game reserves. The Malawi government should consider consolidating legal status of LCBR within national legislation, especially the core zone to be accorded Protected Area (PA) status like a national park.

IV. The Malawi government should put up policy framework that will create a good environment for small businesses to thrive to improve the livelihood. This in turn will divert focus from extraction of resources from the biosphere reserve. A deliberate policy framework must be enacted by the Government to provide for sustainable alternatives protein sources (e.g. aquaculture and small livestock farming).

5.3.2 Recommendations for Further Research

I. While this research's aim was to find out the status of poaching, its drivers and impacts in LCBR, a similar study can be conducted in other ecosystems in Malawi that are of similar provisionary significance as that of LCBR.

II. There is need to conduct an assessment on the effectiveness of management measures for LCBR to give room for amendment and review of existing management measures. ecosystem

III. A study can also be conducted to assess impacts on other ecosystem services such as regulatory and supporting as a result of changes in abundance of birds and fish in LCBR.

IV. Climate change has been shown to contribute to impacts felt in LCBR. Therefore research should focus on the extent climate of change has on the fish production, presence of birds and migratory patterns of birds in relation to LCBR.

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APPENDICES

Appendix I: Household questionnaire for community members

I am Patrick Zakeyo, MSc student at Egerton University in Kenya, Department of Environmental Science. I am doing a research on the status of poaching in Lake Chilwa Biosphere Reserve. I am also keen on establishing the food security status in Lake Chilwa BR, and whether it could be one of the drivers influencing illegal fishing and bird poaching.

You are kindly requested to provide honest answers regarding the above issues. Your responses will be confidential and will be used only to enhance the conservation of L. Chilwa BR and identification of alternative intervention that can help to eradicate food insecurity. Thank you in advance for your cooperation.

1. **Bio-demographic information**
   a) Name of respondent (Optional):...…… b) Age……
   c) Sex: □ Male □ Female. d) No. of HH Occupants…….
   e) Contacts……...
2. **Socio-economic information**
   a) What is your level of education? □No formal education □Primary □Secondary □Tertiary
   b) What are the major sources of income for your family?.....……
   ……....
   c) Are there alternative sources of income apart from the above? □**Yes** □**No**
   d) If yes, mention them …..…….
   e) Do you usually have enough money for your family? □**Yes** □**No**
   f) How much is your daily income on average?
   ……..……..**.....**
   g) What is your main occupation?
   .....
3. **Food security**
   a) Are you involved in faming activities? □**Yes** □ **No**
   b) If yes, which crops do you grow?
      I. Food crops…….
      II. Cash crops…….

c) What are your main sources of protein food /meat, fish, etc.?

.....

d) How much do you harvest on average per year?

.....

e) Do you harvest enough food to take you throughout the year until the next harvesting season? □**Yes** □ **No** □ **Some years**

f) If no (e), what coping mechanisms do you use to take care of the deficit……...

g) Is fish part of your protein source? □**Yes** □ **No**

h) If yes (g), where do you get the fish from?.....

i) Are wild birds part of your protein sources? □**Yes** □ **No**

j) If yes (i), where do you get the birds you need for your proteins?.....

4. Tools used and Fish and Bird species commonly targeted

a) What tools do people use for fishing/ bird hunting?

I. Fishing…….

II. Bird Hunting……

b) Are these tools allowed by the government? □**Yes** □ **No** □ **Some of them**

c) For what use the birds and fish people catch?

…….....

d) Which species of fish/ bird do people catch?

I. Fish species.……

II. Birds species..……..

5. Impacts on species and livelihood and their causes

a) Have you observed any change in the number and amount of fish/ bird species caught over the years? □**Yes** □ **No**

b) If yes, what are these changes

……..

c) If yes, what is causing these changes?

……

……..…

d) What impact is this change posing on people`s livelihood?

.....……

……..…..

6. Perception on conservation and benefits from the Biosphere Reserve

a) What does this community benefit from this Biosphere Reserve?.....……

……

b) Do you think that it is good to conserve the biosphere reserve? □**Yes** □ **No**

c) If yes, why?.....

7. Level of poaching, drivers and anti-poaching strategies

e) Do you think poaching is one of the problems facing management of the Biosphere Reserve? □**Yes** □ **No**

f) If yes, what do you think is the level of poaching? □ **Low** □ **Medium** □ **High** □ **Very High**

g) What drives people within the biosphere reserve to poach birds and fish?

……..……

……..……

h) What ant-poaching strategies do you suggest will be good to conserve the BR?

I. Against illegal fishing…….……..

II. Birds hunting…….……

Appendix II: Questionnaire for Fisheries Officers

I am Patrick Zakeyo, MSc student at Egerton University in Kenya, Department of Environmental Science. I am doing a research on the status of poaching in Lake Chilwa Biosphere Reserve. I am also keen in establishing the food security status in Lake Chilwa BR, and whether it could be one of the drivers influencing illegal fishing and bird poaching. You are kindly requested to provide honest answers regarding the above issues. Your office has been targeted because you are entrusted with the management of Fisheries resources, provision of Fisheries extension services and enforcement of Fisheries regulations. Your responses will be held confidentially and will only be used to fulfill the objectives of this study. Thank you in advance for your cooperation.

Name of respondent (Optional) …… District…….....

Designation……Date…….....

1. What is your opinion on the status of illegal fishing in the District?

   □No illegal fishing □Low □Medium □High □Very High

2. Any Biosphere reserve has three zones, zoned according to their functions and characters. In which zone is illegal fishing more concentrated in the LCBR?

   □Core Zone □Buffer □Transition Zone

3. What are the driving factors to illegal fishing? Please rank from 1-6 (1 is the highest, 6 is lowest) tick as many as possible.

   - □ Increasing population growth- Rank……
   - □ Poverty- Rank …….
   - □ Conflicts and displacement- Rank……
   - □ Lack of alternatives to wild protein- Rank……
   - □ Institutional & governance (lack of effective enforcement of laws, Corruption) - Rank……
   - □ Other (specify)……...

4. What are the main purposes of fish captured in the Biosphere reserve? (*Tick as many as applicable*)

   - □ Commercial purposes (International trade)
   - □ Commercial purposes (Local trade)
   - □ Home Consumption
   - □ Medicinal Purposes
   - □ Cultural practices

□ Sport fishing

5. Which illegal tools or methods are used for fishing?

   ……

6. Which anti-poaching strategies/ methods do you use to combat illegal fishing?

   ……

   ……

7. What impacts is illegal fishing causing to the species diversity and people`s livelihood?.....

   ……

8. What problem do you face during enforcement of regulations?

   .....……

   ……

9. May your office assist with the following information

Category	Year									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of fisher folks										
Number of licensed fisher folks/gears										

Fish catch/production for the last 6 years by species

Species	Fish catch/production									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016

The number and types of fishing gears for the last 10 years

Type	Number of fishing gears									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016

Type and number of illegal fishing gears confiscated in the last 10 years

Type	Number of fishing gears									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016

Appendix III: Questionnaire for Biosphere Reserve Manager

I am Patrick Zakeyo, MSc student at Egerton University in Kenya, Department of Environmental Science. I am doing a research on the status of poaching in Lake Chilwa Biosphere Reserve. I am also keen in establishing the food security status in Lake Chilwa BR, and whether it could be one of the drivers influencing illegal fishing and bird poaching. You are kindly requested to provide honest answers regarding the above issues. Your office has been targeted because you are entrusted with the management of wildlife resources, provision of extension services and enforcement of wildlife regulations. Your responses will be held confidentially and will only be used to fulfill the objectives of this study.

Name of respondent (Optional) ……District…….....

Designation……Date…….....

1. What is your opinion on the status of bird poaching in the District/ LCBR?

   □No Poaching □Low □Medium □High □Very High

2. Any Biosphere Reserve has three zones, zoned according to their functions and characters. In which zone is bird poaching more concentrated in the LCBR?

   □Core Zone □Buffer □Transition Zone

3. What are the driving factors to poaching? Please rank from 1-6 (1 is the highest, 6 is lowest).

   - □ Increasing population growth- Rank……
   - □ Poverty- Rank……
   - □ Conflicts and displacement- Rank……..
   - □ Lack of alternatives to wild protein- Rank……
   - □ Institutional & governance (lack of effective enforcement of laws, Corruption) - Rank- Rank……..
   - □ Other (specify)…….....

4. What are the main purposes of birds killed/ captured in the Biosphere reserve? (*Tick as many as applicable*)

   - □ Commercial purposes (International trade)
   - □ Commercial purposes (Local trade)
   - □ Home Consumption
   - □ Medicinal Purposes
   - □ Cultural practices

5. Which bird species are targeted by bird hunters?

   .....……

   ……..

6. Which tools or methods are used for poaching/ bird hunting?

   ……

7. Which anti-poaching Methods do you use?

   ……

8. What impacts is poaching causing to the species diversity and people`s livelihood?

   .....……

   …….

9. What problem do you face during enforcement of regulations?

   .....……

   ……

10. May your office assist with the following information

Category	Year									
	2016	15	14	13	12	11	10	09	08	2007
Number of Bird Hunters										
Number of licensed bird hunters										
Number of illegal tools confiscated										
Estimate of Bird Catch										

Appendix IV: Questionnaire for Agriculture Officers

I am Patrick Zakeyo, MSc student at Egerton University in Kenya, Department of Environmental Science. I am doing a research on the status of poaching in Lake Chilwa Biosphere Reserve. I am also keen in establishing the food security status in Lake Chilwa BR, and whether it could be one of the drivers influencing illegal fishing and bird poaching. You are kindly requested to provide honest answers regarding the above issues. Your office has been targeted because you are entrusted with provision of agriculture extension services, estimating crop production and estimating food situation for the communities. Your responses will be held confidentially and will only be used to meet the objectives of this study.

Name of respondent (Optional) ……District…….....

Designation…….Date……

1. What is the state of food insecurity in the District in most of the years?

   □**Low** □**Medium** □**High** □**Very high**

2. What factors affect production of the following in the District?
   a) Food crops……
   b) Cash crops……
   c) Livestock……
3. What coping mechanisms are used by food insecure farm households?

   ……

4. May your office assist with the following information
   a. Production of major food crops for the last 10 years

Crop Name	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
Maize										
Rice										
Cassava										
Soybean										
Sweet potatoes										
Sorghum										

b. Statistics of Major livestock for the last 10 years

	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
Cattle										
Goats										
Poultry										
Pigs										
Rabbits										

Appendix V: Focused Group Discussion Guide

I am Patrick Zakeyo, MSc student at Egerton University in Kenya, department of Environmental Science. I am doing a research on the status of poaching in Lake Chilwa Biosphere Reserve. I am also keen in establishing the food security status in Lake Chilwa BR, and whether it could be one of the drivers influencing illegal fishing and bird poaching.

You are kindly requested to provide honest answers regarding the above issues. Your responses will be held confidentially and will be used only to enhance the conservation of L. Chilwa BR and identification of alternative interventions that can help to improve food insecurity.

a) What is the status of poaching in the Lake Chilwa Biosphere Reserve?
b) What are the factors influencing poaching in Lake Chilwa Biosphere Reserve?
c) How does food insecurity influence poaching in Lake Chilwa Biosphere Reserve?
d) What impacts is poaching causing on fish, birds and people's livelihood in LCBR?
e) What anti-poaching strategies and techniques are employed in LCBR?
f) How effective are these strategies in counter poaching?
g) Do you think it is important to conserve the biosphere and its resources?
h) Why is it important to conserve the biosphere and its resources?

Thank you for your cooperation.

Appendix VI: Authorization Letter to Carry Research

EGERTON UNIVERSITY
Tel: Pilot: 254-51-2217620
254-51-2217877
254-51-2217631
Dir.line/Fax: 254-51-2217847
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P.O. Box 536 - 20115
Egerton, Njoro, Kenya
Email: bpgs@egerton.ac.ke
www.egerton.ac.ke

OFFICE OF THE DIRECTOR GRADUATE SCHOOL

Ref: NM12/11685/16 **Date:** 6th Sept., 2017

Mr. Patrick Zakeyo
Dept. of Environmental Science
Egerton University
P. O. Box 536
EGERTON

Dear Mr. Zakeyo,

RE: CORRECTED PROPOSAL

This is to acknowledge receipt of two copies of your corrected proposal, entitled **"Assessment of the Status of Poaching, Its Impacts and Food Security as a Contributing Factor in Lake Chilwa Biosphere Reserve, Malawi.**

You are now at liberty to commence your fieldwork. However note the following:

1. You must register each semester
2. Pay your fees every semester
3. Submit progress reports every four (4) months (Masters) or six (6) months (PHDs). Without this, your thesis/project will not be accepted. Forms are available at the Board
4. You are expected to publish one (1) paper (Masters) or two (2) papers (PhD) in peer-reviewed journal and present them before issuance of "Intent to submit Thesis/Project" forms by the board

Thank you.

Yours sincerely,

Prof. Nzula Kitaka
DIRECTOR, BOARD OF POSTGRADUATE STUDIES

DIRECTOR, BOARD OF POST GRADUATE STUDIES * EGERTON UNIVERSITY P.O. BOX 536, EGERTON * 01 SEP 2017

c.c. Supervisors
COD, Environmental Science
Dean, FERD

NK/ear

Appendix VII: Data on Fishermen, Fishing tools, Fish Catch and Birds Killed

A. Data on Number of fishermen

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of Fishermen	4851	4096	3175	8169	3869	5186	5000	5186	5961

B. Data on number of fishing tools

Year	Name and Number of fishing Tools					Total
	Mosquito Nets	Fish Traps	Chomanga	Line and Hooks	Gill Nets	
2008	37	6,669	5,814	1,133	11,136	24,789
2009	9	505	102	108	900	1,624
2010	13	255	99	14	676	1,057
2011	22	11,995	12,242	498	9,764	34,521
2012	6	5,678	11,480	367	4,739	22,270
2013	9	9,612	18,127	10	934	28,692
2014	14	31,898	30,562	1,435	10,169	74,078
2015	4	22,669	51,529	1,793	6,398	82,393
2016	16	9,765	23,178	420	4,571	37,950

C. Data on fish Catches

Year	Fish Species Catch in Tones				Total
	Tilapia spp	*Clarias species*	*Barbus species*	*Other species*	
2007	1943.07	1703.19	2654.81	115.58	6416.66
2008	1823.00	1753.55	2321.23	109.17	6006.97
2009	1798.00	1685.09	2299.15	96.73	5878.99
2010	3038.23	661.08	4053.93	266.09	8019.33
2011	5999.69	5602.33	5324.42	33.74	16960.18
2012	3516.02	1636.51	2519.57	320.93	7993.03
2013	749.50	1208.13	818.87	206.01	2982.51
2014	1071.05	1286.43	531.45	0.00	2888.93
2015	1451.30	3505.99	613.74	89.46	5660.49
2016	1266.06	960.50	597.32	9.73	2833.61
2017	346.06	2469.25	446.94	7.47	3269.72

Appendix VIII: Responses on Drivers of poaching, Coping mechanisms, Protein sources, Impacts of poaching and Reasons for conservation.

A. Perception on drivers of poaching

Responses	Frequency (N)	Percentage (%)
Unemployment	4	1.7
Poverty	85	35.4
Population increase	42	17.5
Lack of effective enforcement of regulations	26	10.8
Lack of proper education	6	2.5
Lack of enough food for households	77	32.1
Total	**240**	**100**

B. Responses on coping mechanisms

Responses	Frequency (N)	Percentage (%)
Livestock sales	1	0.9
Fishing	18	17.0
Charcoal production	1	0.9
Buy food from market	56	52.8
Business	8	7.5
Bird hunting	1	0.9
Provide casual labour	21	19.8
Total	**106**	**100**

C. Responses on protein sources for Households

Protein Source	Frequency of Response	Percentage of Response
Fish	100	31.3
Poultry	83	25.9
Goat	82	25.6
Cattle	25	7.8
Other	14	4.4
Pork	10	3.1
Birds	4	1.3
Rabbits	2	0.6
Total Responses	**320**	**100**

D. Results on Responses of Impacts of poaching

Response Categories	Frequency	Percentage (%)
Reduction of cheap protein sources	87	27.3
Reduction in income for fishing families and traders	65	20.4
Malnutrition	14	4.4
Some fish species no longer exist	2	0.6
Variability in bird species observed	17	5.3
Reduction in variety of fish species caught over time	35	11.0
Reduction in size of fish caught	10	3.1
Reduction in fish catches	89	27.9
Total Responses	**319**	**100**

E. Reasons for conservation

Response Categories	Frequency of Responses	Percentage (%)
For future generations	52	20.7
To attract tourists	8	3.2
To conserve nature	18	7.2
To control disasters	4	1.6
To maintain beauty of the area	11	4.4
To protect fish and birds from extinction	37	14.7
To sustain fish production and supply	61	24.3
To sustain income base for the community	60	23.9
Total Responses	**251**	**100**