

Investigating Measures, Challenges and Possible Solutions for Protecting Endangered Birds Species Around Lake Chilwa Ramsar Site in Malawi

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Abstract

This study was conducted to investigate measures, challenges and possible solutions established when protecting the endangered bird species around Lake Chilwa Ramsar site. Lake Chirwa is a shallow basin lake located in the south eastern region of Malawi. It is the second largest lake in Malawi and the twelfth largest in Africa. Lake Chilwa was designated as a wetland of international importance in November 1997 (Ramsar site No. 869). Its wetland is approximately 2310 km² and it is a home for various bird species whose lives are endangered because of the high demand for the wetland's resources. The drying out of the lake forced inhabitants who depended on it for fish to hunting birds. In order to protect the endangered bird species, Leadership for Environment and Development (LEAD) of Malawi in collaboration with communities around intervened with measures to protect endangered bird species. This study aimed at investigating the effectiveness of these measures. Data was collected through in-depth interviews and focus group discussions. Findings show that the effectiveness of the measures to protect endangered birds species depend on collaborative efforts of various stakeholders and involvement of the local inhabitants of the area. Interventions such as civic education, natural habitat restoration, creation of sanctuaries, annual closed season and patrolling of sanctuaries by game rangers have proven to be the most effective. However, the study found that these measures were effective when LEAD project was in place and became less effective when the project pulled out. The study further found that conflict of interest, encroachment and poaching, lack of resources and resistance to change by some inhabitants negatively affect implementation of the interventions in the wetland.

1. Introduction

Lake Chilwa is located in the southern region of Malawi and on the country's Eastern border with Mozambique between latitudes 250 00'S and 150 30'S and between longitudes 250 30'E and 350 55'E [1]. The wetland consists of lakes, the swamp, marshes and seasonally flooded grassland floodplain. The entire wetland is approximately 40 km² from East to West and 60 km² from North to South with a total area of about 2310 km² [2]. Lake Chilwa is the twelfth largest lake in Africa and the second largest in Malawi. The water levels of the lake are at an altitude of 627 meters above the sea level. The catchment comprises Phalombe district, most of Zomba district and 43 percent of Machinga district [3]. Being an inland basin lake, it only receives water from inflowing rivers without

any discharging the water. Lake Chilwa has five major rivers that flow into it from shire highlands and Zomba Mountain. These rivers include Domasi, Likangala, Thondwe, Namadzi and Phalombe (Fig. 1). In total they contribute 70% of the total inflow to the lake. From Mozambique side, the river that drain into the lake are Nembo, Mbungwe and Mchimadzi. In total they contribute the remaining 30% of total inflow into the lake [4]. Size and salinity of this lake varies depending on precipitation in the catchment area.

The catchment is 8349 km² of which 5669 km² (68%) is in Malawi and 2680 km² (32%) is in Mozambique [5]. A small increase in water level results in the large increase in the lake's surface area. Lake Chilwa is very shallow, averaging between 1 to 2 meters in depth. The wetland has a history of cyclic drying and filling. In the last century alone, Lake Chilwa wetland has dried and filled eight times. The lake dried completely in 1967/68 and in 1996/97. It almost dried up again in 2011 and 2012, this is according to Professor Sosten Chiotha, an expert with the Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP) which is under Leadership for Environment and Development (LEAD). In 2012 it was extremely hot in the southern Malawi, with little rain to fill the rivers that run into the lake. This almost dried up the vast lake Chilwa.

The climate of this region is largely controlled by the movement of the air masses associated with inter-tropical convergence zone (ITCZ). During the summer, high land temperatures produce low pressure and moisture is brought to the catchment through the inflow of maritime air masses from the Indian Ocean [2]. During the winter, the sun moves north, and it cools the land mass causing the development of the continental high-pressure system, then the descending and outflowing air produces the regional dry season. For this reason, rainfall is seasonal and largely occurs during the summer months. The benefits derived from the wetland include: fish as food for humans and birds, building materials for houses, plant materials for weaving of mats, making of fish traps, bird traps and baskets. The water is used for domestic purposes, irrigation and transport. According to National Statistical Office (NSO) [6], economically the wetland produces about US\$ 19 million or US\$21,305 per square kilometre. With 117,013 households living in the wetland, its value translate into benefits of US\$242 per wetland inhabitant [4].

Nevertheless, Lake Chilwa is particularly under threat because it is surrounded by large and relatively poor population which depend upon the natural resources for survival [2]. Overall, the use of water resources in the catchment has increased over the past few decades. Competition between users for watered land has increased over the past decades or more [4]. In addition to use in the locality, the water is used further upstream by Zomba town and its expanding peri-urban areas. There are also negative downstream effects of high-level pollution from several urban sources. Much of the habitat loss in recent years is due to the anthropogenic activities such as; clearing of vegetation for settlement resulting in urbanization, agricultural purposes, and industrialization [4]. According to Waller [7], anthropogenic activities are all occurrences that originate from human activities, rather than from natural causes. These activities degrade and in extreme cases eliminate the native ecosystems. Even when portion of the ecosystem remain intact creating "islands", the resulting habitat may be too small or too widely dispersed to support species [7]. These conditions endanger species of plants and animals and lead to their extinction. Burns [8], defines endangered species as, species of wild animals and plants that are in danger of extinction throughout all or a significant portion of its range.

Over exploitation is one of the anthropogenic activities which occur when a population is harvested beyond sustainable levels causing changes to the populations' size and age distribution. Hunting as a form of sustaining human livelihood where species are killed for consumption or as source of income or predator control occurs as part of exploitation. Species directly impacted are birds of prey such as African Marsh Harrier (*Circus aeruginosa*) and other predator animals such as Hyenas (*Crocuta crocuta*) and Jackals (*Canis aureus*). Another anthropogenic activity impacting the ecosystem is pollution. According to United Nations Food and Agriculture Organization (FAO) [9], pollution is the addition of harmful substances in the environment. Pollution has endangered many animals including birds. Pesticides and other chemicals introduced to an ecosystem significantly harm untargeted species. For example, Dichloro-diphenyl-trichloroethane (DDT) used to fight mosquitoes was eventually linked to decline in the reproductive rates of birds since it alters the bird's calcium metabolism in a way that result in thin eggshells that fail to support the weight of the incubating bird [10]. Other forms of pollution such as thermal, light and noise can each reduce survival rates of species population.

Reduction in the number of endangered species is also influenced by biological and natural phenomenon. Pathogens and diseases are some of the biological causes. The introduction of domesticated animals to new areas of the world has also helped spreading of the diseases associated with them. Such diseases affect native populations which possess little resistance to invading pathogens [11]. These diseases may reach epidemic levels hence decreasing native species richness and abundance in the process.

Another biotic reason is the introduction of invasive species. Many species arriving in new ecosystem are ill adapted and quickly die off. However, the species that survives in the new environment develop adaptive mechanisms that endanger the native species as they are devastated through competition and predation [12]. Different approaches are used to conserve the endangered bird species globally. Laws and treaties exist to conserve endangered species and their environment. Their effectiveness depend on the willingness and ability of governments to enforce them [13]. For example, United States Conservation laws, such as the Migratory Bird

Treaty Act (MBTA) and Endangered Species Act (ESA) help define the United States stance on conservation [14]. Another Act, is the Alien Species Prevention Enforcement Act of 1992 which requires the secretary of Agriculture to work with the Department of Interior, the postal Service, and the state of Hawaii to operate a program to protect the State of Hawaii from introduction of prohibited plants and plant parts [15].

In-situ conservation is a way of preserving endangered species where they are allowed to live naturally in their environment. This can consist of removing snares, educating the concerned community about the value of their wild neighbors, researching the number and needs of endangered species [11]. Species survival plans and ex-situ conservation involves protecting endangered species outside its natural habitats like zoos and botanical gardens [11]. Delivering messages about endangered species and the factors that threaten them in many avenues like in schools, by including environmental issues in the curriculum, print and electronic media, documentaries and public lectures also help in endangered species conservation [7].

In Europe, calls for wildlife conservation in the United States became famous in the early 1900s because of the visible decline of several species and birds were not exceptional. To address the concerns, congress enacted the Lacey Act 1900. The Lacey Act was the first federal law that regulated commercial animals [14]. It also protected the sale of illegally killed animals between states. Other regulations followed, including the Migratory Bird Conservation Act, a 1937 treaty prohibiting the hunting of right and gray whales, and the Bald and Golden Eagle Protection Act of 1940 [12]. Another approach targeting endangered bird species is the Birds Directive which is the oldest piece of nature legislation and was adopted in 1979, in response to 1979 Bern Convention on the conservation of Europe habitats and species. This legislation places an emphasis on habitats protection for endangered and migratory birds [8].

In Africa, the Endangered Species Act (ESA) was enacted by congress in 1973 [16]. Under the ESA, the federal government has the responsibility to protect endangered species, threatened species and critical habitats (areas vital to the survival of endangered and threatened species). Another act is the International Species Action Plan for Conservation of Critically Endangered birds on Saõ Tomé. This is an international Action Plan designed for the conservation of three critically endangered bird species, endemic to the island of Saõ Tomé in Gulf of Guinea of the western equatorial coast of central Africa [17].

In Tanzania, to protect the country's endangered bird species like the White-bin Backed Vulture (*Gyps africanis*), Madagascar Pond-heron (*Ardeola idea*), the government has designated 16 national parks and atleast 40% of its territory is in some form protected. Non-Governmental Organizations also join hands with the government in protecting endangered species and they play the following major roles in environmental governance and conservation: collecting, disseminating, and analyzing information; providing input to agenda-setting and policy development processes, performing operational functions; assessing environmental conditions and monitoring compliance with environmental agreements; and advocating environmental justice [18].

In Malawi, the Wildlife and Environmental Society of Malawi (WESM) was established in 1947 and is the oldest championing environmental education, natural resource management, conservation and research [19]. It was a membership-based organization that was behind the proposed establishment of major national parks. Another Act is the Malawi National Parks and Wildlife Act which was enacted in 1992 and reviewed in 2010. Some of the Act's purposes include: conservation of selected wildlife communities, the protection of endangered species and endemic species of wild plants and animals, the control of import, export and re-export of wildlife species and specimens, the promotion of local community participation and private sector involvement in conservation and management of wildlife and many others [2]. The law represents a major redraft of the old British game law. It protects endangered species and parks. It also sets out the general game law. Non-Governmental organizations are not left out in protecting endangered species as there are a number of them like LEAD Malawi. The organization is committed in scientific investigations on endangered species, running environmental education and awareness campaigns through Chanco community Radio and other Media outlets, leading projects and many other activities [20].

Lake Chilwa Wetland ecosystem is a Ramsar site; thus, it is a site of international importance due to the large number of birds of international importance being supported by the lake's ecosystem. The lake was designated on 1 November, 1997 as a wetland of international importance (Ramsar site No.869) and it is Malawi's only listed site under Ramsar Convention [21]. However, it is neither a wildlife reserve nor a protected area [2], meaning that there are no prescribed systematic practices on the management of natural resources in Lake Chilwa. However, after ecological studies and surveys/expeditions were carried out in the wetland which included: the Lake Chilwa Co-ordinated Research project by the Biology Department of Chancellor Collage University of Malawi (1968), the University of Bristol Lake Chilwa Expedition (1989), and Lake Chilwa Ramsar site study project by the Biology Department of Chancellor College (1996), different conservation measures were adopted. One of the adopted approaches in conservation of Lake Chilwa wetland was Conservation and Management of degraded Lake Chilwa Wetland and its threatened water bird's species. This is an action plan that was directed at fulfilling the main obligations of the Ramsar Convention that is maintaining the ecological character and making wise use of the natural resources at the site [22].

Lake Chilwa Wetland supports 41 species of intra-African migrant birds' species, as such, measures were established to restore the integrity of the wetland in order to create a suitable environment which could attract more species of water birds for the benefit of current and future generation [3]. Specific objectives of the project were: to conduct environmental education and awareness campaigns on the multiple benefits of the ecosystem and sensitize the communities on the dangers of destroying the wetland and its natural resources, integrate local communities and wetland ecosystem management, mobilize local communities and stakeholders to form water birds management committees (WBMCs) and wildlife clubs to rehabilitate the degraded wetland and halt the illegal killings of birds [22]. This action plan brought to birth about fifteen waterfowl and bird management committees (WBMCs) around Lake Chilwa Wetland where water birds nesting and breeding areas are protected and also established bird sanctuaries in strategic points around the wetland. The formed WBMCs are; Issa, Mtila, Khuzumbi, Msinde, Mposa, Mpheta, Namasalima, Khanda, Mbalu, Kathebe, Chiwale, Chiwalo 2, Chisoni, Ngotangota, and Chimgoma.

In addition, Wildlife Clubs (WCs) were also formed. The WBMCs have management objectives which aim at:- sustaining the optimum yield of waterfowl birds for food and sale through prohibiting shooting of birds during their breeding season (mostly January to May), prohibiting all hunters of birds, both by shooting and trapping in the main breeding areas, protecting the habitat, especially in the waterfowl and other birds breeding areas, by prohibiting fires and wanton cutting down of trees and reeds. The second objective is to fulfil the obligations of Ramsar convention through: - the creation of nature reserves that are protected areas free from any human disturbance. Especially hunting, and to appoint and train wardens to look after these areas and provide legal protection through the Wildlife Act for endangered and vulnerable species of birds. In respect to this, thirteen waterfowl sanctuaries have been designated where waterfowls and other birds could nest and breed [23].

All in all, the growing pressure on birds hunting and the shrinking of the lake in recent years due to climate change resulted in biodiversity decrease in the wetland. This alerted the government and stakeholders to come up with measures to protect the endangered bird species. This study therefore set out to evaluate the effectiveness of the measures put in place to protect the endangered bird species in the wetland.

2. Methodology

2.1 Research Site and Data Source

Data for this research was collected from randomly selected villages such as Namasalima and schools along Lake Chilwa wetland, in some of the Water Bird Management Committees (WBMCs) and from LEAD Malawi organization officials. The reason for choosing these sources is that, they are found within the lake Chilwa catchment area. Geographically Lake Chilwa wetland is located in the eastern part of Malawi (Fig. 1).

2.2 Data Collection

For the purpose of this research, both primary and secondary data were gathered. Primary data was collected using interviews. The researcher prepared interview guides for the selected chiefs and LEAD officials as key informants and wildlife clubs in selected schools and Water Management Committees. English and Chichewa languages were used during the interviews. The guide contained open-ended questions which were essential in gathering more exact data and also allowed the respondents to express their ideas and feelings on the interventions for protecting endangered bird species.

2.3 Sample Population for the Study

The study population included: members of Namasalima BHAs, the areas' Village head, Misangu primary school wildlife club members and one LEAD official.

2.4 Data Analysis

The data was analyzed thematically and Excel was used to generate tables for data presentation.

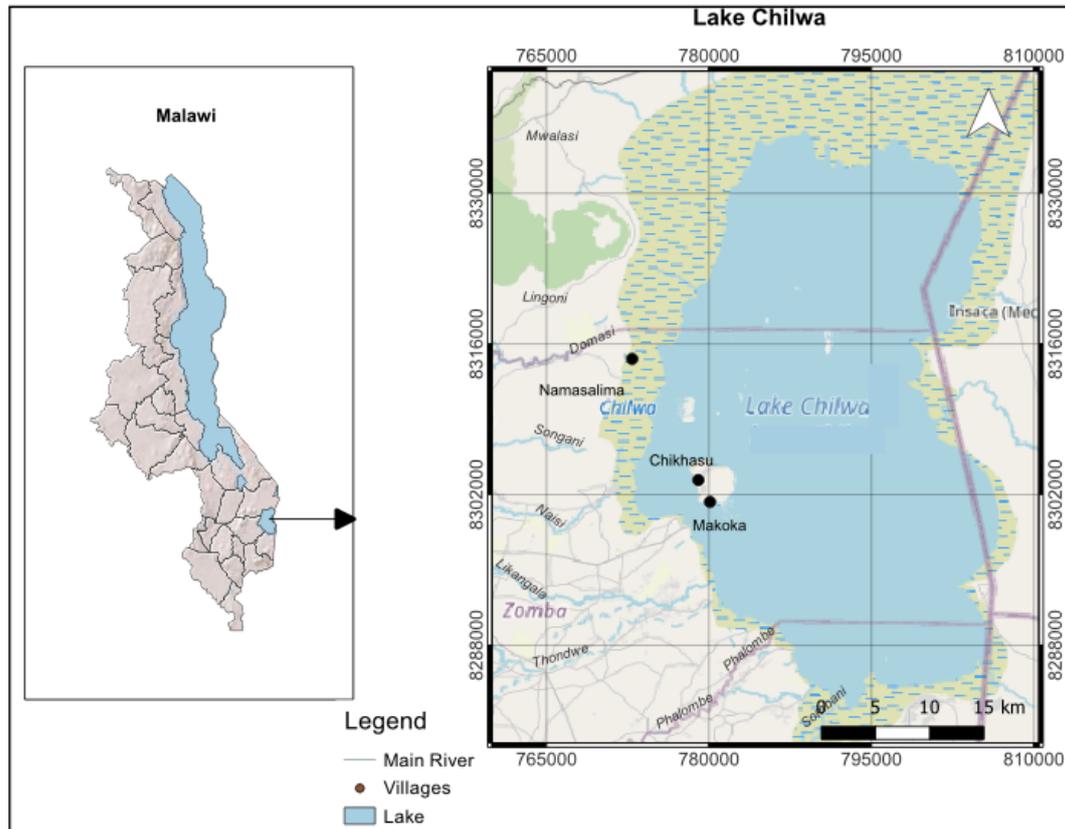


Fig. 1 Showing Lake Chilwa area

3. Result and Discussion

Lake Chilwa has numerous natural resources such as fish, vegetation and a diversity of birds' species. It has about ten resident bird species and 41 species of Palearctic migrant water birds [3]. About 22 species of Palearctic are regular visitors to the lake between September and April every year [3]. These include African spoonbill (*Platalea alba*), Fulvous whistling duck (*Dendrocygna bicolor*), Black-headed heron (*Ardea melanocephala*) and secret marsh birds like Lesser Moorhen (*Gallinula angulata*) and Lesser Gallinule (*Gallinula alleni*). On the other hand, birds of prey are also found in the lake Chilwa wetland. These include the African Marsh Harrier (*Circus aeruginosa*) and the much less common Fish eagle (*Haliaeetus vocifer*). The yellow-billed kite (*Milvus aegypticus*) and the lesser kestrel (*Falco naumanni*) represent the Palearctic migrant birds of prey in the lake Chilwa wetland.

Table 1 Showing local, English and scientific names of birds of Lake Chilwa Basin

Chichewa name	English name	Scientific names
Chiswankhono	African open bill stork	<i>Anostomus lamelligerus</i>
Gagaga	Hadedda ibis	<i>Bostrychia hagedash</i>
Nkhwali	Crested francolin	<i>Dendroperdix sephaena</i>
Nadititi	Southern ground hornbill	<i>Bucorvus leadbeateri</i>
Mpheta	Lesser masked weaver	<i>Ploceus intermedius</i>
Zipiyo	White faced whistling duck	<i>Dendrocygna viduata</i>
Tsekwe	Spur-winged goose	<i>Plectropterus gambensis</i>

There were at least 460 bird trappers in the lake Chilwa catchment [24], and this number has increased over the decade. An estimated 1.2 million birds are trapped every year, with an economic value of US\$21,000. Species trapped in large numbers include the Common moorhen (*Gallinula chloropus*), lesser moorhen (*Gallinula angulata*), Lesser Gallinule (*Gallinula alleni*), Black crowned crane (*Balearica pavonina*), Fulvous whistling duck (*Dendrocygna bicolor*), white-faced whistling duck (*Dendrocygna viduata*) and Hettentont teal (*Anas hottentota*). There are a number of licensed bird hunters. Trapping and shooting of birds of different species takes place every

year with a peak period in the rainy season, which is the hunger season when the harvest from previous year is finished and households look for alternative sources of livelihood [1]. Most recently, in 2018 the lake shrunk by about 60%, forcing most of those fishing there to relocate to other lakes, while the remnants opted for bird hunting as an alternative means of livelihood [3].

In the past decades the number of bird species in Lake Chilwa wetland has been dwindling at an alarming rate because of many reasons including the drying of the lake which meant fisheries collapsed and people resorted to birds hunting as an alternative for sourcing income [24]. Others ventured into charcoal making and basket weaving as alternatives too, these resulted in the depletion of the stands of plants of the birds' habitat [25].

In order to sustain the degraded lake Chilwa wetlands ecosystem, a number of interventions involving the local community, the government and the Non-Governmental Organizations including the international Ramsar convention were reactivated and new ones were also formed. The interventions led to formation of the following Waterfowl and water Bird Management Committees (WBMCs) in 2006 which included Issa, Mposa, Mpheta, Namasalima and Khanda just to mention but a few. In addition to that, nine Wildlife Clubs (WCs) around Lake Chilwa wetland were also formed with 62 women and some were elected as chairpersons and secretaries. This was initiated for the conservation and management of degraded Lake Chilwa wetland and its threatened water bird species in an action plan. This was directed at fulfilling the main obligations of the Ramsar Convention, which is maintaining the ecological character and making wise use of the natural resources at the site [22].

According to Global RCE Network [26], another group of stakeholders in controlling bird hunting is the Bird Hunters Associations (BHAs), locally known as "*Mwai wa Mbalame*" which was formed in September 2001 to promote Community-Based Natural Resource Management (CBNRM) and sustainable ways of hunting the birds. Some are self-supported while others are supported by the Wildlife and Environmental Society of Malawi (WESM).

This brings to the researcher's attention the need to find out the effectiveness of measures put in place to protect the endangered bird species by the government and other stakeholders in Lake Chilwa wetland. An endangered species is a population of organisms which are at the risk of becoming extinct either due to loss of habitat, high death rate or changes in environment and predation parameters [10]. Organisms are termed an endangered species if its population has become small such that free mating and reproduction becomes difficult [11].

3.1 Measures for Protecting Endangered Species of Birds

The participation of various stakeholders in Lake Chilwa wetland established the most successful measures of protecting all the birds including the endangered ones. The interviews revealed that, through the interventions various stakeholders introduced in the area there has been noticeable growth of the birds' population in the area. Including those species that were highly endangered such as: - White faced whistling duck (*Zipiyo*), Spur-winged goose (*Tsekwe*), Southern ground hornbill (*Nadititi*), African open bill stork (*Chiswankhono*) and many others. The measures include the following:

3.1.1 Formation of Water Bird Management Committees (WBMC)

The information gathered from the LEAD officials indicated that they mobilized the communities into forming Water Birds Management Committees (WBMC) who formed BHAs to monitor bird hunting. This was done by certifying members who went for bird hunting trainings to have legal licenses authorizing them to hunt birds during the accepted season. The people were also trained in management of water birds, which included the protection of endangered bird species. This led to the formation of BHAs of which Namasalima BHA was one of them and has been active since its establishment in 2006 [22].

3.1.2 Civic Education and Preservation of Natural Habitats

According to Chiotha et al. [20], environmental education and awareness campaigns are the effective procedures for keeping the inhabitants aware of the measures of protecting endangered bird species and the whole lake Chilwa wetland resources. This is in relation to the research's findings that, intensification of awareness on preservation of natural habitats was the other measure they introduced. This was connected to the information from Misangu primary school wildlife club where the chairperson of the club said; "We do sensitization campaigns where messages on the protection of endangered bird species are conveyed through songs that accompany traditional dances, poems and other activities. Names of the endangered bird species are always included in our performances to help the people to familiarize with these birds' species and check for their safety."

Civic education on climate change and the need to protect the endangered bird species by the wildlife clubs is conducted by the schools within the catchment area. This is done in collaboration with the Chanco Community Radio and has increased awareness amongst the people to be more responsible for their environment. Thus through these various programs the inhabitants of the wetland are more aware of the dangers of setting bush

fires, and they no longer practice farming methods that degrade the land. Most farmers are into organic farming which is more environmentally friendly.

3.1.3 Prohibiting Hunting of Birds Identified as Endangered Species

The respondents' responses were converging to common measures that have brought significant rise in the birds' population in the wetland. Chairperson of Namasalima Birds hunters association (BHA) said;

"Hunting of birds identified as endangered is strictly prohibited and, it is accomplished by encouraging bird hunting using guns to know the kind of bird he or she wants to shoot. If the bird is in class of endangered species it is left and the hunter searches for another species. Because the hunting using guns is not very common as most of the hunters use traps, they are sensitized on importance of conserving the endangered bird species by setting them free if any endangered bird species are caught in their traps as they are taught to be using traps that do not kill the birds instantly".

3.1.4 Formulation of by Laws

In the past, people were hunting birds any how using any method they felt would help them catch many birds. This created a high threat on the endangered bird species in the wetland because some of the methods used were setting of bush fires which caused some birds to fly away from the wetland. This was happening because there were no actions taken on those involved in illegal hunting of the birds in the wetland. Respondents said that;

"By laws were set stating the penalty that one is likely to face if caught hunting and killing the endangered bird species. This works perfectly with the coordination of all the local leaders (chiefs) surrounding the wetland and the police (Sakata and Domasi police stations which are nearest stations)".

A member of Namasalima Bird Hunters Association and the village head Katanda agreed to this in their explanations. This also happens in other countries, for instance in America, there is United States Conservation laws such as Migratory Bird Treaty Act (MBTA) and Endangered Species Act (ESA) which help define the United States stance on conservation [14].

3.1.5 Demarcating the Protected Area

Another measure is creation of a boundary demarcating the protected area. According to Corker, [11] in-situ conservation in which birds are protected in their own natural habitats is the best way of conservation and the inhabitants of the wetland are exactly practicing the same. The monitor of Namasalima BHA said;

"We created a boundary called 'traverse line', the boundary indicates the protected area where farmers or settlers are not required to clear vegetation on that area as it is the habitat for the birds and other organisms. Within the general protected area, a number of sanctuaries were made. These sanctuaries were made deliberately to ensure safety of the birds since the sanctuaries are strictly protected areas where birds breeding takes place".

Sanctuaries are the protected areas within the general demarcated area, which aims at providing a conducive environment for the birds to breed and develop without being disturbed since this area is intensively patrolled by monitors.

3.1.6 Introduction of Closed Season for Birds Hunting

Closed bird hunting season was established and it runs from 31st December to 30th June. During this period, sanctuary patrolling is intensified making sure no one is found hunting or disturbing the birds in any way. The period gives room for the breeding and development of the birds (as some bird species breed about three times within this period). By the time they open in June, the birds are grown, developed enough and are able to fly. This help in conserving bird species in the altricial group of species which are totally helpless at birth and entirely dependent on their parent birds.

"The closed season allows the hatchlings develop into independent birds thereby increasing their chances of survival resulting into increase in the total population of the endangered bird species in the wetland". The Namasalima BHA monitor explained.

Out of the measures that were pointed by the respondents the following measures have proven to be the most effective; habitat restoration through reforestation, which restores the birds' natural habit thereby creating a conducive environment for their multiplication and survival. Another measure is the setting of annual closed season which is the breeding season for the birds where bird hunting is prohibited and sanctuaries patrolling is intensified by the BHA monitors. However, the measure of encouraging bird hunting using guns would have been the most effective one ensuring that the endangered species are not killed in line with the measure of prohibiting the hunting and killing of endangered bird species since the use of guns gives choices on the type of bird to kill rather than traps that creates a higher threat to all birds. This method was ineffective because very few bird hunters own hunting guns since there are laws that regulate gun ownership and most of the hunters do not show interest to undergo all such processes but simply rely on the traps for hunting. Although there is a program that

encourages the hunters not to be using traps that kill the birds at the spot, it has been noticed that other hunters more especially illegal hunters (poachers) use such traps which put lives of endangered bird species at risk.

3.2 Challenges Faced in Protecting the Endangered Bird Species Around Lake Chilwa

The challenges common in all the clubs include; poaching, conflict of interests, encroachment, breaking of the by-laws and low support from the government, non-governmental organizations and the chiefs resulting in the lack of resources

3.2.1 Poaching

The wildlife club, and the BHA indicated that regardless of the awareness campaigns mobile poachers who even kill the endangered species, still invade the protected areas (the sanctuaries) and it is difficult for the monitors to catch them because they have fearful weapons which put their lives in danger. One of the Namasalima Bird Hunters Association monitors narrated that, *“Monitoring or patrolling the sanctuaries is not an easy task since we get attacked and threatened by the poachers. These poachers mostly defeat us because they have with them weapons like guns, panga knives and also boats that help them to overpower us and easily escape through the lake using their boats. The poachers plan and they have their own secret entry and exit points they use. This makes it difficult for us to follow them since we provide our services without weapons since the government does not support us by deploying game rangers as it was in the past. As for the local poachers when we catch them, the traditional leaders who are the custodians of the law, charge them fair fines not as stated in the laws guiding the hunting of birds in the wetland. This problem has risen following the termination of aid from the people of Denmark”.*

3.2.2 Loss of Interest in Bird Conservation

The chairpersons of all the clubs; such as Namasalima BHA and Misangu wildlife club explained how this is negatively affecting their efforts in implementing measures put in place to protect the endangered bird species. The chairperson of Namasalima BHA complained that; chiefs surrounding the lake have stopped mobilizing their subjects on the need to protect the endangered bird species as it was in the past when the measures were being introduced. He explained that; *“There was collaborative efforts where the whole community was responsible for the protection of the birds but now many villagers including the chiefs have switched to farming as such, little is being done in the area of bird protection”.*

This has discouraged many people who were actively involved in the bird protection activities as people are more involved in activities that bring them instant benefits.

3.2.3 Encroachment

This is another challenge which is setting back the protection of endangered bird species in the wetland. It has been noticed that, people are now aware that governments' support through the forestry department in the protection of the birds and the lake Chilwa wetland ecosystem as a whole has declined. Therefore, people are resuming their past practices. Since some chiefs prioritize farming, there are instances where people are opening their farms in the protected areas with backing from chiefs. This increases conflicts between the farmers and the BHAs as the diversion of chiefs away from bird protection programs has made the clubs and associations powerless in controlling the degradation of the wetland. Through this, the protected area is slowly being invaded reducing the total area of the birds' habitat.

3.2.4 Breaking of the Set by Laws

The laws which were effectively impacting the protection of the endangered bird species are no longer valued because the chiefs are becoming more corrupt, favoring the law breakers which are the poachers and the farmers. The clubs' members said that the fines, which were heavy and difficult for poachers to pay, have been diluted to a level that it is not painful for the law breakers to pay. As such, the illegal hunting of birds' syndrome has perpetuated, thus risking the lives and population of the birds in the wetland including those of the endangered species. When people encroach the protected areas, the associations' personnel feel helpless because the people claim to have bought the land from the custodians of laws themselves (the chiefs). This has imposed a great challenge to the lake's ecosystem as it is contributing to the loss of the lake's area. The cultivation of the land accelerates the rate at which soil is eroded thus, depositing the silt in the lake. This reduces the total lake's area as there is increased growth of hydrophytes. Thus, leading to further drying of the lake is a development which keeps migratory birds away from the wetland.

3.2.5 Lack of Resources

Another biggest challenge is the lack of resources in implementing the proposed measures. The problem has risen due to the phasing out of the non-governmental projects. This has also led to reduced support by government in the initiative to protect endangered bird species in the lake Chilwa wetland. The active catchment area projects started phasing out in the year 2014 and others in 2016 to an extent that there are no active non-governmental organizations directly protecting birds.

The government was providing support by deploying game wardens also known as game rangers to the area and wardens were given proper weapons for their work. The work of these game rangers included; patrolling protected areas, monitoring wildlife to prevent poaching, engaging local communities in conservation of the wetland, helping the communities resolve human-wildlife conflicts and assisting tourists (who mainly enjoy bird watching). These activities were being exercised in collaboration with the Bird Hunters Associations and the school's wildlife clubs. The police were also actively involved in enforcing the law, ensuring the protection of the birds. As many projects have been phased out, there is a great financial constrain to sustain the installed measures. Some of the non-governmental organizations working in the area were; LEAD Malawi, Department for International Development (DFID), (Technology Information, Forecasting and Assessment Council (TIFAC) and they were also working with the governmental stakeholders like, the fisheries and forestry departments. Some of the members of the Bird Hunters Associations have lapsed their membership and only a few members have remained. A committee member of the BHAs narrated that;

"We used to support our families with the benefits we used to gain when the donors were active, but now there is no any other benefit as such we are not as committed as before because we also find other means to sustain our families".

They also said that even when they are willing to provide their services in protecting the environment, resources like seedlings for restoration of the wetland ecosystem are scarce too. This implies that the projects lacked a feasible sustainability plan.

3.2.6 Resistance to Change

The other major challenge which stakeholders encountered was intolerance as the inhabitants did not just welcome the new measures but there was some sort of resistance which took some time for them to understand and change their mindset. After a series of awareness campaigns, the inhabitants of the area understood how beneficial it was to protect the wetland ecosystem. In that protecting ecosystems help to provide a conducive environment for birds' development. However, there were a few individuals whose mindset was not transformed and they continued with the activities that kept degrading the ecosystem like charcoal burning, overexploitation of birds, setting bush fires as a means of hunting mice and other activities.

3.3 Solutions to The Challenges Faced by The Local Communities and Stakeholders

The inhabitants and the stakeholders of the wetland collaborated in coming up with the solutions to ease the challenges they were facing in the protection of the lake Chilwa ecosystem. Many of the challenges arose because the locals were over reliant on the direct wetland's resources to sustain their livelihood. Hence the large and relatively poor population relied heavily on the wetland's natural resources for their survival [2]. The ongoing sensitization programs were an eye opener for the villagers to come up with other alternative sources of income generation for their sustainability. The following are the alternatives that have reduced the pressure on the wetlands resources and contributed to the restoration of the wetland's ecosystem.

3.3.1 Introduction of Microfinance Groups

The inhabitants were introduced to other income generating activities so as to prevent them from relying on the wetland resources to sustain their livelihood. In response to this, a number of village banks were introduced where the members join with shares and they borrow the money at a fair interest and after a set period they share the profits and continue with the money saving process. This has improved lives of many households in the area because they are equipped with entrepreneurship skills, bringing an economic revolution in the area as many inhabitants are doing small businesses. For example, there was an introduction of *Kaunjika* (selling second hand clothes), others opened mini-shops where they sell groceries.

Others were trained in designing and tailoring and in production of confectionaries using cassava flour. In response to this, local bakeries were developed where they produce scones, cakes and bread. The businesses have resulted into the development of a market called *ku* bridge where traders from other areas come to sell their goods during market days, hence bringing the peoples' needs closer and enabling them gain diversified entrepreneurship skills. The village head Katanda of the area explained on cassava flower bakery and other businesses which were introduced in the area. She said;

“Villagers are no longer engaging themselves in activities that endanger bird species as was before because they are now introduced to other alternatives in income generating activities such as baking using cassava flour. Village banks were also introduced in the area. This is also helping members to access soft loans as capitals for their businesses such as selling of second hand clothes, hawkers and tailoring”.

The idea of microfinance groups in the area was initially introduced by an organization called Community Savings and Investment Promotion (COMSIP), with an aim of creating opportunities for the community members to be able to save and invest, enabling them to build financial muscle and being self-reliant. The involvement of various stakeholders indeed show that, the effectiveness of the protection of endangered bird species require collaborative efforts as the theory of “Collective action” suggests that there is power in unity [27]. The organization (COMSIP) conducted trainings involving the inhabitants of the area and their chiefs. The people were trained on how to operate the microfinance groups and the entrepreneurship skills, a development which has eased the pressure on the wetland’s resources that’s maintaining the wetland’s ecosystem hence, increased birds’ population.

3.3.2 Livestock Production and Apiculture

Dairy cows were distributed to farmers clubs, and they were sharing one cow per household thus introducing some of the farmers to dairy production instead of fighting for the limited schemes area. Apiculture was also introduced and the farmers were encouraged to establish woodlots within their compounds. These initiatives have improved lives of the farmers economically while reducing deforestation as the farmers were taught to use firewood from pruning of their woodlots. These have created a means of sustainable livelihood for the inhabitants while providing solutions to problems that were being encountered in protection of the endangered bird species. These initiatives have also greatly impacted environmental protection. The patron of Misangu Wildlife club explained that:

“Apiculture has greatly assisted in maintaining the ecosystem in the area. Most families are planting more trees yearly to support their bee farming which in-turn reclaims the lost vegetation in the wetland. Apart from that, dairy farming is also proving to be another reliable source of income in the area. This also prevent unnecessary cutting down of trees in the area which are habitats for some endangered bird species”.

3.3.3 Sensitizing The Farmers on Improved Agricultural Practices

Namasalima is a well-known area for best rice production as the lake Chilwa feeds the irrigation scheme around. Farmers grow crops like water melons, maize, vegetables and many others. The increased population increases pressure on the scheme which eventually creates a threat to the wetlands ecosystem that is home for many wildlife including the water birds. To ease the problem of encroachment, other agricultural practices that conserve the environment were introduced. For example; livestock production where the animals are reared under zero grazing system, organic farming which involves practices like zero tillage, planting of nutrients improving trees such as, *Gliricidia sepium*, *Tephrosia vogelii* and many others, reduce the rate of soil erosion and help fix nitrogen in the soil. This is intensified by the wildlife clubs through their sensitization programs as they include messages of these practices in their songs, poems, drama and speeches. The improved farming practices reduce the rate of soil erosion thus preventing siltation which contributes to the drying of the lake. The nutrient adding trees which are planted are essential in returning moisture and improving soil structure thus, increasing the overall productivity hence leading to food security and financial stability.

4. Conclusion

In conclusion, this research was aimed at finding out the effectiveness of the measures put in place to protect the endangered bird species in Lake Chilwa wetland. The research has discovered that the effectiveness of any intervention relies heavily on the understanding of the interventions introduced, the involvement of the inhabitants of the area and Collaborative efforts of various stakeholders.

The research has also found out that some of the interventions are effective and have an immediate positive impact on the population of the endangered bird species in the wetland. Some of the measures that have proven to be the most effective ones are: civic education campaigns which keep all the people aware of the interventions in the wetland and knowledge of the endangered species and why they have to be protected, natural habitat restoration and preservation to provide a conducive environment for the breeding of the birds and their survival, creation of sanctuaries within the protected wetland to offer a more protected breeding and developmental area for the birds which increases chances of their survival, annual closed season where hunting is prohibited to provide room for the birds to breed and develop by acquiring survival skills like flying and finally patrolling the sanctuaries all the seasons to prevent hunters from hunting in such areas as they are the main breeding areas for the birds.

The challenges encountered in the protection of the endangered bird species are conflict of interest, encroachment and poaching, lack of resources and resistance to change by some inhabitant. On the other hand, introduction of microfinance groups, apiculture and livestock (dairy) production and sensitization of the community members on improved agricultural practices have a greater impact on restoring the environment and protecting the endangered bird species.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Susan Banda, Denis Mwenda, James Majamanda; **data collection:** Susan Banda, Denis Mwenda, James Majamanda; **analysis and interpretation of results:** Susan Banda, Denis Mwenda, James Majamanda; **draft manuscript preparation:** Susan Banda, Denis Mwenda, James Majamanda. All authors reviewed the results and approved the final version of the manuscript.

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