

**THE INFLUENCE OF DIFFERENT LAND-USE TYPES ON BIRD SPECIES
DIVERSITY IN AREAS ADJACENT TO UDZUNGWA MOUNTAINS
NATIONAL PARK, TANZANIA**

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CERTIFICATION

The undersigned certifies that he has read and with this recommends for the acceptance by the Open University of Tanzania a dissertation entitled: *“The influence of different land-use type on bird species diversity in areas adjacent to the Udzungwa Mountains National Park, Tanzania”* in partial fulfilment of the requirements for the Masters of Arts in Natural Resources Assessment Management of The Open University of Tanzania.

.....

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.....

Date

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DECLARATION

I, **Christina Daniel Kibwe**, declare that the work presented in this dissertation is original. It has never been presented to any other University or Institution. Where other people's works have been used, references have been provided. It is in this regard that I declare this work as original mine. It is hereby presented in partial fulfilment of the requirements for the degree of Master of Arts in Natural Resources Assessment Management of The Open University of Tanzania

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Signature

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Date

DEDICATION

This research is mainly dedicated to my beloved family who patiently supported me since day one of my studies. It is their perpetual efforts that made me a good background essential for the confidents' accomplishment of this studies. May Almighty God bless them all.

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ABSTRACT

The study has three specific objectives; to examine the land use practised adjacent to the Udzungwa Mountains National Park; to assess the trend of bird species diversity as per land use category adjacent to UMNP and to evaluate the similarities of bird species composition and structure to adjacent UMNP. In this study, three transects were determined to identify bird species in Udzungwa Mountainous National Park. The three selected villages were Sanje, Mang'ula A and Kanolo. A systematic random sampling technique was used to select 60 heads of households for the questionnaire interview. Purposive sampling was used to identify key informants. Both descriptive and inferential statistical analyses were carried out for quantitative data analysis using IBM SPSS version 16 package. Descriptive statistics based on measures of central tendency and measures of dispersion such as means, frequency counts, and histograms was used in the analysis, likewise, the trend of bird species and to compare the similarities of bird species between two land use are done. The type of land use identified were settlement and plantation. Birds' data collection in all land uses involved two methods; transect and direct observation. The data were analysed using the Shannon-Weiner Index (H'). Sorensen similarity index and SPSS. The Shannon-Wiener Index of bird diversity for settlement and plantation were 3.1 and 3.7, respectively. The Sorensen Similarity Index revealed that these two land uses are not similar (Settlement 11 and plantation 43 species) while 22 species were found in both land uses. The results revealed that a high number of bird species were found in plantation land use because of the availability of food and roosting sites for them. It is recommended that to improve bird diversity in areas disturbed and occupied by human activities, gardening and tree planting should be improved.

Keywords: *Bird species, Diversity, Land use, Udzungwa Mountains National Park*

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LIST OF ABBREVIATIONS

CC	Coefficient of Community
MNRT	Ministry of Natural Resources and Tourism
SPSS	Statistical Package for Social Science
UMNP	Udzungwa Mountains National Park

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Chapter one covers the introduction, background to the problem, statement of the problem, and objectives of the study. The chapter also included research questions, significance of the study, and the organization of the dissertation.

1.2 Background to the the Research Problem

Globally, there is much debate over the potential value of land-use systems for the conservation of tropical biodiversity (Kehoe *et al.* 2015). Although species richness was similar between natural and young secondary forests, the number of endemic bird species is significantly lower in the secondary-growth forests. Murthy *et al.* (2016) found that the species mix changed slowly as the habitat changed from natural forest to secondary forest, agroforestry systems, and annual crops.

The forest in the tropical mountains is famous for harboring an array of bird species representing about 75 percent of all avifauna (Jankowski *et al.* 2009). Bird species communities are at risk due to habitat modification and destruction, whereby only 45 percent of all the species have adopted habitat modifications brought about by human activities (Zhang *et al.* 2016). According to Burgess *et al.* (2007) Mountains as a portion of the Eastern Arc Mountains is among the world-known Important Bird Areas (IBA) due to the high diversity of bird species and endemics such as Udzungwa Forest Partridge (*Xenoperdixudzungwensis*) and Rufous Winged Sunbird (*Cinnyrisrufipennis*) and threatened species such as Palm-nut Vulture and Steppe

Eagle. The area also faces the same threatening anthropogenic activities attaching the Eastern Arch Mountains as stipulated by Kideghesho (2015) that cause forest degradation, such as agriculture, collection of firewood, charcoal production, pole cutting, and settlement, which contribute to changes in the land-use type in areas around the Udzungwa Mountain Forest.

Birds provide an important benefit to humans, which attracts some of the human activities in the areas bordering protected areas. potential and well-known pollination and insect control in agriculture fields (Barros *et al.* 2019). Potapov *et al.* (2019) reported that birds have a critical role in the food chain as their position at the trophic level varies greatly from consumer to predator. Birds are used as signs of a healthy ecosystem in many places, and their role in spreading seeds and pollinating plants can't be denied (Gibru, 2021). Moreover, a more important aspect of birds is that they are attractive, and their songs beautifully add value to our refreshment while also contributing to foreign income through birding tourism in places like Udzungwa Mountains National Park.

Tree and bird species are known to be the most sensitive to change and thus the most important indicators of the biodiversity impact of land-use conversion (Msuha *et al.* 2012). Udzungwa Mountains National Park is among the areas that are experiencing severe land transformation due to various human economic activities. These have resulted in intensive degradation that has transformed most of the natural environment, which in turn influences the rate of biodiversity loss (Johansson and Abdi, 2020).

1.3 Statement of the Research Problem

Global forest loss has increased dramatically in the last few decades (1990-2020) where over 420 million hectares of forest have been lost since 1990 (Tsegay and Meng, 2021). Most deforestation has happened in biodiversity-rich tropical forests, which are expected to face more pressure in the future, largely due to agricultural expansion. The conversion of natural habitats, especially intact old-growth forests into agricultural and pastoral lands are among the greatest threats to biodiversity (Wright *et al.* 2012). The conversion of natural forests to croplands is accompanied by an expansion in monocultures of plantation forests to meet the growing demands for timber and associated wood products. The resulting landscapes comprise different mosaics of anthropogenically modified habitats, including farmlands, agroforests, old-growth remnants, logged forests, secondary forests, and tree plantations. The new agroecosystems are often fundamentally different from indigenous natural forests in composition and structure, leading to different ecological and functional processes (FAO, 2013).

The diversity of bird species around Udzungwa National Park is under pressure due to fast population growth, agricultural expansion, and unsustainable land use (FAO, 2013). An increase in human population leads to a great increase in unsustainable land use such as agricultural activities, deforestation, and forest plantation (Waltert *et al.* 2005) which could lead to further habitat destruction, loss of ecosystem services, and species loss of birds. Various studies on bird diversity have been assessing the impacts of habitat factors and land use on birds' abundance and diversity (Seki *et al.* 2018). Several studies have been conducted in Tanzania related to birds and land

uses. A study by Ntongani and Andrew, (2013) assessed the potential consequences of land-use change on bird community dynamics in Kilombero while a study by Seki *et al.* (2018) based on determining the bird species composition in different land use in Kibasira Swamp at Morogoro Region. Another study was by Mutalemwa (2015) which was done in lake Victoria Basin to assess the influence of different land uses on bird and tree species richness, abundance, and diversity. Despite all the forementioned studies, information concerning bird abundance, richness, and diversity per land use are not yet explored. Therefore, this study is designed to assess the influence of land use on bird species in the area adjacent to Udzungwa Mountains National Park.

1.4 Objectives of the Study

1.4.1 General Objective of the Study

The general objective of this study is to evaluate the influence of land use activities on bird species in the area adjacent to the Udzungwa Mountains National Park, Tanzania.

1.4.2 Specific objectives of the study

- i) To examine the land use practiced adjacent to the Udzungwa Mountains National Park
- ii) To assess the trend of bird species diversity as per land use category adjacent to UMNP.
- iii) To evaluate the similarities of bird species composition and structure to adjacent UMNP.

1.4.3 Research Questions

- i) What are the different land-use activities practiced adjacent to the Udzungwa Mountains National Park?
- ii) What is the bird species diversity adjacent to the Udzungwa Mountains National Park?
- iii) What is bird species composition and structure differing area adjacent to the Udzungwa Mountains National Park?

1.5 Significance of the Study

The findings of this study was extremely beneficial in recording various land-use types and bird diversity in the Udzungwa Mountains National Park. Furthermore, the findings are aid in the protection of birds and biodiversity. Furthermore, this research is contribute to a better understanding of the possible effects of land-use change on bird species. In general, the study's findings was used by a variety of stakeholders, including the government's Ministry of Natural Resources and Tourism (MNRT), the Wildlife Division, Wildlife Policy and researchers, to guarantee the long-term protection of biological diversity, including birds.

1.6 Organization of the Dissertation

The dissertation is organized into five chapters. Chapter one includes the background to research problem information, statement of the research problem, research objectives and research questions, significance of the study, and organization of the dissertation. Chapter two covers the definition of key terms,

theoretical literature review, empirical literature review, conceptual framework, and research gap.

Chapter three presents the study area and research methodology. It specifically covers the study area, research design, research approach, population of the study, sampling procedure and sample size, type of data, data collection methods, and data analysis technique. It further includes the validity and reliability of the research instrument and ethical considerations. Chapter four presents the findings and discussions. Issues discussed and elaborated in this chapter include abundance, richness and diversity of species of birds in relation to settlements and plantations. This chapter presents field data collected using different methods such as transect walks established through direct observation in different land-use types. Interviews and questionnaire was administered to the communities found in the study area. Chapter five presents a summary of the study, conclusion, recommendations, and finally presents suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter summarized what others have written regarding the impact of land development on bird diversity. Various research on the impact of land usage on bird species was collected and reported in this chapter. The chapter, on the other hand, focuses on definitions concepts, theoretical literature reviews, and empirical literature reviews. The same data was utilized in the study analysis, making it simple to establish the conceptual framework and research gap for this study.

2.2 Definition of Concepts

2.2.1 National Park

A national park is a government-designated area dedicated to environmental protection(URT, 2009). A national park may be established for public leisure and enjoyment, or historical or scientific reasons. In a national park, the majority of the landscapes, as well as the plants and animals that inhabit them, are preserved in their natural condition. Tanzania's national parks are primarily concerned with conservation. The national parks, which are part of a broader protected environment, were established to conserve the country's unique natural history and offer safe breeding sites for the country's wildlife and plants.

2.2.2 Land Use

Land use refers to the management and transformation of natural or wilderness areas into constructed environments like towns and semi-natural ecosystems like arable

fields, pastures, and managed woodlands (Msofe *et al.* 2019). In other words, land use refers to the classification of land based on what may be constructed on it and how it can be utilized. It's figuring out what kind of community, ecosystem, or settlement can be built on a certain piece of property (Verburg *et al.* 2011).

2.2.3 Bird Species

Bird species are defined as a group of birds that look alike and breed with one another (Fuxjager *et al.* 2016). Bird species characterized by feathers, toothless beaked jaws, the laying of hard-shelled eggs, a rapid metabolic rate, a four-chambered heart, and a robust yet lightweight skeleton distinguish birds from other warm-blooded vertebrates in the Aves class. There are over 10,000 distinct species of birds in the world (Choudhary *et al.*, 2021). Birds have developed over time to obtain forelimbs, by the survival of the fittest argument (Fuxjager *et al.* 2016).

2.3 Theoretical Literature Review

2.3.1 Island Biogeography Theory

Island biogeography is the study of the distribution of species and ecosystems in geographic space and through geological time. Organisms and biological communities often vary regularly along geographic gradients of latitudes, elevation, isolation, and habitat area. Biogeography is the discipline of biology that studies the present and past distribution patterns of biological diversity and they are underlying environmental and historical causes. Biogeography is broken into two subcategories namely phytogeography (which is the study of how plants are distributed on the earth) and zoogeography (the study of how animals are distributed on the earth).

including bird species). The theory of island biogeography proposed in the 1960s is a milestone in understanding how biodiversity is established and maintained (Bermudez and Lindemann-Matthies, 2020).

Alfred Russel Wallace was the one who founded the theory of biogeography after he studied the distribution of flora and fauna in the Amazon Basin and the Malay Archipelago in the mid-19th century. His research was essential to the further development of biogeography, and he was later nicknamed the “father of Biogeography”. Biogeography is very important in understanding how animals and plants have changed the landscape over time. In modern uses of biogeography, scientists have identified plants and animals that live in certain ecosystems or areas classified by their climate, vegetation, and the kinds of life that exist there. There are many ways to distinguish species of birds, the most common being morphology, beaks, scales on legs, jaw muscles, syrinx, and feather tracts.

The theory of biogeography predicts that the species richness observed in an ecosystem is the result of the interplay between three fundamental processes namely extinction, colonization (the dispersal and establishment of species from the continental landmass to an island), and speciation (the generation of new species). The island biogeography theory has three assumptions: 1) species richness is a balance between immigration rates and extinction rates 2) immigration rates are modified by island size and distance from the mainland and 3) immigration and extinction rates are random events and all species have an equal ability to immigrate or become extinct.

Within a few years of the publishing of the theory, its potential application to the field of biodiversity conservation had been realized and was being vigorously debated in ecological circles. Reserves and national parks formed islands inside human-altered landscapes (habitat fragmentation), and these reserves could lose species as they achieved their new equilibrium number, known as ecosystem decay. In species diversity, island biogeography most describes allopatric speciation. Allopatric speciation is where new gene pools arise out of natural selection in isolated gene pools. It is also useful in considering sympatric speciation, the idea of different species arising from one ancestral species in the same area. Interbreeding between the two differently adapted species would prevent speciation. Island Biogeography Theory is a useful tool because it helps ecologists to understand different species how they interact with each other, and how they interact with their environment. Ecologists can look at potential mechanisms that lead to a decrease in species diversity within an ecosystem, and from this knowledge find ways to ensure sustainability in the conservation of the ecosystems.

This theory, island biogeography relates to this study in the sense that speciation and extinction of biological diversity including birds are impacted by habitat loss and fragmentation of terrestrial biodiversity. These two events, habitat loss and fragmentation of the ecosystem are caused by human socio-economic activities such as agriculture and urbanization resulting in land use and land cover change. The study by Msuha *et al.* (2012) argued that large reserves were able to house large population sizes, thus minimizing the risk of extinction of the species present. In small reserves, high extinction rates would result in changes in the species

assemblages in the reserve and lead to habitats that were very different from those initially targeted for conservation. Rimal (2006) found more species of birds in disturbed habitats than undisturbed ones.

Similarly, (Katuwal *et al.* 2016) after analyzing the species richness and composition of breeding birds concluded more species richness can be found in moderately disturbed areas than in disturbed ones. Also, he argued for having higher alpha diversity in the moderately disturbed area but higher beta diversity in the disturbed landscape. Msuha *et al.* (2012) concluded that land-use change ranks among the highest threats to biodiversity and for birds, land-use changes may mean habitat loss, fragmentation, changes in resources availability, and disruption of biotic interactions.

As a result, avian population sizes and assemblage diversity decline in areas subjected to urbanization, agricultural intensification, and land abandonment worldwide. The Island Biogeography Theory fits in this study in the sense that, speciation and extinction of biological diversity including birds are affected by habitat loss and fragmentation of terrestrial biodiversity. These two events, habitat loss and fragmentation of the ecosystem are caused by human socio-economic activities such as agriculture and urbanization resulting in land use and land cover change.

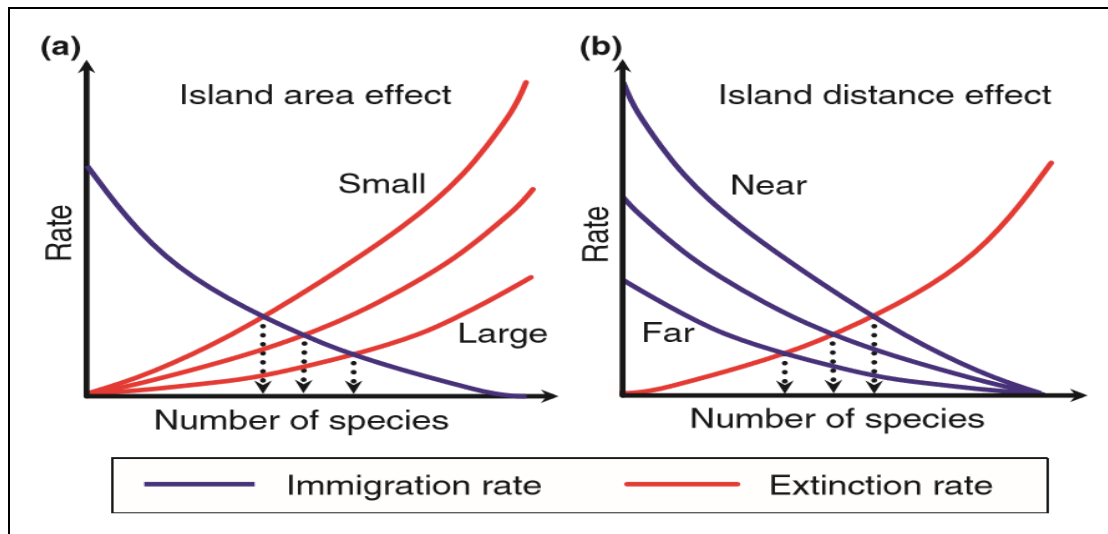


Figure 2.1: Predictions of the distant islands immigration rate and extinction rate

Figure 2.1 Predictions of the distant islands will have lower immigration rates than those close to the mainland, and equilibrium will occur with fewer species on distant islands. Similarly, closer islands will have high immigration rates and support more species MacArthur & Wilson (2001).

2.4 Empirical Literature Review

2.4.1 Birds Diversity and Land Use

As the human population grows, so does the need for socioeconomic activity (Msofe *et al.*, 2019). Settlements, agricultural land, fossil fuel burning, forest cutting, and animal grazing are all affecting vital wildlife habitats, bird diversity patterns, and general biodiversity across the world (Msofe *et al.* 2019). Habitats have been transformed in unprecedented ways, and the effects of these changes on bird community composition, structure, and diversity are yet unknown (Ntongani and Andrew, 2013). It should be emphasized, however, that a failure to comprehend the

impact of changes in these natural habitats on wetland biodiversity is likely to increase human pressure on natural resources in wetlands, particularly birds.

Bird diversity in the early successional forest is usually lower than in mature forest and correlates positively with vegetation complexity and food availability (Mutalemwa, 2015). The results of many studies suggest that a substantial proportion of the native bird fauna in tropical forests is still in secondary habitats, but species composition usually differs markedly in younger secondary forests (Seki *et al.* 2018). The ability of forest birds to persist over the longer term in secondary habitats also depends on the availability of nesting sites and on several other factors such as parasitism, competition, and predation, for which we do not yet have good assessments (Waltert *et al.* 2005). Results of a nest-predation study carried out at Lore Lindu suggest considerably higher predation rates than those in the near-primary forest, a finding that might also be relevant for natural bird populations (Waltert *et al.* 2005).

2.4.2 Birds Diversity in Different Land Uses

2.4.2.1 Habitat Factor

Birds are quite sensitive to changes in habitat structure and composition and are therefore excellent indicators of changes and stresses in the ecosystem. Several studies have found that many recorded bird species have low densities and limited distribution in urban areas. Birds are habitat-specific and some can occupy more than one habitat type, however, because of land uses changes, most of the birds have been displaced from their original habitats. Removal or reduction of vegetation reduces

the total area of contiguous habitat available to birds and increases the isolation of the habitat which results in fragmentation. The fragmented habitat provides a way for various predators that can successfully exploit by eating bird eggs, young and even adults which impacts bird populations (Schlossberg and King, 2008).

In most habitats, plant communities determine the physical structure of the environment, and therefore, have a considerable influence on the distributions, abundance, and diversity of birds and interactions with other animal species. For example, for bird species diversity in forests, (Tews *et al.* 2004) evidenced that the physical structure of a plant community, i.e. how the foliage is distributed vertically, maybe more important than the actual composition of plant species.

2.4.2.2 Anthropogenic Activities

The rapid increase in the human population has adversely affected the diversity of birds around the globe. The negative impact on the human population includes pollution, climate change, deforestation, habitat loss, and the invasion of exotic species. The urbanized areas are very much different from the natural habitats of the species, and with the development of new residential areas and allied facilities, the bigger ecosystems have been fragmented, the natural vegetation has been removed, and many native species have been replaced either with exotic ornamental or with the plants having better yields. Therefore, the natural ecosystems have been altered and changed in urbanized, peri-urban, and forested landscapes. To some extent, moderate urbanization enhances the diversity of some species by providing nesting and foraging sites (Clavel *et al.* 2011). (Mueller, 2022) outlined major threats to birds

including illegal hunting, urbanization, agricultural intensification, eutrophication, pollution, and livestock grazing. These threats are leading species toward extinction.

2.4.2.3 Altitude

The idea that species diversity decreases as you move into higher elevations after a potential peak at middle elevations is one of the most recognized and general patterns in ecology (Schumm *et al.* 2020). Altitude affects bird species distribution and diversity in montane settings (McCain, 2009). Elevation creates a micro-climate which in turn determines the temperature, soil characteristics, and vegetation type of the given environment (Waterhouse *et al.* 2003). This is affecting the distribution and diversity of bird species directly or indirectly by limiting the availability of the requirement and energy in the ecosystem (Bideberi, 2013). Ecological studies show that lower altitude has more bird species than higher altitude while some species are restricted to certain zones and others occur throughout the altitudes (Schumm *et al.* 2020).

2.4.2.4 Climate

Birds face many challenges from climate change, with declines in diversity near the top of the list. The potential for local or continental extinctions increases with the extent of warming. The measure of diversity, known as species richness, is particularly susceptible to local declines as climate changes because bird species richness tends to be lower in hot areas than in cool areas. Birds, like other organisms, depend on their habitat for food, water, shelter, and opportunities to breed and raise their young (Mayr *et al.* 2020). According to (Mueller, 2022), climate change may

alter animal behavior, population size, species distributions, plant and animal communities, and ecosystem function and stability. Temperature is among the climatic element influencing bird distribution. Both the ranges and the abundances of birds shift, on an annual basis, in concert with temperature. For example, one study found that 20 species of migrating birds were arriving about three weeks earlier in 1994 than they had in 1965. A 90% decline in sooty shearwaters off the California coast in just seven years (1987-1994) has been associated with the warming of the California current, which flows from southern British Columbia to Baja California (Lorda and Lafferty, 2012). Hence this reveals that several bird species can, and do, respond to changing climatic conditions.

2.5 Policy Review

National Wildlife Policy was adopted in 1998. The policy was designed to provide the overall objectives and strategies necessary to ensure the sustainable conservation of biodiversity in the country by The Ministry of Natural Resources and Tourism (MNRT). Among others, the vision for the wildlife sector was to promote the conservation of biological diversity (including bird species). After several years there have been considerable changes on the political, economic, and social fronts within the country, which raised the need for regular review of the policy. The focus of these changes has been on stimulating efforts to expand the private sector, in tandem with the disengagement of the Government to promote sustainable utilization of wildlife resources concerning the development of other sectors including land use.

Knowing the potentiality of the wildlife sector as a strategy for poverty alleviation, the National Wildlife Policy of Tanzania was reviewed in 2002, 2007, and 2009 to cope with the dynamism of wildlife conservation. The government of Tanzania's institutional structure reflects co-ownership and co-management of the wildlife community. It streamlines the recently adopted new Wildlife Policy intended to better address the problems and obstacles that have plagued wildlife management in Tanzania. The Wildlife Policy (2009) creates the currently fragmented institutional and legal structure for wildlife management in Tanzania to minimize institutional rivalry and conflicts.

The Wildlife Policy also recognizes Land and Resources Tenure Issues. The National Land Policy acknowledges the growing land and resources tenure conflicts caused by haphazard allocation and extensive exclusion of rangelands for large-scale agriculture (Msofe *et al.* 2019).

Despite the legal status of customary land rights, however, rural lands and particularly pastoral lands, primarily held through deemed rights of occupancy, have been highly susceptible to an allocation by the state in favor of outside interests. A prominent threat to customary rights is from wildlife conservation interests; today about 25 percent of Tanzania's landmass is in the protected estate. Before being gazette-protected areas, these lands and resources were customarily held and utilized by rural people. Because of active state intervention, many citizens have been dispossessed of their property, and this has resulted in a landscape of consumption and not landscapes of production (de Bont *et al.* 2019).

One of the strategies for conserving and managing wildlife resources is to manage wildlife resources based on the ecosystems, rather than administrative boundaries due to the mobility nature of wild animals, availability of resources, and habitat coverage; adding and extending the Protected Areas network based on a system plan, prepared in coordination among different sectors, including consideration of the distribution of species and habitats, present coverage of Protected Areas and patterns of land use. Wildlife conservation is an important form of land use in Tanzania that generates a substantial amount of revenue and foreign exchange. If well developed, wildlife conservation could compete with other forms of land use. However, wildlife conservation has not been developed to its full potential, especially outside Protected Areas.

2.6 Conceptual Framework

The conceptual framework is a figure typically presented as a concept map that summarizes all key information presented in the literature review of the study Elhai *et al.* (2019). The interpretation of this approach is that the species richness observed in an ecosystem is the result of the interplay between two fundamental processes namely speciation and extinction. Speciation can be caused by land-use change or driven by natural selection which can result in organisms that are likely to survive and reproduce and may eventually lead to emerging of new species. Extinction is an irreversible loss of part of the biological richness of the earth, extinction can also be a natural occurrence or caused by land-use change. In this study, extinction and speciation have been caused by land-use change resulting from habitat fragmentation. As a result, habitat fragmentation (including Population pressure,

demand for fuelwood and construction materials, and agricultural expansion) combined with policy and tenure insecurity are the major driving forces behind land-use change which has a direct impact on bird species.

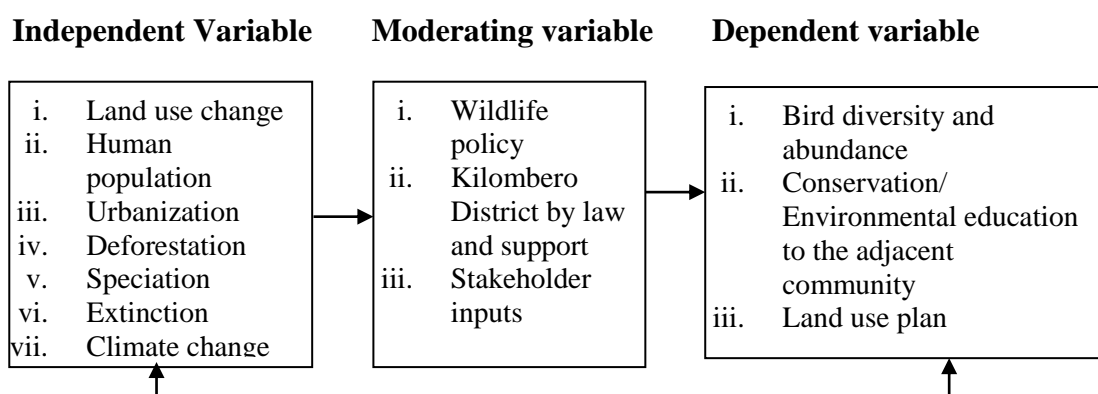


Figure 2.2: The influence of land use on bird diversity and abundance adjacent to Udzungwa Mountains National Park

Source: Kremen et al. (2007)

2.7 2.7 Research Gap

Ntongani and Andrew, (2013) assessed bird species in the montane forest evergreen forests of the Udzungwa Mountains. He found that there was a strong linear relationship between the number of montane species and the size of the forest. He further pointed out that larger forests generally offer a wide range of habitats, and larger populations have less chance of extirpation.

Hariharan and Raman (2022) studied bird diversity across different stages of forests in Uganda and found that tree density was the only vegetation variable that is a significant predictor of the number of bird species. The majority of studies focused mainly on forest ecology or bird richness in the Udzungwa Mountains. None of the

kinds of literature described the linkage between the effects of land-use change on birds' species richness. Hence this study tries to bridge the gap existing between the two aforementioned variables by assessing the influence of land use on bird species in the area adjacent to Udzungwa Mountains National Park.

2.8 Chapter Summary

This chapter reviewed different literature with bearing to the study. It started with the definition of concepts where land, land use, bird, and bird species were defined. It further presented a theoretical literature review. The theory presented in this chapter is land-use expansion and intensification theory. Furthermore, the empirical literature review is provided where different individual studies related to specific objectives were discussed. Finally, the policy review, conceptual framework, research gap, and chapter summary are presented.

CHAPTER THREE

THE STUDY AREA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the study area, research design, target population, sampling procedures, and sample size. This chapter also presents data collection methods, data analysis, interpretation and presentation, reliability and validity of the research instrument.

3.2 Research Design

Research design is the conceptual structure in which research is conducted. The research design enables the researcher to collect data with minimal expenditure of effort time and money (Malodia *et al.*, 2023). According to Hassan and Khairuldin (2020), a research design is a general plan or Strategy for conducting a research study to examine specific testable research questions of interest. A descriptive research design was chosen for this study. The descriptive research design was used in this study because it allow different research methods be used to look into the variables (species diversity, species index, and species similarity) that were studied.

3.3 Target Population

The target population defined as the entire group of individuals, events, or objects having common observable characteristics (Hassan and Khairuldin, 2020). Malodia *et al.* (2023) explain that a population is a subject on which measurement is undertaken, and from which a sampling unity is obtained. The target population

consisted of households located near Udzungwa Mountain National Park, the sampling frame is then drawn from this target population. The target population included bird species from various land uses as well as adult residents (over the age of 30) living near Udzungwa National Park. The reason behind choosing the adult inhabitants is that these people have a lot of experiences and knowledge, as well as the historical background of an area concerning bird species diversity and the external factors resulting in land-use change around UMNP.

3.4 Sampling Procedure

In this study both purposive sampling and simple random sampling techniques were used in selecting the sample. Three villages used in this study were Sanje, Mang'ula A, and Kanolo. From each village, three transects which were located close to Udzungwa Mountainous National Park were identified. A purposive sampling method was used to select the dominant land uses in each street. In all the three villages elders, local government leaders/ officials, and religious and traditional leaders were purposively selected and interviewed.

A simple random sampling technique was employed in this study where the sampling unit of analysis was heads of households from each village (Sanje 1146, Mang'ula A 809 Kanolo 247). Mang'ula A village has 809 households ranging from 1 to 809. A random sample of 10% of the population was chosen, and 81 samples were drawn from the population, or $(10/100 * 809 = 80.9)$ approximately 81, followed by $809/81 = 9.98$ approximately 10. Therefore, random sampling was done for households 1 to 10. Sanje village has 1146 households ranging from 1 to 1146), where 115 samples from

the population were randomly selected, ($10/100 \times 1146 = 114.6$) approximately 115, and the next step was $1146/115 = 9.96$ approximately 10. Therefore, random sampling was done for households 1 to 10. Kanolo village has 247 households ranging from 1 to 247), randomly selected 10%, and 25 samples from the population were taken, ($10/100 \times 247 = 24.7$) approximately 25, next step was $247/25 = 9.88$ approximately 10. Therefore, random sampling was done for households 1 to 10.

3.5 The Study Area

The study was conducted in the village adjacent to the Udzungwa Mountains National Park (Figure 3.1) which is a mountain range lying between $07^{\circ}46'S$ and $36^{\circ}49' E$ at an altitude of 2,579 m (8,461 ft.) above sea level. The Udzungwa Mountains intercept moisture-laden winds from the Indian Ocean and receive more rainfall than the surrounding lowlands. Most of the rainfall occurs in the wet season, which runs from November to May. The reasons for selecting UMNP for this study were its rich biodiversity especially in birds and tree species, where there are more than 400 bird species, 2500 plant species (25% of which are endemics), and 11 primate species. Although there is pressure due to fast population growth, agricultural expansion, persistence in land degradation, and unsustainable land use, Furthermore, the area is home to many endemic plant and animal species (including bird species), which are only found in this part of the world. Thus, enough efforts, including research activities, should be intensified to ensure that the ecological integrity of the area is maintained

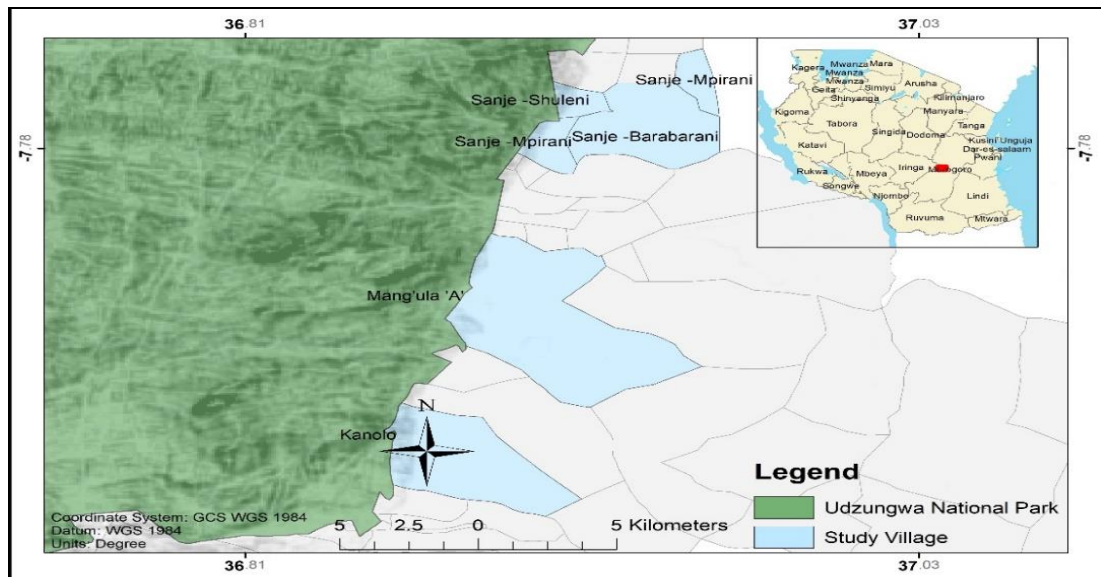


Figure 3.1: Map showing the study area adjacent to Udzungwa National Park

Source: Redlands, 2011

3.6 Sources of Data and Collection Methods

3.6.1 Secondary Data

Secondary data were collected from published and unpublished documents from books, journals, websites, reports, manuscripts, and other documents found in office files and other collections from the library. Secondary data from Udzungwa National Park was used as control data, which was used to make a comparison with primary data from three different land uses selected in this study.

3.6.2 Primary Data

Primary data were collected using transect walk coupled with direct observation in different land-use types (forest reserve, settlement, sugarcane plantation, and rubber plantation). Observation through a transect walk enabled researcher to observe birds per land use category. Questionnaires and interviews were also used to collect

primary data collection from the heads of the household. The heads of the household were asked questions related to bird species, birds diversity and land-use change over time. In the interviews, the study used both structured, unstructured, and semi-structured questions during the interview in the study area. A checklist was used to get information from key informants such as park wardens and forest reserve managers.

3.7 Data Analysis, Interpretation and Presentation

After the data is edited and coded, it was entered into the computer for analysis. The analysis was done using the Statistical Package for Social Science (SPSS) program Version 28.0 (IBM Corp, 2021). The IBM computer software of SPSS was useful in analyzing data by their percentages, frequencies, and in the form of tables, charts, and graphs. The species diversity for both birds and trees was analyzed using the Shannon-Weiner index (H') by using the following formula:

$$H' = - \sum p_i \ln p_i$$

Where: H' = Shannon's diversity index, p_i = proportion of species, i = from the total sample, \ln = natural logarithm, and S = number of species (Seki *et al.* 2018). Also, Species richness was obtained by counting the total number of bird and tree species available within the area. The Sorensen similarity index was used to compare the similarity of bird species between land use categories. It measures similarity in species composition (Gibru, 2021; Kale, 2014; Mahiga *et al.* 2019) for two sites, A and B, by the Equation:

$$C_s = \frac{2ab}{a + b} \dots\dots\dots(2)$$

Where “a” is the number of species found in site A; “b” is the number of species in site B and “ab” is the number of species shared by the two sites. Tables and figures were used to present the results.

3.8 Validity and Reliability of the Research Instruments

3.8.1 Validity of the Research Instruments

According to Sürücü and Maslakci (2020), validity can be defined as the degree to which a test measures what it is supposed to measure. In this study, coding categories connected to context, situation, ways of thinking, perspectives, processes, activities, events, strategies, and relationships were used to ensure the consistency of data. Also, the research participants (informants) who generate the raw data were asked to evaluate the interpretation and explanation pulled from the raw data if represented their experience and knowledge. Other informants were asked to provide commentary on the results.

3.8.2 Reliability of the Research Instrument

To ensure reliability of the research instrument, well-constructed primary data collection methods; interviews and questionnaires were operationalized and supported by direct observation. This ensured reliability, as defined by Sürücü and Maslakci, (2020): reliability is the extent to which an experiment, test, or measuring procedure yields the same results on repeated trials. Reliability refers to the extent to which data collection techniques yield consistent findings. In other words, similar observations or conclusions were reached by other researchers where there is transparency in how sense was made from the raw data (Sürücü and Maslakci, 2020).

Secondary data was collected through document review from other researchers with a high response rate to ensure reliability. The researcher also ensured that the authority or reputation of the source of data was well assessed.

3.9 Ethical Issues

This study maintains the principles of research ethics including the principles of voluntary consent, confidentiality, and enhancement of the rights of individuals. Respondents' participation was voluntary, and the information provided by the respondents was treated as confidential. The researcher had an introduction letter from academic research or research institute as well as following the informed-consent rule. The participants also were informed of their right to access the results of the investigation. In the situations where the case questions that require mentioning names, letters and numbers were used instead. The study also did not intend to cause any harm to the participants in terms of psychological, social, emotional, or physical aspects.

3.10 Chapter Summary

This chapter presented different information about the study area and research methodology which includes an introduction that describes the study area, location, and climate of the study area as well as a justification of the area. The research methodology includes the research design, target population, sampling procedure and sample size. It also includes the Source of data where secondary data and primary data were covered, and data collection methods including questionnaires, interviews, and direct observation. The other sections covered were data analysis including

species diversity, species richness, and species similarity; data interpretation as well as data presentation. Furthermore, the validity and reliability of the research instruments as well as ethical issues were presented in this chapter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings and discussions. Issues discussed and elaborated in this chapter include abundance, richness and diversity of species of birds in relation to settlements and plantations. This chapter presents field data collected using different methods such as transect walks established through direct observation in different land-use types. Interviews and questionnaire was administered to the communities found in the study area.

4.2 Socio-Demographic Characteristics of the Respondents

4.2.1 Age of the Respondents

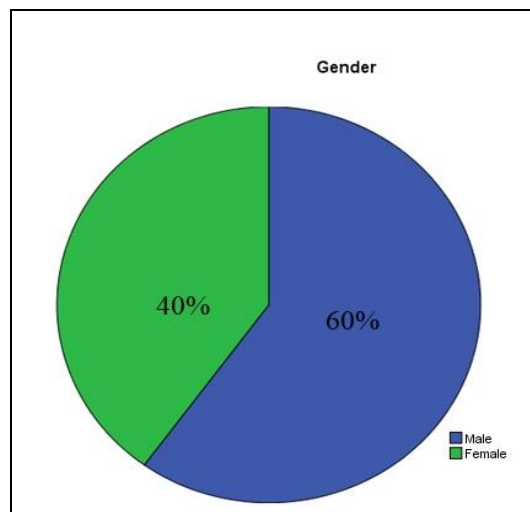
According to the analysis, the respondents were matured enough in a way that they were able to understand and respond to the questionnaires well. About 63.7% of respondents were aged between 28 and above years, while 33.3% of respondents were aged between 18 and 28 years making this sample being with more than half respondents with more than 28 years (Table 4.1). This result shows that, respondents had the knowledge about the area and the trend of land use land cover change in the study area; they were also having knowledge about species of birds and changes in their locality.

Table 4.1: Age of the respondents

S/no	Age groups	Respondents	Percentages
1.	18-28years	20	33.3
2.	29-38years	17	28.3
3.	39-48years	13	21.7
4.	49 and above	10	16.7
	Total	60	100.0

4.2.2 Gender of the respondents

During this study information was collected without gender selection, such that males and females were involved in responding to the questionnaires. The results show that, 60% of the respondents were males while 40% were females (Figure 4.1). Traditionally, in Tanzania men are heads of household as the results most of respondents to the questionnaires were men, in most cases during this study we noted that, women responded to questions only in absence of men from their home. Usually, production activities including agricultural activities that have higher contribution in birds' abundance and diversity are headed by men in their households.

**Figure 4.1: Gender of the respondents**

4.2.3 Education Level of the Respondents

In this study respondents were requested to state their highest level of education according to Tanzanian education system so that their education levels can be identified (Figure 4.2). The results show that majority of the respondents (50.0%) had primary school education level, 36.7% of the respondents have secondary school education level while, 6.7% of the respondents have College/University education level. It was further noted that, only 5% of the respondents did not attend school at all in their life while 1 respondent equivalent to 1.7% of the sample respondents did not state his education level. These results showed that, majority of the respondents have ideas on birds' abundance/diversity on their locality and to some extent they were able to explain how land use changes affected the abundance and diversity of birds in their areas.

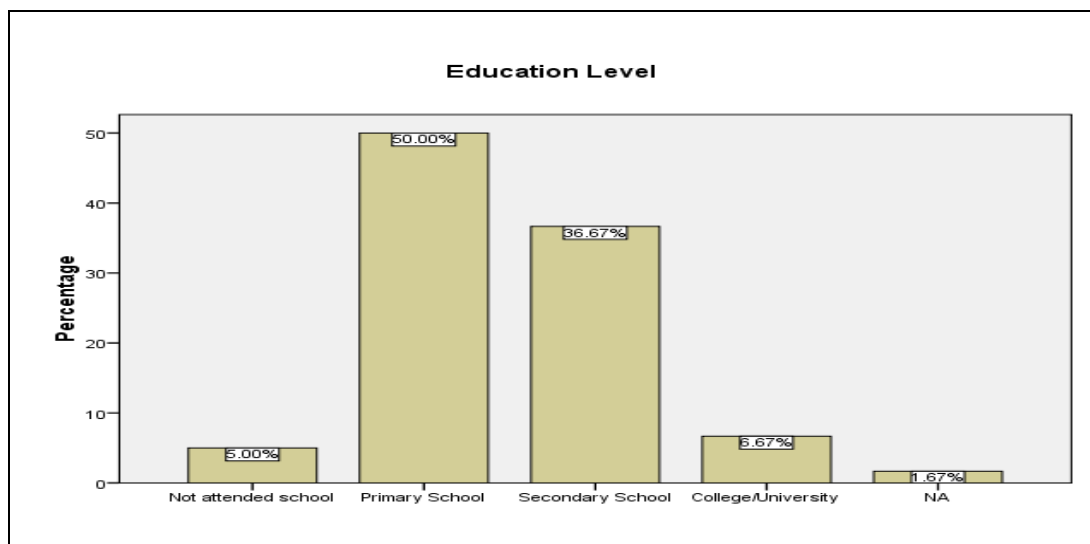


Figure 4. 2: Education level of the respondents

4.2.4 Occupation of the respondents

The study results showed that, majority of the respondents (63.3%) in the study area were engaging in agricultural activities as their main economic activities (Table 4.2).

About 20.0% of respondents engaged on entrepreneur while other respondents were engaging on different economic activities like drivers (3.3%), tour guide 1.7%), livestock keeping (1.7%) and government employee (civil servant) (1.7%). However, 5% of the respondents were un-employed while 3.3% of the respondents did not describe their occupation situation. According to the study finding, the occupation of the respondents is thought to influence bird's species diversity and abundance and contribute to land use change of the area. More than 50% of the respondents seem to engage in the agricultural activities hence have higher contribution to birds' abundance and diversity in their locality in terms of food for birds and other factors related to agricultural activities.

Table 4.2: Occupation of the respondents

S/no	Occupations	Respondents	Percentages
1.	Agriculture	38	63.3
2.	Livestock keeping	1	1.7
3.	Business	12	20.0
4.	Driver	2	3.3
5.	Tour Guide	1	1.7
6.	Unemployed	3	5.0
7.	Did not reveal their occupation	2	3.3
8.	Civil servant	1	1.7
	Total	60	100.0

4.3 Documentation of Different Bird Species, Land Uses and their Varieties

A total of two land use types were documented in the study area which include settlement and plantation (Table 4.3). Settlement land use type consisted of houses surrounded by trees/shrubs and grasses of which some are native and others are exotics. In this study, settlement land use type is found in areas such as Sanje,

Mang’ula ‘A’ and Kanolo (Table 4.3). Land use type in this study is defined as the social-economical change in the study area, though from the ecological point of view land use is defined as the indicator of habitat loss of bird species due to human-induced activities.

Plantation land uses type comprises of different crops including food such as bananas, cassava, yams, rice, maize and sugarcane and no houses in this land use type as compared to the settlement land use type area. During this study, the plantation land use type was encountered in areas like Sanje, Mangula A and Kanolo. Both land use type settlement and plantation was found in the study areas indicating that the community in the study area engaged themselves in both settlement and plantation except for Udzungwa Mountain National Park which is Natural Forest (Table 4.3).

Table 4.3: Land use type adjacent to UMNP

Land use type	Sanje	Mang’ula A	Kanolo	UMNP
Plantation	✓	✓	✓	
Settlement	✓	✓	✓	
Natural forest				✓

The type of land-use determines the abundance, diversity and richness of bird species available in an area. For instance, (Panda *et al.* 2021) argues that, the high number of birds in Indian cities can be explained by the amount of food available, the number of trees that can provide breeding sites, and the traditional goodwill of Indians to all living beings. He further showed that the activity pattern of birds in croplands is influenced by a number of factors such as crop type, non-crop physical structural

arrangement and the agricultural practices. Shift in cultivation timing also significantly affects the activity pattern of cropland birds, which causes further reduction of the population of farmland birds (Panda *et al.* 2021).

4.3.1 Bird Species Richness in Different Land Uses

The study finding showed that, a total of 76 bird species were found in the study area in both habitat types settlement and plantation from which these 76 species belonged to 33 bird families. Data collected from the field revealed that, plantation land had the highest species richness compared to settlement land uses. A total of 43 species of birds' equivalent to 57% of all encountered bird species in the study were exclusively observed in the plantation land while only 11 species of birds (14%) were found in the settlement habitat while the remaining 22 species of birds (29%) were shared in both habitats (Figure 4.3).

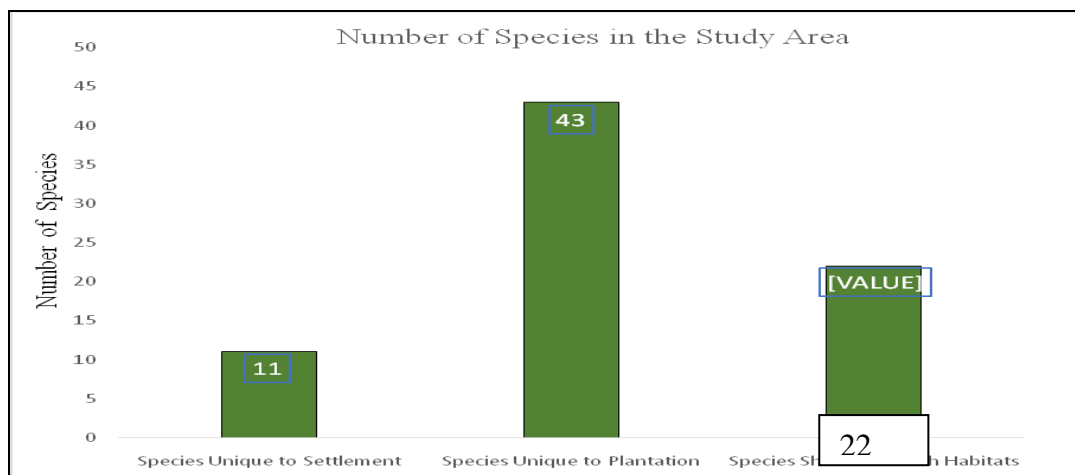


Figure 4.3: Bird species richness between land use types, adjacent to UMNP

The higher bird species richness in the plantation land use type is probably due to presence of food resources including crop remains and fruits as well as less human disturbance. Differences in resource availability between habitats such as breeding

sites, nesting materials, cover, food and water restrict some species to certain habitat type while allowing others to be widely distributed. The high species richness might also be attributed to diverse habitat conditions and seasonality in environmental factors like light, temperature, humidity, precipitation, food availability, vegetation, as well as flowering of plants in plantation landscape.

A study conducted by (Msofe *et al.* 2019; Mueller, 2022; Mutalemwa, 2015) found that the number of endemic bird species was significantly lower in the secondary than in the near-primary forest sites, suggesting that endemic species are more sensitive to forest change and fragmentation than more widespread species. (Mueller, 2022) suggested that the regions with higher available energy (net primary production) will have higher number of species present.

4.3.2 Bird's Abundance in Different Land Uses

The research finding indicates that, a total of 507 individual birds were recorded in the study area which included plantation and settlement areas. Data collected from the field indicates that among 507 individuals collected 174 individuals 34% were sampled at settlements land use type while 333 individual birds 66% were encountered at plantation land use type. This data revealed that plantations land use type has a greater number of individuals bird's species as compared to settlement land use type. Therefore, field data collected indicates that there is higher abundance of birds in the plantation land use type as compared to the settlement land use type because of the variety of foods and micro-habitats found in the plantation.(Figure 4.4).

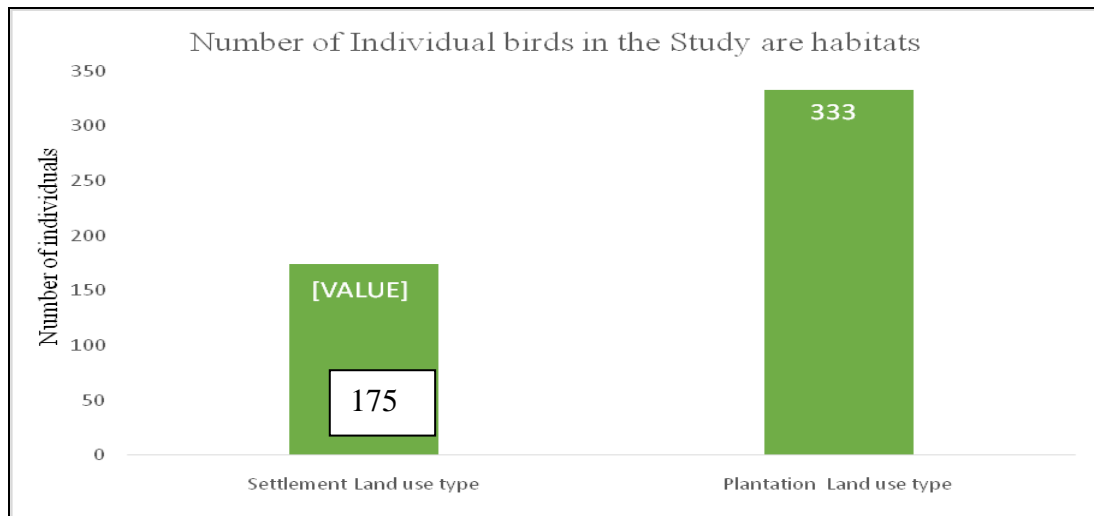


Figure 4.4: Abundance of the bird between two land use types, adjacent to UMNP

Studies show that the level of human disturbance might influence several species found in the area. This goes in line with the findings obtained in the study conducted by (Parajuli, 2022) that, birds in Karra River were seriously threatened by pollution, habitat fragmentation and degradation, mining, poaching and fishing. Overgrazing by domestic cattle, fodder collection, human disturbance, mining, and fires were seriously degrading the bird's habitat of Karra. The ability of the forest birds to persist over the longer term in secondary habitats also depends on the availability of forest resources such as food and nesting materials. Birds are highly sensitive as well as mobile, and thus eminently suitable to study the impact of anthropogenic disturbance on biodiversity (Mahiga *et al.* 2019; Mueller, 2022; Seki *et al.* 2018).

4.3.3 Bird Species Diversity As Per Land Use Category

The results showed that the number of species varies in the two habitats that are characterized by different land use types which are settlements and plantations. The

research findings indicated that the plantation land use type has more species as compared to the settlement land use type whereby during field data collection, a total of 76 species were recorded in this study of which 65 species (86%) were recorded in plantations where by 43 species equivalent to 66% of species found in plantations were described to be unique to this habitat while 22 species equivalent to 34% of the recorded species in plantations land use type were the shared species such that, the same species were recorded in the settlement land use type habitat.

Data collected in this study indicated that a total of 33 species (43%) were recorded in the settlement land use type where 11 species equivalent to 33% of species found in settlements were described to be unique to this habitat while 22 species equivalents to 67% of the recorded species in settlements land use type were the shared species such that the same species were recorded in the plantations land use type habitat. This field data revealed that plantation land use type comprises of higher number of species as compared to settlement land use type. Furthermore, the plantation land use type habitat inhabits a huge number of species that are in the Settlement land use type habitat. This scenario may be related to many human activities conducted by people in the settlement land use type as compared to plantation land use type habitat. This scenario is also described by Kremen *et al.* (2007); Mahiga *et al.* (2019); Msofe *et al.* (2019); Msuha *et al.* (2012); Naidoo, (2004) that, the coexistence between closely related species of biologically diverse ecosystems, thus, could depend on micro-habitats in habitat partitioning (as shading conditions) and species-specific tolerance to environmental conditions (such as thermal stress).

Shannon-Weiner index (H') by using the following formula:

$$H' = - \sum p_i \ln p_i$$

Where:

H' = Shannon's diversity index,

p_i = proportion of species,

i = from the total sample,

\ln = natural logarithm, and

S = number of species (Omayio *et al.* 2019).

From calculations, the Shannon Wiener reveals that plantation land use type has higher diversity compared to settlement land use type such that the Shannon Wiener diversity indices for the two habitats plantations and settlements were Plantation 3.7 and Settlement=3.1 respectively indicating that plantations are highly diverse in terms of species than settlements habitat (Table 4.5).

Table 4.4: Diversity index of birds in the plantation's land use type

Land uses	Settlement	Plantation
Settlement	3.1	
Plantation		3.7

4.3.4 Similarities of Bird Species between Land Use Categories

According to the data collected in the field, a total of 76 species were recorded both in plantations and settlements (Figure 4.5; Table 4.6). Data shows that 11 species were unique to settlements land use type habitat while 43 species were unique to plantations land use type. However, 22 species were recorded to exist in both land

use types i.e., settlements and plantations. The similarities of species in these two habitats were calculated using Sorenson's (1948) similarity index and Coefficient of Community (CC) using the following formula;

$$\text{Coefficient of community } CC = \frac{2c}{a + b + 2c}$$

Whereby,

a= Number of species unique to Plantations land use type habitat which is 43

b= Number of species unique to Settlements land use type habitat which is 11

c= Number of species shared by both land use types habitats which are 22

Therefore;

$$\text{Coefficient of community } CC = \frac{2 \times 22}{43 + 11 + 2 \times 22} = \frac{44}{98} = 0.445$$

According to Sorenson (1948), the two habitats, settlement and plantation land use types are not similar in terms of bird species although these two habitats share some bird species.

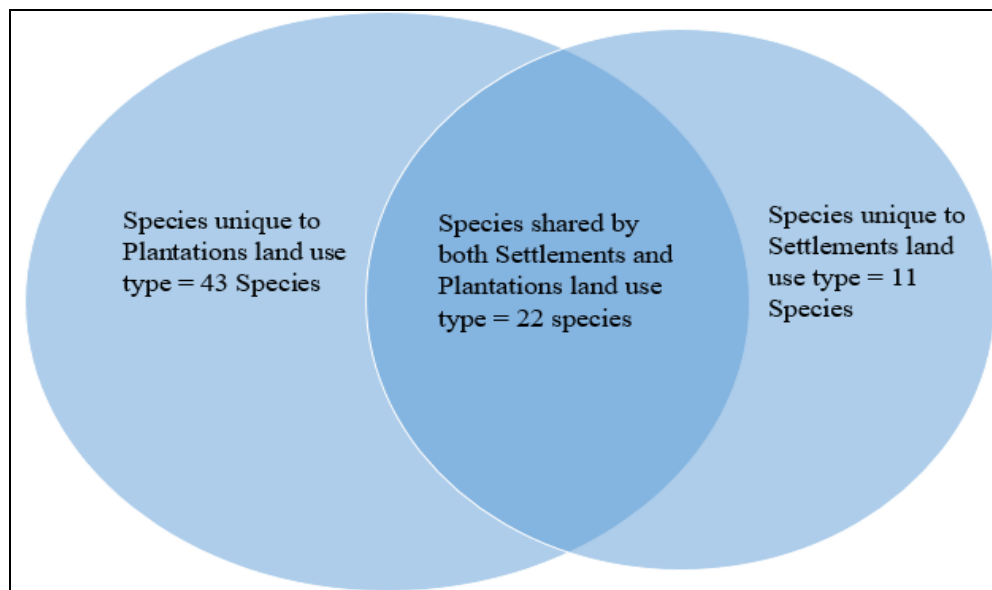


Figure 4.5: Venn diagrams showing species shared and not shared by the land uses studied

Table 4.5: List of bird species shared and not shared by the two land uses studied

Settlement	Shared habitat	Plantation
Black-winged bishop	African firefinch	African grey flycatcher
Black-winged red bishop	African golden weaver	African moustached warbler
Crowned hornbill	Augur buzzed	African open bill stock
Grey-headed kingfisher	Black backed puffbuck	Arrowmarked baler
Grosbeak Weaver	Blue sported wood dove	Black and white mannikin
House sparrow	Bronze mannikin	Black-chested snake eagle
Lesser striped swallow	Collared palm thrush	Black-crowned Tchagra
Little swift	Collared Sunbird	Black egret
Long-crested eagle	Common Bulbul	Black-headed heron
Morning dove	Fantailed widowbird	Black kite
Zanzibar red bishop	Kipengere seed eater	Brown crowned Tchagra
	Pin-tailed whydah	Brown-hooded kingfisher
	Red-billed firefinch	Diederik coucal
	Red-eyed dove	Dwarf bitten
	Southern cordon bleu	Eurasian bee-eater
	Specked mousebird	Fork-tailed drongo
	Striped kingfisher	Grey-backed camaroptera
	Trumpet hornbill	Gros beak
	White-browed coucal	Intermediate Egret
	Browed robin chat	Long-crested eagle
	Yellow bishop	Long-tailed cormorant
	Yellow-fronted canary	Malachite kingfisher
		Marsh sandpaper
		Marsh warbler
		Olive Sunbird
		Pied crow
		Pied Kingfisher
		Red caped Robin-chat
		Rufous bellied heron
		Sacred ibis
		Spectacle mousebird
		Spectacle weaver
		Spotted flycatcher
		Tambourine dove
		Tawny flanked prinia
		Tropical boubou
		Village weaver
		White-browed coucal
		White-browed Robin-chat
		White-throated bee-eater
		White-winged widowbird
		Winding cisticola
		Green parrot

Human disturbances between the land-use types were observed between settlement and plantation. This goes in line with the findings obtained in the study conducted by Seki *et al.* (2018) which stated that bird species diversity and composition in agricultural landscapes in the wet tropics are strongly influenced by the availability of groups of trees and patches of second-growth. Bird diversity in early successional forests is usually lower than in mature forests and correlates positively with vegetation complexity and food availability. Mutalemwa, (2015); Ntongani and Andrew, (2013); and Seki *et al.* (2018) found that bird species diversity was higher in the areas with less human activities i.e. forest, woodland and shrubland than in the settlement and farmland. The higher diversity suggests higher ecological stability compared to human-disturbed habitats where few species occur. The results intersect with those from the study conducted by (Ntongani and Andrew, 2013) that examined the importance of understanding the anthropogenic impacts on the occurrence of avian functional groups because they determine ecosystem functioning.

4.3.5 Land Uses in the Study Area

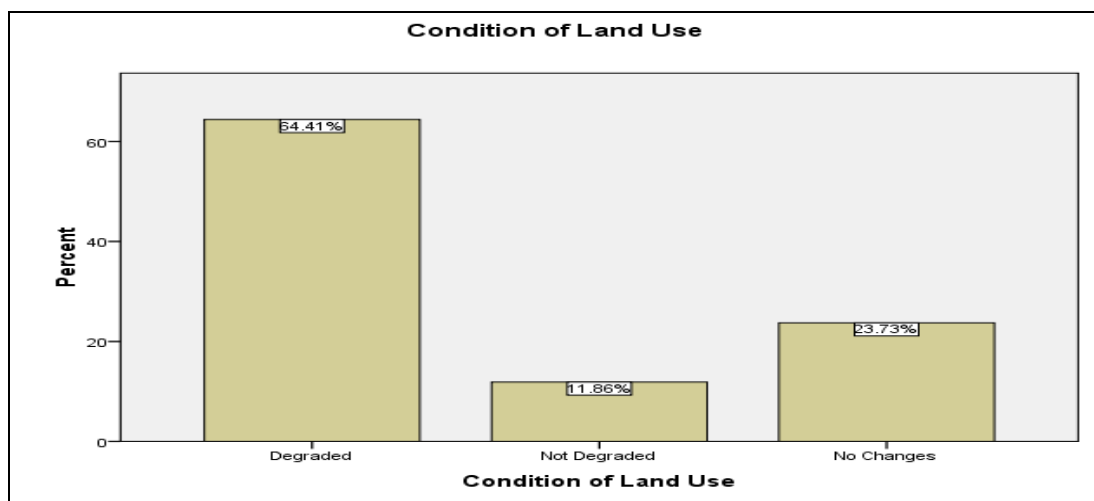
The results of this study showed that the majority of the respondents (66.7%) were engaging in agriculture while 11.7% of respondents explained both agriculture and settlement as another land use in the study areas (Table 4.7). About 8.3% mentioned settlement alone as one of the land uses in the study area. Other land uses include those combining farming and livestock keeping (1.7%); farming and fishing (10%) and 1.7% who deal with farming, livestock keeping and fishing. These land uses have a high influence on the diversity, type of bird species and number of birds found in the particular.

Table 4.6: Land uses in the study area

S/no	Land Use Types	Frequencies	Percentages
1.	Agriculture	40	66.7
2.	Agriculture and settlements	7	11.7
3.	Settlements	5	8.3
4.	Agriculture and livestock keeping	1	1.7
5.	Agriculture and fishing	6	10.0
6.	Agriculture, livestock keeping and fishing	1	1.7
	Total	60	100.0

4.3.6 Condition of Land Uses in the Study Area

The result of the study showed that the land use type conducted by the community in the study area has significant impacts on land degradation as it was revealed through a questionnaire whereby 64.41% of the respondents explained that the land has been degraded. It was further noted that, approximately 23.73% of respondents explained that the land has no change that can be noted while only 11.86% of the respondents explained their land not been degraded at all. Data from the field revealed that land use types conducted by the community in the study area lead to land degradation hence influencing the types and number of birds in the area by affecting resource availability. Resources considered here include food and undisturbed areas for hanging their nests.

**Figure 4.6: Condition of Land Uses in the Study Area**

4.3.7 Drivers for Land Use Changes in the Study Area

Results collected through the questionnaire showed that land use changes in the study area are caused by human activities. Tree cutting, charcoal burning and firewood collection was the main driver of land use changes as revealed by the majority of the respondents (43%) (Table 4.*. Other drivers for land use changes mentioned by the respondents include agriculture and livestock keeping (15.0%), rainfall patterns (16.7%), outbreak of fires (8.3%), climate change (1.7%) and other factors (3.3%). Other factors include floods and monoculture. From the field, data collected from 11.7% of the respondents were not aware of the drivers for land use changes in the study area. Drivers for land use change have significant effects on the availability of resources which are important for birds such as food and water. Hence, these drivers for land use change affected the abundance and diversity of birds in the study area.

Table 4.7: Drivers for land use changes in the study area

SN	Drivers of land-use change	Frequencies	Percentages
1	Tree cutting, charcoal burning, firewood collection	26	43.3
2	Fires	5	8.3
3	Agriculture and livestock keeping	9	15.0
4	Rainfall	10	16.7
5	Climate Change	1	1.7
6	Others	9	15
	Total	60	100.0

4.3.8 Reason for Bird Change Trend in Study Area

Study finding indicates that there have been changes in birds' abundance in the study area over time caused by different reasons. From this study, it was noted that the

strong reason for the change of birds is the food availability. This was revealed in the field where the majority of the respondents (73.33%) explained food insecurity to be the reason for changes in the number of birds found in their areas. Other reasons explained by the respondents to be among the causes of the change in the number and type of birds in the study area were drought (13.33%), destruction of birds roosting sites (5%), agricultural activities (1.67%) and water availability 3.33%.

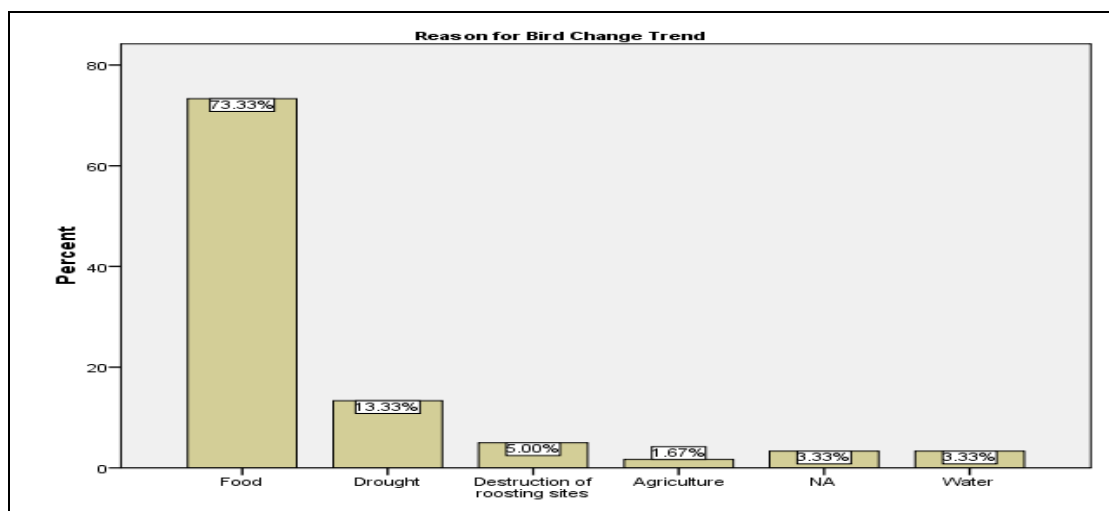


Figure 4.7: Reason for bird change trend in the study area

4.4 Chapter summary

This chapter summarised the results of the study. It started with socio-demographic characteristics of the respondent which comprised with age of the respondents, gender, education levels, and occupations. Documentation of different bird species, land use and their varieties, bird species richness in different land uses. Bird's abundance in different land uses, bird species diversity as per land use category and similarities of bird species between land use categories. The chapter describes the land uses in the study area, condition of the land use, drivers for land use changes and reason for bird change trend in the study area.

CHAPTER FIVE

SYNTHESIS

5.1 Introduction

This chapter presents a summary of the study, conclusion, recommendations, and finally presents suggestions for further research.

5.2 Summary of the Study

The study investigated the influence of various land-use types on bird species diversity and composition in the area surrounding Udzungwa Mountain National Park. The research sought to understand how human activities and land-use changes affect bird populations and provide insights for effective conservation strategies. The introduction chapter provided a comprehensive background of the study, emphasizing the significance of Udzungwa National Mountains National Park as a biodiversity hotspot with diverse bird species. It highlighted the potential threats posed by human activities such as agriculture, logging, and infrastructure development to bird species in the adjacent areas. The objective of the study focuses on assessing the relationship between different land-use types and birds' diversity and composition. Chapter three is a methodology chapter. It presents the study area, research approach, research design and target population. It further covers sampling techniques and data collection methods. Sampling sites were selected across various land-use types, including intact forests, agricultural areas, and urbanized regions. Bird surveys were conducted using standardized methods to record species presence in the study area and its abundance.

The findings presented in Chapter Four revealed the impact of different land-use types on bird species diversity and composition. It was observed that areas with intact forests and natural habitats adjacent to the national park supported higher bird diversity compared to areas with intensive agriculture or urban development. Forest-dwelling and specialist bird species were more abundant in intact forest areas, while generalist species were more prevalent in disturbed and urbanized landscapes.

Statistical analyses, such as species richness calculations, diversity indices, and community composition comparisons, supported these findings. The results highlighted the importance of maintaining and restoring natural habitats in the study area to conserve bird species diversity. They underscored the need for sustainable land-use practices, including responsible agricultural practices and urban planning that considers the needs of bird populations.

The implications of the research findings for conservation planning were discussed, emphasizing the necessity of incorporating the protection and restoration of natural habitats in land-use management strategies. Recommendations were made for future management approaches, including the establishment of buffer zones, reforestation efforts, and promoting community engagement in conservation initiatives.

Overall, the study provided valuable insights into the influence of different land-use types on bird species diversity and composition in the area adjacent to Udzungwa National Mountains National Park. The findings contribute to the understanding of

how human activities impact bird populations and offer guidance for conservation efforts aimed at preserving the rich avian biodiversity of the region.

5.3 Conclusion

Plantation and settlement were the only dominant land use types documented in the study site around UMNP. Their dominance is due to habitat fragmentation caused by human activities including land clearing for agriculture and establishment of settlements. Plantation was the land use type with higher bird species richness compared to settlement because plantation contains a variety of resources such as breeding sites, nesting materials, cover, food and water allowing different bird species to be widely distributed.

Plantation provided the highest species diversity compared to the area of the settlements. This might be due to the level of human disturbance between the two land-use types in which plantation was characterized by a lower degree of human disturbance compared to settlements. Impacts from human disturbance can negatively influence ecosystems profoundly specifically bird species diversity. The higher diversity in plantation land-use type suggests higher ecological stability compared to human-disturbed habitats where few species occur.

Researchers often use MANOVA in various fields, such as psychology, biology, social sciences, and ecology, when they want to analyze the combined effects of multiple dependent variables and determine whether there are significant differences among groups. In this study, MANOVA revealed that there were no significant

differences in bird community composition between the two land use types. This suggests that there is a close similarity in human disturbance between plantation and settlement land-use types. Despite that human-induced disturbance may cause low diversity, settlement and plantation are important land-use types of the ecosystem that harbour large numbers of birds.

5.4 Recommendations

By implementing the following recommendations, it is possible to enhance bird conservation efforts in the study area and contribute to the overall biodiversity conservation at Udzungwa Mountains National Park and its surrounding regions. Protecting and preserving bird habitats will not only benefit avian populations but also contribute to the overall ecological integrity and sustainable development of the area.

- i) Based on the study findings, it is recommended to develop comprehensive conservation plans that prioritize the protection of intact forest areas and designate buffer zones around Udzungwa Mountains National Park. These plans should consider the specific needs of bird species and their habitats.
- ii) Stakeholders, including local communities, government agencies, and landowners, should collaborate to promote sustainable land-use practices. This can include implementing agroforestry techniques, promoting organic farming, and adopting land-use zoning strategies that preserve critical bird habitats.
- iii) Increasing public awareness about the importance of bird conservation and the role of different land-use types in supporting bird diversity is crucial.

Educational programs and campaigns should be developed to engage local communities, tourists, and policymakers, fostering a sense of responsibility towards protecting bird habitats.

- iv) Research and monitoring should be emphasized. Continuous research and monitoring efforts are essential to track changes in bird populations and their responses to land-use changes. Long-term monitoring programs should be established to assess the effectiveness of conservation measures and inform adaptive management strategies.
- v) Strengthening collaboration between TANAPA, local communities, research institutions, and conservation organizations is essential for effective bird conservation. Joint initiatives can facilitate knowledge exchange, capacity building, and the implementation of conservation actions.
- vi) Advocacy for the integration of bird conservation considerations into land-use policies and regulations at regional and national levels is vital. Policy frameworks should include incentives for sustainable land-use practices and provide guidelines for minimizing negative impacts on bird habitats.
- vii) Exploration of conducting additional research to gain deeper insights into how different land uses affect bird species.

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APPENDICES

APPENDIX I: QUESTIONNAIRES FOR THE HEADS OF HOUSEHOLD

SECTION A: PERSONAL PARTICULARS

1. District	2. Ward	3. village
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4. **The education level of the respondent**

[1] informal [2] Primary [3] Secondary [4] Professional certificate [5] Diploma
[6] Degree

5. **Occupation of the respondent**

[1] Farming [2] Pastoralism [3] Fishing [4] Business [5] Employed [6] Hunting

6. Age of the respondents (i) 18 – 25 (ii) 26 – 35 (iii) 36 – 45 (iv) 46 – 64 (v) 65+

7. Sex of the respondents (i) Male [] (ii) Female []

8. Marital status of the respondents: (i) Single []; Married []; Separated [];
Widow []; Divorced []

SECTION B

9. List land use available in your area

- i
- ii
- iii
- iv
- v

10. What are the conditions of land use listed? (Use the table below to show the condition of each land use).

Land use	Degraded	Not degraded	No change

11. What is the trend for each land use over 10 years? (Use the table below to show the trend of each land use over ten years by selecting the following option [1] Increase greatly [2] Increase slightly [3] Decrease greatly [4] Decrease slightly [5] No change).

Land use	Trend over time	Reason

12. mention the key drivers of the land-use change in your area.

- i
- ii
- iii

13. What are the threats of changes in the land use in your area?

- i
- ii
- iii

14. List birds that are available in your location.

- i.
- ii.
- iii.
- iv.
- v.

15. What is the trend for each bird species over 10 years in your area? (Use the table below to show the trend of each land use over ten years by selecting the following option [1] Increase greatly [2] Increase slightly [3] Decrease greatly [4] Decrease slightly [5] No change).

Birds Species	Trend over time	Reason

16. Mention the Key drivers of change in bird species in your area.

- i.
- ii.

iii.

17. What are the threats of changes to bird species in your area?

i.

ii.

iii.

18. What is your view on the effect of land use on the bird's species

i.

ii.

iii.

iv.

APPENDIX II: INTERVIEW FOR VILLAGE LEADER AND ELDERS

1. What are the types of land uses in your area?
2. What are the causes of this land use?
3. Is the use of land, the same as in the past or has it changed? And what is the reason for it to change? What was the previous land use?
4. What year the land was put under the current use?
5. What are the effects of these land use types in your area?
6. How does this land use affect bird diversity in your area?
7. What are the types of birds found in your area currently?
8. What bird species are not seen any more in the area, and what are the reasons for those species to disappear?
9. What are the potential threats to bird species diversity?

APPENDIX III: OBSERVATION GUIDE**Bird identification**

Transect No.	Habitat/ land use	Species name	Number	Activity done with birds

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Our Ref: PG201900059

1st September 2022

Assistant Conservation Commissioner,
Tanzania National Parks (Udzungwa Mountains National Park),
P.O.Box 99,

MOROGORO.

RE: RESEARCH CLEARANCE

The Open University of Tanzania was established by an Act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No.55 in the official Gazette. The Act was however replaced by the Open University of Tanzania Charter of 2005, which became operational on 1st January 2007. In line with the Charter, the Open University of Tanzania mission is to generate and apply knowledge through research.

To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you Ms. KIBWE, Christina Daniel, Reg No: PG201900059 pursuing Master of Arts in Natural Resources Assessment Management (MANRAM). We here by grant this clearance to conduct a research titled "The Influence of Different Land-Use Type on Bird Species Diversity and Composition in Areas Adjacent to Udzungwa Mountains National Park, Morogoro " She will collect her data at your office from 2nd September 2022 to 30th September 2022.

In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O.Box 23409, Dar es Salaam.Tel: 022-2-2668820. We lastly thank you in advance for your assumed cooperation and facilitation of this research academic activity.

Yours,

THE OPEN UNIVERSITY OF TANZANIA

Prof. Magreth S. Bushesha
DIRECTOR OF POSTGRADUATE STUDIES.