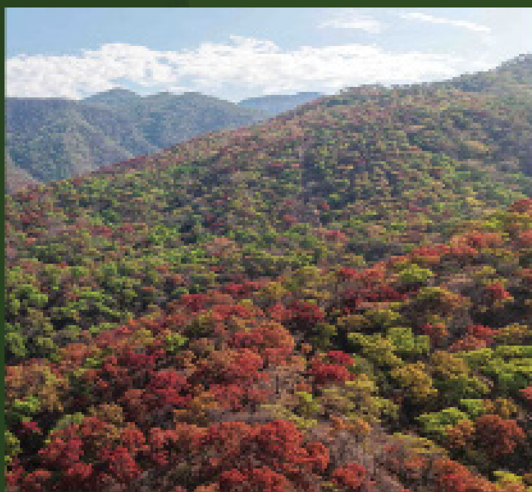
MALAWI NATIONAL ECOSYSTEM ASSESSMENT

Technical Report



Linking **Science** and **Policy** on Biodiversity and Ecosystem Services Conservation

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Disclaimer

This report has been produced by the Malawi Government, as part of the Biodiversity and Ecosystem Services Network (BES-Net) Phase II project with technical support from the National Ecosystem Assessment (NEA) Initiative at UNEP-WCMC. This project is supported by the International Climate Initiative (IKI) of the Federal Government of Germany and SwedBio at Stockholm Resilience Centre. Within the Federal Government of Germany, the IKI is anchored in the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN). Selected individual projects are also the responsibility of the Federal Foreign Office (AA).

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FOREWORD

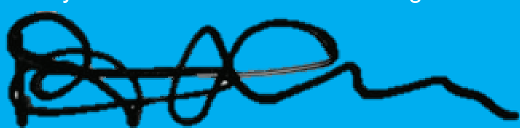
The Government of Malawi recognizes that biodiversity and ecosystem services constitute the foundation of the nation's socio-economic development, underpinning critical sectors including agriculture, fisheries, forestry, tourism, and energy. Approximately 85% of the country's population depends directly on natural resources for livelihoods confirming that the sustainable management of ecosystems represents not only an environmental imperative but also a cornerstone of national development.

Malawi's ecosystems are however, increasingly under pressure from a combination of social, economic, and environmental drivers, including rapid population growth, land degradation, climate variability, and unsustainable resource use. These pressures are contributing to biodiversity loss and the degradation of ecosystem services, with far-reaching consequences for food security, economic stability, and human well-being.

In order to generate credible, policy-relevant evidence on the status, trends, and value of biodiversity and ecosystem services, the Government initiated the Malawi National Ecosystem Assessment (NEA). This report represents a significant milestone in linking science, policy, and practice by integrating scientific knowledge with Indigenous and Local Knowledge systems to provide a comprehensive understanding of Malawi's ecosystems. The NEA provides critical insights into terrestrial, aquatic, and wetland ecosystems, highlighting their interlinkages and the implications of their degradation on livelihoods and economic development. It further offers an important evidence base to guide national planning processes, including the National Biodiversity Strategy and Action Plan (NBSAP), climate change adaptation frameworks, and other commitments under the multilateral environmental agreements.

The Government of Malawi extends its sincere appreciation to all co-chairs, chapter authors, and other stakeholders including government institutions, academia, and local communities for their invaluable contributions towards realisation of the objectives of this assessment. Special recognition is extended to the Government of Germany for its financial assistance; and the United Nations Environment Programme-World Conservation and Monitoring Centre (UNEP-WCMC), United Nations Education Scientific and Cultural Organisation (UNESCO), and United Nations Development Programme (UNDP) for their technical support.

The Government of Malawi is fully committed to ensuring that the findings, key messages, and Summary for Policymakers from this assessment directly inform national conservation policies and decision-making processes. By translating evidence into action, we aim to safeguard our ecosystems for current and future generations.



Honourable Patricia Wiskes, MP.
MINISTER OF NATURAL RESOURCES

PREFACE

The Malawi National Ecosystem Assessment (NEA) was undertaken to address key knowledge gaps and enhance the empirical foundation for biodiversity conservation and ecosystem management in Malawi. This assessment provides rigorously synthesized data and integrated analyses to inform policy formulation, strategic planning, and the design of sustainable development interventions.

The National Ecosystem Assessment (NEA) employs a Multiple Evidence Base (MEB) approach, integrating scientific knowledge with Indigenous and Local Knowledge (ILK) to deliver a comprehensive analysis of ecosystem dynamics and their contributions to human well-being. This integrative framework acknowledges the co-evolutionary relationship between ecosystems and local communities, underscoring the critical role of ILK in enabling effective stewardship and sustainable biodiversity management.

The assessment focused on three priority ecosystems namely, terrestrial, aquatic, and wetlands which were selected based on their ecological and socio-economic significance. It evaluated their current status, trends, drivers of change, and the implications for livelihoods, food security, and national development. Using internationally recognized frameworks, including the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the NEA integrates diverse data sources and applies analytical tools such as the Drivers-Pressures-State-Impact-Response (DPSIR) framework to examine ecosystem dynamics and future scenarios.

Findings of the assessment underscore the strong interconnections between ecosystems and highlight how degradation in one system can trigger cascading effects across others, affecting water security, agricultural productivity, biodiversity, and human well-being. At the same time, the report identified key governance challenges, including fragmented policies, weak enforcement, and limited integration of Indigenous and Local Knowledge.

Beyond assessing the current conditions, the NEA serves as a strategic tool for policy and decision-making. It supports national reporting obligations, informs the development of biodiversity strategies and climate adaptation plans, and provides a monitoring framework for tracking biodiversity status, ecosystem trends and evaluating the effectiveness of interventions over time. Ultimately, this report is intended to guide Malawi towards a more integrated and sustainable approach to ecosystem management, one that balances development needs with conservation priorities while enhancing resilience and improving the well-being of its people.

Effective implementation of the findings of the National Ecosystem Assessment will require strong collaboration across all levels of government, enhanced partnerships with stakeholders, and sustained investment in biodiversity conservation. It is our expectation that the assessment will serve as a practical and guiding framework for collective action in safeguarding Malawi's biodiversity while advancing sustainable development for the benefit of present and future generations.

Misheck Munthali, PhD
SECRETARY FOR NATURAL RESOURCES

ACKNOWLEDGEMENTS

The Ministry of Natural Resources, through the Environmental Affairs Department, in collaboration with Lilongwe University of Agriculture and Natural Resources, wishes to acknowledge and sincerely thank all stakeholders who contributed to the assessment process that culminated in the production of this report. In particular, the Ministry expresses its appreciation to Indigenous and Local Knowledge Holders, academia, government departments, policymakers, and other relevant stakeholders for their time, valuable insights, and constructive contributions to the content of this document.

Furthermore, the Ministry extends its heartfelt gratitude to the following experts for their support in reviewing the technical report: Dr. Joseph Karanja of the United Nations Educational, Scientific and Cultural Organization (UNESCO), Ms. Juanita Chaves, Pratik Tendon, Abisha Mapendembe and Noor Noor of the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC).

The Ministry also gratefully acknowledges the financial support provided by the International Climate Initiative (IKI) of the Federal Government of Germany in the Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN), and SwedBio at Stockholm Resilience Centre, through the Biodiversity and Ecosystem Services Network (BES-Net), which facilitated the smooth implementation of the National Ecosystem Assessment (NEA) process in Malawi.

In addition, sincere appreciation is extended to the following partners for their continued and invaluable technical support throughout the entire assessment process: the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), the United Nations Development Programme (UNDP), and UNESCO.

Finally, special recognition is given to all Co-Chairs, lead authors and members of the Technical Working Groups for their dedication, commitment, and expertise in advancing the NEA process.

Tawonga Mbale-Luka
DIRECTOR OF ENVIRONMENTAL AFFAIRS

ABBREVIATIONS AND ACRONYMS

BAU	Business as Usual
BES-Net	Biodiversity and Ecosystem Services Network
BIOFIN	Biodiversity Finance Initiative
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species.
FDG	Focus Group Discussion
FPIC	Free, Prior, Informed Consent
GDP	Gross Domestic Product
GESI	Gender Equality and Social Inclusion
GIS	Geographic Information System
ILK	Indigenous and Local Knowledge
INDC	Intended Nationally Determined Contribution
IPBES	Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Assessment Services
IPPC	International Plant Protection Convention
LUANAR	Lilongwe University of Agriculture and Natural Resources
MEAs	Multilateral Environmental Agreements
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NEA	National Ecosystem Assessment
NFLRS	National Forest Landscape Restoration Strategy
NGOs	Non-governmental Organizations
PA	Protected Area
SEM	Sustainable Ecosystem Management
TORs	Terms of Reference
TWG	Technical Working Group
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

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1. INTRODUCTION

Malawi's economy and livelihoods are fundamentally dependent on natural capital. Key sectors including agriculture, fisheries, forestry, tourism, and energy rely heavily on biodiversity and ecosystem services. Approximately 85% of the population lives in rural areas and depends directly on natural resources for food security, income, and social well-being. Consequently, biodiversity loss and ecosystem degradation are undermining ecological functions, national economic performance, household resilience, and social cohesion. These pressures are intensified by rapid population growth, now exceeding 20 million people, which places increasing strain on land, water, and biological resources and often relegates conservation priorities behind short-term development needs.

Recognizing the urgency of these challenges, the Government of Malawi initiated the National Ecosystem Assessment (NEA) to generate credible, policy-relevant evidence to inform sustainable management of biodiversity and ecosystems. The Malawi NEA adopts a Multiple Evidence Base (MEB) approach, integrating scientific knowledge with Indigenous and Local Knowledge (ILK), acknowledging that ecosystems have co-evolved with Indigenous Peoples and Local Communities (IPLCs) whose knowledge systems remain critical for effective stewardship.

The assessment focuses on three priority ecosystems terrestrial, aquatic, and wetlands and evaluates their status, trends, drivers of change, and implications for human well-being. It highlights trade-offs among development pathways and provides evidence to guide sustainable investments aligned with national development strategies, environmental management objectives, and the Sustainable Development Goals (SDGs). The NEA further supports Malawi's national and international commitments, including updating the National Biodiversity Strategy and Action Plan (NBSAP), domesticating the Kunming–Montreal Global Biodiversity Framework, informing ecosystem-based adaptation for the National Adaptation Plan (NAP) and Nationally Determined Contributions (NDCs), and reporting to Multilateral Environmental Agreements (MEAs). The Malawi NEA therefore serves as a foundational tool for long-term sustainable development and resilience.

2. Methodology

The Malawi NEA assessed terrestrial, aquatic, and wetland ecosystems by synthesizing existing literature and ILK, following the assessment framework of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Ecosystems were prioritised according to their ecological significance, socio-economic importance, and potential for successful intervention.

Policy-relevant questions were developed through engagement with stakeholders and knowledge-holders during the scoping phase. These questions guided the assessment of ecosystem status and trends, drivers of change, impacts on human well-being, and existing policy and institutional frameworks. ILK was systematically integrated across all thematic areas and throughout the assessment process. The DPSIR (Drivers–Pressures–State–Impact–Response) framework was applied to analyse ecosystem dynamics and develop scenarios projecting future ecosystem conditions under alternative management pathways.

3. Status, Trends, and Drivers of Change

Aquatic Ecosystems

Aquatic ecosystems cover approximately 20% of Malawi's surface area and include major lakes (Malawi, Chilwa, Malombe, Chiuta, Kazuni) and key river systems (Shire, Bua, North and South Rukuru, Linthipe, Dwangwa, Songwe) (Global water leadership program, 2022). Shallow lakes and rivers experience high seasonal and interannual variability, making them particularly vulnerable to climate change. Widespread sedimentation driven by deforestation, agricultural expansion, and poor land-use practices has reduced water quality, altered hydrological regimes, and increased flood risks.

Nutrient pollution from agricultural runoff and other sources has caused eutrophication and algal blooms, with water quality parameters frequently exceeding national standards. Although Malawi's aquatic ecosystems host globally significant biodiversity, they face increasing threats from habitat degradation, climate variability, and invasive alien species.

Fisheries, which provide 60–70% of animal protein intake and livelihoods for over 1.6 million Malawians, are in decline. Iconic species such as Chambo (Oreochromis spp.) have experienced catch declines exceeding 70%, while increased reliance on smaller, less valuable species indicates ecosystem imbalance. ILK remains an important but underutilised conservation asset, evidenced through traditional taboos, sacred sites, and local governance systems that protect critical habitats. However, weak integration of ILK into formal management limits its potential contribution.

Terrestrial Ecosystems

Terrestrial ecosystems include forests, mountains, grasslands, and agricultural landscapes. Malawi's protected area network comprising forest reserves, national parks, wildlife reserves, and nature sanctuaries covers approximately 11.6% of the country. Miombo woodlands dominate forest ecosystems, yet forest condition varies widely. Biomass and wood volumes are significantly reduced in degraded areas, and harvesting often occurs before trees reach maturity.

Forest cover has declined sharply from 47% in 1975 to 24% in 2020, with accelerating deforestation driven by land-use change, unsustainable harvesting, weak enforcement, poverty, and climate change. Mountain ecosystems, covering over 25% of Malawi's land area and supporting nearly one-third of the population, face increasing encroachment from rapid urbanisation and agricultural expansion, heightening risks of land degradation, landslides, and climate-related disasters.

Agro-biodiversity is also declining, with indigenous crops increasingly replaced by monocultures and hybrid varieties, reducing genetic diversity and resilience. Despite evidence of effective ILK-based conservation in sites such as Khulubvi Sacred Forest, ILK remains marginalised in most terrestrial management systems due to policy gaps, socio-cultural change, and institutional bias toward Western science.

Wetland Ecosystems

Wetlands cover approximately 30% of Malawi's land area and include lakes, rivers, floodplains, marshes, swamps, and dambos. These ecosystems provide critical services, including fisheries, flood regulation, water purification, and livelihoods, with economic values running into hundreds of millions of US dollars annually. Two wetlands Lake Chilwa and Elephant Marsh, are designated Ramsar sites of international importance.

Despite their value, wetlands are rapidly degrading due to agricultural expansion, overfishing, siltation, pollution, and climate change. Most wetlands remain under open-access regimes, with limited formal protection, making them highly vulnerable to unsustainable use. Degradation has resulted in declining fisheries, altered hydrological regimes, increased salinity, biodiversity loss, and heightened vulnerability to floods and droughts. Drivers include policy and governance gaps, population pressure, weak enforcement, and erosion of ILK.

4. Policy Framework, Management Options, and Gaps

Malawi has relatively strong policy and legislative frameworks for aquatic and terrestrial ecosystems, including the Environmental Management Act (2017), Forestry Act (2020), Fisheries and Water-related policies, and biodiversity strategies. Community-based co-management approaches particularly in fisheries through Beach Village Committees and Ecosystem Approach to Fisheries Management have demonstrated positive outcomes, including fish stock recovery and strengthened local stewardship. However, major implementation gaps persist across ecosystems. These include fragmented sectoral policies, weak enforcement, insufficient climate integration, limited inter-agency coordination, inadequate financing, and the lack of formal recognition and integration of ILK. Wetlands face the most significant governance gap, as Malawi lacks a dedicated wetland policy, resulting in uncoordinated management and limited protection.

Nexus Analysis, Scenarios, and Outlook

Malawi's terrestrial, aquatic, and wetland ecosystems are tightly interconnected through hydrological flows, nutrient cycles, biodiversity exchange, and climate regulation. Degradation in one ecosystem triggers cascading impacts across others, affecting water security, food systems, biodiversity, and human well-being. The assessment identifies two future scenarios: a business-as-usual pathway leading to accelerated ecosystem degradation and heightened vulnerability, and an integrated nexus governance pathway that restores ecosystem connectivity, enhances resilience, and supports sustainable livelihoods.

Achieving the latter requires a decisive shift toward integrated ecosystem governance, strengthened policy coherence under the Environmental Management Act, effective enforcement, genuine community co-management, formal integration of ILK, and mainstreaming ecosystem-based climate adaptation across national planning and investment frameworks.

CHAPTER 1

INTRODUCTION

CHAPTER 1 - INTRODUCTION

1.1 Rationale of the assessement

Malawi's economy is partly contingent upon biodiversity and ecosystem services, most of which currently are quickly succumbing to complex social, economic, and ecological pressures across all landscapes. Many sectors that contribute to the country's gross domestic product (GDP) rely on biodiversity and ecosystem services, and these include but are not limited to: agriculture, fisheries, forest resources, tourism, and energy. Millions of rural Malawians, who constitute about 85% of the population, rely on biodiversity and ecosystems for their livelihoods. The continued loss of biodiversity and ecosystem services is eroding critical ecological functions, with cascading effects on food security, household incomes, and social cohesion. With the national population surpassing 20 million, conservation objectives often receive limited attention, exacerbating the challenges faced by Women, girls, children, and other vulnerable groups in society.

Most Women in Malawi are informally employed in ecosystem-related sectors, and their livelihoods and food security at the household level are more likely to be adversely affected with the loss of biodiversity. According to the World Bank's Malawi Country Environmental Analysis (2019), approximately 90% of Women over the age of 15 rely on natural resources such as firewood, water, and wild fruits for domestic needs, compared to only 24% of men. The report also notes that about 24% of households in Malawi are female-headed, making them particularly vulnerable to resource scarcity and increasing their likelihood of falling into poverty. Conservation initiatives that fail to address the unique challenges faced by Women and children risk achieving limited impact. Furthermore, data on household dependence and the benefits derived from different ecosystems remain inadequate, hindering effective programming and the integration of gender equality and social inclusion (GESI) considerations

The National Ecosystem Assessment (NEA) in Malawi was undertaken to generate credible, science-based and traditional based evidence on the status, trends, and value of biodiversity and ecosystem services that underpinned livelihoods and economic growth. It sought to address existing knowledge gaps and strengthen the information base required for informed policy and decision-making across sectors. In particular, the assessment was prioritised to provide information and data to serve as baseline information for setting realistic targets in national biodiversity strategies and plans including, poverty reduction strategies, and climate change adaptation plans. The process further aimed to build national capacity, foster collaboration among government institutions, academia, civil society, and local communities, and raise awareness among policymakers and stakeholders on the critical role of biodiversity and ecosystems services in sustaining human well-being and national development.

Malawi is vulnerable to the impacts of climate change and extreme weather events such as floods and droughts, and the urgency for climate action resonates in many national documents with imperatives for data and information needs. The designing of ecosystem-based adaptation to climate change as propagated in the Updated Nationally Intended Contributions (GoM, 2021), and the formulation of the National Adaptation Plan (NAP) cannot materialize in the absence of relevant pieces of information about status, trends, and distribution of ecosystem types and their drivers of change. Currently, such information is scattered in sectoral ministries and departments, making it more difficult to discern the overall country picture and changes over time and space. Nature-based solutions to climate change include allowing natural forests to regenerate, restoring wetlands, and restocking. There are ongoing projects and programs at various scales on restoration, but the degree of success remains hardly detected. Moreover, the success of these calls for continuous monitoring which require baseline information with clear indicators.

By undertaking the NEA process, the prospects for the country to avoid unforeseen, long-term consequences of decisions made can be avoided. The country is undertaking the NEA process to support the critical judgement of options and uncertainty, enabling decisions to choose policies that sustain the appropriate mix of services, i.e., between attaining food security and the ongoing maintenance of biodiversity conservation. This is critical when the country is confronted with the urgency to diversify its economic base to rescue the shrinking economy. The NEA process is proportionately necessary to support the requirement for international and regional reporting on biodiversity, besides providing baseline information for national biodiversity planning and monitoring.Currently, these obligations face information hiccups and insufficient understanding, which are formidable barriers to sound strategic action planning.

Without proper ecosystem assessment, Malawi stands to face the extreme challenge of justifying the benefits of biodiversity and ecosystem services, thereby perpetuating decision-makers' misunderstanding of how their actions affect these services. Misconceptions are loaded when short-term political and monetary benefits take precedence over ideals of sustainability. NEA holds promise to expel these misconceptions by providing evidence-based information regarding status and trends in biodiversity.

The NEA process is intended to support decisions on biodiversity and ecosystems to take full account of their values to the country's economy and human well-being. The scoping stage which is the first stage of NEA process was conducted and has already begun bridging development and environmental communities by increasing awareness on the linkages between ecosystem management and the attainment of economic and social goals. Political support is growing given the country's unique position to reverse ongoing challenges of land degradation, deforestation, waterbody pollution, and climate change. The NEA process is in a juxtaposition within these myriads of wicked problems to aid sound and informed decisions.

To meet both local and global conservation goals, Malawi's biodiversity, especially those occurring in Protected Areas (PAs), is regulated under both Multilateral Environmental Agreements (MEAs) and domestic legal frameworks, both of which provide guiding principles and standards upon which conservation endeavour affiliates. On a global scene, Malawi is party to several MEAs including the Convention on Biological Diversity (CBD), the African Convention on the Conservation of Nature and Natural Resources, the Ramsar Convention on Wetlands of International Importance, UNESCO Convention specifically the World Heritage Convention for the Protection of the World Cultural and Natural Heritage, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) among others. MEAs are pertinently necessary instruments to ensure the effective protection of biodiversity and ecosystems as well as ensuring their sustainable utilization. For example, the CBD upholds the notion of sustainable wildlife management which entails the sound management of the wildlife species to sustain their populations and habitats over time, considering socioeconomic needs of the human populations (Decision 14/7).

CITES, on the other hand, aims to ensure that international trade in wild animals and plants does not threaten the survival of the species. The CBD relates to the fact that, governments are committed to completing ecologically-representative systems of PAs , and this process usually starts by identifying gaps in the current system typically through an ecological gap analysis which involves identifying biodiversity (i.e., species, ecosystems and ecological processes) not adequately conserved within a PA system or through other effective and long-term conservation measures. The NEA process has a role to play in this context, although stakeholders must attend first to immediate priorities before these long-term exigencies.

1.1.1 International and National Legal and Policy Frameworks

1.1.1.1 International Legal Framework

Although the Multilateral Environmental Agreements are legally binding for Parties, they do not substitute national laws; rather, they provide frameworks to be respected by each Party, which must adopt its domestic legislation to ensure that they are implemented at the national level. For example, the (CITES) is particularly relevant to the planning for PAs since they harbour, among others, African elephant populations which with the exception of the populations of Botswana, Namibia, South Africa, and Zimbabwe are included in CITES Appendix I. Malawi is also a Party to the United Nations Framework Convention on Climate Change (UNFCCC). The country seeks to contribute to the ambitious goal of limiting temperature rise to 2oC with efforts to reach 1.5oC agreed under the Paris Agreement.

Malawi ratified the UNFCCC in 1994 and, in line with the Paris Agreement, submitted its Intended Nationally Determined Contribution (INDC) in 2016, which became its first NDC in 2020. The Malawi NEA is cognizant of the UNFCCC since biodiversity and ecosystems management have implications for both mitigation and adaptation to climate change. This is coupled with the fact that climate change is one of the key drivers of biodiversity loss.

Malawi recognizes that biodiversity and ecosystem conservation cannot be governed by a single framework of legislation, as such the National Biodiversity Strategy and Action Plan (NBSAP) was developed to serve as a national guidance document across sectors for prioritizing and implementing biodiversity conservation programs. Implementation of NBSAPII (2015-2025) demonstrates Malawi's commitment to the implementation of Decision X/2 of the Tenth Conference of the Parties (CoP10) of the Convention on Biological Diversity (CBD), which requested country Parties to revise their strategies in line with the Global Strategic Plan for Biodiversity and its Aichi Biodiversity Targets. Recently, Malawi has revised its NBSAPII to align it to the Kunming Montreal Global Biodiversity Framework and its 23 Targets. The NEA has been instrumental in informing the revision process of the NBSAPII through provision on baseline information that has guided formulation of realistic and measurable targets.

1.1.1.2 National Legal and Policy Framework

The NEA process not only aligns with legal instruments that broadly recognize the value of biodiversity and ecosystems services and the principles of benefit sharing, public engagement in decision making, GESI, and the sustainability for future generations, but also a process for the operationalization of these instruments. These instruments include the Republic of Malawi (Constitution) of 1995, the National Environmental Policy (NEP) of 2004, and the Environment Management Act (EMA) of 2017. Sector-specific policies/legislation relevant to the implementation of biodiversity programs in Malawi include: the National Forestry Policy of 2016; the National Forestry Act of 2019; the National Fisheries and Aquaculture Policy of 2016; the Fisheries Conservation and Management Act of 2014; the Wildlife Policy of 2018; the National Parks and Wildlife Amendment Act of 2017; the National Land Resources Management Policy and Strategy of 2002; The National Herbarium and Botanic Gardens Act of 2014; the Water Resources Act of 2013; the Irrigation Policy of 2016; the Energy Policy of 2018; the Biosafety Act of 2002; the Biosafety (Genetically Modified Organisms) Regulations of 2007; the National Biosafety and Biotechnology policy of 2008; the Patents Act of 2008; the National Monuments and Relics Act of 2014; the Plant Protection Act of 2018; the Local Government Act of 2017.

The Malawi NEA process is cognizant of the fact that biodiversity and ecosystems have for centuries co-existed with indigenous people and local communities either within or in adjacent areas. Due to land use pressure, most ecosystems in the country do not have buffer zones to absorb the negative interactions between biodiversity and adjacent agroecosystems. An important outcome of the preceding observation, coupled with the large scope of the legal and policy frameworks, points to the call for interdisciplinary and transdisciplinary approaches to the NEA process. Identification and implementation of solutions to challenges facing the biodiversity and ecosystem services further calls for a shared responsibility and cooperation with Indigenous People and local communities' perspectives, the private sector, NGOs, and civil society in addressing common challenges of biodiversity loss.

1.2 Types of ecosystem under assessment

The Malawi NEA covers three main types of ecosystems: **terrestrial**, **aquatic**, and **wetland**. The choice of these ecosystems was based on a set of criteria that included parameters such as:

- ecological significance,
- socio-economic significance, and
- likelihood of successful intervention.

1.3 Background to the assesement method

A scoping report was developed during the scoping stage which adopted and followed the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)'s guidelines-based framework and the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)'s guidance. During the scoping stage, stakeholders identified thematic areas and developed policy questions.

Based on the framework, the assessment team undertook several activities during the scoping stage which included (i) launch of the NEA process (ii) establishment of Technical Working Groups (TWGs) and the revamping of the National Biodiversity Platform (ii) collaborative identification and prioritization of ecosystem types for assessment at national level (iii) development of Terms of Reference (ToRs) to guide the TWGs (iv) community consultations through regional framing workshops and dialogues with Indigenous and local knowledge (ILK) holders and (iv) national scoping report validation workshop through a trialogue methodology involving policymakers, scientists and Indigenous and Local Knowledge (ILK) holders. The scoping stage was finalised by developing a scoping report to guide the expert evaluation stage.

During the expert evaluation stage, the assessment team adopted the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) conceptual framework to capture an integrated view of the biodiversity knowledge policy interface to stimulate new thinking, accommodate diverse human perceptions of biodiversity, for effective and useful engagement of a wide range of stakeholders. The main aim of the expert evaluation stage was to synthesize, analyze, and review scientific and other knowledge, including indigenous and local knowledge. It also helped to understand the trends, conservation and sustainable use of biodiversity and ecosystem services, human well-being, and the linkages with sustainable development. The expert evaluation examined six interlinked elements constituting a social-ecological system that operates at various scales in time and space: (i) nature; (ii) nature's contributions to people; (iii) anthropogenic assets; (iv) institutions and governance systems and other indirect drivers of change; (iv) direct drivers of change; and (vi) good quality of life. The evaluation stage was guided by the policy questions developed during the scoping stage.

1.4 Policy questions

Specifically, the expert evaluation addressed the following broader policy questions:

- *How do the biodiversity and ecosystem services provided by wetlands, lakes and rivers, forests, woodlands, national parks, and wildlife reserves across the country contribute to the country's economy, local livelihoods, food security, and good quality of life, and what are their interdependencies with each other?*

- *How do biodiversity and ecosystem governance including the use of scientific, Indigenous, and local knowledge interact to influence policy and decision-making processes?*

- *What are the status, trends, and potential future dynamics of aquatic, terrestrial, and wetland biodiversity and ecosystem services, and what are the pressures that affect their contributions to the country's economy, livelihoods, and well-being in the various regions in the country?*

- *What are the actual and potential impacts of various policies and interventions on the contribution of biodiversity and ecosystem functions and services to the sustainability of the national economy, local livelihoods, food security, and good quality of life in the country?*

- *What knowledge gaps exist to better understand and assess drivers, impacts, and responses to wetland, aquatic and terrestrial biodiversity, and ecosystem services at the national level?*

To address these policy questions, the expert evaluation stage of the assessment employed a comprehensive synthesis of available information through deskwork and engagement with technical stakeholders and knowledge holders. Stakeholder and knowledge holders' consultations and workshops with experts from various fields, including but not limited to natural science, economists, social scientists, geographic information system (GIS) experts, and indigenous and local knowledge holders were conducted. The inclusion of experts from natural resources-based sectors such as agriculture, forestry, fisheries, and water in the technical working groups was done purposefully to enhance access to available publications and reports from their sectors. Available national websites relevant to biodiversity such as the Biodiversity Information Facility, Clearing House Mechanism and the country page on Biodiversity Financing Initiative (BIOFIN) also provided the required data and knowledge on biodiversity.

Data and knowledge gaps were identified with reference to the prioritized key policy questions for each of the ecosystem types under the assessment. Where the available data was deemed insufficient or absent to address the key policy questions, the gap served as an indicator for data or knowledg. All data and knowledge gaps were reported as such and recommendations were made for future research where appropriate.

1.5 Potential uses of the report

Throughout the assessment process, it has been clear that a cross-section of society, including government ministries and departments, the private sector, academic institutions and conservation NGOs will make use of the NEA report in many different ways.

Reporting Obligations: Malawi has reporting obligations under different multilateral environmental agreements (MEAs) such as the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change and the United Nation Convention on Combating Desertification (UNCCD) among others. Comprehensive reports to these MEAs require relevant information and data which is often scattered across various sectors. The NEA report which synthesizes available information on biodiversity trends, distribution, and status serves as a key source of the information required for the national reports to MEAs. In addition, the NEA technical report serves as source of information for preparation of periodic country's Environmental Analysis Reports by the World Bank.

Strategic Planning and Action: The NEA technical report provides critical information on the status of biodiversity and ecosystems including scenarios that describes the plausible future under different governance options that serves as baseline information for biodiversity conservation planning including updating of National Biodiversity Strategies and Action Plans in line with adopted global bio. In addition, information on the status of biodiversity is critical in informing the updating of the NAP as well as the NDC for scheming nature-based adaptation solutions to climate change.

Policy and Decision Making: the NEA report guide development of policies and conservation decisions that are informed by science and Indigenous and Local Knowledge (ILK). Evidence for policy. Management of wetlands in Malawi lack clear policy direction as they fall under no jurisdiction. They are open to abuse at the expense of habitat conservation. The current status of wetlands and their values to various groups of people in the Malawi society remain unknown. The NEA report guides the policy direction highlighting subtle balances among competing demands.

Monitoring Tool for Biodiversity and Ecosystem Services: National Ecosystem Assessment (NEA) report serves as an effective monitoring tool for biodiversity and ecosystem services by establishing baselines, developing indicators, and tracking long-term trends in ecosystem condition, species diversity, and service provision. It enables the quantification and valuation of ecosystem services, helping to reveal trade-offs and synergies in resource use while providing evidence to assess the effectiveness of policies and interventions. Ultimately, NEA report function as both a feedback and early warning system, ensuring informed decision-making, adaptive management, and the sustainable use of biodiversity and ecosystem services.

1.6 Organization of this report

The rest of the report is structured into three additional chapters. Chapter three covers Aquatic ecosystems the conceptual framework and methodological approach to both the scoping process and the upcoming expert evaluation stage. Chapter four covers terrestrial ecosystems and Chapter five covers Wetlands Ecosystems. Chapter six covers interlinkages across the different ecosystems and finally Chapter seven is conclusions and recommendations Scope of the Report (ILK in Biodiversity and Ecosystem Management)

The Malawi National Ecosystem Assessment (NEA) technical report provides a comprehensive assessment of Malawi's Aquatic, Terrestrial and Wetlands ecosystems with integration of Indigenous and Local Knowledge (ILK). This report is intended to inform decision making on policies related to biodiversity and ecosystem conservation and management aligned with Malawi's national and international biodiversity commitments.

1.6.1 Prioritized Ecosystems of Focus and Coverage

Malawi's ecosystems encompass a wide diversity of freshwater, terrestrial, and wetland systems that provide vital habitats, support biodiversity, and sustain human well-being.

Different policies of the Malawi Government guide the management of the ecosystems in the different areas. Protected ecosystems such as national parks and wildlife reserves have the richest biodiversity while public and community areas are characterized by general degradation of resources largely due to habitat loss and over exploitation. Three ecosystems have been selected for more rigorous assessment and the criteria that has been used in selecting such terrestrial ecosystems. This section provides elements assessed including data and information on prioritised ecosystems. Based on existing data and knowledge needs, the expert evaluation established the status of the different ecosystems, size, and the socioeconomic contribution of each of the ecosystems to the national GDP, livelihood and other services.

Common classifications of ecosystems in Malawi broadly refer to two major categories including terrestrial and aquatic ecosystems. However, for the purposes of the NEA, wetlands was separated from aquatic and terrestrial ecosystems to give adequate attention to the wetlands which the country's biodiversity and ecosystem policies have neglected for some time now.

(a) Aquatic ecosystems

These are interdependent systems of plants, animals and their physical environment in a water body (USFWS, 2021). Aquatic ecosystems cover about 20% of the total surface area of Malawi and are habitats to a diversity of fish and other aquatic fauna and flora. Major aquatic ecosystems in Malawi include lakes (Malawi, Malombe, Chilwa, Kazuni and Chiuta), rivers (Songwe, South Rukuru, North Rukuru, Dwangwa, Linthipe, Shire, Bua River), and Lake Malawi crosses Karonga, Nkhata Bay, Nkhotakota, Salima and Mangochi.

(b) Terrestrial ecosystems: The terrestrial

ecosystems are well distributed across the country, and they include forests, mountains and grasslands. The country supports 87 forest reserves, five national parks, four wildlife reserves and three nature sanctuaries. The goal of establishing national parks, wildlife reserves and nature sanctuaries is to preserve Malawi's natural heritage and to promote their use for scientific and recreational purposes. National parks protect important wildlife populations, major water catchment areas, and landscapes of high aesthetic value. The Nyika National Park occupies part of the Northern Region. Mulanje Mountain is in Mulanje District.

(c) Wetland ecosystems

Wetlands are small water bodies including floodplains which are found in all regions of the country but occupy large areas down south. The small water bodies include lagoons and manmade reservoirs. The largest lagoon is Chia which harbors more than 24 fish species located in Nkhotakota. Other wetlands such as Elephant Marsh and Lake Chilwa are big and play an important ecological function as bird sanctuaries and destinations for migratory birds. Elephant Marsh is located down lower Shire in Nsanje District while Lake Chilwa is in Zomba District.

(d) Species Diversity

Terrestrial, aquatic as well as wetland ecosystems are rich in both plant and animal species diversity. Some species are threatened, others are rare, and others are endangered while some are endemic to specific regions of the country. A detailed discussion regarding the species richness and diversity across the country may not be necessary for the purpose of this report.

It was technically problematic to distinguish between a wetland and an aquatic ecosystem given the existing international conceptualization of these types of ecosystems. The Ramsar Convention (1971) defines wetlands as: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. This definition is so encompassing that every waterbody can be regarded as a wetland. Notwithstanding, the United States Fish and Wildlife Service definition considers wetlands as: “lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water”. For priority ecosystems for the NEA, we adopt the later definition and refine it to refer to wetlands to include floodplains, swamps, and marshes locally known as dambos.

CHAPTER 2

CONCEPTUAL FRAMEWORK AND METHODOLOGY

CHAPTER 2 - CONCEPTUAL FRAMEWORK AND METHODOLOGY

This chapter describes the conceptual framework that guides the methodological approach to the expert evaluation stage. The scoping stage engaged various sources of information, including the scientific, ILK systems across three regions of the country: Southern, Central, and Northern. In the subsequent stage, which is the expert evaluation stage, the conceptual framework remains instrumental in translating usable knowledge into policymaking across spatial scales alongside a normative function to engage diverse knowledge systems, promoting inclusivity and enhancing the legitimacy of the process.

Considering the diversity of perspectives on nature and different epistemologies the assessment envisages balancing power inequalities and meeting the wider normative objectives of the national conservation goals. The framework subscribes to the notion of bridging different knowledge systems which require more than merely co-creating but also addressing the normative issues of how, where, and why knowledge is used to support action (Wyborn 2015). To develop this more critical and reflexive approach, the framework is recognizance of the gap between science, policy, and practice as a space for continuous communication and negotiation throughout the process (Wyborn 2015).

2.1 Purpose and objectives of the framework

To guide the Malawi NEA team to assess biodiversity and ecosystems based on consistent concepts, resulting in knowledge and information that is useful to policymakers and practitioners in biodiversity and ecosystem conservation. Specifically, the conceptual framework has the objectives to:

a. Elucidate concepts that help the Malawi NEA team to consider in making judgements when application of the concepts does not lead to a single meaning.

b. Determine the appropriate boundary of the national assessment by considering the information needs of the users of the assessment report that is relevant and that faithfully represents what it purports to achieve.

2.2 General description of the framework

The assessment team adopted the IPBES conceptual framework which provides an integrated view of the biodiversity knowledge policy interface to stimulate new thinking, and accommodate diverse human perceptions of biodiversity, for effective and useful engagement of a wide range of stakeholders and knowledge holders **(Figure. 1)**. By adopting this framework, the assessment process comprehensively captures varied stakeholder interests and where conflicts of interests emerged, the engagement of all stakeholders provided a platform for reconciliation.

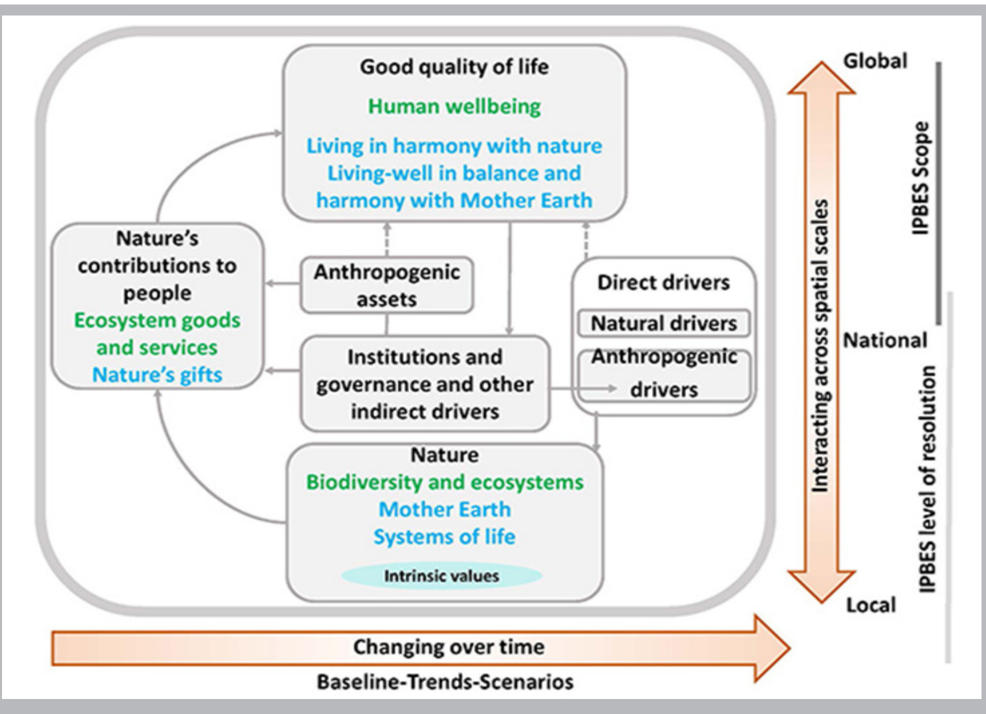


Figure 2-1: Conceptual Framework (Adopted from IPBES as Cited from Diaz et al., 2015)

This conceptual framework is a highly simplified model of the complex interactions between the natural world and human societies and how they constantly influence the state of each other. The conceptual framework includes six interlinked elements constituting a social-ecological system that operates at various scales in time and space and these include: (i) nature (ii) nature's contributions to people (iii) anthropogenic assets (iv) institutions and governance systems and other indirect drivers of change (v) direct drivers of change; and (vi) good quality of life. These elements are treated as the most relevant to the assessment's goal in the generation of knowledge to inform policy and the required capacity-building.

2.2.1 Conceptual grounds of understanding

To reduce divergent interpretations of the concepts used in the assessment, this section provides context-based meanings.

Nature: The concept of nature carries both broad and specific meanings depending on the context. "Nature" can refer to the phenomena of the physical world and to life in general. The study of nature is a large, if not the only, part of science. Although humans are part of nature, human activity is often understood as a separate category from other natural phenomena. Specifically, this assessment refers to nature in the natural world, including categories such as biodiversity, ecosystems and its functions, the biosphere, humankind's shared evolutionary heritage, and biocultural diversity. The assessment may not be comprehensive enough to capture nature's intrinsic values, that is, the value inherent to it, independent of human experience and somewhat beyond the scope of anthropocentric valuation approaches.

Anthropogenic assets: Refers to built-up infrastructure, knowledge including ILK systems and technical or scientific knowledge, as well as formal and non-formal education, technology (both physical objects and procedures), and financial assets, among others. The relevance of this concept to the assessment is that a good life is achieved by a co-production of benefits between nature and societies.

Nature's benefits to people: Refers to all the advantages humans derive from the natural world. This category includes ecosystem products and services, whether they are viewed individually, or. Nature's gifts and related terms in different knowledge systems refer to the advantages of nature from which people draw a high standard of living. This broad category also includes elements of nature that may be harmful to humans, such as pests, infections, or predators.

All of nature's benefits have anthropocentric value, including relational values that promote desirable relationships, such as those between people and nature, and instrumental values that contribute to a good quality of life, which can be conceptualized in terms of preference satisfaction.

Institutions and governance systems and other indirect drivers. Governance systems refer to the ways in which societies organize themselves, and the resulting influences on other components. They are the underlying causes of environmental change that are exogenous to the ecosystem in question. Because of their central role in influencing all aspects of human relationships with nature, governance systems are key levers for decision-making. Institutions encompass all formal and informal interactions among stakeholders and social structures that determine how decisions are taken and implemented, how power is exercised, and how responsibilities are distributed. Institutions determine, to various degrees, access to, and the control, allocation and distribution of components of nature and anthropogenic assets and their benefits to people. Examples of institutions are systems of property and access rights to land (e.g., public, common-pool, private), legislative arrangements, treaties, informal social norms and rules, including those emerging from ILK systems, and international regimes such as agreements against stratospheric ozone depletion or the protection of endangered species of wild fauna and flora. Economic policies, including macroeconomic, fiscal, monetary or agricultural policies, play a significant role in influencing people's decisions and behaviour and the way in which they relate to nature in the pursuit of benefits. Many drivers of human behaviour and preferences, however, which reflect different perspectives on a good quality of life, work largely outside the market system.

Drivers of change refers to all those external factors that affect nature, anthropogenic assets, nature's benefits to people and a good quality of life. They include institutions and governance systems and other indirect drivers and direct drivers (both natural and anthropogenic).

Direct drivers, both natural and anthropogenic, affect nature directly. "Natural drivers" are those that are not the result of human activities and are beyond human control. These include earthquakes, volcanic eruptions and tsunamis, extreme weather or ocean-related events such as prolonged drought or cold periods, tropical cyclones and floods, the El Niño/La Niña Southern Oscillation and extreme tidal events. The direct anthropogenic drivers are those that are the result of human decisions, namely, of institutions and governance systems and other indirect drivers.

Anthropogenic drivers include habitat conversion, e.g., degradation of land and aquatic habitats, deforestation and afforestation, exploitation of wild populations, climate change, pollution of soil, water and air and species introductions. Some of these drivers, such as pollution, can have negative impacts on nature; others, as in the case of habitat restoration, or the introduction of a natural enemy to combat invasive species, can have positive effects.

Good quality of life is the achievement of a fulfilled human life, a notion which varies strongly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising access to food, water, energy and livelihood security, and health, good social relationships and equity, security, cultural identity, and freedom of choice and action. From virtually all standpoints, a good quality of life is multidimensional, having material as well as immaterial and spiritual components. What a good quality of life entails, however, is highly dependent on place, time and culture, with different societies espousing different views of their relationships with nature and placing different levels of importance on collective versus individual rights, the material versus the spiritual domain, intrinsic versus instrumental values, and the present time versus the past or the future.

2.2.2 Interlinkages Between the Elements

The attainment of a high standard of living within a society and the perception of what this involves have a direct impact on institutions, governance structures, and other indirect factors, which in turn have an impact on all other elements. For instance, to the extent that a good life refers to a person's immediate material needs and rights, or the collective needs and rights of the present and future generations, it affects institutions that operate on a range of scales, from the subnational level, such as land and water use rights, pollution control, and customary hunting and extraction arrangements, to the global level, such as ratification of international treaties.

Through institutions, a high quality of life and its views also indirectly influence how people and groups view nature. Perceptions of nature range from nature being considered as a separate entity to be exploited for the benefit of human societies to nature being seen as a sacred living entity of which humans are only one part.

Institutions, governance structures, and other indirect drivers also have an impact on all elements and are the main causes of the anthropogenic factors that have an adverse impact on nature. For instance, the amount of land that is converted and allocated to food crops, plantations, or energy crops is influenced by lifestyle decisions, economic and demographic growth, and lifestyle choices (indirect drivers). Synthetic fertilizer subsidy policies have also significantly contributed to the detrimental nutrient loading of freshwater and coastal ecosystems, to name a few.

All of these have significant impacts on ecosystem health, biodiversity, and the benefits they provide, which in turn affect the many social structures designed to address these issues. For example, the convention on the United Nations Framework Convention on Climate Change, which operate on a worldwide scale the Convention on Biological Diversity, the Convention on the Conservation of Migratory Species of Wild Animals or, at the national and subnational levels, arrangements in ministries or laws that have effectively contributed to the protection, restoration, and sustainable management of biodiversity.

Additionally, institutions and governance systems and other indirect drivers also affect the interactions and balance between nature and human assets in the co-production of nature's benefits to people, for example by regulating urban sprawl over agricultural or recreational areas. This element also modulates the link between nature's benefits to people and the achievement of a good quality of life, for example, by different regimes of property and access to land and goods and services; transport and circulation policies; and such economic incentives as taxation or subsidies. For each of nature's

2.2.3 Contextualizing the Framework

This framework shall guide in understanding of relationships between social and environmental drivers of the country's ecosystem changes over space and time. The assessment shall identify drivers that generate stress and cause both positive and negative pressures on the terrestrial, aquatic, and wetlands ecosystems, considering their geographic distribution as agreed during stakeholder engagement processes at the scoping stage. The resulting feedback of ecosystem changes are assumed to alter the physical, chemical, and biological state of the ecosystems to cause impacts on ecosystems and livelihoods. Humans may react to pressures by taking mitigating measures to manage the various priority ecosystems in this assessment. In the interest of this assessment, focus shall be directed towards identifying various knowledge systems that have informed different programs and have been proven working. This will include indigenous and scientific knowledge systems with related practices.

Policy consideration in the assessment is one of the most important elements as depicted in the conceptual framework. However, policies can be supportive of biodiversity and ecosystems, although they can also conflict with their conservation. Similarly, practices may be informed by policies and vice versa. In Malawi, there are several policies that have been formulated but understanding how they promote biodiversity and ecosystem conservation remains unclear. Most importantly the role of indigenous and local knowledge in this regard has received limited attention. For instance, contemporaneous ecosystem challenges have exacerbated given major drifts in socio-political, cultural and economic transitions that have occurred in the past decades since the advent of democracy in the country rendering ILK less relevant. The assessment team shall focus on examining the impacts of the existing policies and identify knowledge gaps.

2.2.4 Emerging Policy Related Questions

Against the preceding framework supported by the scoping findings, the NEA team addressed five policy related questions. These policy questions were revisited and revised throughout the assessment process to ensure the assessment remained relevant to decision-making processes and emerging needs. Authors developed specific policy questions for each chapter to guide them address the main policy questions as highlighted in the scoping report and mention in chapter 1 above.

2.2.5 Specific Policy Questions within Thematic Chapters

2.2.5.1 Policy questions under wetlands ecosystem

i. How do the biodiversity and ecosystem services provided by wetlands across the country contribute to the country's economy, local livelihoods, food security, and good quality of life, and what are their interdependencies with each other?

ii. How do biodiversity and ecosystem services governance include the use of scientific, Indigenous, and local knowledge to influence policy and decision-making processes in wetland management?

iii. What is the nature of wetland governance and knowledge management systems required for the integration of local and scientific knowledge for a more comprehensive knowledge base for policy and decision-making?

iv. What is the status, trends, and potential future dynamics of wetlands biodiversity and ecosystem services, and pressures that affect their contribution to the country's economy, livelihoods, and well-being in the various regions of the country?

v. What are the most prevalent pressures and factors undermining the contributions of wetland ecosystems to human well-being and the livelihoods of present and future generations of local communities?

vi. What are the key drivers of wetland ecosystems that undermine sustainability for the benefit of both current and future generations?

vii. What are the actual and potential impacts of various policies and interventions on wetland biodiversity and ecosystem services to the sustainability of the national economy and local livelihoods?

viii. What policy responses, measures, and processes exist for the strengthening and improving the governance of wetlands and delivery of ecosystem services, regarding local communities, their knowledge and practices.

ix. What are the contributions of local communities in terms of their knowledge, practices, and views on wetland management and species conservation, including the delivery of ecosystem services for human well-being and livelihoods at the local and national level?

2.2.5.2 Policy questions under Aquatic ecosystems

. How do the aquatic biodiversity and ecosystem services provided across the country contribute to the country's economy, local livelihoods, food security, and good quality of life, and what are their interdependencies with each other?

i. How do aquatic biodiversity and ecosystem governance, including the use of scientific, Indigenous, and local knowledge, interact to influence policy and decision-making processes?

ii. How has the transition from a party to a multiparty dispensation in Malawi affected the traditional values and ILK that influence the management and conservation of aquatic ecosystems?

iii. What is the status, trends, and potential future dynamics of aquatic, biodiversity and ecosystem services, and what are the pressures that affect their contribution to the country's economy, livelihoods, and well-being in the various regions of the country?

iv. How have local, national level institutions contributed to the conservation of aquatic resources for the last fifty years?

v. What are the actual and potential impacts of various policies and interventions on the contribution of aquatic biodiversity and ecosystem functions and services to the sustainability of the national economy and local livelihoods.

vi. How can the nation strengthen the knowledge and practices of Indigenous Peoples and local communities in managing aquatic ecosystems and ensuring their sustainability?

vii. What are the possibilities of using ILK in improving policy instruments and institutional arrangements for aquatic biodiversity conservation and the cost of not doing so?

viii. How are recognizing and implementing indigenous peoples' rights at the national level affecting aquatic resources in areas managed by IPLC's

ix. Have national interventions been effective in protecting ILK in the aquatic ecosystem?

2.2.5.3 Policy questions under Terrestrial ecosystems

i. How do the biodiversity and ecosystem services provided by forests, woodlands, national parks, and wildlife reserves across the country contribute to the country's economy, local livelihoods, food security, and good quality of life, and what are their interdependences with each other?

ii. How do biodiversity and ecosystem governance for terrestrial ecosystems, including the use of scientific and local knowledge, interact to influence policy and decision-making processes?

iii. Do current community-level bylaws (CNRM, beach village committees) incorporate cultural and traditional beliefs and practices?

iv. What is the status, trends, and potential future dynamics of terrestrial biodiversity and ecosystem services, and what are the pressures that affect their contribution to the country's economy, livelihoods, and well-being in the various regions of the country?

v. How do natural resource management policies address human population issues against resource increase demand?

vi. What are the actual and potential impacts of various policies and interventions on the contribution of biodiversity and ecosystem functions and services in terrestrial ecosystems?

vii. Have all environmental multilateral agreements in which Malawi is a member country, been domesticated through local instruments or legal permits?

viii. How have local, national and international level institutions and policy tools, and strategies involving IPLCs contributed to the conservation of nature and sustainable provision of nature's contributions to people over the last fifty years?

ix. What knowledge gaps need to be addressed to better understand and assess drivers, impacts, and responses to wetland, aquatic and terrestrial biodiversity, and ecosystem services at the national level?

2.3 Temporal Scale Consideration

It is widely recognized that ecosystem services operate at different spatial and temporal scales. It is noted that functions are directly linked to larger and longer-term scales of ecological processes, and that services are more related to current short-term socio-cultural and economic processes. The NEA process is driven by policy needs, but policies have different time scales of their implementation.

The NEA report draws from different sources of knowledge – scientific and Indigenous and local knowledge with secondary sources dating back to ten years. The choice of this time scale is driven by the need to set a baseline enough for exploring potential future scenarios. Addressing the policy questions presented earlier suggests the need for sufficient time scale to discern trends. The country began undergoing significant environmental change in 1994 (source) and soon the country transitioned into a democratic dispensation. Since then, state control over renewable natural resources has remained a toll order. Ten years down the line, observation was clear that the country was undergoing an environmental transformation, but documentation has remained challenging until recently when international and national reporting requirements have intensified. Hence, the choice of ten years.

Again, inclusive biodiversity policies have been developed in the past twenty years. Thus, data availability and reliability may vary through time in the country's context within the past ten years based on lessons drawn so far. In the same vein, twenty years in the future will be a suitable time scale for the assessment to be relevant. This suggests that the assessment will take a multiple scale approach to cater for different policies, national planning requirements and international reporting needs.

2.4 Approach to the expert evaluation

The scoping stage marks the first step of the national ecosystem assessment process. During the scoping stage, the framework and direction of the assessment are identified in collaboration with stakeholders and knowledge holders. This stage dwells much on stakeholder engagements and multiple evidence-based approaches. The scoping stage facilitates the development of the rationale and methodologies of the assessment, it also informs the potential uses of the assessment, ensuring that all components of the assessment are relevant to decision-makers and practitioners. The scoping stage supports the creation of a shared understanding of the national ecosystem assessment process and is collectively owned by the relevant stakeholders. Engagement of key stakeholders at the onset of the scoping stage helps to instil ownership of the assessment process and its outputs.

2.4.1 Stakeholder Engagement

2.4.1.1 Project Communication, Stakeholder Engagement and Capacity Building

The NEA project has developed a communication strategy which involves compiling a plan to effectively disseminate information about the NEA's findings, goals and importance to various stakeholders. The communication strategy has been developed to meet the following objectives:

1. Strengthened collaboration among various key stakeholders in information sharing for decision making, strategic planning and action for biodiversity conservation and management.
2. Enhanced engagement with policymakers, academia, and local communities in the assessment of biodiversity and ecosystem services for knowledge co-production and utilization.
3. Strengthened evidence-based decision-making and awareness for sustained biodiversity and ecosystem services, and sustained livelihoods.
4. Increased gender consideration and women's participation in the national ecosystem assessment for inclusive decision-making.

2.4.1.2 Target Audiences

The target audiences for this communication strategy include the following:

- Project team and partners institutions within and outside Malawi
- Local communities
- Government Ministries, Departments & Agencies (MDAs)
- Traditional leaders
- Local government structures.
- Policymakers
- The academia
- Civil Societies Organisations (CSOs)
- Non-Governmental Organizations (NGOs)
- The media

Communication activities will be disseminated using the broadest possible means. The organization and participation of various events, the regular flow of information about the NEA in different media houses, dissemination of different publications including flyers and policy briefs, and the dissemination of information about the NEA on social networks are the main means of communication. In addition, NEA plans to hold several events at Lilongwe University of Agriculture and Natural Resources (LUANAR) with the participation of students.

All NEA documents will be translated into the local language and distributed to all stakeholders, universities, academia and research organizations, MDAs, civil society, and community organizations. Project communication and stakeholder engagements of the project began with four stakeholder workshops. In these workshops, project partners and stakeholders came together to develop comprehensive action plans for the project. International workshops were also held for capacity building. There have been several capacity-building activities among the authors as well as the project team. The capacity building activities were delivered through international webinars, local meetings as well as international in-person workshops with UNEP-WCMC, UNDP and UNESCO. The NEA project will continue to build capacity among the project team and technical working groups for a successful expert evaluation.

2.5 Scenario building

2.5.1 Integration of Scenarios for the Future

The current state of ecosystems in all ecosystem types as prioritized, past status and future change trends will be assessed in the form of various scenarios and models that will be developed. The period from the past to the present will be assessed in the form of a trend or one scenario, while the period from today to the future will be assessed in the form of two scenarios. These scenarios will mainly focus on Business as usual (BAU) and Sustainable Ecosystem Management (SEM) scenarios. The length of the past period will vary depending on the availability of information. The next period will be forecast for all ecosystem types until 2050. For example, for aquatic ecosystems, the past will cover 1973-2018 and the future will be forecast until 2050.

Scenarios will be developed based on both raw data (e.g., forest area) and indicators (e.g., forest cover and species index), and the choice of which indicator will depend on the availability of information. Below is the suggested tentative scenario during the NEA.

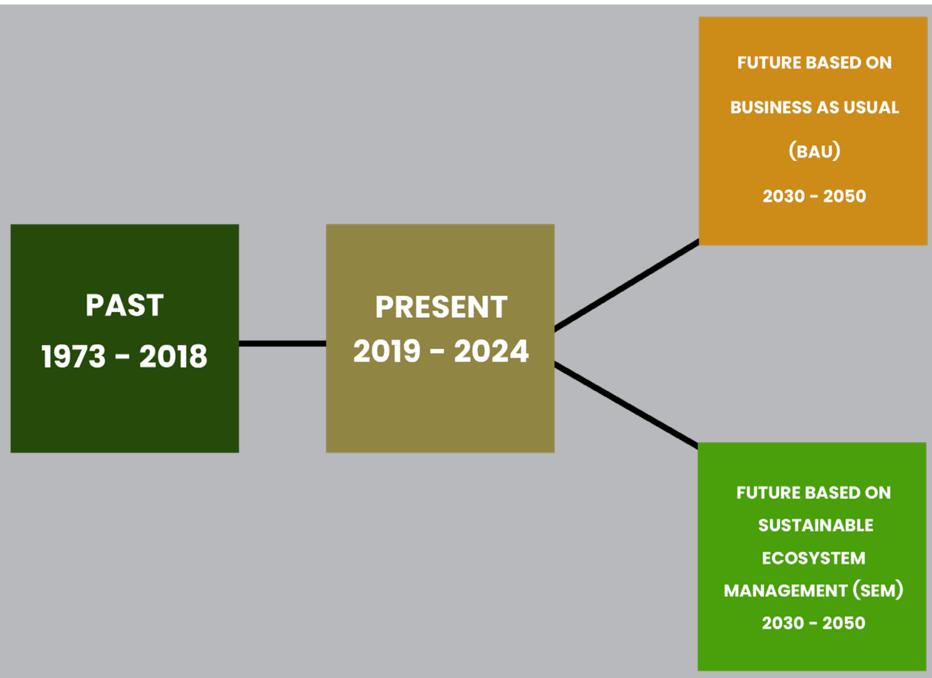


Figure 2-2: Scenario development process

Scenario development will proceed in the NEA process as a useful approach to creating awareness, articulating and searching for feasible solutions to the challenges of governing ecosystem services articulated earlier in each thematic areas of the assessment. The approach to building scenarios will originate from both models and stakeholder participation, to assess outcomes from alternative future trajectories, through model analysis and planning with stakeholders, to inform decision making.

The degree of stakeholder involvement in scenario planning will range from roles with information input (consulting) to mutual process design (co-development). We propose five steps of scenario development and analysis to guide the integration of stakeholders for discussion:

Step 1: Identification and prioritization of relevant system's components. For each ecosystem type, components of interest will be identified.

Step 2: Characterization of past and current conditions and trends. For each ecosystem type, baseline conditions will be characterized to provide a reference point for understanding the patterns and processes driving change.

Step 3: Development of a set of scenarios (explorative). A set of scenarios will be developed for each ecosystem type and a set of assumptions will guide the various scenarios of interest. Climate change, population growth and land use changes are some of the major driving factors to consider.

Step 4: Choice of response variables and targets to assess scenarios according to services provided by the specific ecosystem (normative step), and

Step 5: Proposal of potential management strategies to achieve a desirable future through a back casting process.

2.5.1.1 Procedures for scenario development

To progress from the baseline scenario to the development of policy/management scenarios, the following procedures will be undertaken:

Step 1: Choosing a relevant baseline (agreed with stakeholders) as a reference for policy scenario assessments.

Step 2: Identifying problems, challenges, barriers (formulation of an objective) and specifying targets (as a result from the baseline assessment).

Step 3: Screen measures and instruments (partly suggested by stakeholders) suitable to be analyzed with scenarios and models.

Step 4: Designing and constructing alternative pathways, or indicator trajectories, i.e., response actions derived from strategies, through models and/or narratives.

Step 5: Build relevant policy scenarios and analyze outputs.

CHAPTER 3

AQUATIC ECOSYSTEMS

CHAPTER 3 - **AQUATIC ECOSYSTEMS**

3.1 Introduction

Aquatic ecosystems are water-based environments, wherein, living organisms interact with both physical and chemical features of the environment (USFWS, 2021, Brown et al., 2013). These ecosystems include marine freshwater habitats like lakes, rivers, streams, ponds, oceans, wetlands, swamp, etc. where water-dependent living species including plants, animals, and microbes are housed (Brown et al, 2013). While there are generic two types of aquatic ecosystems namely marine and freshwater (Brown et al, 2013), Malawi has freshwater aquatic ecosystems only. These ecosystems however suffer from lack of proper accounting and assessment. Nevertheless, without proper ecosystem assessment, the proper functioning of these ecosystems and their health may be affected, as justifying the benefits of their accompanying ecosystem services may be understood. This may perpetuate decision-makers' and communities misinterpreting on how their actions might change these ecosystem services, and leading to their degradation. In this chapter, aquatic ecosystems exclude wetland ecosystems as they have been discussed and assessed as a stand alone ecosystem and/or thematic area in chapter five of this document.

Aquatic ecosystems cover about 20% of the total surface area of Malawi and are habitats to a diversity of fish and other aquatic fauna and flora (FAO, 2006). Major aquatic ecosystems in Malawi include lakes (Malawi, Malombe, Chilwa, Kazuni and Chiuta) and rivers (Songwe, South Rukuru, North Rukuru, Dwangwa, Linthipe, Shire, Bua River etc.), which are also the interest of this assessment. Aquatic ecosystems are socio-economically and ecologically important because of the number of fish species, other unique aquatic animals and vegetation they contain and the ecosystem services they provide.

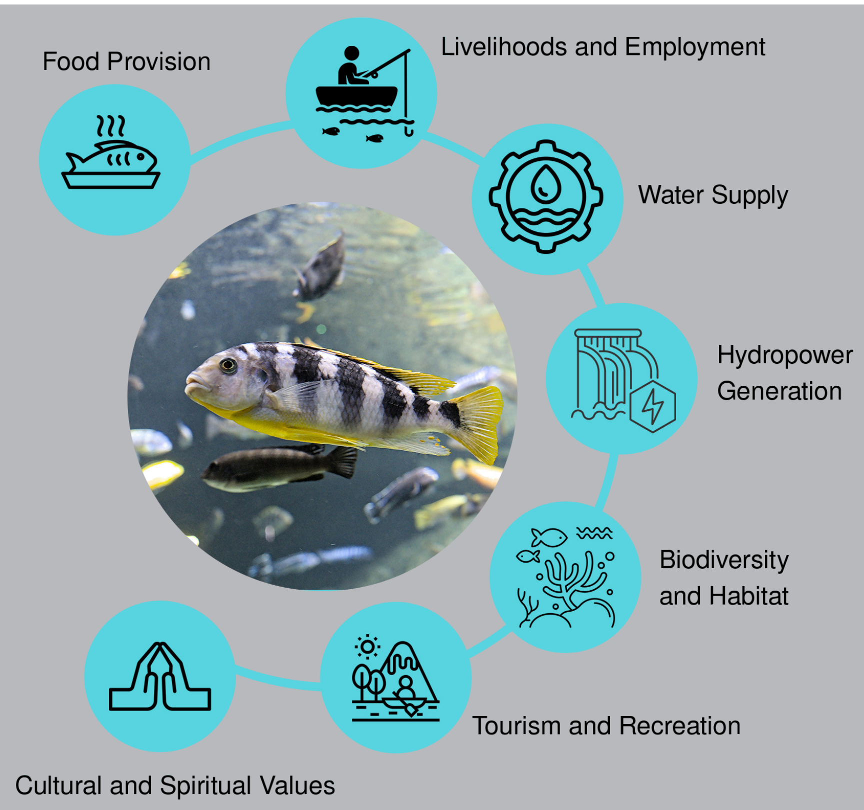


Figure 3-1: Contributions of Aquatic Ecosystems. (Source: NEA)

Over 1,000 fish species have been described in Lake Malawi alone, 95% being haplochromine cichlids, 99% of which are endemic to the Lake (Turner et al, 1991; Turner, et al., 2001& FAO, 2006). The lake also hosts Lake Malawi National Park and in recognition of this national park's unique biological diversity, it was declared a World Heritage Site by UNESCO in 1984 (Lewis and Trendall, 1986; Chavula et al, 2023). The lake's outflow is also harnessed for hydroelectric power generation in the middle reach of the Shire River and it highly contributes to the fishery industry, which is the main source of animal protein for millions of people in Malawi. Based on the National Annual Report of 2024, the per capita fish consumption in 2024 in Malawi was reported at approximately 8.5 kg/person/year, contributing significantly to dietary protein of up to 40% of animal protein intake. Additionally, Lake Malawi is also used as a source of domestic water supply and irrigated agriculture in the lakeshore areas while steamer ships that ply on Lake Malawi such as Ilala and Chilembwe ferry passengers and cargo to various destinations across the lake.

This chapter therefore, seeks to provide evidence on the status of aquatic ecosystems in Malawi and their future scenarios through assessment of the prioritized ecosystems. The assessment has brought together evidence-based information from various scientific disciplines and ILK systems. Lévêque (1999) notes that ILK and traditional practices may yield new ideas about conservation and management of natural resources and also recognizes the inclusion of ILK as a new resource management tool that could contribute to ecological sustainability. It is in this regard that the assessment has incorporated multiple sources of evidence-based information on Lakes Malawi, Malombe, Chilwa, Kazuni and Chiuta, and the river systems including Songwe, South Rukuru, North Rukuru, Dwangwa, Linthipe, Shire and Bua. See Map of Malawi in **Figure 3-1**, showing location of some of the prioritized aquatic ecosystems.

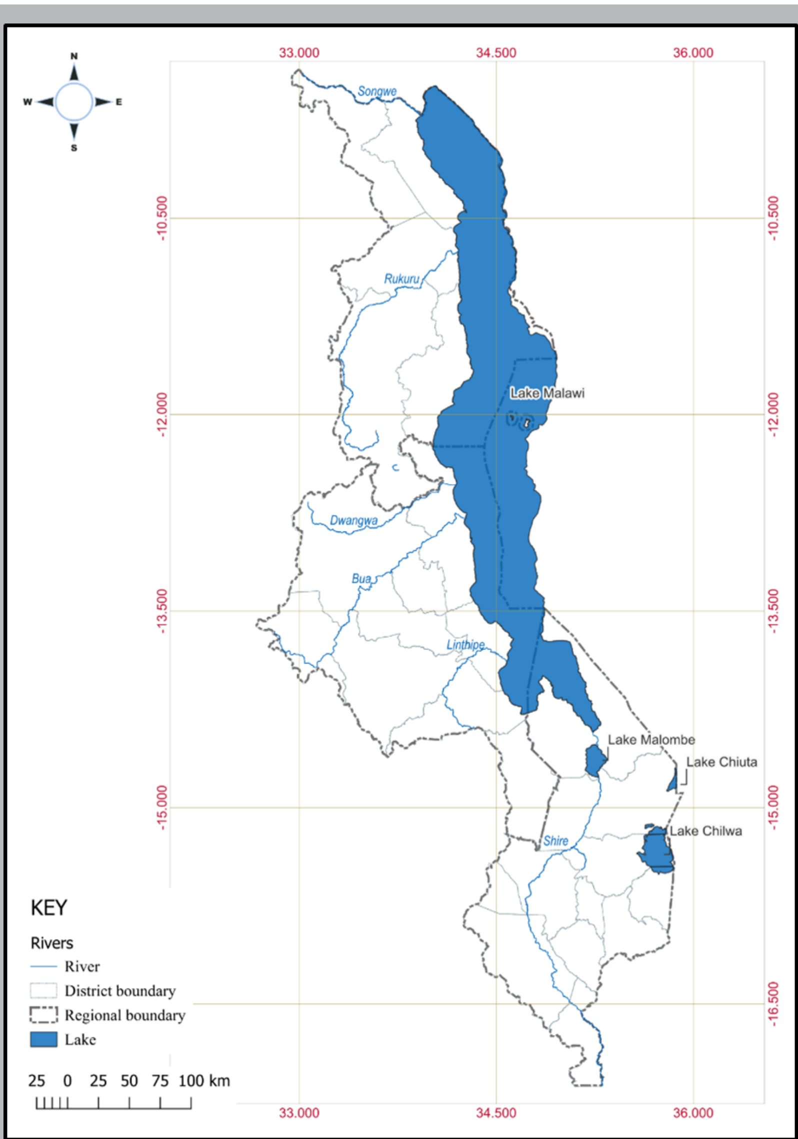


Figure 3-2: Map of Malawi showing location of some of the prioritized aquatic ecosystems

3.2 Situation Analysis

This section provides the current status of the aquatic ecosystems which will provide a basis for comparison with the future scenarios after policy questions are addressed and restoration strategies are implemented. Malawi's aquatic ecosystems as prioritized in this assessment have been affected with a lot of pressures such as human activities, climate change, pollution, and unsustainable resource use are increasingly threatening these ecosystems (GoM, 2019) leading to degradation of their functions and ecological integrity. Despite their importance, these ecosystems are frequently inadequately assessed and poorly accounted for in policy development, management and conservation frameworks. This situation analysis aims to highlight the current state of aquatic ecosystems, identifying their key drivers of change, and assess challenges and opportunities in sustainably managing and conserving these critical resources.

Annual variations in lake surface area and lake levels coupled with seasonal volume fluctuations have been noted in all lakes under this assessment. Wide fluctuations have however been noted in shallow lakes such as Lakes Chilwa, Malombe, Chiuta and Kazuni. These shallow lakes are vulnerable to changes in climate as variability in seasonal and annual precipitation directly affects their water levels. Sparse hydrometric time series (levels/area) data was however observed for small lakes such as Kazuni and Chiuta. This assessment therefore recommends studies to gather this data including monitoring of these systems. Table 3.1 presents the generic summary of morphometry and hydrological data for prioritized lakes in Malawi thereby showing data on fluctuations in lake levels and seasonal volume fluctuations.

Trends and status of hydrological regimes

Table 3-1: Generic Summary of Morphometry and Hydrological Data for Lakes Malawi, Chilwa, Malombe, Chiuta and Kazuni

Characteristic	Lake Malawi	Lake Chilwa	Lake Chiuta	Lake Malombe	Lake Kazuni
Surface Area (km2)	22,490	683 (Varies with seasons)	190 (Fluctuates from 25 to 300)	390	2
Depth (m)	700; mean 294	6	3-4	5-7	2-3
Maximum length (km)	570	40	40	30	2
Mean width (km)	48 (but ranges from 25 to 75)	30	20	15	1
Shoreline length (km)	1,500	120 km (with seasonal variations)	60	100	5 (with seasonal variations)
Altitude (masl)	471	627	622	474	1,200
Volume (km3)	8,400	0.35 (with seasonal fluctuations)	0.4	0.38	≤0.01 (with seasonal fluctuations)
Total catchment (km2)	97,740	8,349	1400	4,250	100
Major inflowing rivers	9	8	2	1	1
Total inflow (km3/ year)	63	0.25	0.1-0.15	4	0.01
Average annual outflow (km3/ year)	16 (395 m3/s)	Through evapo-ration	Occasional out-flow	4	Occasional out-flow
Outflow rivers	1	0	1	1	1

Sources: Bootsma and Hecky, 2003. World Lake Database; Jamu et al. 2011., UNESCO, 2015

Precipitation over the lake (mm/ year)	1549	800-900	600-1600	902	800-1,200
Evaporation Outflow (km3 / year)	60	0.3	0.1	1	0.005
Residence time	114 yr	less than 1 year,	1 year or less	1-2 years,	less than 1 year
Flushing rate	less than 1% per year	0	Variable	50% per year	Variable
Secchi depth (m)	1–5 (shallow area); 12–20 m (open water)	0.2–0.5	0.5–1	0.5–1	0.2–0.5
pH	7.9–8.5at surface and 7.8 at 300 m	7.5–8.5	7.5–8.0	7.8–8.2	7.0–7.8
Depth of oxygenated (m) water	170–250	1–2	2–3	4–5	1–2

3.2.1 Lake Malawi

Lake Malawi is the third-largest African Great Lake and the largest freshwater ecosystem in Malawi stretching from Karonga, Rumphi, Nkhata Bay, Nkhotakota, Salima, Dedza and Mangochi districts.

3.2.1.1 Hydrological Regimes

Water level fluctuations in Lake Malawi have historically been moderate, typically ranging between 0.7 and 1.8 meters. This relative stability is largely due to the lake's considerable depth and the regulated outflow managed by the automated Kamuzu Barrage in Liwonde, Machinga District (GoM, 2010).

Significant hydrological changes were recorded primarily in the late 1970s and early 1980s. During this period, the average annual lake outflow normally around 395 m^3/s peaked at 825 m^3/s in 1979/ 80 and 820 m^3/s in 1980/ 81 (GoM, 2010). Similarly, while the long-term average lake level sits at 474 meters above sea level (masl), extreme highs and lows were observed between 1915 and 1998: a peak of 477.16 masl in May 1980 and a low of 472.96 masl in November 1997 (Shela, 2000).
Following these events, lake levels remained relatively stable until the 2022/ 2023 hydrological year, when intense rainfall in northern Malawi and Tanzania, the lake's primary catchment caused water levels to rise to 475.31 masl. This was also reinforced by management of the Kamuzu barrage, leading to extensive flooding. This increase continued into 2024, with the lake's volume growing by 44 centimetres (GoM, 2023). The rising waters submerged lakeshore lodges, villages, and farms, resulting in the export of nutrients and pollutants into the lake.
By the third quarter of 2024, however, water levels had begun to recede, a trend that was expected to persist until the start of the next hydrological year in November 2024 (NRWA in Umali, 2024). Overall, Lake Malawi's hydrological regime remains characterized by an average level of 474 masl and an estimated volume of 8,400 km^3 (Bootsma & Hecky, 2003).

3.2.1.2 Sediment Regimes

Sedimentation poses significant challenges thereby impacting on water quality, biodiversity conservation, sustaining ecosystem services and livelihoods, among others.

Lake Malawi is experiencing severe adverse impacts (population growth and urbanization) resulting from anthropogenic and climatic stressors leading to increased sediment and nutrient loading. While the lake is estimated to be over 5 million years old (Ivory et al., 2016) and is the third-largest lake in Africa (after Lakes Victoria and Tanganyika), sedimentation is a significant concern in the lake and has resulted into water level fluctuations and overall water quality changes thereby impacting on fish populations, biodiversity, and overall ecosystem health. Bootsma and Hecky (1999) observed that the annual yield of sediments and nutrients brought into Lake Malawi by tributary rivers depends on flow conditions each year. More sediments and nutrients are washed into the lake during the rainy season (November to April) than during the dry season (May to October).

For instance, in the 2022/2023 increased water level anomaly, the amount of sediment the rains carried into the lake was also high and heavily influenced by land use in the catchment. Though specific 2022/2023 data for the entire sediment deposition into Lake Malawi isn't available, scientific research on Lake Malawi shows that nearshore areas have high sedimentation rates, which are worsened by land use changes like deforestation and agricultural practices in the catchment triggering soil erosion. Hecky et al., (2003) also noted that sediment and nutrient concentrations, loads, and yields are sensitive to the degree of agricultural land in the sub-basins, with the lowest sediments transported from small steep forested watersheds and highest amounts carried by tributaries in densely settled catchments with extensive agricultural activity and deforested areas.

During the period over which Bootsma & Hecky (1999) also conducted their study, and noted that rivers supplied 0.26 – 0.40 g P m– 2 per year and 2.0 – 4.5 g N m– 2 per year to the lake, despite gaps in the recent data of the same. Additionally, the study also observed that rivers were the largest source of total P to the lake, and those rivers carried higher concentrations of sediments and nutrients early in the rainy season than did similar flows late in the rainy season. This was explained as resulting from the flushing of debris from the prolonged dry season and soil loss from cultivated and planted fields prepared for the beginning of the rains. Nutrient richness in water bodies has been reported to lead to algal blooms which have significant negative effects to the aquatic resources and human beings, raising concern about continued increases in nutrients from agricultural catchments (Hecky et al., 2003).

The lake has the catchment area of 97,740 km2 of which 64,373 km2 lies in Malawi, 26,600 km2 in Tanzania, and 6,768 km2 in Mozambique (Bootsma & Hecky, 1999). The lake has a maximum depth of 700 m which results in vertical variations in water temperature and density that restrictive mixing through which upwelling occurs very regularly (Bootsma & and Jorgensen, 2004).

3.2.1.3 Water Quality

Lake Malawi is a deep meromictic lake, with average water temperatures decreasing from 25.4 °C at the surface to 22.8 °C at a depth of 240 m. Major ions include NO , PO^{3} , Na , Cl , Ca^{2} , K , and Mg^{2} , while trace elements include Mn, Fe, Al, Ni, Pb, Cd, Ba, Sr, F, Cr, Cu, and Mo. The concentrations of most chemical elements are generally well below the World Health Organization (WHO) thresholds for drinking water. However, elevated levels of lead (Pb) and fluoride (F) have been detected at certain locations, influenced by hydrothermal springs within the lake's watershed.

The Lake has over the years had an increase in phosphorus and nitrogen concentration noted in sediment cores from the lake mostly because of land use changes and increased fertilizer application in farms along the shorelines. While atmospheric deposition has also been named as another important source of nitrogen and phosphorus for Lake Malawi due to that 60 % of the total input of water is derived from direct rainfall and that the surface area of the lake is large (Bootsma and Jorgensen, 2004), land use changes have also contributed to water quality changes.

A global comparison indicates that atmospheric deposition rates of nitrogen and phosphorus in Lake Malawi is among the highest in the world (Bootsma and Jorgensen, 2004). This study states that the sources of nutrients are biomass burning, increased exposure of soil to wind erosion promoted by burning, deforestation, and overgrazing of land. They also stated that the region around Lake Malawi was among the most frequently burned regions in Africa. Reasons for the burning include preparation of fields for cultivation, burning of woodlands to open up agricultural areas, promotion of early growth of grass for livestock, hunting, accidental fires and tradition, among others. Additionally, there exist some general insights into the water quality issues that have historically and presently affected Lake Malawi. For instance, in the 2022/2023 hydrological year, Malawi registered extreme rainfall events with lake levels going up to 475.31 meters above sea level. Most of the lodges, villages and farms along the lakeshore areas were submerged, leading to export of nutrients and pollutants such as nitrogen and phosphorus into the lake. During such rainfall events, indicators of water quality change to a great extent thereby affecting the ecosystems within the lake (DCCMS, 2023)

Additionally with respect to pH and other water quality parameters, a study by MoWS (2023) indicated that chemically, water from thirty-four surface water points along the whole stretch of Lake Malawi ranged from slightly acidic to alkaline and soft to moderately soft i.e. Total Hardness (as CaCO3) (ranged from 7.62-8.94 and 64-87 mg/L, respectively) , a departure from the alkaline nature of the lake (is usually between pH 7.7–8.6). Nitrates and phosphates registered values that ranged from <0.001 -0.191 mg/L and <0.001 – 0.77 mg/L respectively. Nitrates levels complied with the thresholds set by Malawi Bureau of Standards (MS691:2005) of <50 mg/L. On the other hand, the phosphates levels indicated higher quantities than the set thresholds for wastewater (MS691:2005) of <0.15 mg/L. Physical parameters, namely, Turbidity and Suspended Solids (SS) registered values that ranged from 1.05– 28.3 NTU and <0.01 – 19 mg/L, respectively.

High turbidity and suspended solids can significantly reduce the aesthetic quality of lakes and streams having harmful impact on recreation and tourism. Elevated levels of turbidity in lakes can also harm fish and other aquatic life by degrading spawning beds and affecting gill function. Sediments often top the list of substances or pollutants causing turbidity.

The MoWS (2023) study further reported that Dissolved Oxygen levels in Lake Malawi and in all the thirty-four sampling stations ranged from 4.88 to 8.79 mg/L. The lowest Dissolved Oxygen (DO) level below the maximum acceptable limit of 5.0 mg/L according to Malawi Bureau of Standards (MS691:2005) was registered in Nkhotakota district. Dissolved oxygen is the amount of oxygen dissolved in water and this component in water is critical to the survival of various living aquatic organisms including fish.

Biochemical Oxygen Demand registered values that ranged from 0.10-4.68 mg/L. The registered values were all within the acceptable limit of 20 mg/L according to the Malawi Bureau of Standards (MS691:2005). Biochemical Oxygen Demand is a measure of how much oxygen is used by microorganisms in aerobic oxidation, or the breakdown of organic matter. Usually, the higher the amount of organic material found in the body of water, the more oxygen is used for aerobic oxidation. BOD depletes the amount of dissolved oxygen available to other aquatic life. This measurement is obtained over a period of five days hence referred to as BOD5 and is expressed in mg/ℓ. The levels of BOD in receiving waters is directly increased by the discharge of wastes high in organic matter, resulting in localized areas of dissolved oxygen depletion.

The lake's water conditions are however generally alkaline (pH 7.7–8.6) and warm with a typical surface temperature between 24 and 29 °C, while deep sections typically are about 22 °C. The oxygen limit is at a depth of approximately 250 m, effectively restricting fish and other aerobic organisms to the upper part of the lake. The water is very clear for a lake and the visibility can be up to 20 m, but more common is visibility below 3 m, especially in muddy bays. However, during the rainy season months of January to March, the waters are muddier due to muddy river inflows (Lowe-McConnel, 2003; Vudo et. al., 2019). While water quality parameters were reported from a 34-station snapshot (MoWS (2023); temporal context (season/ yearly) data that can be compared to historic baselines is critically missing. Recent efforts have been done by the Department of Climate Change and Meteorological Services to install automatic gauging stations including along Lake Malawi through the Modernised Climate Information and Early Warning Systems (MCLIMES) project. This modern infrastructure has resulted in collecting seasonal/yearly water quality data from Lake Malawi 's twelve gauging stations, with initial data collected in May 2025 and as shown in **Table 3-2**, when the parameters were compared to Malawi Standards (MS691:2005) and previous data, Total dissolved solids are a main parameter that is above the standard and are of concern, while having alkaline pH in all the stations but within the standard . The situation on TDS change can be attributed to degraded catchment area, requiring further efforts on catchment restoration.

Table 3-2: Lake Malawi Water quality data for May 2025

SOURCE TYPE/ LOCATION	Nkhotakota Jetty T/A Malengachanzi Nkhotakota District	Sunbird Livingstonia Salima District	Chipoka Jetty Salima District	Malawi Shipping Company Mangochi District	Monkey Bay Gauging Station (3A2), Mangochi District	Malawi Standards (MS691:2005)
pH Value	8.49	8.51	8.33	8.05	8.78	6.0 – 9.0
Temperature	IN	IN	IN	IN	27.4	40
CONDUCTIVITY (µs/cm at 250C)	242	246	249	279	250	3500
TOTAL DISSOLVED SOLIDS, mg/l	145	148	149	166	126	100
NITRATE (as NO3-), mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<50

Table 3-2 (Continued): Lake Malawi Water quality data for May 2025

SOURCE TYPE/ LOCATION	Beach Chamber T/A Kyungu Karonga District	Mufwa Lodge T/A Kyungu Karonga District	Mikoma Beach Lodge T/A Kyungu Karonga District	Ngara Fishing Camp T/A Kyungu Karonga District	Chilumba Jetty T/A Wasambo Karonga District	NkhataBay Jetty NkhataBay District	Chintheche NRWB Intake NkhataBay District
pH Value	8.61	8.80	8.88	8.92	8.64	8.70	8.55
CONDUCTIVITY (µs/cm at 250C)	252	252	244	247	233	260	265
TOTAL DISSOLVED SOLIDS, mg/l	151	153	147	148	139	161	158
NITRATE (as NO3-), mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PHOSPHATE (as PO4), mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

3.2.1.4 Fisheries (Food fish and Ornamental fish)

Malawi's aquatic ecosystems collectively possess one of the most diverse fish species assemblages in the world. In total, the number of described fish species in Malawi accounts for about 15% of the global total number of freshwater fish species and roughly 4% of the world's fish species (Konings 1990, Ribbink 2001). Fish account for up to 28% of animal protein intake by the population (FAO, 2020). In addition, the fisheries sector in Malawi is an important source of employment and income for a considerable number of people. This is also acknowledged by the IPLC's around the lakes who find different types of piece works from fishes and owners of fishing gears. This section describesdr the status and trends of fish species in Malawi's aquatic ecosystems over time.

Fish stocks in Lake Malawi are declining and in particular there is the decline of the endemic Oreochromis spp locally known as Chambo, as evidenced by decreasing catch rates (catch per unit effort) (GoM, 2021). Lake Malawi is over 5 to 10 million years old (Delvaux, 1995) and a center of endemism for the Cichlid fish with at least 800 species, which accounts for 15 % of the global freshwater fish biodiversity (Kapute, 2008), and of which 117 are classified as threatened by the IUCN. The lake contains the largest number of fish species in the world, 30% of all known cichlid species,44 and 4% of the world's fish species (NSOER, 2010)

According to Konings (2016), over 500 species have been formally described in Lake Malawi; and most cichlids are endemic. Eleven (11) families are represented in the lake, with the Cichlidae family being dominant in species richness. **Table 3-2** shows a comprehensive list of riverine (R) and lacustrine (L) fishes of the Lake Malawi system, and the percentage of endemicity (Weyl et al., 2010).
The Cichlidae family in Lake Malawi is represented by two principal phylogenetic lineages, namely: The Tilapiines and the Haplochromines (Konings, 2016; Shaw et al., 2000;). The tilapiines consist of the genera Oreochromis, Tilapia and Coptodon. The Oreochromis spp. are represented by a small, endemic species-flock comprising four members that are collectively referred to as Chambo, and a fifth non- Chambo species, Oreochromis shiranus (Konings, 2016; Turner, 1996). The only representative member of the genus Tilapia is a non-endemic species Tilapia sparrmanii and the genus Coptodon is represented by the Coptodon rendalli. Haplochromines species belong to fish species numbering between 700 and 800 (Konings, 2016). Most of the haplochromines are endemic to Lake Malawi, except for Pseudocrenilabrus philander commonly found in peripheral lagoons; Astatotilapia calliptera and Serranochromis robustus, formerly regarded as non-endemic and are now recognised as distinct lineages (Seehausen, 2002). The origin and age of the endemic cichlid fauna currently form the focus of much research and debate (Genner et al., 2007; Genner & Michel, 2003) but other, more conservative (in terms of speciation) fish families and genera provide clear evidence for the history of fish colonisation of the lake and its inflowing rivers.

Table 3-3: Comprehensive list of riverine (R) and lacustrine (L) fish families of Lake Malawi system and their percentage endemicity

Fish families list of Lake Malawi system	R or L Fishes	Genera	Endemic	Species	Endemic
Protopteridae	R	1	0	1	0
Anguillidae	R and L	1	0	1	0
Mormyridae	R and L	6	0	7	0
Nothobranchiidae	R	1	2	2	0
Alestidae	R and L	2	0	2	0
Cyprinidae	R and L	5	1	26	35
Bagridae	R and L	1	0	1	100
Amphiliidae	R	2	0	4	40
Clariidae	R and L	2	1	17	71
Mochokidae	R and L	2	0	3	33
Cyprinodontidae	R and L	1	0	1	0
Aplocheilidae	R	1	0	2	50
Mastacembilidae	R and L	1	0	1	100
Cichlidae	R and L	56	51	800	99.5

Sources: Sayer et al, 2019; Chavula et al, 2023; Adapted from Ribbink (2001); Kapute, 2008

Regarding fisheries in Lake Malawi, the sector comprises capture fisheries and aquaculture, with the former being dominant in contributing total fish landings in the country. Capture fisheries include small- scale, large-scale (trawling) and export trade fisheries (Malawi Government, 2021; Chavula et al, 2023). The small-scale fisheries are however "open entry" in nature (van Zwieten et al., 2016), and dominant among capture fisheries, contributing close to 90% of total fish landings in the country. In Malawi, over 1,600,000 people are involved in fisheries-related activities such as processing, marketing, fishing gear production, boat building, net mending and maintenance, engine repair and other activities (GoM, 2021). A total of 74,222 people are directly employed by the fisheries sector as fishers (GoM, 2021). However, the majority of this is made up of crew members (82%) while gear owners make up 18 %. The fishery industry is dominated by male gear owners, who account for 98 % of the total population while 2 % are female gear owners (GoM, 2021).

Generally, however, it is now accepted by the public that the fish stocks in Lake Malawi are declining as evidenced by decreasing catch rates (catch per unit effort). In particular, there has been a decline of the endemic Oreochromis (Nyasalapia), or Chambo, which exists in three species. For example, in Lake Malombe C hambo catches were around 4,000 tonnes in the late 1970s, increasing to over 6,000 tonnes in the early 1980s. In the late 1980s a drastic decline was observed with catches falling to less than 600 tonnes per year by the early 1990s and to less than 200 tonnes per year in the late 1990s.

This decline in total catch is directly matched by severe declines in CPUE in the two main fisheries harvesting the stock, namely gill nets and chambo seines (Sayer et al, 2019). Chambo is listed as an endangered species according to the International Union for Conservation of Nature (IUCN) Red List. According to NSOER, 2010, the total Chambo catch (for Lake Malawi, Upper Shire River, and Lake Malombe combined) had at that time declined by over 70% over the past 10 years before 2010. This was attributed to limited enforcement of type of fishing gear and closed seasons. However,, while Lake Malawi fisheries resources are managed through among many approaches, the use of catch and effort statistics or data collection system introduced in Malawi by the Food and Agriculture Organization (FAO) (Chavula et al, 2023); the catch and effort data reveals that catches in trawl fishery have had a decreasing trend since the late 1980s. With this reduction, current fishery reports (2016 data) indicate about only 3,000 metric tonnes are realized in the fishery **(Figure. 3-3)**.

Furthermore, the composition of catch landings from large-scale fisheries has changed over time and Turner et al. (2005) blames it on the introduction of commercial trawling. Between 1976 and the early 1990s, the fishery was dominated by Oreochromis spp. (Chambo) and Lethrinops spp. (Chisawasawa) **(Figure. 3-3)**. These two species groups were later replaced by Diplotaxodon spp. (Ndunduma) while Copadichromis spp. (Utaka) has had a rather stable trend over the years. The dominance of Engraulicypris sardella (Usipa) catches in the small-scale fisheries accounting to over 60 % of the total catch) has been observed from the year 2000 to data of 2016 (GoM, 2021).

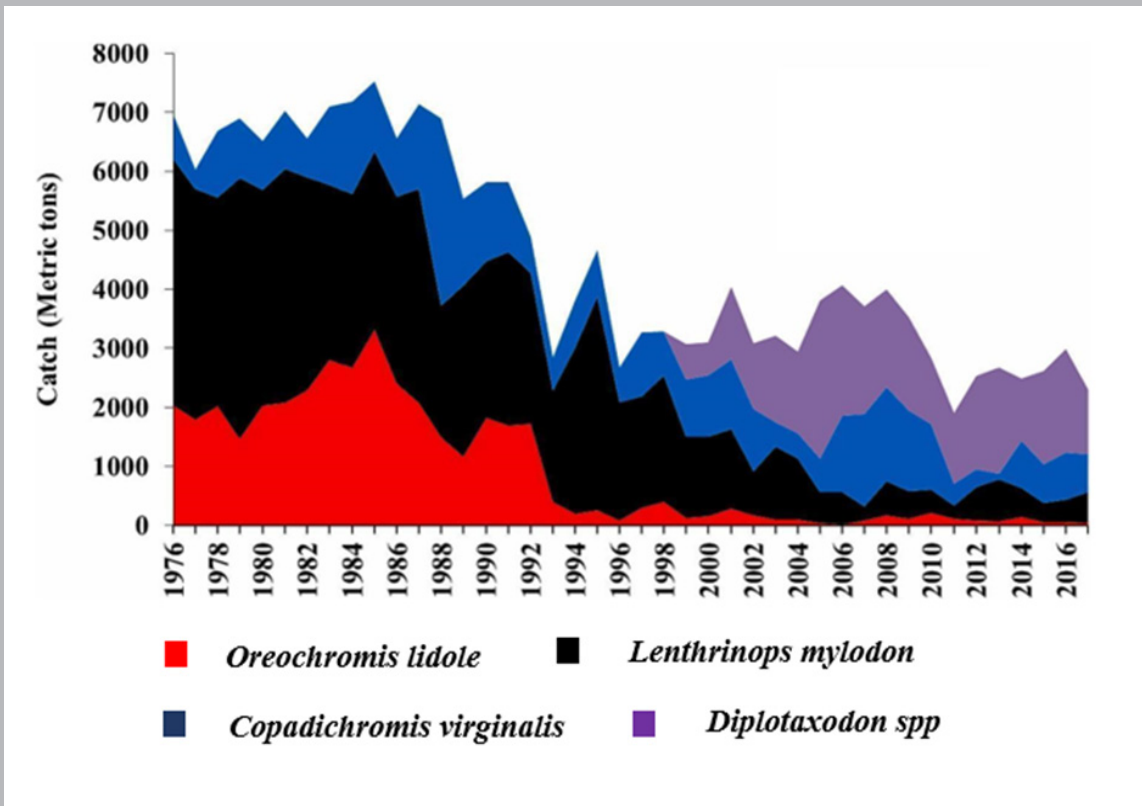


Figure 3-3: Fish production of commercially important fishes by large-scale trawlers. Chambo (Oreochromis spp.), Chisawasawa (Lethrinops spp.), Utaka (Copadichromis spp.) and Ndunduma (Diplotaxodon spp.) (Source: GoM, 2021)

Recent data from 2018- 2023 however shows that total fish landings from Lake Malawi have been stable over that period **(Figure. 3-4)** with Usipa, Ndunduma and Utaka fish species contributing greatly to the total catch with fish catches estimated around 170,844 in 2020. However, despite the general increase in the trend of fish catches, catches of some of the large-sized species, such as Chambo, have declined (Fig. 3-5). During the late 1970s, production of Chambo was about 9,000 tons annually but landings have since declined to 2,500 tons (72% decline) and less annually (GoM, 2021).

These challenges in fishery recovery (especially Chambo stocks) are still emerging despite new efforts to adopt co-management approaches (after 2010) that have improved community buy-in, leading to widespread compliance with closed seasons and mesh-size regulations. This decline in Chambo therefore is driven by a convergence of factors including habitat degradation from increased sedimentation (which destroys nearshore spawning beds and macrophyte habitats) and nutrient pollution from deforestation and agriculture; apart from gear selectivity and overfishing. To recover Chambo stocks, a holistic approach is therefore required, combining establishment of community-managed fish sanctuaries (proven successful at sites like Chisi Island), strictly enforced closed areas and seasons through co management and catchment restoration.

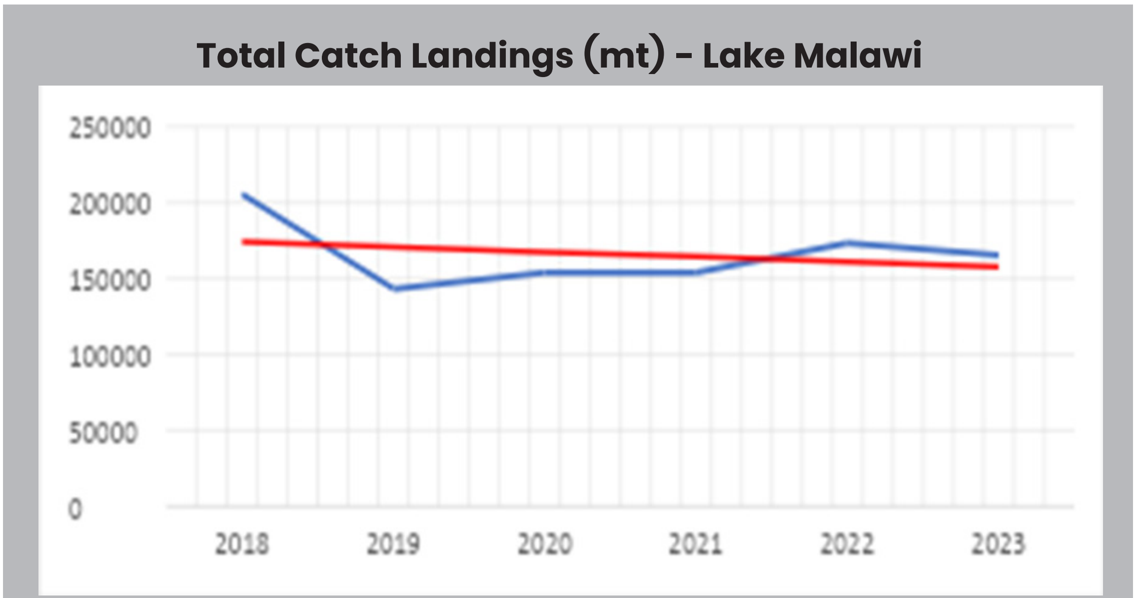


Figure 3-4: Annual total catch landings for Lake Malawi between 2018 and 2023 (Source: GOM, 2024)

Lake Malawi is also facing an increased rate of post-harvest fish losses with over 27% of fish processed in Malawi continuing to undergo physical and quality losses despite recent efforts to address them. Several challenges impact sustainable management of fisheries resources. One of such challenges is the increased rate of post-harvest fish losses. Efforts like the development of post-harvest fish loss reduction technologies such as solar tent dryers and improved smoking kilns have however been developed though losses persist (Chavula et al, 2023; Torell et al., 2020 in Chavula et al, 2023). As a result, fish reaches consumers in less quantities leading to low levels of per capita fish consumption and an increase in demand for fish thereby promoting overfishing (Torell et al., 2020). Siltation is also causing a lot of challenges to Lake Malawi by destroying fish habitats and causing nutrient loading. Non-compliance to fisheries rules and regulations is another concern. The fisheries in Malawi are controlled through technical restrictions, i.e., closed season, fishing effort control through licensing, minimum mesh sizes, time of fishing and minimum takeable size of fish. However, there have been challenges in enforcing these restrictions. Scientists have faulted the approach as it is considered a top-down fisheries management system, hence local compliance becomes a challenge (Jul- Larsen et al., 2003 in Chavula et al, 2023).

Despite the challenges, several initiatives are being taken to resolve problems and ensure sustainable management of the fisheries resources. The latest intervention by the Malawi Government is the installation of a vessel monitoring system (VMS) on trawling boats. Other ongoing interventions are the introduction of the closed season and the ban on the importation of monofilament gillnets and others to do with governance and regulatory framework. However, these initiatives have not been fully successful because they took a top-down approach by ignoring the knowledge of the local people who have lived and interacted with the lake for centuries. For example, there is a need to enhance and embrace co- management which has proven to produce positive results notably in Lake Chiuta (Njaya, 2007). Thus, community engagement in fisheries resources management has proven to be cost-effective and sustainable. Communities should be encouraged to identify potential sites for fish sanctuary establishment which has also proven to be successful as observed by local communities at Chisi Island at Lake Chilwa basin.

Further urgent actions that are holistic in nature (combining ecology, social and regulatory frameworks) are further required to reverse some of the critical issues currently being experienced, including putting extra effort into capacity-building efforts, aiming at addressing issues of fish postharvest losses, targeting the fishermen, fish processors, fish distributors and fish marketers (Chavula et al, 2023).

Ornamental fish from Lake Malawi

The ichthyofauna of Lake Malawi alone comprises not less than 600 species of cichlids, most of which have evolved in this lake within a geologically short period of time and are found nowhere else in the world as natives (Genner & Turner 2005). Malawi's aquatic ecosystems collectively possess one of the most diverse fish species assemblages in the world. Among them are ornamental fish. These include coloured cichlids and rock-dwelling cichlids (mbuna) among others. Of these cichlids, five

five species are of the tilapiine subgroup while the rest are haplochromines (Turner 1996). This great diversity of fish species of Lake Malawi attracts international tourists and researchers (GoM, 2021; Msukwa et al., 2021a).
The fishery which is currently dominated by the ornamental fish is practiced in Malawi and Tanzanian sides of Lake Malawi (Msukwa et al., 2021b).

Furthermore, exploitation of export fish is allowed in all waters of Lake Malawi except in National Parks although cases of poaching have widely been reported (Msukwa et al., 2021a). The operations of fishing for the export fish trade are currently confined to four licensees in Malawi and commonly target Mbuna fish species (Msukwa et al., 2021b). The export fish trade thrives on the exploitation and exportation of these cichlids, mostly to Europe, North America and Asia (GoM, 2021). In 2020, a total of 23,985 units of fish worth USD 137,600 was exported to Europe, Japan, the USA and South Africa (GoM, 2021). This was, however, a huge drop when compared with 66,461 live fish in 2019, which generated a total income of USD 295,090. The drop was attributed to the impact of COVID-19-restricted exports (GoM, 2021).

3.2.1.5 Aquatic Vegetation

Phytoplankton species are the major aquatic vegetation in lakes of Malawi including Lake Malawi. Among these are diatoms, cyanobacteria (blue-green algae) and green algae. Macrophytes are also aquatic vegetation in Lake Malawi, though their abundance and distribution are poorly understood (Bootsma and Jorgensen, 2004). Seasonal variations in phytoplankton species composition in Lake Malawi with diatoms dominating during the windy season (May to August) and cyanobacteria (blue-green algae) dominating during September to November were also reported (Bootsma and Jorgensen, 2004). On the other hand, a mixture of small diatoms, blue-green algae, and green algae was reported to occur from December to April, with an unusual distribution of Scenedesmus bloom and the Aulacoseira between March 1990 to March 1991, in Lake Malawi (Chavula et al, 2023).

3.2.1.6 Other Aquatic Wildlife

There is a rich variety of flora and fauna, including more than 5,000 plants and over 8,500 invertebrate species in both riverine and lacustrine aquatic ecosystems of Malawi (NSOER, 2010). Chavula et al. (2023) indicated the presence of invertebrate species, mostly dominated by crustaceans, nematodes and insects. NBSAP (2006) indicated that number of non-insect aquatic invertebrates, including nematodes, mollusks, rotifers, crustaceans, annelids and acarins is estimated at about 280 species, and insect nymphs and Chironomids of various taxa are also widespread. Specific data on other wildlife in Lake Malawi is however scanty.

Regarding zooplankton community, Lake Malawi has been reported species-poor (Ngochera, 2016), as it comprises two species of cyclopoids (Mesocyclops aequatorialis and Thermocyclops neglectus), calanoid (Tropodiaptomus cunningtoni and Thermodiaptomus mixtus), two species of cladocera (Diaphanosoma excisum and Bosmina longirostris), and the midge Chaoborus edulis (Chavula et al., 2023). While these zooplankton species are observed throughout the year, fluctuations in population sizes and abundance are observed in the Southeast Arm of the lake and their biomass ranges from 16 and 46 mg m-3 (Chavula et al, 2023).

3.2.2 Lake Chilwa

Lake Chilwa is the second largest lake in Malawi, located in Phalombe and Zomba districts and has the surface area of 683 km2 (Nkhoma, et. al., 2020). The water level of the lake is at an altitude of 627 m asl and has no outflow, as such water levels vary considerably in size and salinity depending on precipitation in the catchment area. Additionally, Lake Chilwa is very shallow, with a maximum depth of 6 meters; intrinsically, a small increase in water level results in a large increase in the lake's surface area.

3.2.2.1 Hydrological regimes

Lake Chilwa has been experiencing recurrent hydrologic shocks, leading to major lake recession and a history of cyclic drying and filling over the years (Kambombe et al. 2021). The lake's cyclic and mostly declining hydrological regime is mainly caused by significant declining streamflow of some rivers in the basin and flowing into the lake. This situation threatens both water and food security and the livelihood of the people depending on the ecosystem; as Lake Chilwa benefits more than 2 million dependents through fishing, rice farming and other ecosystem services.

Between 1900 and 2019, the lake experienced drought induced water level fluctuations.). Historically, there were severe recessions in 1879, 1900, 1914-15, 1922, 1931-32, 1934, 1954, 1960-61, 1967, 1973, 1995, 2012, 2015 and 2019 (Kalk et al. 1979; Njaya et al. 2001; GoM, 2000; Jamu et al. 2012, Chiotha et al, 2017; Zuzani et al, 2019 in Manase et al, 2022). Some of these recessions were complete dry-ups such as in 1934, 1967, and 1995. These complete dry ups are attributed to land use changes e.g. agricultural expansion and irrigation and climate change (Manase et al, 2022) .Mostly, Lake Chilwa has been experiencing seasonal water level fluctuation of approximately 1 m, and sometimes fluctuating by 2 to 3 m (Rivett et al, 2020). These historic changes in water levels and subsequent desiccation, also suggests the need to understand both natural and anthropogenic factors as the cause of sediment load and the changes in water levels. In recent decades, the lake has also been frequently drying, especially during every extreme high temperature experienced. USAID, 2015 also reports of shocks on mean annual water levels under the period between 1984 to 2012 (USAID (2015), (See **Figure. 3-6**).

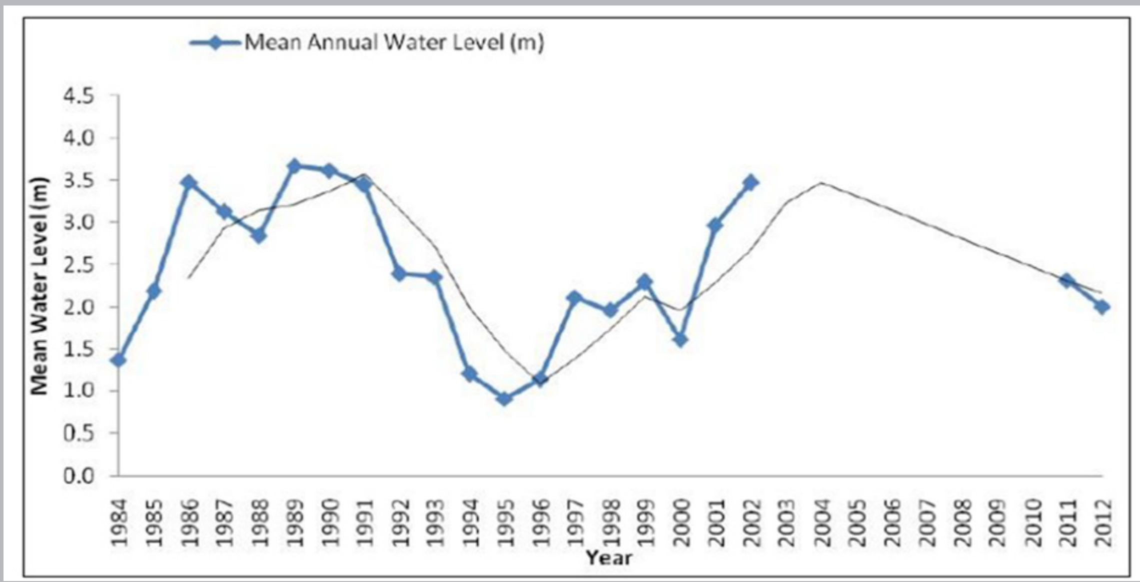


Figure 3-5: Trends in water levels, 1984-2001 and 2011- 2012.

Source: USAID, (2015)

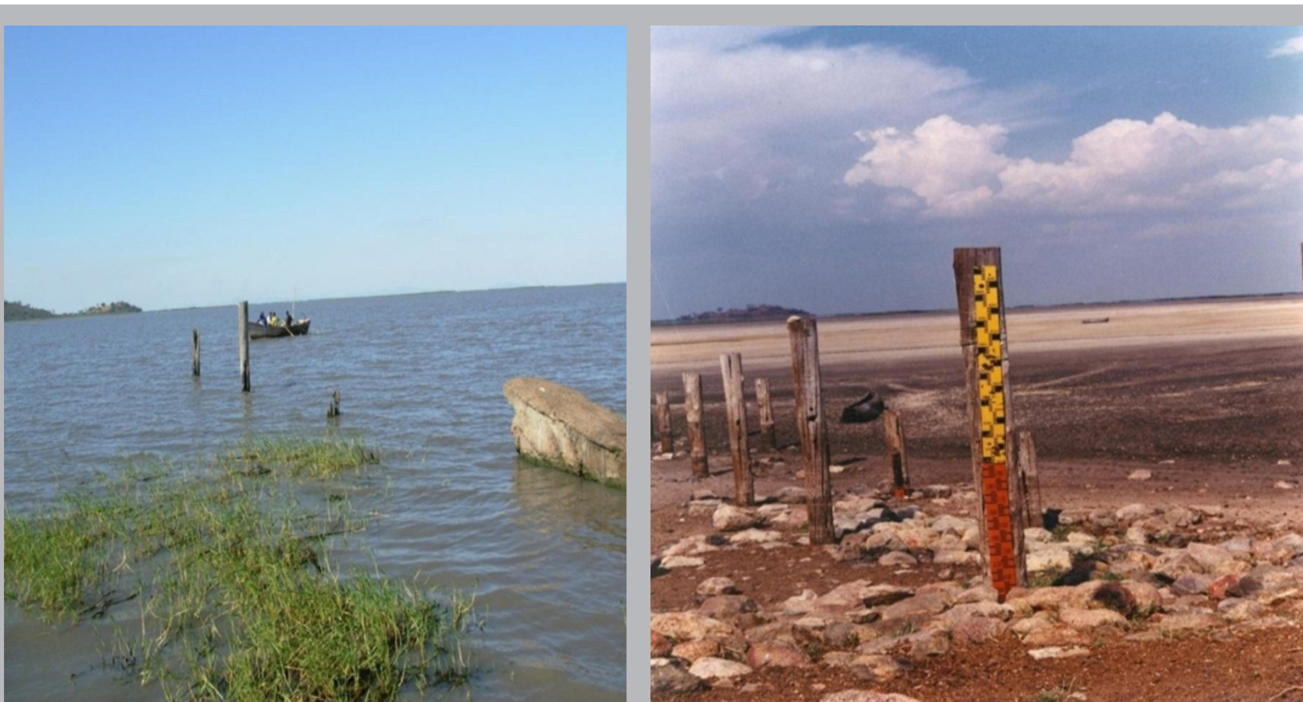


Figure 3-6: Lake Chilwa in Normal years (left) and in drying periods (right)

Source: Lead SEA

Lake Chilwa Situation in 1995

Figure 3-7: Lake Chilwa drying situation in 1995 (Source: LEAD)

Deforestation and cropland expansion are considered the main causes of the frequent hydrological shocks in Lake Chilwa especially from the year 2000 (Kambombe et al, 2023). Explicitly, from year 2000, evidence of increasing runoff of up to 11% and subsequent declining base flows have been experienced mainly due to deforestation and increased crop land (by at least 8% from 39.6% of the total country land area) (Li et al., 2021). Other than deforestation and cropland expansion, climate influence also portrayed a decrease–increase–decrease decadal impact on streamflow and hence the lake (see **Figure 3-5**). That is to say, climatological changes from 1980 to 1990s resulted in a notable reduction in rainfall which in turn reduced the decadal streamflow by 18%. From 1990 to 2000s, climatological changes accounted for a 10% increase in streamflow, while from 2000 to 2010s a 7% decrease was observed (Kambombe et al, 2023). The notable decrease in streamflow from the 1980s to 1990s is consistent with the general climate pattern reported by other researchers including Nkhoma et al. (2021) who observed a 49.8% reduction in decadal rainfall from the 1980s to 1990s over Southern Malawi.

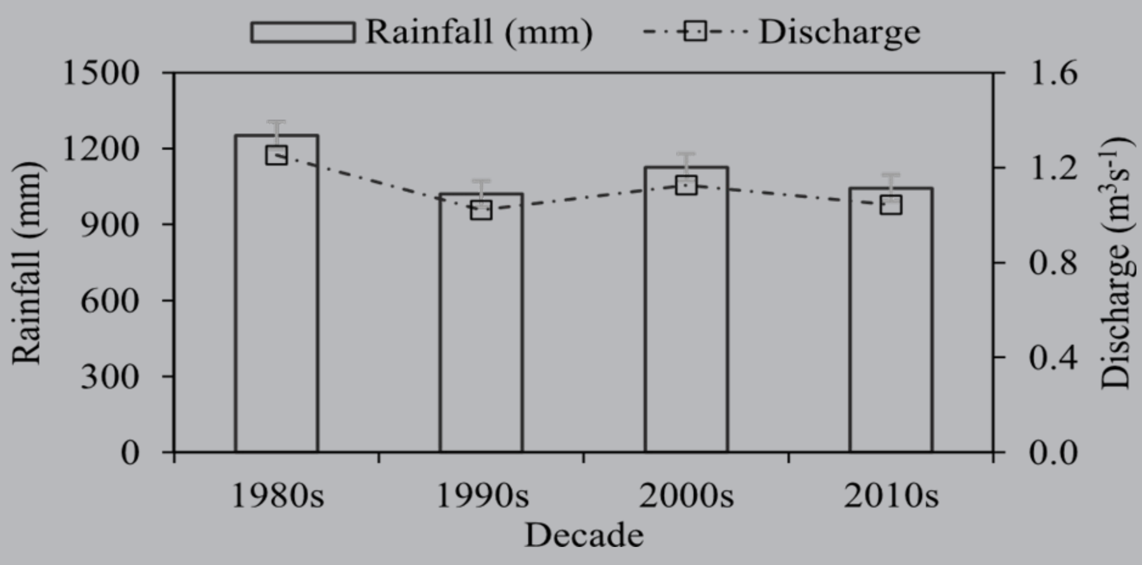


Figure 3-8: The inter-decadal relationship between rainfall and discharge in Lake Chilwa basin. Source: Kambombe et al, 2023

3.2.2.2 Sediment Regimes

Similar to Lake Malawi, Lake Chilwa faces challenges related to sedimentation, mostly due to deforestation, soil erosion, and agricultural runoff. These have led to changing in depth as well as water levels because of sediment load over the past 50 years.

While Lake Chilwa is shallow in nature and that its catchment area has over the years experienced agricultural expansion, deforestation and urbanization, increased runoff and resultant soil erosion leading to sediment transport and increased sediment loads entering the lake has been evident (Makwinja et al, 2021). While natural causes and climate change have contributed to the dynamic nature of the lakes, human activities induced sediments have also exacerbated the changes.

3.2.2.3 Water quality

Lake Chilwa has generally freshwater, though salinity can increase in certain areas during dry seasons as evaporation outpaces inflow (Njaya et al., 2011). In general, the water temperature is warm, ranging from 24°C to 30°C, with slight variations depending on the season (Mwichansi, 2021). The pH is typically alkaline and ranges from 7.5 to 9.0 (Kadyampakeni & Nkhoma, 2017). Dissolved Oxygen levels of the lake fluctuates, with hypoxic conditions developing in areas with high organic matter decomposition, particularly in the shallower parts of the lake.

Limnologically, while Lake Chilwa is shallow its limnology is heavily influenced by climatic variations, seasonal flooding, and human impacts on the watershed (Kassam, 2014). Nutrient levels of the lake changes mostly due to agricultural runoff, domestic waste, and deforestation in the catchment area (Mwenefumbo et al., 2021). The nutrient loading however, contributes to high productivity and eutrophic conditions of the lake (Milupi et al., 2017).

3.2.2.4 Fisheries (Food fish and Ornamental fish)

Lake Chilwa as among the major aquatic ecosystems in Malawi, is also one of the most productive in Africa, with some years contributing up to 30% of the total annual fish catches for Malawi (NSOER, 2010; Jamu et al., 2011, Schuyt 2005, Delaney et al. 2006). This Lake ecosystem has about 21 species of fish represented across four families of Cichlidae, Clariidae, Nothobranchiidae and Cyprinidae. Three types of fishes Chambo (Oreochromis spp), Catfish (Clarias spp), and Matemba (Barbus paludinosus) are the most common ones. This is despite the lake's history of undergoing drought induced water level fluctuations, during periods of desiccation; which forces fishes of the lake to utilise inflowing rivers and swamps as spawning grounds and refuge (Jamu & Brummett, 1999).

Details of the 21 species (seven sampled plus thirteen reported), including their IUCN Red List Status are given in Table 3-4. Of these 21 fish species, 15 are classified as being of least concern (LC), five are classified as not evaluated (NE) while one is vulnerable (VU) under the IUCN Red list (version 2023-1).

Table 3-4: Conservation status of some fish species of Lake Chilwa, Southern Malawi (IUCN Red List version 2023-1).

Ser. No.	Species Name	Family Name	IUCN Red List Status
1	Astatotilapia calliptera (Günther, 1894)	cichlidae	LC
2	Brycinus imberi (Peters, 1852)	Alestidae	LC
3	Clarias theodorae (Weber, 1897)	clariidae	LC
4	Clarias gariepinus (Burchell, 1822)	clariidae	LC
5	Coptodon rendalli (Boulenger, 1897)	cichlidae	LC
6	Enteromius kerstenii (Peters, 1868)	cyprinidae	LC
7	Enteromius innocens (Pfeffer, 1896)	cyprinidae	NE
8	Enteromius manicensis (Pellegrin, 1919)	cyprinidae	NE
9	Enteromius paludinosus (Peters, 1852)	cyprinidae	LC
10	Enteromius radiatus (Peters, 1853)	cyprinidae	NE
11	Enteromius toppini (Boulenger, 1916)	cyprinidae	NE
12	Enteromius trimaculatus (Peters, 1852)	cyprinidae	LC
13	Hemigrammopetersius barnardi (Herre, 1936)	Alestidae	LC
14	Labeo cylindricus (Peters, 1852)	cyprinidae	LC
15	Marcusenius macrolepidotus (Peters, 1852)	Mormyridae	LC
16	Mormyrops anguilloides (Linnaeus, 1758)	Mormyridae	LC
17	Nothobranchius kirki (Jubb, 1969)	Northobranchidae	VU
18	Oreochromis shiranus (Boulenger, 1897)	cichlidae	LC
19	Pareutropius longifilis (Steindachner, 1914)	Schilbeidae	LC
20	Petrocephalus catostoma (Gunther, 1866)	Mormyridae	LC
21	Pseudocrenilabrus philander (Weber, 1897)	cichlidae	NE

Regarding the state of fish stocks in Lake Chilwa, in the 1990s, the lake was able to produce up to some 12,000 tonnes of fish annually, all from artisanal fishermen (Njaya et al, 1996). The bulk of the catch was matemba (Barbus paludinosus), and the rest being a mixture of catfish (Clarias spp), Oreochromis shiranus and other species. However, with the lake's continued undergoing considerable seasonal and annual changes in water levels and salinity and sometimes the lake drying out in the recent decades, fish stocks have so far declined.
The decline in fish stocks have resulted in increased enforcement and tough management measures put in place.

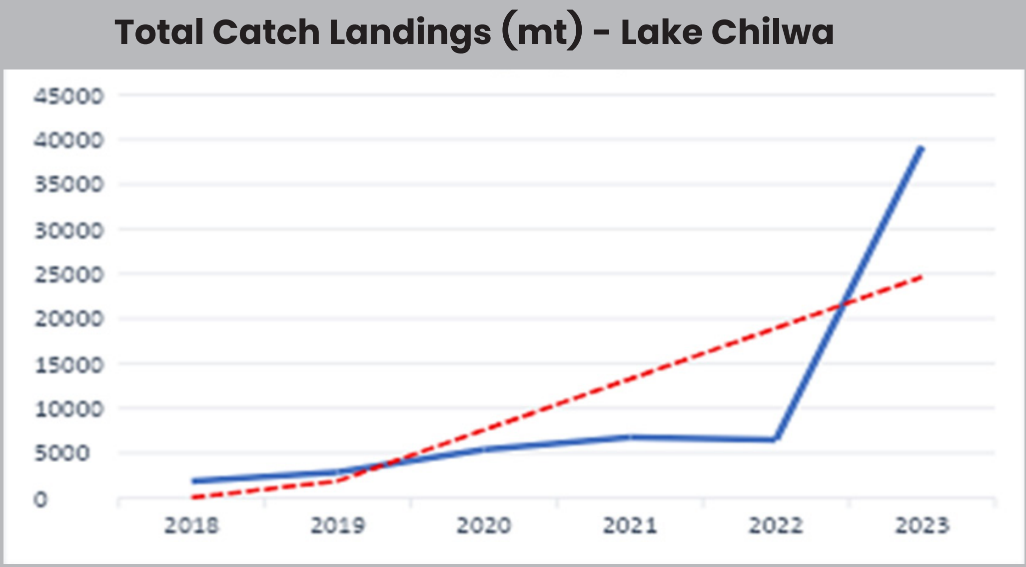
The communities around lake Chilwa now use sustainable fishing methods that align with the lake's seasonal fluctuations and to maintain fish populations from the conventional fishing methods of using seine and gill nets (which prompted overfishing), and so far was banned. The common sustainable practices now include corralling using reeds and establishment of temporary no-fishing zones during breeding seasons. The co-management and co-governance practices are in place in the catchment and are made possible through the coordination and collaboration of communities Beach Village Committees (BVCs), Area Development Committees (ADCs), Riverline Village Committees (RVC), Fisheries Department officials, Forestry Department officials, and Traditional Leaders.

This is guided by the Fisheries Act (1997), where these committees came up with by-laws that sought to regulate fishing activities on Lake Chilwa. Following the communities and Government sustainable efforts, there is hope of the ability of Lake Chilwa fishes to repopulate the lake rapidly that (Njaya et al, 1996). This follows evidence that fish population was able to repopulate within three years to former levels following total desiccation of the lake in the 1990s (Njaya et al, 1996).

With regards to catch landings from Lake Chilwa, data indicates fluctuations over time with an increasing trend (Figure 3-8). Most of the catches are dominated by Matemba species (Barbus paludinosus). The annual catch landings however, have been relatively below 5,000 metric tons from early 2000s to 2018, only to increase to over 30,000 metric tons in the year 2023 (see **Figure 3-6**) (GoM, 2024).

This increased catch landing may be unsustainable and may risk further reduction of the fishery if done without effort controls. This suggests adaptive co-management efforts and controls of effort amidst abrupt spikes in catch landings which may be triggered by pollution.

Figure 3-9: Annual total catch landings for Lake Chilwa between 2018 and 2023 (Source: GOM, 2024)



3.2.2.5 Aquatic Vegetation

Lake Chirwa has rich flora found in varying habitat types of its wetlands, with marshes and swamps dominated by Typha dominguesis and floating species such as Pistia stratiotes and Ceraphyllum demersus especially on the lake edge of the swamp. Large sedge Scirpus littoralis and the aquatic grass Paspalidium germinatum are however commonly found in open water of the lake which makes up one third of the lake in normal years. Generic to vegetation in Lake ecosystems are also macrophytes e.g. water hyacinth (Eichhornia crassipes); which are usually confined to shallow areas along the lake shores. However, Lake Chilwa's biodiversity is mostly influenced by the fluctuation of the water levels (Kalindekafe, 2014).

3.2.2.6 Other Aquatic Wildlife

Apart from its diverse fish community, Lake Chilwa supports a rich assemblage of other aquatic fauna. The lake is a critical habitat for numerous waterbird species, including large populations of migratory Palearctic waders, resident ducks, and flamingos, which rely on its wetlands for feeding and breeding (Bhima & Daudi, 2007; Boelee et al., 2017). The lake basin is recognized as a Ramsar Site due to its international importance for these bird populations.

The lake's ecosystem also supports a variety of macroinvertebrates, which form a crucial component of the food web. These include aquatic insects, mollusks, and crustaceans. The gastropod Melanoides tuberculata and the freshwater shrimp Caridina nilotica are commonly found, serving as important prey for fish and birds (Kadyampakeni & Nkhoma, 2017; Njaya et al., 2011).

Additionally, Amphibians are a significant but less documented component. Frogs and toads inhabit the surrounding marshes and seasonally inundated floodplains, contributing to the aquatic-terrestrial trophic linkages (Boelee et al., 2017). Historically, the lake was home to populations of the hippopotamus (Hippopotamus amphibius) and the Nile crocodile (Crocodylus niloticus), though their numbers have drastically declined due to habitat pressure and hunting (Kassam, 2014; Njaya et al., 2011).

The zooplankton community, including copepods and cladocerans, is a vital link between primary producers (algae/phytoplankton) and higher trophic levels like fish. This community exhibits significant seasonal and spatial dynamics linked to the lake's fluctuating water levels and nutrient cycles (Milupi et al., 2017).

3.2.3 Lake Malombe

Lake Malombe is among the shallow lakes of Malawi with depth ranging from 5meters to 7meters, located in the southern part of Malawi, specifically in Mangochi district. The lake is essentially a large oxbow lake, formed due to ponding out of the Shire River (only outlet of Lake Malawi), and with Shire flow running through the center of the lake (World Bank, 2019). While the lake is from a protrusion of Shire River, it lies at approximately 470 m asl, covers a catchment area of 4,250 km2 (Bootsma and Hecky, 2003), and has the surface area of 390 km2 (Bootsma and Hecky, 2003. World Lake Database; Jamu et al. 2011),

3.2.3.1 Hydrological Regime

The lake is fed and drained by the Shire River and hence its water levels are influenced by levels of Lake Malawi. When lake Malawi levels are too low to allow outflow into the Shire River, so are low water levels of lake Malombe, with the lake mostly depending on groundwater recharge systems and highly affected by evapotranspiration (World Bank, 2019).
Lake Malombe is vulnerable to changes in climate as variability in seasonal and annual precipitation directly affects the lakes' water levels. Lowering lake levels have been experienced over the years in Lake Malombe coupled with variations in lake surface area. Landsat Classification by Dulanya et al. (2013) documented fluctuations in the lake's overall area between 1973 and 2008 (see Table 3-5); mostly attributed to erratic rainfall from climate change and increased sedimentation.

The reliability of the approach to generating the data was verified through comparison with local rainfall and satellite altimetry data. The shallow depth of Lake Malombe has also been named as the cause of increased vulnerabilities to the changes in climate as variability in annual and seasonal precipitation can affect the lake's water levels. Sedimentation also affects lake levels and is mostly due to deforestation along the western side of the lake. As the sediments accumulate at the bottom of the lake, the displaced water is released via Shire River outlet, in turn lowering the overall level of the lake (Dulanya et al., 2013).

Table 3-5: Annual variations in lake surface area since 1973 to 2018 for Lake Malombe

Year	Lake Surface Area (km2)	% lake surface area based on 390 km2 published surface area
1973	317.5	81.4
1975	316.0	81.0
1979	320.0	82.1
1984	328.0	84.1
1989	335,6	86.1
1994	321.0	82.3
2002	316.7	81.2
2008	323.0	82.8

3.2.3.2 Sediment regime

Sedimentation has exacerbated severe aquatic ecosystem degradation and continues to occur in most lakes and rivers in Malawi including Lake Malombe. Similar to all aquatic ecosystems in Malawi, lake Malombe also faces challenges related to sedimentation, mostly due to deforestation, soil erosion, and agricultural runoff. These have led them to equally be changing in depth as well as water levels because of sediment load over the past 50 years.
Sedimentation rates for Lake Malombe have increased since the 1960s with depth and level fluctuations recorded to have been changing over the past four decades (1989-2017) (Makwinja et al, 2021) (see Figure 3-8). The main reasons attributed to the decreased water body and resultant area fluctuations have been named as increased siltation, due to changes in the catchment despite there being climate related factors (rainfall decline/ droughts). In 2019, the hilly part of Lake Malombe catchment was totally deforested and bare, with increased gullies developing each rainy season as trees are continuously harvested (Makwinja et al, 2021). As a result, the waterbody size decreased from 33,300 ha in 1989 to 30,483 in 2019. This followed an increase of agricultural land from 52,932 ha to 78,983 ha during the same period with tremendous increase in cultivated land reported from 1974 to 2019 (Makwinja et al, 2021).

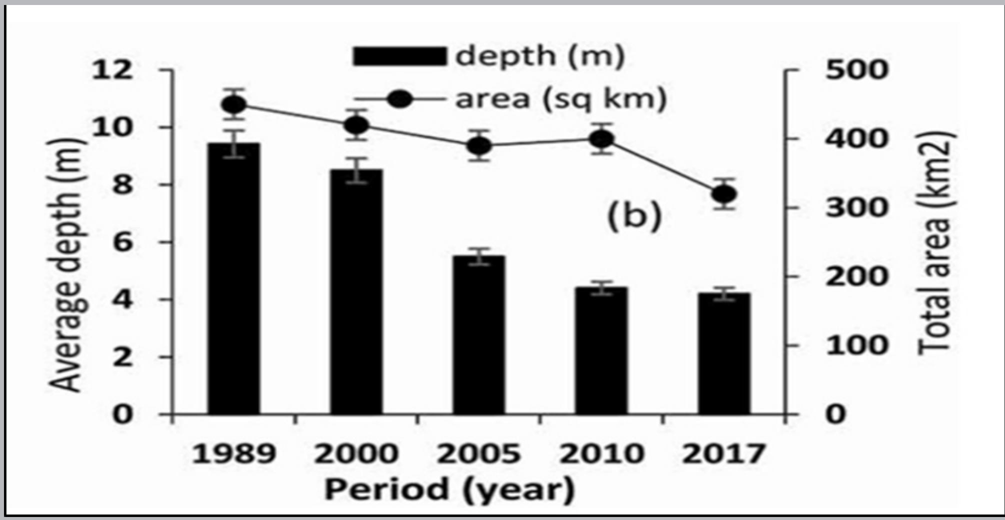


Figure 3-10: Lake Malombe depth and lake area fluctuations from 1989-2017
(Source: Makwinja et al, 2021)

3.2.3.3 Water quality

Limnologically, while Lake Malombe is shallow, it is also turbid, and nutrient-rich lake with shelving vegetated shores compared to Lake Malawi (Makwinja et al., 2021). The lake is highly productive because of the water column, which mixes freely, recycling the bottom nutrients. Although the current trend indicates otherwise. Water Temperature varies seasonally but typically ranges between 23-28°C, with lower temperatures in deeper areas during colder months. Chemically, the lake waters have pH typically ranging between 7.0 and 8.0, indicating slightly alkaline conditions. Nutrient levels are however variable with the lake experiencing nutrient loading, especially from the Shire River. High levels of nitrogen (N) and phosphorus (P) are associated with agricultural runoff and domestic waste, leading to eutrophication, particularly in areas close to the river inflow (Makwinja et al., 2021). Dissolved Oxygen concentrations are higher during the day especially in shallow zones, due to photosynthesis, however, hypoxic conditions can develop in deeper waters, especially during periods of high nutrient loading (Makwinja et al., 2021).

3.2.3.4 Fisheries (Food fish and Ornamental fish)

Lake Malombe has occurrence of a total of at least 57 fish species belonging to nine families (Alestidae, Anguillidae, Bagridae, Cichlidae, Clariidae, Cyprinidae, Mastacembelidae, Mochokidae and Mormyridae) and is among major aquatic ecosystems in Malawi and an important fisheries ground for small-scale artisanal fishers. Despite its small size compared to Lake Malawi, it used to provide approximately 10% of the national total fish catch in the 1990s (GoM, 1993), and fish landings contribution in the country was estimated between 2 and 5% in the 2000s (NSOER, 2010). It is an important breeding ground for some fish species such as Oreochromis spp, for example, are known to move to shallower depth, e.g., in Lake Malombe, during the breeding season and some of them migrate up the Shire River into Lake Malawi at the proper age (GoM, 1993). Thus, the lake is strategic for fisheries conservation for some of Lake Malawi's fish species. However, the fisheries industry in Lake Malombe collapsed in the early 1990s attributed entirely to overfishing (Msiska & Lwanda, 2008). Thus, the trend of fish catches since 1976 to 2014 exhibited cyclical fluctuations with species such as Labeo mesops (Nchila) and Engraulicypris sardella (Usipa) reaching record low from the 1990s while the total amounts of Bagrus meridionalis (Kampango), Clarias spp (Mlamba) and Labeo mesops (Nchila) harvested also all declined over the past from 1990s (Figure 3.8). This was similarly for chambo (Oreochromis spp), mbaba and utaka during the same period (**Figure 3-9**).

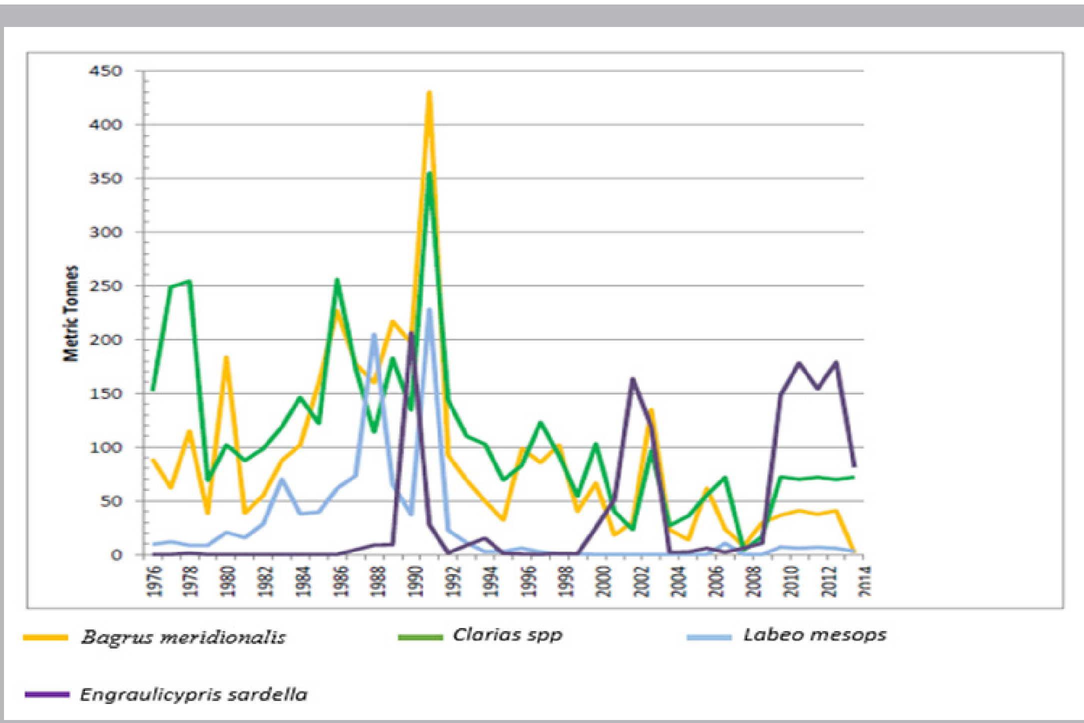


Figure 3-11: Total catch of Bagrus meridionalis (Kampango), Clarias spp (Mlamba), Labeo mesops (Nchila) and Engraulicypris sardella (Usipa) in Lake Malombe (1976-2014). (Source: Fisheries Research Unit)

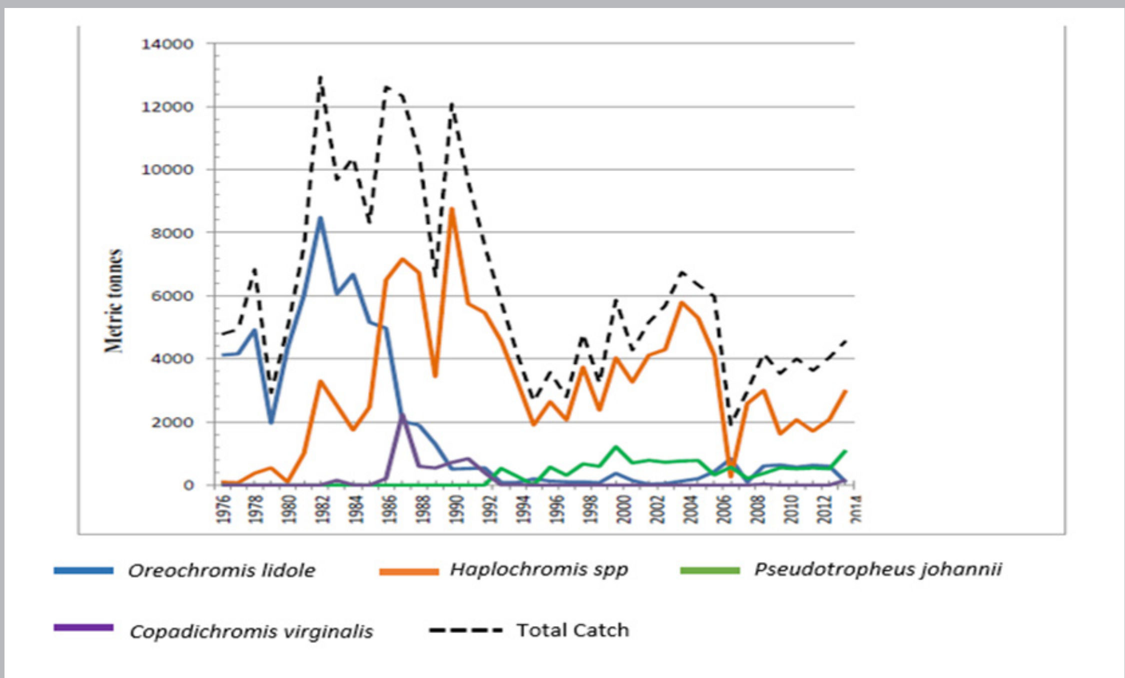


Figure 3-12: Overall total catch and total catch of Oreochromis lidole (Chambo), Haplochromis spp (Kambuzi), Pseudotropheus johannii (Mbaba) and Copadichromis virginalis (Utaka) in Lake Malombe (1976-2014) (Source : Fisheries Research Unit)

Recovery has, however, been there but at a slower rate as overfishing is still ongoing despite the regulations in place.

While the lake has a total of at least 57 fish species, Cichlidae are by far the most abundant, contributing over 75% of the recorded species in this area. Details of the IUCN Red list status (version 2023-1) of these species are given in **Table 3-6**. Of these fish species, 3 are classified as critically endangered (CR), 3 are data deficient (DD), 1 is endangered (EN), 47 are of least concern (LC), 1 is near threatened (NT), 1 is not yet evaluated (NE) and 1 is vulnerable (VU (Palmer-Newton & Darwall, 2019; UCN Red List Database)

Table 3-6: Conservation status of some fish species of Lake Malombe, southern Malawi (IUCN Red List version 2023-1).

Ser. No.	Species Name	Family Name	IUCN Red List Status
1	Bagrus meridionalis	Bagridae	Critically endangered (CR)
2	Oreochromis karongae	Cichlidae	Critically endangered (CR)
3	Serranochromis robustus	Cichlidae	Critically endangered (CR)
4	Buccochromis atritaeniatus	Cichlidae	Data deficient (DD)
5	Enteromius litamba	Cyprinidae	Data deficient (DD)
6	Rhamphochromis ferox	Cichlidae	Data deficient (DD)
7	Aulonocara guentheri	Cichlidae	Endangered (EN)
8	Astatotilapia calliptera	Cichlidae	Least Concern (LC)
9	Aulonocara rostratum	Cichlidae	Least Concern (LC)
10	Brycinus imberi	Alestidae	Least Concern (LC)
11	Buccochromis nototaenia	Cichlidae	Least Concern (LC)
12	Clarias gariepinus	Clariidae	Least Concern (LC)
13	Copadichromis chrysonotus	Cichlidae	Least Concern (LC)
14	Copadichromis cyaneus	Cichlidae	Least Concern (LC)
15	Copadichromis trimaculatus	Cichlidae	Least Concern (LC)
16	Coptodon rendalli	Cichlidae	Least Concern (LC)
17	Corematodus taeniatus	Cichlidae	Least Concern (LC)
18	Ctenopharynx intermedius	Cichlidae	Least Concern (LC)
19	Cyphomyrus discorhynchus	Mormyridae	Least Concern (LC)
20	Dimidiochromis compressiceps	Cichlidae	Least Concern (LC)
21	Dimidiochromis dimidiatus	Cichlidae	Least Concern (LC)
22	Dimidiochromis kiwinge	Cichlidae	Least Concern (LC)
23	Engraulicypris sardella	Cyprinidae	Least Concern (LC)
24	Enteromius arcislongae	Cyprinidae	Least Concern (LC)
25	Enteromius paludinosus	Cyprinidae	Least Concern (LC)
26	Enteromius trimaculatus	Cyprinidae	Least Concern (LC)
27	Fossorochromis rostratus	Cichlidae	Least Concern (LC)
28	Hemitilapia oxyrhyncha	Cichlidae	Least Concern (LC)
29	Labeobarbus johnstonii	Cyprinidae	Least Concern (LC)
30	Lethrinops lethrinus	Cichlidae	Least Concern (LC)
31	Lethrinops longipinnis	Cichlidae	Least Concern (LC)
32	Lethrinops macrochir	Cichlidae	Least Concern (LC)
33	Lethrinops parvidens	Cichlidae	Least Concern (LC)
34	Lethrinops turneri	Cichlidae	Least Concern (LC)
35	Marcusenius macrolepidotus	Mormyridae	Least Concern (LC)
36	Mastacembelus shiranus	Mastacembelidae	Least Concern (LC)
37	Mylochromis anaphyrmus	Cichlidae	Least Concern (LC)
38	Mylochromis mola	Cichlidae	Least Concern (LC)
39	Opsaridium microcephalum	Cyprinidae	Least Concern (LC)
40	Oreochromis shiranus	Cichlidae	Least Concern (LC)
41	Otopharynx argyrosoma	Cichlidae	Least Concern (LC)
42	Otopharynx tetraspilus	Cichlidae	Least Concern (LC)
43	Otopharynx tetrastigma	Cichlidae	Least Concern (LC)

Table 3-6 Cont.: Conservation status of some fish species of Lake Malombe, southern Malawi (IUCN Red List version 2023-1).

44	Placidochromis subocularis	Cichlidae	Least Concern (LC)
45	Protomelas labridens	Cichlidae	Least Concern (LC)
46	Protomelas similis	Cichlidae	Least Concern (LC)
47	Protomelas triaenodon	Cichlidae	Least Concern (LC)
48	Pseudotropheus livingstonii	Cichlidae	Least Concern (LC)
49	Rhamphochromis macrophthalmus	Cichlidae	Least Concern (LC)
50	Stigmatochromis woodi	Cichlidae	Least Concern (LC)
51	Synodontis njassae	Mochokidae	Least Concern (LC)

Regarding the status of fish stocks in Lake Malombe, the total landings of the Malombe fishery in 1996 were estimated at 8,000 tonnes per year (Njaya et al, 1996). The fishery consisted of Lethrinops spp (Kambuzi) which is a collective name describing a group of small closely related fishes called Haplochromines), Oreochromis lidole (Chambo), Clarias spp (Mlamba) and Labeo mesops (Nchila). However, the Chambo stocks and the other species, catches had collapsed from approximately 6,000 tonnes in 1987 to 500 tonnes in 1996. The total fishing effort in this fishery dropped to low levels apparently because of poor catch rates. However, during the same period, a community-based fisheries management programme was instituted to arrest and reverse the downward trend (Scholz, 1996). Similarly, kambuzi fishery was estimated to be about 8,000 tonnes per annum, implying maximum exploitation of the -fishery. Prior to 1981, the kambuzi catches constituted only 4% of the total catch of the lake while in 1996 catches represented over 90% of the total fish landings in the lake.

However, the stocks and estimated fishery has evolved over the years to current dates due to changes in the management regimes e.g. enforcement of banning fish resources exploitation using seine nets (Nkacha) that have small sized meshes and used to catch all sizes of fish to bigger size nets that targets grown fishes. In addition, human population growth and climate change issues have negatively impacted the fishery in Lake Malombe.

Recent data indicates that while Lake Malombe was historically one of the hotspots for Chambo (Oreochromis spp) fishery, with early 1980s, Chambo species (Oreochromis spp) used to dominate the catch landings of this lake, with time, a great species change occurred where Kambuzi species overtook the Chambo species (Oreochromis spp) in dominating the total catch landings of this lake. Since then, the annual catch landings have fluctuated to some 2000 metric tons (Jamu, et. al., 2011; FAO, 2003) (**Figure 3-11**).

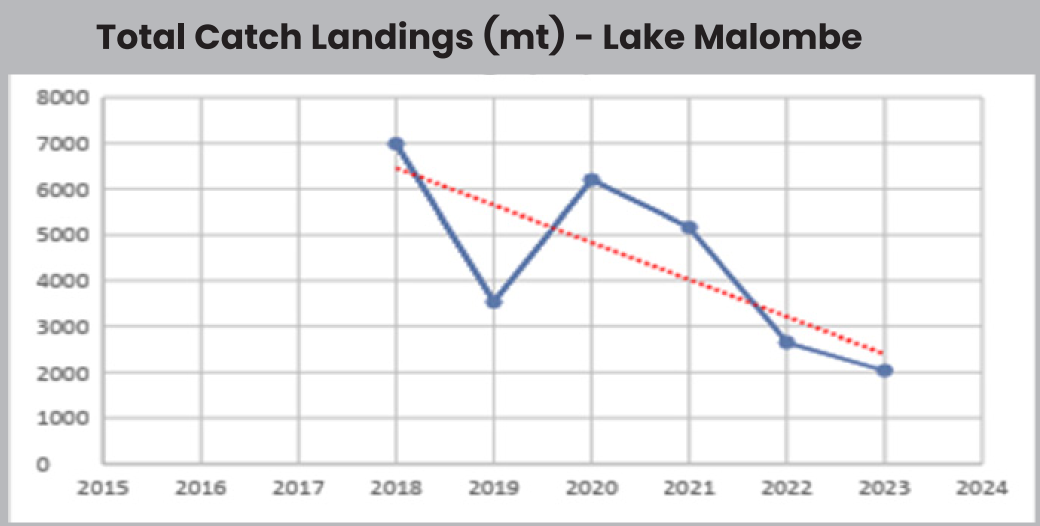


Figure 3-13: Annual total catch landings for Lake Malombe between 2018 and 2023

This decline is species abundance and associated changes in species composition and size have been due to many factors. Chief among these factors include high fisher population due to open access nature of the fishery in the country, high population growth, increasing use of destructive fishing gears and methods and habitat degradation which has been exacerbated by the advent of climate change. It is likely that dominance of low value fish species in landings has contributed to reduced incomes for both fishers and fish traders.

3.2.3.5 Aquatic Vegetation

Phytoplankton species are the major aquatic vegetation in Lakes of Malawi and and so is Lake Malombe. The dominant phytoplankton in Lake Malombe are however Surirella and Aulacoseira while the vegetation along the lakeshore is comprised of Phragmites australis (reeds), Typha domingensis (bulrush), Cyperus papyrus (papyrus), Vossia cuspidate (Hippo grass), Pennisetum purpureum), interspersed with hyacinth, scrubs, woodlands and thicket especially along the northeastern and western sides of the lake, while the southeastern side has scattered patches of mopane woodland. These vegetation descriptions are based primarily on field ecological surveys and regional biodiversity inventories compiled for the lake Malawi basin during the 1900s-early 20002. (WWF 2005).

3.2.3.6 Other Aquatic Wildlife

Lake Malombe, as a shallow floodplain lake hosts a variety of non-fish aquatic fauna that are ecologically significant. Its extensive vegetated margins and seasonal floodplains provide critical habitat for waterbirds e.g. herons, kingfishers, African fish eagles, and various waders, though it is less documented for large migratory flocks compared to Lake Chilwa (Msukwa et al., 2021; Jambo et al., 2021).

The lake’s macroinvertebrate community is diverse and serves as a primary food source for its important fish stocks. Benthic surveys have documented the presence of aquatic insects (e.g., dipteran larvae, odonate nymphs), mollusks (notably the gastropod Melanoides tuberculata), and crustaceans like crabs (Pale et al., 2016; Duponchelle et al., 2022). This community structure is heavily influenced by seasonal water level fluctuations and vegetation cover.

Large aquatic reptiles and mammals are present but face significant anthropogenic pressure. The Nile crocodile (Crocodylus niloticus) persists in the lake, though populations are threatened by habitat alteration and conflict (Jambo et al., 2021). Hippopotamus (Hippopotamus amphibius) are also reported in the lake and associated riverine systems, where they contribute to nutrient cycling and habitat modification (Msukwa et al., 2021).

The zooplankton community, mainly Bosmina and Mesocyclops as dominant with as well other communities e.g. rotifers, cladocerans, and copepods, forms a crucial trophic link (Chavula et al, 2023).

3.2.4 Lake Chiuta

Lake Chiuta is also one of the shallow lakes of Malawi which with no outlet and is located on the border between Malawi and Mozambique in Machinga district. The lake lies to the north of Lake Chilwa, and these lakes are separated by a sandy ridge (Bootsma and Hecky, 2003). Lake Chiuta has an average depth of approximately 2-3 meters and a maximum depth of around 4-5 meters during wet seasons (Jambo & Kaunda, 2020). Its surface area ranges from 25 to 130 square kilometers, depending also on the season and rainfall but with an average of 60 square kilometers (Bootsma and Hecky, 2003).

3.2.4.1 Hydrological Regime

Water levels of Lake Chiuta exhibit extreme seasonal variability. Levels rise sharply during the rainy season (November-April) and decline rapidly due to high evaporation rates (exceeding 2000 mm/yr) in the dry season (May-October) (Boelee et al., 2017; Mwale et al., 2019). The lake has experienced complete desiccation in severe drought years (e.g., 1995, 2016), highlighting its vulnerability.

The primary water input into the lake is direct rainfall, inflow from Luthili river and other seasonal streams (Jambo & Kaunda, 2020). Lakes Chiuta has its water levels fluctuating significantly with the seasons despite having no significant outflow. This means water loss from this lake is primarily due to evaporation and seepage (GoM, 2010). Small lakes like Lake Chiuta have sparse hydrometric time series (levels/area) data. This assessment therefore recommends studies to gather this data including monitoring of this ecosystem.

3.2.4.2 Sediment Regime

Lake Chiuta’s catchment area experiences human activities such as agricultural expansion and deforestation, leading to increased runoff and resultant soil erosion, sediment transport, deposition and increased sediment loads entering the lake (Makwinja et al, 2021). Specifically, Lake Chiuta’s sediment regime is dominated by allochthonous (externally derived) inputs.

The primary source is sheet, rill, and gully erosion from bare landscapes and sediment transported via a network of seasonal rivers and streams, most notably the Luthili River, during intense rainfall events (Jambo & Kaunda, 2020; Msukwa et al., 2021). Direct wind deposition of sand and dust may also be a minor source during the dry season.

While sediment sources are similar to those of other shallow lakes i.e. agricultural runoff and deforestation, leading to the inflow from the surrounding catchment area bringing sediment-rich water into the lakes, research on these lakes is less extensive, such that data on hydrological shifts due to sediment patterns was rarely available.

3.2.4.3 Water Quality

Lake Chiuta's hydrology tends to be highly seasonal, with water levels dropping significantly during the dry season and increasing during wet seasons. The pH is slightly alkaline, with values ranging from 7.5 to 8.5 and like other lakes, nutrient enrichment from agricultural runoff is a significant issue. This leads to increased productivity and eutrophication. Dissolved Oxygen is usually low in some areas, especially in deeper waters, due to organic matter decomposition and increased nutrient input (Makwinja et al, 2021). However, despite availability of this generic information, time series information is lacking due to lack of monitoring, marking an evidence gap to motivate informed policy action for the ecosystem.

3.2.4.4 Fisheries

Lake Chiuta as among the aquatic ecosystems of Malawi has its portion in contributing to fisheries of the country. According to Njaya et al. (1996), state of fish stocks in Lake Chiuta in the 1990s produced annual landings estimated at 3,000 tonnes, all produced by traditional fishermen. The catches were dominated by O. shiranus (makumba), Clarias spp. (mlamba) and Barbus paludinosus (matemba). The information available at present on the fisheries of the lake is not adequate for establishing a sound basis for the management of the fisheries, though Prior to 2010, Lake Chiuta only contributed between 1 to 3% of the fish landings (NSOER, 2010).

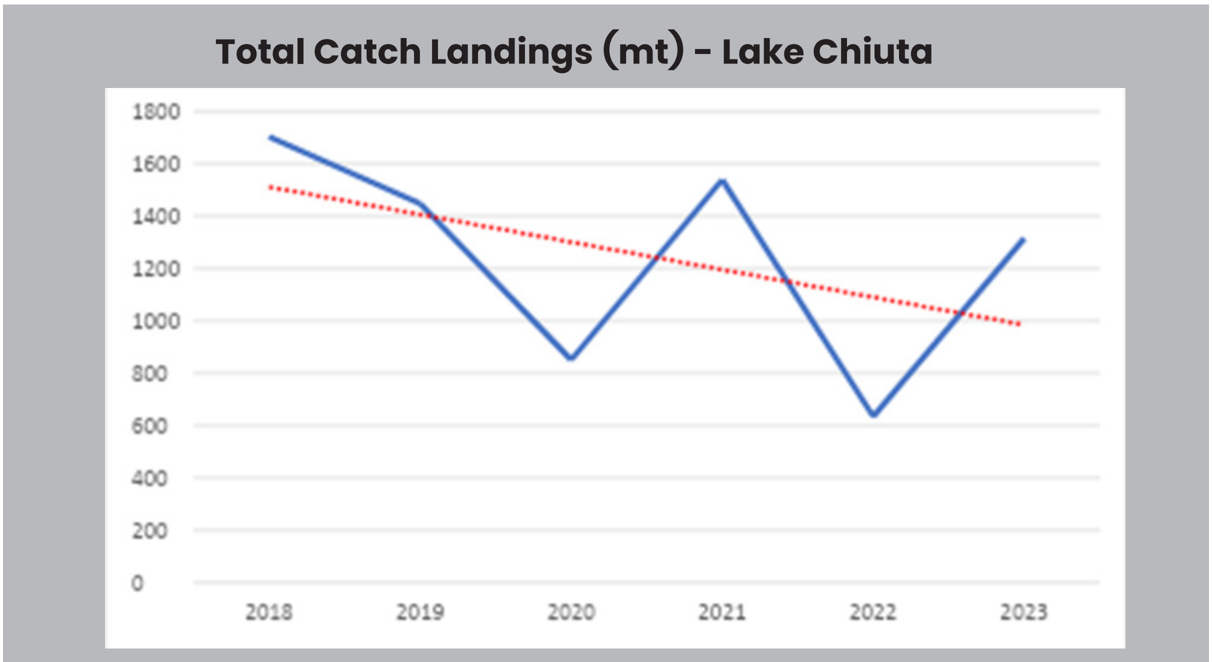


Figure 3-14: Annual catch landings for Lake Chiuta between 2018 and 2023

Despite the challenges of declining trends in the fishery of Lake Chiuta, several initiatives are being taken to resolve them and one of them is to do with governance and regulatory framework. There is, therefore, a need to enhance and embrace co- management which has proven to be a success story in Malawi, specifically along Lake Malawi fishery.

3.2.4.5 Aquatic Vegetation

Lake Chiuta's aquatic vegetation is characterized by a dynamic mosaic of floating, submerged, and emergent macrophytes that play a critical role in its ecosystem structure and function (Kadyampakeni & Nkhoma, 2017). This vegetation is highly responsive to the lake's dramatic hydrological fluctuations. The vegetation is dominated by floating-leaved and emergent species, with submerged forms being less prominent due to seasonal water level changes and turbidity.

The lake also possesses floating and floating-leaved macrophytes specifically water lilies (Nymphaea spp.), which are key habitats for invertebrates and juvenile fish (Kadyampakeni & Nkhoma, 2017). Common reed (Phragmites mauritianus) are also often found mixed with papyrus or in shallower margins of the lake.

3.2.4.6 Other Aquatic Wildlife

Lake Chiuta, supports a distinctive assemblage of aquatic fauna beyond fish, adapted to its seasonal water fluctuations. Lake Chiuta is a regionally significant habitat for resident and migratory waterbirds, recognized under the Ramsar Convention as part of the "Lake Chilwa/Chiuta Important Bird Area (IBA) (Boelee et al., 2017; Jambo & Kaunda, 2020)." Notable birds are ducks (e.g., Red-billed Teal, Anas erythrorhyncha), waders, herons, egrets, and the iconic Grey Crowned-Crane (Balearica regulorum). During wet cycles, it also attracts Palaearctic migrants like sandpipers and plovers.

The lake also hosts a diverse macroinvertebrate community dominant groups include: Mollusks, freshwater shrimps (Caridina nilotica), crabs and Insects such as larvae of dragonflies (Odonata), midges (Chironomidae), and water beetles (Coleoptera). The open water hosts a dynamic zooplankton community, essential for transferring energy from phytoplankton to fish. Additionally, the marsh areas of the lake and deeper channels near papyrus swamps also hosts amphibians and reptiles respectively e.g. several frog species (Ptychadena spp., Xenopus spp.), Nile crocodile (Crocodylus niloticus) and Hippopotamus (Hippopotamus amphibius). The survival of these species is threatened by habitat disturbance and human-wildlife conflicts (Boelee et al., 2017).

3.2.5 Lake Kazuni

Lake Kazuni is located in Vwaza Marsh Wildlife Reserve and found in the Northern Malawi's Rumphi district. The lake is also a shallow aquatic ecosystem which has surface area of 2 km2, with a maximum depth of 2-3m. The lake resulted from ponding out of North Rukuru River, and having the same as an outlet. This is a unique hydrological characteristic that make the size and depth of the lake vary significantly depending on the varying conditions of the river, which is mostly influenced by seasonal rainfall patterns and surface runoff during the rainy season, including low inflow in the dry season (May to October). This ecosystem is a crucial part of the Vwaza Wildlife Reserve's ecosystem, providing water for wildlife and sustaining the surrounding marshlands.

3.2.5.1 Hydrological Regime

Lakes Kazuni as a small and shallow lake and currently suffering from degradation. The lakes water levels are highly seasonal and directly controlled by local precipitation and evaporation, peaking during the rainy season (December-April). The severity of dry season therefore determines the water levels of the lake such that it can shrink considerably during dry season, and in other severe years it can dry out completely (Macuiane et. al., 2011) . However, similar to Lake Chiuta, Lake Kazuni lacks hydrometric time series (levels/area) data. This assessment therefore recommends studies to gather this data including monitoring of its water levels.

3.2.5.2 Water Quality

Water quality of Lake Kazuni is influenced by factors such as sedimentation and pollution from nearby areas, although its location by being in the protected reserve, helps mitigate some of these risks. As a small and shallow lake with a maximum depth of around 5 meters, it experiences seasonal fluctuations in water level (Bootsma and Hecky, 2003).

Table 3-7: Water Quality Parameter for Lake Kazuni near the Kazuni lodge, Rumphi District.
(Source: Ministry of Water Development, May, 2025)

Parameter	Lake Kazuni near the Kazuni lodge,	Malawi Standards (MS691:2005)
pH Value	8.17	6.0 – 9.0
CONDUCTIVITY (µs/cm at 250C)	218	3500
TOTAL DISSOLVED SOLIDS, mg/l	130	100
NITRATE (as NO3-), mg/l	<0.001	<50
PHOSPHATE (as PO4) mg/l	0.254	0.15

pH is typically slightly alkaline, with pH values around 7.0-7.8 and nutrient levels are similar to other lakes in the assessment due to agricultural runoff contributing to nutrient loading (Bootsma and Hecky, 2003). Dissolved Oxygen levels is low because of high turbidity levels of the lake.

3.2.5.3 Fisheries

The assessment of fish stocks in Lake Kazuni identified the fishery which is small scale in nature, was found to be composed of species typical of such environments in Malawi, such as Matemba (Barbus paludinosus), Makumba (Oreochromis shiranus chilwae), and Mlamba (Clarias gariepinus) (Kanyerere and Mwale 2010). Though the study provided evidence of high fishing pressure resulting to decline in fish stock levels on the lake despite being located in the wildlife reserve, data on detailed stock assessment was not carried out to determine total catch landings change over the years (Kanyerere and Mwale 2010).This research, along with others in the region, highlights that small-scale fisheries in Malawi's small water bodies often face significant stress, necessitating management intervention to maintain sustainability. (Kanyerere and Mwale, 2010).

3.2.5.4 Aquatic Vegetation

Lake Kazuni having located within the Vwaza Marsh Wildlife Reserve, its aquatic vegetation plays a crucial role in the lake's ecosystem, providing habitat, food, and oxygen, while stabilizing sediments. The vegetation composition for the lake is typical of shallow, tropical African lakes with fluctuating water levels. Major vegetation types and species noted within the aquatic body are free-floating plants which are not rooted to the bottom, floating on or just below the surface. These include duckweed (Lemna spp.) which form a green carpet on the water's surface in calm, nutrient-rich areas. The other species are submerged plants that grow entirely underwater and includes; pondweeds (Potamogeton spp.), Najas spp. (Water Nymph), Stoneworts (Characeae family) and Hornwort (Ceratophyllum demersum).

The vegetation provides critical habitat for fish breeding (especially cichlids), invertebrates, and birds like the African fish eagle and various herons. Hippopotami (Hippopotamus amphibius), which are abundant in the lake, heavily graze on aquatic vegetation and physically modify the habitat through their movements, creating channels and maintaining open water areas (Brendonck et al., 2003).

3.2.5.5 Other Aquatic Wildlife

Other than fish, the lake Kazuni hosts invertebrates, and birds such as the African fish eagle and various herons. The lake is also the habitat of hippopotami (Hippopotamus amphibius), which are abundant in the lake as well as Nile Crocodile (Crocodylus niloticus) (Brendonck et al., 2003).

3.2.6 Shire River

Shire River is the only outflow of Lake Malawi. Shire is the longest river in Malawi flowing approximately 410 km from Mangochi to Ziu Ziu in Mozambique. The river is used for hydroelectric power generation which accounts for about 98% of the country's hydro power generating capacity (Malawi Water Partnership, 2016) and requires a firm river flow of over 170 m3 s– 1 for sufficient operation of the hydroelectric power plants in the Lower Shire River (Mtilatila et al., 2020).

3.2.6.1 Hydrological Regimes

As an outflow of lake Malawi, Shire River's flow is overwhelmingly determined by the water level of Lake Malawi, which acts as a massive natural reservoir. The river only flows when the lake level is above approximately 473.5 meters above sea level (masl) at its outlet (historically, the Lake level at Liwonde barrage). This level represents the natural sill of the lake outlet. Consequently, the river's flow is highly stable compared to typical rainfall-fed rivers, with a dampened response to seasonal rains (Drayton, 1984; Sene & Plinston, 1994). The mean annual flow (long-term average outflow from Lake Malawi into the Shire River) is approximately 16 billion cubic meters per year (BM^3/yr), equivalent to an average discharge of about 500 cubic meters per second (m^3/s) (Sene & Plinston, 1994). Pre-barrage, flows could range from zero to over 1,000 m^3/s. Post-barrage, minimum flows are maintained, but extreme high flows during floods still occur (e.g., 2015 floods were estimated > 3,000 m^3/s at some points).

Seasonal flow patterns (preregulation) of Shire river peaks in February/March through May/June due to peak Inflows into Lake Malawi from its vast catchment, causing the lake level to rise. This results in increased outflow and higher Shire River flows. Low flows are usually experienced between August and November as Lake Malawi inflows decline, and lake level falls, leading to reduced or even negligible flow in the Shire River. Historically, the river could cease flowing entirely during severe droughts (e.g., 1915, 1995-97). Additionally, the flow of Shire river is facilitated by its tributary contributions, most significant tributary being Ruo River. This river drains the high-rainfall from Mulanje and Zomba massifs and contributes substantial flashy, storm-driven flows that join the Shire downstream of the Kamuzu Barrage, introducing more immediate rainfall-runoff dynamics to the system (Gómez et al., 2014).

Human intervention has fundamentally transformed the natural hydrological regime. Kamuzu Barrage, which was constructed in 1965 at the lake outlet at Liwonde, is the single most important piece of hydrological infrastructure. Its primary purposes are to maintain the lake level above the natural sill, ensuring perennial flow in the Shire River; to regulate outflow for downstream hydropower generation and other uses etc. This barrage therefore decouples the lake level from the immediate river flow and operators can release water even when the natural lake level is below the sill, while restricting flow during high lake periods to store water. This has created a more artificially managed, less variable flow regime in the Upper Shire (Hazelwood & Kachika, 2008). Additionally, hydropower dams cascaded at Nkula, Tedzani, and Kapichira within Shire river further regulate flow for energy production. They create a series of stepped reservoirs, transforming a free-flowing river into a heavily managed system. Their operation dictates daily and weekly flow fluctuations (hydropeaking) downstream. However, Shire river waters are also abstracted for Irrigation particularly in the Middle Shire (e.g., for the Nchalo and Illovo sugar estates) and from the Lower Shire flood plains This reduces river flow volume, especially in the dry season (SRBMP, 2015).

However, despite Shire river flow regulation systems are in place, critical hydrological issues and challenges are also experienced by the river ranging from its vulnerability to prolonged droughts that cause lake levels to fall e.g. During the major 1995-1997 drought, Lake Malawi levels dropped nearly 3 meters, and Shire River flows were critically low, leading to widespread power rationing. High sediment loads from catchment erosion are raising the riverbed, particularly in the Upper Shire. This reduces the hydraulic capacity of the channel, meaning higher water levels are now needed to convey the same volume of flow. This increases flood risk and complicates barrage and dam operations (Gómez et al., 2014).

Despite regulation, the river experiences extremes. The January 2015 floods (exacerbated by Cyclones) saw catastrophic peak discharges, overtopping banks and causing widespread damage. These extreme events are interspersed with dry-season low flows that stress water users (WWF, 2017). The highly regulated flow often fails to replicate the natural timing, magnitude, and duration of floods needed to maintain downstream ecosystems. The Elephant Marsh, a critical floodplain wetland and Ramsar site, is particularly impacted by attenuated flood peaks and reduced inundation, degrading its ecological health and fishery productivity (Ribbink et al., 2017).

3.2.6.2 Sediment Regimes

The sediment load of the Shire River is directly influenced by catchment erosion, lake outflows, and reservoir operations. The Upper Shire (from Lake Malawi outlet to Liwonde) historically have lower sediment loads due to the settling effect of Lake Malawi, which acts as a giant sediment trap. The major sediment input originates from the catchment between Lake Malawi and the first major reservoir, particularly from the Ruo River tributary and gully erosion on the eastern bank escarpments. Studies indicate severe erosion hotspots in the Machinga, Phalombe, and Zomba districts, contribute significantly to the siltation of the river and reservoirs (Chavula, 2012; Mwafongo, 2018).

The construction of the Kamuzu Barrage (1965) at the Lake Malawi outlet and a cascade of hydropower dams (Tedzani, Nkula, Kapichira) along the Shire has altered the natural sediment transport. The barrage controls lake outflow, while the downstream dams trap sediment, leading to reduced sediment load below dams, which can lead to riverbed scouring (incision) and impacts on riparian agriculture. Reservoir siltation which is a critical threat to hydropower. The Kapichira dam reservoir, for example, had experienced significant sedimentation, reducing its storage and operational capacity. A 2013 survey estimated a sediment accumulation rate of 1.1 million tonnes per year in the Kamuzu Barrage pond (Gómez et al., 2014). The catastrophic flooding in January 2015, triggered by heavy rainfall, caused massive sediment mobilization and riverbank erosion. This event alone delivered an estimated 18 million tonnes of sediment into the Shire River system, equivalent to about 16 years of normal sediment load, severely impacting infrastructure and water quality (WWF, 2017).

3.2.6.3 Water Quality

The quality of surface water resources in Malawi is affected by various factors namely, land use changes, chemical composition of parent rocks, agricultural activities and the discharge of effluents including the disposal of wastes from residential areas and industrial sites. While data gaps exist for the water quality of most of the individual rivers in the assessment, it is generalized that the chemistry of the vast majority of surface water resources in Malawi is characterized by alkaline earth dominance in the caution group; and by the carbonate system in the anion group. Most of the surface waters in Malawi can be classified as soft to moderately soft i.e. hardness less than 100 mg/l of calcium carbonate. The total dissolved solids content values are generally less than 100 mg/l.

Specifically, water quality in the Shire River is under pressure from multiple anthropogenic sources and natural processes with key parameters and issues of concern being nutrient pollution and eutrophication due to increasing levels of nitrates and phosphates from agricultural runoff (fertilizers), untreated sewage from urban centers (e.g. Blantyre via its tributaries), and waste from informal settlements. This has affected the quality of water leading to algal blooms, in some areas particularly in slower-moving sections and reservoirs (Moutha et al., 2021).

Turbidity and total suspended solids (TSS) levels have also been noted to spike dramatically during the rainy season (Nov-April) due to surface runoff. High turbidity increases sedimentation and affects aquatic photosynthesis of the river (Msilimba, 2011). Additionally, high counts of E. coli and other faecal coliforms are consistently reported, especially downstream due to tributary flow from major cities and trading centers, indicating contamination from inadequate sanitation (Government of Malawi, 2017).

As for conductivity and pH, generally acceptable ranges for most uses were reported for the river, though localized increases in conductivity have been reported to occur from industrial and agricultural discharges. Emerging concerns for the quality of the river remain pesticide residues from cash crop estates, as well as potential irrigation facilities that are being developed along the river. Also heavy metal inputs from urban and industrial waste, are noted as growing concerns, though comprehensive monitoring data is limited (Naphade et al., 2022).

Despite availability of above generic water quality information for Shire river, historical monitoring has been lacking and hence lack of consistent and time series water quality data for the river. However, through MCLIMES project, automated monitoring systems have been installed along the river with initial data for the river's two gauging stations and collected in May, 2025 presented in **Table 3-8**.

Table 3-8: Water quality data for Shire river's two gauging stations
(Source: Ministry of Water Development, May, 2025)

Source Type/Location	Shire river at Mangochi Road Bridge (1T1) Mangochi District	Shire river at Liwonde Raiway Bridge (1B1), Machinga District	Malawi Standards (MS691:200)
Ph value	8.32	8.55	6.0-9.0
Temperature, 0C	26.2	26.5	40
Electrical conductivity, µs/cm	256	277	3500
Total Dissolved Solids, mg/l	131	141	100
Nitrate (as NO3), mg/l	<0.001	<0.001	<50
Phosphate (as PO4), mg/l	<0.001	<0.001	0.15

3.2.6.4 Fish resources and fishery

The Shire River system is an important ecosystem for fish biodiversity and one of the formidable fishing grounds in the country. It harbours both the Zambezian and Lake Malawi fish lineages that are separated by a stretch of falls and rapids towards the end of its middle reaches (from Lake Malawi downstream). Thus, Shire River as the only outlet for Lake Malawi, has been playing a role of obligatory river breeding fishes from the lake. The fish fauna in the middle and upper shire are represented in Lakes Malawi and Malombe. The Lower Shire and associated marshes have a Lower Zambezi fish fauna, separated physically and ecologically from the Lake Malawi fauna by a series of cataracts, rapids and falls between Matope and Chikwawa (NSOER, 2010).

According to published reports (See Tweddle et al. 1979; Chimatiro 2004; Multi Consult 2018; AGRI-PRO Ambiente 2018) the Shire River harbours a diversity of fishes amounting to at least 47 species belonging to 14 families (Alestidae, Bagridae, Cichlidae, Clariidae, Cyprinidae, Danionidae, Mastacembalidae, Mochokidae, Mormyridae, Schilbeidae, Distichodontidae, Protopteridae, Malapteruridae and Procatopodidae). Of these fish species, two are classified as critically endangered (CR), three are data deficient (DD) while the rest are of least concern (LC) under the IUCN Red List (IUCN Red List Version 2023-1, accessed 27 March 2024). **Table 3-9**

Table 3-9: Fish species of the Shire River, Southern Malawi and their IUCN conservation status (IUCN Red List Version 2023-1, accessed on 27 March 2024).

Ser. No.	Species Name	Family Name	List Status
1	Bagrus meridionalis (Günther, 1894)	Bagridae	Critically endangered
2	Serranochromis robustus (Günther, 1864)	Cichlidae	Critically endangered
3	Chiloglanis neumanni (Boulenger, 1911)	Mochokidae	Data Deficient
4	Enteromius choloensis (Norman, 1925)	Cyprinidae	Data Deficient
5	Opsaridium tweddleorum (Skelton 1996)	Danionidae	Data Deficient
6	Astatotilapia calliptera (Günther, 1894)	Cichlidae	Least Concern
7	Brycinus imberi (Peters, 1852)	Alestidae	Least Concern
8	Brycinus lateralis (Boulenger, 1900)	Alestidae	Least Concern
9	Clarias ngamensis (Castelnau, 1861)	Clariidae	Least Concern
10	Clarias theodoae (Weber, 1897)	Clariidae	Least Concern
11	Clarias gariepinus (Burchell, 1822)	Clariidae	Least Concern
12	Copadichromis chrysonotus (Boulenger, 1908)	Cichlidae	Least Concern
13	Coptodon rendalli (Boulenger, 1897)	Cichlidae	Least Concern
14	Cyphomyrus discorhynchus (Peters, 1852)	Mormyridae	Least Concern
15	Distichodus mossambicus (Peters, 1852)	Distichodontidae	Least Concern
16	Distichodus shenga (Peters, 1852)	Distichodontidae	Least Concern
17	Enteromius afrohamiltoni (Crass, 1960)	Cyprinidae	Least Concern
18	Enteromius kerstenii (Peters 1868)	Cyprinidae	Least Concern
19	Enteromius lineomaculatus (Boulenger, 1903)	Cyprinidae	Least Concern
20	Enteromius macrotaenia (Worthington, 1933)	Cyprinidae	Least Concern
21	Enteromius radiatus (Peters, 1853)	Cyprinidae	Least Concern
22	Enteromius arcislongae (Keilhack, 1908)	Cyprinidae	Least Concern
23	Enteromius atkinsoni (Bailey, 1969)	Cyprinidae	Least Concern
24	Enteromius paludinosus (Peters, 1852)	Cyprinidae	Least Concern
25	Enteromius trimaculatus (Peters, 1852)	Cyprinidae	Least Concern
26	Hemigrammopetersius barnardi (Herre, 1936)	Alestidae	Least Concern
27	Heterobranchus longifilis (Valenciennes, 1840)	Clariidae	Least Concern
28	Hippopotamyrus ansorgii (Boulenger, 1905)	Mormyridae	Least Concern
29	Hydrocynus vittatus (Castelnau, 1861)	Alestidae	Least Concern
30	Labeo altivelis (Peters, 1852)	Cyprinidae	Least Concern

Table 3-9 Cont.: Fish species of the Shire River, Southern Malawi and their IUCN conservation status (IUCN Red List Version 2023-1, accessed on 27 March 2024).

31	Labeo congoro (Peters, 1852)	Cyprinidae	Least Concern
32	Labeo cylindricus (Peters, 1852)	Cyprinidae	Least Concern
33	Labeobarbus johnstonii (Boulenger, 1907)	Cyprinidae	Least Concern
34	Malapterurus shirensis (Roberts, 2000)	Melapteruridae	Least Concern
35	Marcusenius macrolepidotus (Peters 1852)	Mormyridae	Least Concern
36	Mastacembalus shiranus (Günther, 1896)	Mastacembalidae	Least Concern
37	Micropanchax johnstoni (Günther, 1894)	Procatopodidae	Least Concern
38	Mormyrops anguilloides (Linnaeus, 1758)	Mormyridae	Least Concern
39	Mormyrus longirostris (Peters 1852)	Mormyridae	Least Concern
40	Opsaridium microcephalum (Günther, 1864)	Danionidae	Least Concern
41	Oreochromis placidus (Trewavas, 1941)	Cichlidae	Least Concern
42	Oreochromis shiranus (Boulenger, 1897)	Cichlidae	Least Concern
43	Protomelas kirkii (Günther, 1894)	Cichlidae	Least Concern
44	Protopterus annectens (Owen, 1939)	Protopteridae	Least Concern
45	Schilbe intermedius (Ruppel, 1832)	Schilbeidae	Least Concern
46	Synodontis njassae (Keilhack, 1908)	Mochokidae	Least Concern
47	Synodontis zambezensis (Peters, 1852)	Mochokidae	Least Concern

Regarding fish landings, NSOER (2010) reported that historically, Shire River has been producing an average of 4 to 10 thousand metric tonnes of fish per annum specifically in the Lower Shire valley and this contributes between 10 and 15% of the total national landings, with the fishery being small scale and subsistence in nature. The report further indicated that historically, the shire river system is complex, highly productive and efficiently utilized by fishermen. However, of the 61 species found in the Lower Shire Valley, only 3 species (C. gariepinus, O. mossambicus and C. ngamensis) are of economic importance, pursued almost exclusively using dugout canoes from numerous permanent and temporary traditional fishing villages. The fishing gear used are gill nets (most common), fish traps, cast nets, seine nets, encircling fish fences and long lines.

While catches have been fluctuating seasonally in relation to the flooding pattern of Shire river, which seems to be influenced in part by the operations of the Liwonde barrage, the average catch landings have however declined. This has been exacerbated by current population pressure on the fish resources among other factors.

The Chambo species used to dominate the catch landings the Upper Shire River, but these catches have now been decimated. Recent data indicates the general decline of the catch landings in a similar fashion as has been the case of most aquatic ecosystems in Malawi (**Figure 3-13**).

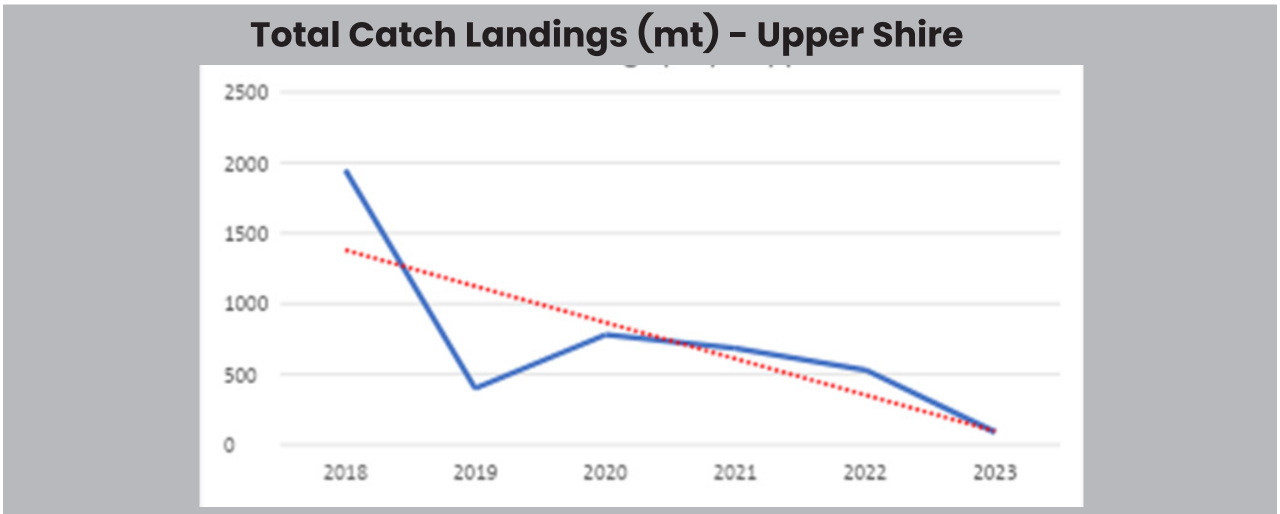


Figure 3-15: Annual total catch landings for Upper Shire River between 2018 and 2023

On the other hand, the Lower Shire which is dominated by Oreochromis mossambicus (Makakana) and Clarias gariepinus (Mlamba), has the annual catch landings fluctuating with increasing trends between 2018 and 2023 (**Figure 3-16**). The enormous catches between 2021 and 2023 coincide with the occurrence of the cyclones with similar impacts as those that have occurred in Lake Chilwa.

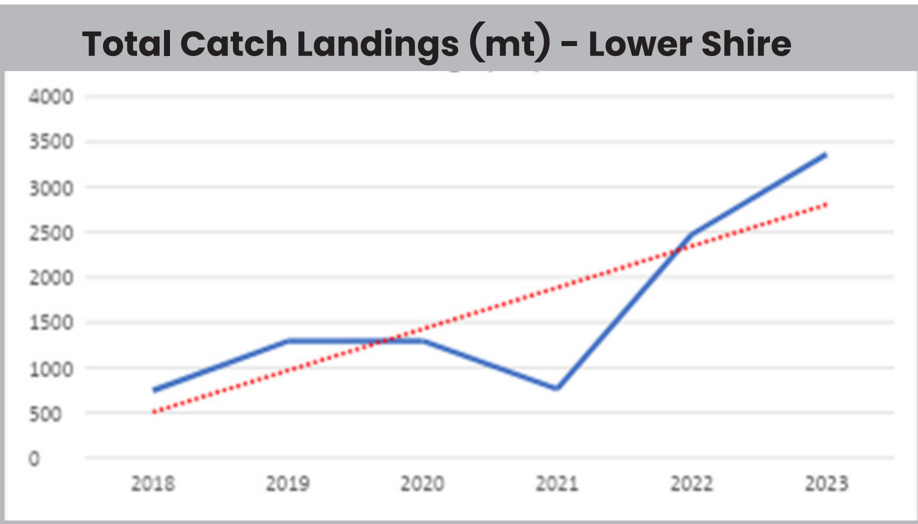


Figure 3-16: Annual catch landings for Lower Shire River between 2018 and 2023

In relation to national fish production, the Shire river accounted for 1.6% of total production in the year 2024/25 season. In other rivers, fish production data in not yet being collected.

3.2.6.5 Aquatic Vegetation

The Shire River hosts a diverse and ecologically significant array of aquatic and semi-aquatic vegetation, reptiles, birds, and mammals apart from fish. Its ecosystems range from the lacustrine (lake-like) Upper Shire near Lake Malawi to the flowing riverine habitats, floodplains, and marshes further downstream, supporting high biodiversity that is both nationally and globally important.

Aquatic and Semi-Aquatic Vegetation of the river has critical role in providing habitat, stabilizing banks, and improving water quality. Macrophyte communities are important vegetation particularly in its slower moving sections, lagoons, and floodplains which supports beds of submerged, floating, and emergent macrophytes.
Other common dominant species of the river include the submerged Vallisneria aethiopica and Ceratophyllum demersum (hornwort), floating-leaved Nymphaea spp. (water lilies), and extensive stands of emergent reeds and sedges such as Cyperus papyrus (papyrus), Phragmites mauritianus (reed), and Typha domingensis (cattail) (Dutton, 2010; WWF, 2017).

3.2.6.6 Other Aquatic wildlife

While Shire River is part of the Lake Malawi and serves as a migration corridor and habitat for both lake and riverine species, the river also hosts critical habitats such as the Elephant marsh which apart from being the Malawi's most important fishery production zone, acting as a vast seasonal breeding and nursery ground. It also supports other wildlife e.g. over 300 bird species including saddled stork (Ephippiorhynchus senegalensis), African skimmer (Rynchops flavirostris), and various herons, kingfishers, and waders (BirdLife International, 2023). The Elephant Marsh is a Key Biodiversity Area (KBA) and a Ramsar Site of international importance.

The river also hosts the African helmeted turtle (Pelomedusa galeata), the vulnerable African bullfrog (Pyxicephalus edulis), hippopotamus (Hippopotamus amphibius), large populations of the Nile crocodile (Crocodylus niloticus), the marsh mongoose (Atilax paludinosus) and the rare African clawless otter (Aonyx capensis) which are also present but less frequently observed. (Bourgarel, 2004).

3.2.7 North Rukuru Rivers

The North Rukuru river is one of the major Northern Malawi rivers originating from the highlands and dense miombo woodlands north of Mzimba district. Its headwaters flow through the Chikangawa forest (a major pine plantation area) and the Vwaza marsh Wildlife reserve, a vast seasonal wetland. The river flows eastwards and form Lake Kazuni around Vwaza marsh, and eventually draining into Lake Malawi at the Luwegu delta, south of Nkhatabay. The catchment area for North Rukuru is approximately 7,200 km², making it one of the largest river basins in the north (Jørgensen et al., 2013).

3.2.7.1 Hydrological Regime

The river exhibits a classic intermittent, flashy regime. Its flow is heavily dependent on seasonal rainfall. Wet Season (November-April) experiences high and often flashy peak flows due to runoff from its catchment. The river is the lifeblood of Vwaza wildlife reserve, sustaining its wetlands and associated wildlife, which support tourism. The Vwaza marsh also acts as a significant natural sponge, absorbing floodwaters and gradually releasing them, providing some attenuation. In dry season (May-October), flows diminish drastically. Many upper and middle reaches become a series of isolated pools or run completely dry, particularly in years of low rainfall. This makes it an ephemeral river in many sections (Munthali et al., 2019).

The North Rukuru basin however is highly vulnerable to climate variability. Prolonged droughts lead to severe water shortages, while intense rainfall events cause destructive flooding. Climate models suggest a trend towards increased rainfall intensity, which could worsen both extremes (Saka et al., 2022).

3.2.7.2 Sediment Regime

The North Rukuru catchment is a hotspot for soil erosion, driven by large-scale clearing of indigenous miombo woodland for charcoal production and agriculture, coupled with plantation forestry cycles in Chikangawa, which exposes soil. Unsustainable agriculture through cultivation of steep slopes without conservation measures and riverbank cultivation. Sediment load as the river transports high sediment loads, particularly during the early rainy season when bare soils are first exposed. This leads to siltation, reduced water quality (high turbidity persistence problem).

3.2.7.3 Water Quality

Water quality of North Rukuru generally degrades from source to mouth. Headwaters in forested areas are relatively clean, but rapid deterioration occurs downstream. Key parameters affected are Turbidity(TSS), Nutri ents and microbial contamination. With regards to TSS, very high levels of turbidity are experienced during rains due to erosion, with moderate enrichment of nutrients from agricultural runoff and livestock, though less intense than in more densely populated southern basins. Microbiological contamination is mainly from faecal contamination (E. coli) from livestock, poor sanitation, and riverside defecation, posing serious health risks for communities using river water directly (Palamuleni, 2020). Dissolved oxygen levels drop in stagnant in dry-season. This water quality information for the river being generic, the lacking time series information is needed to mark as evidence that can motivate informed policy action for the ecosystem. Monitoring efforts are in place however by the Water Resources Department, with initial water quality data for the river's three gauging stations and for the month of May, 2025 being available and presented in Table 3-10.

Table 3-10: Water quality data for North Rukuru river for the month of May, 2025

Source Type/ Location	North Rukuru River at Uledi Gauging Station (8A8), Chitipa District	North Rukuru river at M1 Road Bridge, Karonga District (Grid ref: 601731; 8903609)	North Rukuru river at M26 Road Bridge, Karonga District (Grid Ref: 584918;	Malawi Standards (MS691:200)
Ph value	7.29	7.77	7.99	6.0-0.0
Temperature, 0C	22.2	NI	NI	
Electrical conductivity, µs/cm	38	131	93	3500
Total Dissolved Solids, mg/l	19	78	55	100
Nitrate (as NO3), mg/l	<0.001	<0.001	<0.001	<50
Phosphate (as PO4), mg/l	1.089	0.236	0.227	0.15

3.2.7.4 Fish Resources

The North Rukuru's fish community is adapted to its seasonal, flood-pulse system. The river is dominated by riverine generalists and floodplain specialists. The river provides diverse but seasonal habitats informed by rocky riffles, sandy runs, and floodplain wetlands (notably the Lake Kazuni and Vwaza Marsh). The river therefore supports a specialized community of riverine fish species, distinct from the lake's famous cichlids. Important species include African carp (Labeo mesops) a migratory species, Various barbels (Barbus spp.) and Catfish (Clarias gariepinus and Bagrus meridionalis). Tilapiines mostly the Red-breast Tilapia (Coptodon rendalli) also thrives in the vegetated floodplain lagoons including of North Rukuru river (Banda et al., 2019).

The fishery of North Rukuru provides seasonal subsistence fishing for local communities. The fishery is entirely small-scale and vulnerable to low dry-season flows and habitat siltation. The fishery is also threatened by overfishing, siltation from catchment erosion smothers spawning substrates (gravel beds) and reduces water clarity and climate variability, mostly extended droughts that cause complete drying of river sections and marsh pools, leading to fish kills (Banda et al., 2019).

3.2.7.5 Aquatic Vegetation

The North Rukuru River supports a dynamic but seasonally variable assemblage of aquatic vegetation shaped by its ephemeral hydrological regime, connection to Lake Malawi, and the presence of the extensive Vwaza Marsh wetland. While less studied than the major lakes, its aquatic ecosystems are vital for biodiversity and wetland function. The river has floating and submerged mats Including species like the floating fern (Salvinia molesta) and submerged Ceratophyllum demersum (Chafuwa, 2018; Duponchelle et al., 2021). These macrophyte beds provide crucial nursery habitats for juvenile fish and invertebrates. The river has also river channel vegetation, emergent grasses and sedges established on exposed sandbars and banks during low flow.

The vegetation is mostly stratified along the river's gradient from its swampy headwaters to its delta and is highly responsive to seasonal flooding. Vwaza marsh complex a seasonally inundated wetland at the river's headwaters is the most significant feature along the river. It is dominated by extensive stands of Papyrus (Cyperus papyrus) that forms monotypic swamps in permanently flooded areas. These swamps are critical for nutrient cycling, water filtration, and providing habitat structure. The marsh has also Common dseed (Phragmites mauritianus) and Cattails (Typha domingensis) along wetland margins and riverbanks.

3.2.7.6 Other Aquatic wildlife

The North Rukuru supports rich birdlife, hippos, and crocodiles (Duponchelle et al., 2021). Nile Crocodile (Crocodylus niloticus) is present throughout the river, with significant populations. Hippopotamus (Hippopotamus amphibius) are also abundant, especially around Vwaza Marsh and deeper river pools. Their grazing trails and wallows significantly modify wetland habitats. African helmeted turtle (Pelomedusa galeata), diverse frog communities, including the edible bullfrog (Pyxicephalus edulis), thrive in the along North Rukuru wetlands and floodplains.

Key species of birds also find refuge along the river corridor, especially Vwaza Marsh. These species are such as the African fish eagle (Haliaeetus vocifer), African skimmer (Rynchops flavirostris) (nesting on sandbanks), saddled stork (Ephippiorhynchus senegalensis), white-faced whistling duck (Dendrocygna viduata), and numerous herons, kingfishers, and waders (BirdLife International, 2023), such that Vwaza Marsh is recognized as an Important Bird Area (IBA) due to its congregations of resident and Palearctic migrant waterbirds.

3.2.8 South Rukuru River

South Rukuru river is a vital and also among the iconic river system in Malawi's Northern Region, distinguished by its origin in the UNESCO-recognized Nyika Plateau and its role as a lifeline for the population in Rumphi Valley. The river originates from the montane grasslands and dambos (wet meadows) of the Nyika Plateau National Park, a high-altitude (1,800-2,500 masl) UNESCO Biosphere Reserve. It descends steeply via the Nyika escarpment, flows through the agriculturally rich Rumphi valley, and finally enters Lake Malawi at the Usisya bay. The river has a catchment area of approximately 5,900 km², encompassing the unique ecosystems of the Nyika Plateau and the mid-altitude valley landscapes (Mbano et al., 2019).

3.2.8.1 Hydrological Regime

The river has a highly seasonal but relatively perennial regime compared to the North Rukuru. In wet season (November-April), the river experiences sharp, high peak flows. Runoff from the plateau and its steep escarpments is rapid, leading to significant flood events that recharge valley aquifers and inundate floodplains. On the other hand, in the dry season (May-October), the river is sustained by base flow from groundwater reserves recharged in the Nyika's porous grasslands and from valley alluvial aquifers. While flows diminish significantly, it typically maintains a continuous, shallow flow in its main channel, making it a critical dry-season water source (Msilimba & Wanda, 2017).

3.2.8.2 Sediment Regime

The South Rukuru catchment is recognized as one of Malawi's most severe soil erosion areas. Key drivers include cultivation on extreme slopes, catchment- wide deforestation and riverbank cultivation. These activities have caused river edge and banks destabilization causing collapse and adding direct sediment input into the river. The river has an exceptionally high sediment load with massive, persistent turbidity plume extending into Lake Malawi at its mouth. Studies estimate sediment yields among the highest in the country (Msilimba & Wanda, 2017).

3.2.8.3 Water Quality

Water quality of the river is a major issue, deteriorating sharply from the pristine headwaters on the Nyika to heavily polluted sections in the valley. Key pollutants include extreme turbidity caused by very high levels of Total Suspended Solids (TSS) especially during rains, often exceeding national standards by large margins. Nutrient loads due to significant enrichment from fertilizer and manure runoff from the intensely cultivated valley, contribute also to eutrophication risk. Agrochemicals especially pesticide and herbicide residues from tobacco and rice farms are also a documented emerging contaminant and also severe faecal contamination due to poor sanitation coverage, livestock access making its waters unsafe for domestic use without treatment (Palamuleni, 2020; Mkandawire & Mwagomba, 2015).

Table 3-11: Water quality Parameters for South Rukuru River

MAP SHEET/ GRID REFERENCE		570593	570593		570593			
		570593	570593		570593			
SOURCE TYPE/ LOCATION	**South Rukuru at Vwaza Game reserve – Rumphi District**	**South Rukuru River at the Source M1 Road Bridge Mzimba**	**South Rukuru river at Njakwa Road Bridge Rumphi District**	**South Rukuru R at M1 Road Bridge Rumphi District**	**South Rukuru at Jenda Embangweni RB Mzimba**	**South Rukulu River at M1 Road Bridge (7G14), Phwezi, Rumphi District**	**South Rukulu River at Chimsewezo(7A3), T/A Mbelwa , Mzimba District**	**Malawi Standards (MS691:2005)**
pH Value	7.95	7.21	7.64	7.87	7.93	7.38	8.03	6.0 – 9.0
Temperature, Degrees Celsius						16.1	17.0	40
CONDUCTIVITY (µs/cm at 250C)	219	81	106	125	175	87	201	3500
TOTAL DISSOLVED SOLIDS, mg/l	131	48	63	75	81	44	97	100
NITRATE (as NO3-), mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	0.063	<0.001	<50
PHOSPHATE (as PO4) mg/l	0.224	0.251	0.212	0.310	0.242	0.570	0.569	0.15

3.2.8.4 Fish Resources and fishery

The South Rukuru is a vital migration corridor and supports an important subsistence fishery, heavily reliant on seasonal floods. The river provides critical habitats: fast-flowing rocky stretches from the escarpment, sandy runs, and seasonal floodplain wetlands in the lower valley. Like the North Rukuru, the river is dominated by riverine and floodplain-dependent species. Key taxa include; migratory Cyprinids (Labeo mesops and Barbus species) and Catfish (Clarias gariepinus) (Banda et al., 2019). Tilapiines especially the Red-breast Tilapia (Coptodon rendalli) also thrives in floodplain lagoons and vegetated backwaters. The river also acts as a seasonal migration corridor for Lake Malawi species.

The fishery is exclusively small-scale and vital for local protein and income, and primarily using gill nets, seine nets, and traps (Banda et al., 2019). Fishing is highly seasonal, peaking during the falling flood period (April-July) when fish are concentrated. Critical threats to the fishery include sedimentation as it smothers eggs, fills interstitial spaces in gravel used for spawning, and reduces feeding efficiency for sight-feeding fish. Habitat Fragmentation due to small irrigation weirs and diversions, overfishing and pollution from agrochemical runoff and faecal contamination have also been named as other threats.

3.2.8.5 Aquatic Vegetation

South Rukuru River supports a distinct aquatic ecosystem shaped by its clear, swift-flowing upper reaches from the Nyika Plateau, its sediment-laden middle and lower sections, and its connection to Lake Malawi. Its biodiversity is adapted to high seasonal variability and faces acute threats from habitat degradation.

Vegetation in the river is strongly influenced by flow velocity, substrate, and the extreme turbidity of the river. The headwaters are characterized by pristine, cold, fast-flowing streams. The vegetation therefore colonising this space of the river are Mosses and liverworts especially in stable rocks. The other primary riparian vegetation consists of montane grassland and heathland, which stabilize banks and filter runoff (Chapman & Chapman, 2001). The mid to lower reaches (Rumphi Valley to Lake Malawi) of the river has limited instream vegetation mostly due to combination of high sediment loads, unstable sandy/ silty substrates, and seasonal scouring floods severely limiting the establishment of rooted submerged macrophytes (e.g., Vallisneria). Vegetation is primarily confined to margins. This marginal vegetation are therefore patches of common reed (Phragmites mauritianus), sedges (Cyperus spp.), and grasses establish on stabilized banks and sandbars. Riverbank cultivation has extensively cleared natural riparian woodland, increasing erosion and reducing organic input (Msilimba & Wanda, 2017).

3.2.8.6 Other Aquatic wildlife

Other than fish, South Rukuru river hosts Reptiles and Amphibians. Nile Crocodile (Crocodylus niloticus) is present, particularly in deeper pools and closer to the lake., with Hippopotamus (Hippopotamus amphibius) populations existing, primarily in the lower reaches and near the delta. Their movements create pathways and wallows that modify aquatic habitats. Amphibians present are diverse frog communities such as Müller's platanna (Xenopus muelleri) and various Ptychadena ridged frogs exploit the seasonal floodplains and rain-filled depressions.

Macroinvertebrates and Other Fauna such as Benthic macroinvertebrates which are pollution-tolerant e.g. mayfly larvae (e.g., Tricorythus), oligochaete worms, and tolerant molluscs are also hosted within the river while Sensitive taxa (e.g., many stoneflies, caddisflies) are restricted to the cleaner, faster headwaters on the Nyika Plateau (Palamuleni, 2020).

3.2.9 Bua River

The Bua River is a major river system in central Malawi, flowing approximately 300 km from the Kasungu Plateau where it originates, to Lake Malawi through the Lifupa Conservation Area and Nkhotakota Wildlife Reserve. It is a vital water source for agriculture, communities, and wildlife, but faces intensifying pressures from land use change and climate variability.

3.2.9.1 Hydrological Regime

Since Bua river originates from the Kasungu Plateau near Kasungu Town, It flows eastward through the two Conservation Areas of Lifupa and Nkhotakota Wildlife Reserve, forming a significant delta wetland before entering Lake Malawi's central-west coast.The Bua catchment is highly seasonal with "flashy" hydrology, typical of Malawi's rain-fed rivers. In wet season (November-April), the river experiences sharp, high-peak flows, often leading to flooding of its lower floodplains and delta. These floods are critical for recharging wetlands and triggering ecological processes. In dry season however, (May-October), the flows diminish drastically. The upper and middle reaches can become a series of isolated pools or run completely dry, especially during drought years. The river is largely perennial only in its lower reaches and within the protected Nkhotakota Reserve, where groundwater and forest cover help sustain baseflow (Mkandawire et al., 2018).

Climate and Human Impacts are the reason for the basin's vulnerabilities, with projections suggesting increased rainfall intensity and drought frequency, upstream water abstraction for irrigation and deforestation as the factors that significantly exacerbate dry-season water scarcity, reducing flows critical for downstream ecosystems (Kambewa et al., 2020).

3.2.9.2 Sediment Regime

The Bua catchment is severely degraded, making it a major contributor of sediment to Lake Malawi. Deforestation and land conversion and Unsustainable farming practices without soil conservation measures contribute large sediment volumes (Msilimba, 2009). The river therefore carries very high sediment load, visibly discolouring Lake Malawi at its mouth.

3.2.9.3 Water Quality

Water quality of Bua river deteriorates markedly from the relatively clean headwaters to the polluted lower reaches. Key parameters include turbidity/TSS which is in extreme high levels, particularly during rains and are driven by catchment erosion. Nutrients are moderate to high (nitrate, phosphate) loading and are from agricultural runoff and livestock, leading to eutrophication risk in slow-flowing sections of the aquatic ecosystem.

Pesticide residues from intensive tobacco farming are a documented and growing concern, within Bua catchment with potential toxic effects on aquatic life (Ndala et al., 2021). Though sparse time series water quality data is lacking for Bua river, the Government of Malawi, (2025) through the Water Resources Department documented May 2025 data from eight gauging stations of Bua river as shown in Table: 3-12 indicating variations in the parameters with others being within and other gauging stations beyond the Malawi standard (MS691:2005).

Table 3-12: Bua River Water quality data for May 2025

SOURCE TYPE/ LOCATION	Bua River at LI/Santhe Road Bridge Lilongwe District (Grid Ref: 543371; 8508587)	Bua River Mchinji Border Road Bridge Mchinji District (Grid Ref: 487357 8474157	Bua River at Foot Path to Customs Office (5E6), Mchinji district	Bua River at LI/Mchinji Road Bridge Mchinji (Grid Ref: 514844 8461289)	Bua River M1 Road Bridge Dowa District (Grid Ref: 55930 8528686)	Bua River at Old Bridge (5C1), Nkhotakota District	Bua River at KU/KK Road Bridge (5D1), Malomo, Kasungu District	Bua River at M5 Road Bridge Nkhotakota District (Grid Ref:629850; 8586065)	Malawi Standards (MS691:2005)
pH Value	8.37	8.54	7.72	7.91	8.69	7.37	8.94	9.05	6.0 – 9.0
Temperature, Degrees Celsius	NI	NI	22.7	NI	NI	29.7	24.6	NI	40
CONDUCTIVITY (µs/cm at 250C)	165	93	120	90	223	297	346	281	3500
TOTAL DISSOLVED SOLIDS, mg/l	99	56	58	54	134	153	168	169	100
NITRATE (as NO3-), mg/l	0.079	0.202	0.061	0.063	0.30	0.074	0.083	0.264	<50
PHOSPHATE (as PO4) mg/l	<0.001	<0.001	0.623	0.009	<0.001	0.789	0.833	0.067	0.15

3.2.9.4 Fish and Fisheries

Bua river supports a mixture of riverine species and those that migrate from Lake Malawi, as the river acts as a seasonal corridor for some lake species. Key species are the migratory cyprinid Ndunduma (Labeo mesops), various Barbus species, the catfish Clarias gariepinus, and in lower reaches and lagoons, the tilapia Coptodon rendalli (Tweddle et al., 2015).

The river provides crucial subsistence fishing for riverside communities. The Bua Delta wetlands and seasonal floodplain lagoons are particularly productive fishing grounds during and after the rainy season. The fishery however is threatened by a number of factors ranging from sedimentation, dry season water scarcity, overfishing and pollution, mainly from agrochemicals.

3.2.9.5 Aquatic Vegetation

Vegetation in the Bua river is concentrated in stable, low-flow environments, with the upper and middle reaches having sparse instream vegetation due to high sediment and seasonal scouring. Riparian zones are often degraded, but remnants of riverine forest exist in the Nkhotakota Wildlife Reserve. Lower reaches and delta wetlands have however most significant area for aquatic plants supporting stands of common reed (Phragmites mauritianus), sedges (Cyperus spp.), and water lilies (Nymphaea spp.).

The Bua Delta itself contains significant papyrus (Cyperus papyrus) swamps and mixed marsh vegetation. These wetlands are vital for water filtration, flood attenuation, and providing fish nursery habitat (Duponchelle et al., 2021).

3.2.9.6 Other Aquatic Wildlife

The Nkhotakota Wildlife Reserve section of the river is a stronghold for hippopotamus (Hippopotamus amphibius) and Nile crocodile (Crocodylus niloticus). Elephants and other wildlife depend on the river as a dry-season water source. The river corridor and delta wetlands are important for waterbirds, including herons, storks, kingfishers, and the African fish eagle (Haliaeetus vocifer). The delta is likely a significant site for Palearctic migrants (BirdLife International, 2023). Amphibians and reptiles within Bua river include diverse frog communities that utilize the seasonal wetlands e.g. the African helmeted turtle (Pelomedusa galeata). Macroinvertebrates are mostly sediment-tolerant species (e.g., burrowing mayflies, worms) due to high turbidity.

3.2.10 Dwangwa River

Dwangwa River is among the major rivers in central Malawi, flowing approximately 150 km from the Dowa highlands to Lake Malawi. The river is critically important as the primary water source for the large-scale Dwangwa Sugar Estate and supports significant biodiversity.

3.2.10.1 Hydrological Regime

From Dowa escarpment where Dwangwa river originates, the river flows north-east through the Kasungu Plain, past the Dwangwa Sugar Estate, and into Lake Malawi just north of the Nkhotakota Wildlife Reserve. The river has a highly seasonal and increasingly erratic hydrology. Wet Season (November-April) experiences sharp, high-peak flows. However, the extensive network of dams and weirs owned by the Dwangwa Sugar Estate for irrigation significantly attenuates and regulates these peaks, storing water for the dry season. In dry season (May-October) however, flows are almost entirely anthropogenically controlled. Releases from the estate's dams maintain a minimum flow, but natural baseflow is extremely low. Outside the regulated sections, the river often becomes a series of stagnant pools or runs dry (SADC, 2015).

Apart from Shire river, Dwangwa is also one of Malawi's most heavily regulated rivers. The sugar estate's Lifupa Dam and other impoundments have fundamentally altered its natural flow regime, creating a perennial, managed system in the middle reaches but exacerbating scarcity elsewhere. High-volume abstraction for irrigation leaves little "environmental flow" for downstream ecosystems, especially during droughts (Mbewe, 2018).

3.2.10.2 Sediment Regime

The Dwangwa catchment is severely degraded, rivalling the South Rukuru as a national erosion hotspot. Large-scale clearing of miombo woodland for tobacco farming, charcoal production, and subsistence agriculture, cultivation on steep Dowa escarpment and surrounding hills with minimal conservation, riverbank cultivation and sand mining are the major drivers that directly disturb the riparian zone of the river, add sediments and destabilizes banks (Munthali & Mwafongo, 2021).

The river is renowned for its exceptionally high sediment yield, delivering a massive, permanent plume of silt into Lake Malawi. This has led to severe aggradation of the riverbed (raising it by several meters in places), increased flood risk for the sugar estate and communities, and rapid siltation of irrigation infrastructure and reservoirs. The delta is heavily silted, degrading near-shore lake habitats (Msilimba, 2012).

3.2.10.3 Water Quality

Water quality is critically poor, affected by both diffuse and point-source pollution. Key Parameters of concern are extreme Turbidity, with Dwangwa being one of the most turbid rivers in Malawi year-round due to chronic erosion, with Total Suspended Solids (TSS) far exceeding national standards. Nutrient and organic pollution mainly from significant inputs from agricultural fertilizers and sugar mill effluents, organic waste and chemicals are evident; leading to localized eutrophication, oxygen depletion (BOD/COD issues), and fish kills downstream of the outfall (Government of Malawi, 2017; Njaya et al., 2019).

High and documented levels of pesticides (e.g., atrazine, endosulfan) and herbicides from tobacco and sugar cane farms pollute the river, posing toxicity risks to aquatic life and human health (Ndala et al., 2021). Faecal contamination characterised by high bacterial loads from settlements and livestock is also evident. This information is provided despite sparse time series water quality data and lacking detailed information for the water quality of the river. Government of Malawi, (2025) though and through the Water Resources Department documented 2025 data from two gauging stations of Dwangwa river as shown in **Table 3-13**

Table 3-13: Dwangwa River Water quality data for May 2025

SOURCE TYPE/ LOCATION	Dwangwa River at M1 Road Bridge (6D10), Kasungu District	Dwangwa River downstream Road Bridge (6C1), Nkhotakota District	Dwangwa River at M5 Road Bridge Nkhotakota District (Grid Ref: 549259 8575795)	Dwangwa River at M1 Road Bridge District (Grid Ref: 620987 8616193	Bua River M1 Road Bridge Dowa District (Grid Ref: 55930 8528686)	Bua River at Old Bridge (5C1), Nkhotakota District	Bua River at KU/KK Road Bridge (5D1), Malomo, Kasungu District	Malawi Standards (MS691:2005)
pH value	8.72	6.92	8.67	8.35	6.0 – 9.0	7.37	8.94	9.05
Temperature, Degrees Celsius	25.3	29.3	NI	NI	NI	NI	24.6	NI
Electrical conductivity, (µs/cm at 25 0C)	649	93	113	574	3500	297	346	281
Total Dissolved Solids, mg/l	320	47	68	344	100	153	168	169
Nitrate (as NO3), mg/l	0.079	0.079	0.409	0.303	<50	0.074	0.083	0.264
Phosphate (as PO4), mg/l	0.751	0.498	0.205	0.039	0.15	0.789	0.833	0.067

3.2.10.4 Fish and Fisheries

Dwangwa river community was historically important for migratory fish from Lake Malawi, but the community is now heavily impacted. Migratory species such as Ndunduma (Labeo mesops) and cyprinids used to dominate as Dwangwa river fishes but currently have experienced severe declines due to blocked migration (by dams and weirs), silted spawning grounds, and pollution (Duponchelle et al., 2021). Current fish composition is dominated by more tolerant, non-migratory species like certain Barbus species, the catfish Clarias gariepinus, and the tilapia Oreochromis shiranus in polluted, stagnant sections.

As for the fishery, the once productive subsistence fishery has largely collapsed. This is attributed to habitat degradation, blocked access to spawning grounds, and direct toxicity from agrochemicals and mill effluents. Fishing in Dwangwa river now provides minimal catch for local communities (Banda et al., 2020).

3.2.10.5 Aquatic Vegetation

With Dwangwa river characterised by high turbidity and sediment instability, there are limited instream submerged and rooted vegetation in the river. However, the characteristic of the river being also a managed river system, within the sugar estate's irrigation canals and managed drainage ditches, controlled water levels allow for growth of aquatic weeds e.g., Pistia stratiotes - water lettuce, which require regular removal. The heavily silted delta area supports limited fringing vegetation, such as hardy reeds (Phragmites), but lacks the extensive papyrus swamps found in less disturbed deltas like the Bua.

3.2.10.6 Other Aquatic Wildlife

The combination of pollution, habitat loss, and flow alteration has severely impacted aquatic wildlife of Dwangwa river. Large fauna along the river catchment are Hippopotamus and Nile crocodile populations, however are only confined to the immediate lake-shore area, away from the polluted river mouth. Also while the lake shore attracts waterbirds, the river itself, due to its poor quality, supports lower diversitities. African fish eagles may still be present but face reduced fish prey. (Palamuleni, 2020).

3.2.11 Linthipe River

Linthipe River is a found in Central Malawi and is approximately 170 km long, flowing from the Dedza highlands into Lake Malawi's southwestern arm. It is the largest single contributor of water to Lake Malawi by volume and one of the most economically and ecologically critical and threatened river systems in the country.

3.2.11.1 Hydrological Regime

The flows northwards, passing through the agricultural heartlands of Lilongwe river from its origin i.e. the Dedza Highlands near Dedza Mountain. The river is joined by the Lilongwe River), eastward past the Mua-Livulezi Forest Reserve, before entering Lake Malawi at the Linthipe Delta near Chipoka. Linthipe has a large catchment (~8,800 km²) and a highly seasonal, flashy hydrology heavily influenced by human activity. Wet esason (November –April), carries enormous volumes of water, contributing up to 20-25% of Lake Malawi's total annual inflow and it experiences sharp, high magnitude flood peaks (World Bank, 2020).

In the dry season (May-October) however, flows diminish drastically. However, due to its size and contributions from tributaries like the Lilongwe River, it maintains perennial flow in its lower reaches, though at very low levels. The river is heavily influenced by upstream abstractions from the Lilongwe Water Board (the main water source for the capital city) and extensive irrigation schemes (Chavula, 2012).

3.2.11.2 Sediment Regime

The Linthipe is Malawi's single largest contributor of sediment to Lake Malawi, delivering an estimated 30-40% of the lake's total sediment load. Major erosion drivers are widespread deforestation for agriculture and charcoal in the upper Dedza highlands and throughout the catchment, Riverbank cultivation and sand mining along the river, directly destabilizing the channel and gully erosion on the mid-catchment (especially around the Livulezi area) is scarred by some of the largest and most active gully systems in southern Africa, which funnel massive amounts of soil directly into the river (Msilimba & Holmes, 2005).

3.2.11.3 Water Quality

Water quality for Linthipe river is severely degraded from source to mouth, representing a major public health and ecological crisis. Key parameters and issues include; extreme Turbidity with permanently high levels of Total Suspended Solids (TSS), among the highest recorded in the country; severe faecal pollution as the river receives untreated or partially treated sewage from Lilongwe City (via the Likuni and other tributaries) and numerous market centers. E. coli counts consistently exceed safe limits by several orders of magnitude, making the water dangerously unsafe for domestic use (Government of Malawi, 2017; Palamuleni, 2021). Nutrient and organic pollution due to high loads of nitrates, phosphates, and organic waste from sewage and agricultural runoff also cause eutrophication and oxygen depletion in slower sections. Agrochemicals from significant pesticide and herbicide residues from the intensive tobacco, maize, and rice farming in the catchment also is the main issue compromising water quality of the river (Ndala et al., 2021).

Table 3-14: South Rukuru River Water quality data for May 2025

Map Sheet/Grid Reference	549160	570593	597371	613540	553059	627357	605687	
	8783984	8661182	8780013	8795646	8643377	8810183	8807814	
SOURCE TYPE/ LOCATION	**South Rukuru at Vwaza Game reserve Rumphi District**	**South Rukuru River at the Source M1 Road BridgeMzimba**	**South Rukuru river at Njakwa Road Bridge Rumphi District**	**South Rukuru R at M1 Road Bridge Rumphi District**	**South Rukuru at Jenda Embangweni RB Mzimba**	**South Rukulu River at M1 Road Bridge (7G14), Phwezi, Rumphi District**	**South Rukulu River at Chimsewezo (7A3), T/A Mbelwa , Mzimba District**	**Malawi Standards (MS691:2005)**
Ph Value	Rumphi District	South Rukuru R at M1 Road Bridge	7.64	7.87	7.93	7.38	8.03	6.0-9.0
Temperature, 0C	Rumphi District	South Rukuru at Jenda Embangweni RB	NI	NI	NI	16.1	17.0	40
Electrical conductivity, μs/cm	Mzimba	South Rukulu River at M1 Road Bridge (7G14), Phwezi,	106	125	175	87	201	3500
Total Dissolved Solids, mg/l	Rumphi District	South Rukulu River at Chimsewezo (7A3), T/A Mbelwa ,	63	75	81	44	97	100
Nitrate (as NO3), mg/l	Mzimba District	Malawi Standards	<0.001	<0.001	<0.001	0.063	<0.001	<50
Phosphate (as PO4), mg/l	(MS691:2005)	0.251	0.212	0.310	0.242	0.570	0.569	0.15

3.2.11.4 Fish and Fishery

Besides the river being a vital migration corridor for Lake Malawi fish, the migratory fish community is now severely depleted. The iconic Ndunduma (Labeo mesops) and other migratory cyprinids have experienced catastrophic declines due to blocked migration by silt-smothered spawning gravels, and toxic pollution (Duponchelle et al., 2021). Current composition of fish in the river is dominated by a few pollution-tolerant, non-migratory species such as the sharp tooth catfish (Clarias gariepinus) and some hardy tilapias (Oreochromis shiranus).

3.2.11.5 Aquatic Vegetation

The extremely high turbidity and unstable, shifting sediments in Linthipe river prevent the establishment of most submerged and rooted aquatic macrophytes (e.g., Vallisneria) in the main channel. The Linthipe river channel is characterised by patches of reeds (Phragmites) and sedges (Cyperus) existing on stable banks. The Linthipe delta, though heavily silted, still contains some papyrus (Cyperus papyrus) swamps and marsh vegetation. However, these wetlands are shrinking due to drainage for agriculture and altered flood regimes (Duponchelle et al., 2021).

3.2.11.6 Other Aquatic Wildlife

The river's poor water quality and habitat degradation support minimal aquatic wildlife. Large Fauna such as Hippopotamus and Nile crocodile populations are now extremely rare or locally extinct in the river, persisting only near the lake shore. Waterbird diversity is low along the polluted main stem though the delta area still attracts some herons, kingfishers, and waders, but at reduced numbers. Macroinvertebrates are dominated by pollution-tolerant taxa such as oligochaete worms, red chironomid larvae ("bloodworms"), and certain snails (Palamuleni, 2021).

3.3 Situation analysis of ILK in Aquatic Resource Management

This section expounds on the situation analysis of ILK in managing aquatic resources while reflecting on historical trends, current practices, opportunities, challenges, threats and, future directions.

The topic on ILK began several decades ago with the study of ethno-science and taxonomy. It was then expanded into several areas of agricultural development and natural resource management (Iticha & Husen, 2018). Such knowledge tends to be the result of cumulative experience and observation, tested in the context of everyday life, and devolved by oral communication and repetitive engagement rather than through formal instruction.
The weaving of ILK in aquatic resource management has a long history in Malawi, dating back to pre-colonial times. Traditional fishing methods, which included the use of mono, traps and weirs were sustainable and designed with an intimate knowledge of the local ecosystems. However, colonial regulations introduced in the 1930s dismissed these methods as primitive and destructive, ignoring their ecological benefits and the intricate knowledge systems behind them.

Customs, beliefs and practices play a role in aquatic resource management and conservation. Traditional value systems still influence and guide their day to day life for the majority of rural based Malawians (ICLARM/GTZ, 1991). For example, fishers' taboo that used to be practiced at Lake Chilwa that "a man whose wife was pregnant was not allowed to go fishing" contributed to conservation of fishery at the Lake. There is also a best known example of strict adherence to closing seasons at Mbenji Island located in the central part of Lake Malawi in Sub-Chief Msosa's jurisdiction within Salima District. The season is marked by elaborate ceremonies for its closing and opening which include offering sacrifice to the ancestral spirits (Scholz et al. 1998). A closed season runs from December to March to allow stocks to recover. During the closed season no one is permitted to remain on the island or to fish in the surrounding waters to allow the fish to breed and for the communities to focus on agricultural activities.

In addition, within ILK systems, there are closed areas based on belief and the magico-religious systems of the communities. The local magico-religious systems in Malawi often dictate the boundaries of "closed" ecological areas. A prominent example is Phiri la Mtsatsi (Hill of Castor Oil), one of three small islands situated on Lake Chiuta. Within this island and its surrounding waters, all fishing and human activities are strictly prohibited due to the cultural belief that land spirits inhabit the area. Compliance remains absolute; the community maintains a powerful narrative that anyone who trespasses simply vanishes, with no recorded instances of anyone returning to challenge this claim (Donda, 1998). A comparable phenomenon is observed along the western shoreline of northern Lake Malawi where fishers avoid a small island locally known as Mizimu (Spirits), believing that the overabundance of monkeys sighted there are actually spirits in disguise. While the area is generally avoided, traditional norms permit fishers to seek shelter there during severe weather conditions (Donda, 1998).

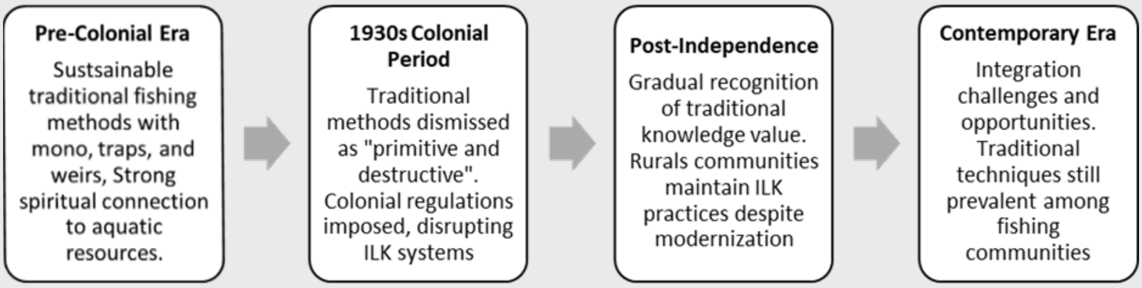


Figure 3-17: The Historical Evolution of ILK aquatic resources in Malawi

In Malawi, traditional techniques are still prevalent despite gradual changes in fisheries practices during the history of Malawi, (GOM, 1989); (ICLARM/GTZ, 1991); (Chirwa, 1996); (Banda & Tomasson, 1997). Fishers' knowledge is seen in all steps of fish production, harvesting, handling or processing, marketing and consumption. Central to this is the learning system. Folklore, which serves as one of the channels along which knowledge can flow to future generations, is rich in beliefs, customs and practices, in many communities such as the Chewa (Kalipeni, 1998).

3.4 Drivers, Pressures, State, Impact and Responses in Aquatic Ecosystems

Malawi's Lakes and river basins sizes, flow and water quality (Total Phosphorus, Total nitrogen and Nitrate) have all been changing and affected over the years (Hecky et al, 2003). Sediment and nutrient concentrations, loads, and yields, Invasive alien species, effects of climate change, pollution and eutrophication have been named as among drivers. Similarly, since the late 1980s, the fish resources and/or annual fish landings within Malawi's aquatic ecosystems, have been declining, owing to overfishing, the open access nature of the basins, limited observance of closed seasons and low 'conservation awareness' (Msomphora, et al, 2022).

Malawi's rapid population growth (exceeding 20 million, with annual rates around 2.9%) and accelerating urbanization intensify pressures on aquatic ecosystems. Increased settlement and agricultural expansion along shorelines lead to direct encroachment, reducing riparian buffers, degrading fish habitats, and limiting access to breeding/nursery areas. Concurrently, heightened nutrient loading from intensified agriculture (e.g., fertilizer runoff) and untreated urban/peri-urban waste contributes to eutrophication, algal blooms, and declining water quality in lakes (e.g., Chilwa, Malombe) and rivers (e.g., Shire). These pressures exacerbate overfishing and biodiversity loss, with cascading impacts on food security for ~1.6 million people dependent on fisheries.

3.4.1 Excessive Sediment and Nutrient concentration, loads and yield

Sedimentation and nutrient (C, N, P, Si) concentrations, loads, and yields are among the causes of degradation in all Malawi's lakes and rivers. The drivers to such change have been named as anthropogenic activities mainly increased deforestation, increased population growth and associated infrastructure development and agriculture, and mining activities in the catchment areas of the basins, which increase erosion and then deposition. Hecky et al., (2003), established that sedimentation was more responsive to basin disturbance than places of intact forests even if with steep slopes. Further, Hecky et al 2003 indicated that increasing human population along Lake Malawi a corresponding intense agricultural development and deforestation, leading to increased nutrient loading to the lake by 50% in 2003. Lakes and rivers are naturally terminal sinks for sediments eroded and transported from surrounding catchment areas. As such, changes in cover within the catchments, mostly due to deforestation, agricultural practices etc, increases the erosive potential of most of the catchment areas and hence the amount of sediment deposition increases.

3.4.2 Climate Change impacts on Aquatic ecosystem

While increasing temperatures and decreased rainfall (which are mostly climate change effects) has an implication of water flow, climate change has also led to a decline in fish catches (Limuwa et al.,2018), and hence negatively affected the livelihoods of fishing communities around those aquatic ecosystems in Malawi. Additionally, climate change has led to a shift in the composition of fish species, with some species becoming more dominant while others are declining (Limuwa et al., 2018).

Of late, Aquatic ecosystems like Lake Malawi, had a number of reported cases of mass fish kills, particularly in the southern part of the lake. Although the major threat to the sustenance of the fishery in Lake Malawi and other aquatic ecosystems is overfishing, impacts of climate change resulting from increased temperatures (which fuel algal blooms) and increased speeds of Mwera winds only help to exacerbate these threats, and so are the mass fish kills, in Lake Malawi attributed to this. Additionally, a study inferring the impact of rainfall and temperature on the catches of Chambo (Oreochromis spp) was done by Makwinja and M'balaka (2017). In this study, observations were made that unlike the air temperature, rainfall fluctuations had a significant impact on the total catches of Chambo, and hence climate change being attributed to imposing negative impacts on aquatic ecosystems and fishery.

3.4.3 Invasive alien species

Most lakes and rivers in Malawi e,g, Lake Malawi and Shire River, have been reported to face threats from invasive alien species introductions mostly human-mediated (intentionally and/or unintentionally) through land use changes; tourism; climate change; economics and trade; regulatory regimes; biological control of pests and public health (Moore, 2005). These invasive alien species potentially threaten fish diversity and the existence of the water bodies. While not all introductions cause problems, when the alien species gets established, they cause problems; and it is widely accepted that one-tenth of the introduced species get established (Wittmann et al., 2013). Observed introductions are reported for Lake Malawi as invasive Tilapiines, Oreochromis niloticus and Oreochromis leucostictus. These species were introduced as an initiative to develop aquaculture and new capture fisheries (Genner et al., 2013; Weyl et al., 2010). It was, however, noted that the introduction of O. leucostictus was accidental as it was misidentified as O. niloticus. Though currently, there is no evidence that these newly introduced species are impacting native species in the lake, the situation needs to be closely checked as may change (Sayer et al., 2019). Other introductions in Lake Malawi are the piscivorous Oncorhynchus mykiss in Nyika plateau and Protopterus annectens near Salima (Genner et al., 2013).

As for the riverline ecosystems, water hyacinth (Pontederia crassipes) is the major invasive alien species introduced. The plant, known locally as "namasupuni," was first reported in Malawi during the 1960s. By at least 2001, it was recognized as a significant threat, "strangling life" in Lake Malawi and the Shire River.

Current Status: Water hyacinth remains a persistent and notable problem. Recent environmental monitoring efforts in 2023 observed a "notable increase of water hyacinth across all sampled locations" in the Mangochi, Chikwawa, and Nsanje Districts, specifically within the Lower Shire River Valley. This indicates that the plant continues to be an active and growing concern in Malawi's freshwater systems.

Ecological Impacts: The plant forms dense mats on the water surface, which can have severe environmental consequences. These mats block sunlight from penetrating the water, which inhibits the growth of plankton—a critical base of the aquatic food chain. As the plant dies and decays, it can also sharply increase nutrient levels in the water, leading to algal blooms that further reduce oxygen levels, which is harmful to fish and other aquatic life

and Nile tilapia distribution, and add management measures/costs (mechanical removal, biological control) with lessons from Elephant Marsh and Shire system.

3.4.4 Pollution

Excessive nutrient inputs and pollution from agricultural runoff, sewage discharge, industrial activities, human settlements and other sources can lead to contamination of lakes and rivers. Elevated levels of nutrients, such as phosphorus and nitrogen, can lead to eutrophication, which is characterized by algal blooms and decreased oxygen levels in the water, harming aquatic life. This can negatively impact aquatic life and alter the lake's/ rivers ecological balance.

3.4.5 Overfishing due to population growth

Overfishing has been named as among the drivers of changes in the fishery. Overfishing has resulted in decreasing catch rates in all aquatic ecosystems over the years. In a study by Weyl et al (2020), catch per fishing gear or catch per unit effort is observed to be declining including in Lake Malawi and other major aquatic ecosystems in Malawi and such response is considered a strong indicator of overfishing. Overfishing also characterize depletion of high value fish e.g. the decline of the endemic Oreochromis (Nyasalapia) species i.e Chambo which used to contribute between 20 and 40% of the total 5000–9000 t y^{-1} catch until 1992 when fishery crashed between 1992 and 1999 especially in the southern Lake Malawi, and annual catch decreased from 5000ty^{-1} to about 2000ty^{-1} (Weyl, 2010). In addition, high levels of poverty and population growth have been named as the major factors that have contributed to overfishing and leading to collapse of most of Malawi's aquatic ecosystems and the fishery. This is in addition to the use of illegal seine nets.

3.4.6 Drivers of loss and pressures of ILK in aquatic biodiversity

As noted earlier, Malawi is experiencing a reduction/ loss of biodiversity. For instance, the effects of climate change have resulted in diverse disruption of weather patterns and increased frequency of extreme weather events such as droughts and floods which have affected aquatic biodiversity. During cyclone Freddy (2023), for example, aquatic sanctuaries and fish breeding sites were washed off; barriers were removed and fish stocks were reduced. Deforestation, soil erosion, and loss of biodiversity affect the ecosystems that local communities depend on consequently leads to pressure created by high demand on the few ecosystems. Therefore, apart from scientific measures of restoring the lost biodiversity, there is great need to incorporate people' local knowledge. Sadly, though, the country is experiencing the loss of ILK in the management of aquatic biodiversity Malawi which has been influenced by a variety of pressures and drivers, which can be broadly categorized into socio-economic, cultural, and policy-related factors amongst others.

3.4.6.1 Poverty and Corruption

High levels of poverty push communities towards short-term survival strategies, often at the expense of sustainable practices rooted in ILK. There are cases of corruption which enables a few corrupt fishers an opportunity to overexploit the aquatic resources with prohibited fishing gears. There has also been migration and urbanization in most fishing areas. This leads to the loss of community cohesion and the transmission of traditional knowledge. Most fisheries centers and Lake Shores are places which have experienced more migration and immigration which has negatively affected the culture of the indigenous people. The effect of migration is clearly seen between communities at Mbenje Island in Salima.

3.4.6.2 Modernisation, Westernisation and Generational gap

Modernisation, westernisation and generational gap are some of the drivers of loss for ILK in Malawi. Modernisation and westernisation have been brought in through modern education systems which carry western cultural values. Some western innovations such as televisions and social media have devalued traditional knowledge systems and practices and have widened the generation gap between the youth and older generations. This has been very evident in the younger generations losing interest in traditional practices, leading to a discontinuity in the transmission of ILK. In addition, internal and external migration of youths from rural to urban; and from Malawi to other countries in search of better life has also enabled the younger generation to lose contact with their ILK roots and focus on economic activities.

3.4.6.3 Religious Influences

The preference for Christianity and other alien religion practices have also led to the loss of ILK in Malawi. Some taboos might be taken as heathen, hence not accepted or practiced by some religious groups. There are some common religious beliefs in Africa which are also practiced in Malawi, which prohibits members from eating certain fish species. An example is the forbidding of mlamba (Clarias spp.), bombe (Bathyclarias spp.), kampango (Bagrus meridionalis) and related species (nkunga; Anguilla nebulosa). This belief is strong in communities of Judeo-Christian background. This is based on one of the Bible Laws in the Old Testament, which forbids eating fish which do not possess scales (Carroll and Pricket 1997). This therefore gives pressure on the remaining preferred species, especially those with scales. Further, rituals and ceremonies that embody ILK in the management of aquatic biodiversity are declining as communities adopt new religions and lifestyles at the expense of their own.

3.4.6.4 Inadquate policy support for ILK

Inadequate policy support for the preservation and weaving of ILK into national developmental plans is also another challenge. There is also lack of legal recognition and protection for ILK against exploitation and misuse by external parties, even though Section 26 of the Constitution for the Republic of Malawi stipulates that "every person shall have the right to use and participate in the cultural life of his or her choice". This legal provision just remains work on paper without supporting implementation mechanisms in practice. There is an urgent need to involve local communities in participatory mapping and the provision for protection of intellectual rights of the traditional ecological knowledge. To achieve meaningful weaving of ILK within Malawi's aquatic sector, the state must transition from discretionary consultation to formal legal recognition grounded in Section 26 of the Constitution. This constitutional mandate, which guarantees the right to participate in cultural life, necessitates a sui generis legal framework that recognizes communal intellectual property over traditional ecological practices. By institutionalizing Biocultural Community Protocols (BCPs) and gazetting local bylaws such as those governing sacred 'spirit pools' or traditional closed fishing seasons Malawi can transform ILK from an informal resource into a legally enforceable pillar of biodiversity governance. This approach ensures that the 'living heritage' of lakeshore and riverine communities is protected against biopiracy and exclusion, fulfilling the state's obligation to harmonize statutory conservation with the customary rights of its people.

To effectively incorporate Participatory Mapping (PM) into Malawi's biodiversity framework, the state must adopt it as a formal spatial tool for documenting 'invisible' ecological data held by Indigenous People and local communities. This process involves employing Counter-Mapping and Participatory GIS (PGIS) to record critical aquatic assets such as traditional fish breeding sanctuaries, sacred 'spirit pools,' and historical flood-plain patterns that are often omitted from standard satellite imagery. For these maps to be functionally integrated, they must be 'ground-truthed' by village elders and formally recognized by the Department of Environmental Affairs and Fisheries department as primary evidence during Environmental Impact Assessments (EIAs) and resource management planning. By layering this community-derived spatial knowledge over scientific datasets, Malawi can create a 'Bio-Cultural Atlas' that ensures customary boundaries and traditional 'no-take zones' are legally legible and protected from encroachment or unsustainable development".

Mapping Indicators that can be prioritized during participatory mapping of aquatic and wetland ecosystems in Malawi. These indicators capture the ecological and social nuances often missed by top-down scientific surveys.

Table 3-15: Key Participatory Mapping Indicators for Aquatic ILK

Indicator Category	Specific Features to Map	Conservation Value
Hydrological Memory	Historical flood extents, permanent vs. seasonal pools (Dambos), and "hidden" underground springs.	Identifies climate-resilient water sources and long-term flood-risk zones.
Critical Life Stages	Traditional Chambo or Usipa breeding grounds (Malo obala) and nursery areas in reed beds.	Provides spatial data for localized "closed seasons" and artisanal gear restrictions.
Bio-Cultural Sites	Sacred "spirit pools," ritual shrines (Mituulo), and burial sites near water bodies.	Acts as high-compliance "de facto" protected areas due to cultural taboos.
Medicinal & Flora	Locations of specialized wetland plants used for traditional healing or craft (e.g., specific reeds for Michira).	Prevents over-harvesting and protects genetic resources from biopiracy.
Indicator Species	Presence of "Sentinel Species" (e.g., specific birds or amphibians) that signal seasonal changes or water quality.	Provides an early-warning system for ecological degradation or drought.

Efforts to address these drivers and pressures require a multi-faceted approach that involves local communities, government and non-governmental agencies, and international bodies to work together to safeguard, promote the recognition, to value, and preserve ILK in conservation of aquatic biodiversity.

3.5 Aquatic ecosystem services (benefits and values)

This subsection discusses the role of aquatic ecosystems in different sectors, such as the energy sector, fisheries, water transport, biodiversity conservation, hydrography, ecotourism, food production and other non-economic values.

3.5.1 Sustainable Energy Production

The aquatic ecosystems provide several important ecosystem services that contribute to sustainable energy production, economic development, and environmental conservation (Thomaz, 2023). The country's electricity generation is primarily from hydropower. As of 2023 the country had a total installed capacity of 398.39 megawatts. Out of this, 390.15 MW is produced by EGENCO from Shire and Wovwe rivers, while 8.2 MW is produced by Mulanje Hydro from Ruo river (www.energy.gov.mw/statistics/). Hydropower stations/ dams cascaded in Shire river alone are responsible for over 95% of all the electricity generated in the country (Bronstert, et al, 2024) the most important source of hydro power in the country. The hydroelectric dams on the Shire River are Nkula hydropower stations A and B, Tedzani hydropower stations (I, II and III) and Kapichira hydropower stations (I and II) (Bhave et al., 2022; Mtilatila et al., 2020). A bigger hydro power scheme is being proposed to be be built at Mpatamanga on the same Shire river to aid in power peaking, making Shire river, an important aquatic ecosystem sustaining energy needs in Malawi.

This form of renewable energy helps diversify the energy mix, reduce dependence on fossil fuels, and mitigate greenhouse gas emissions, contributing to climate change mitigation efforts (Chirambo, 2017; Usiabulu et al., 2024).

3.5.2 Biodiversity Conservation

Regarding the importance of aquatic ecosystems in the conservation of biodiversity, Malawi's aquatic ecosystems harbor a rich diversity of plant and animal species, including endemic and migratory species (Odada & Olago, 2006; Stauffer Jr et al., 2022). Just to mention a few, among notable examples of fish species in Lake Malawi include the famous Oreochromis spp (Chambo) and other fish species such as the Melanochromis auratus, and the Lake Malawi sardine (Engraulicypris sardella) (Phiri et al., 2013; Sanudi, 2020; van Wyk et al., 2018). Notable invasive alien plant species include Water Hyacinth (Eichhornia crassipes), which is often invasive and does negatively impact water ecosystems (Chapungu et al., 2018; Ilo et al., 2020). Another significant endemic plant species is the Malawi Water Lilies (Nymphaea spp.), contributing to the ecological diversity and local biodiversity of these aquatic environments (Nzei et al., 2021). It is therefore evident from this review that the aquatic ecosystems support biodiversity conservation, playing a vital role in maintaining ecosystem balance and resilience.

3.5.3 Hydrology

In Malawi, aquatic ecosystems also play a crucial role in providing hydrological services. To begin with, these ecosystems act as natural regulators of water flow, helping in mitigating floods and droughts by storing and releasing water (Makwinja et al., 2021). Secondly, Lakes and rivers improve water quality through filtration and nutrient cycling, supporting the availability of clean water for human consumption, agriculture, and industry (Ray et al., 2003). In addition, aquatic habitats serve as critical breeding grounds for fish and other aquatic species, contributing significantly to food security and the livelihoods of local communities who rely on fisheries (Kolding et al., 2015; Murawu, 2022).

3.5.4 Ecotourism

Malawi's tourism sector depends heavily on its aquatic habitats, which provide a variety of attractions that entice tourists from all over the world. The breathtaking lakes of the nation, like as Lake Malawi, Lake Chilwa, and Lake Malombe, offer chances for water sports like diving, snorkeling, swimming, and boating, drawing in both nature lovers and thrill-seekers (Briggs & Connolly, 2013; Fritsch & Johannsen, 2014; Kalina et al., 2021). These lakes are excellent locations for ecotourism and wildlife viewing because they support a diverse range of aquatic life, including vibrant cichlid fish species that are unique to the globe (Chimatiro et al., 2021). Furthermore, birdwatching possibilities and picturesque boat safaris are provided by Malawi's waterways, like the Shire River, along their verdant banks (Baipai et al., 2020). The Nyika Plateau and the Mulanje Massif are two mountainous areas that offer more opportunities for hiking, trekking, and discovering a variety of habitats, such as alpine grasslands and montane forests. These habitat descriptions are based on field-based ecological surveys, vegetation inventories, and floristic records collected primarily between the 1980s and early 2010s (Briggs & Connolly, 2013).

3.5.5 Food Production

Access to water sources is beneficial for both livestock and humans. Malawi's aquatic environments are essential for the production of staple foods like fish, livestock, and vegetables. In Malawi, fish from lakes, rivers, and reservoirs are a major part of Malawian cuisine, giving millions of people's diets vital nutrients and protein (Weyl et al., 2010). Aquatic habitats support crop irrigation by supplying water, which is necessary to maintain agricultural production, especially in drought-prone areas (Chidammodzi & Muhandiki, 2017; Chimtengo et al., 2014). Furthermore, the wetlands and floodplains found in aquatic environments offer rich soil for growing vegetables and grains (McCartney et al., 2010). In addition, plankton and other aquatic plants flourish in the nutrient-rich waters of aquatic environments, supporting a variety of fish populations and serving as the foundation of aquatic food chains (Abo-Taleb et al., 2023). While economic ecosystem services have been reported for aquatic ecosystems, quantitative valuation beyond fisheries to include other services such as water supply and reliability, hydropower regulation, tourism, facilitating food production is lacking. This indicates ; data gaps and this assessment recommends rapid valuation studies for priority lakes and rivers in the assessment.

3.5.6 Non-economic values

In Malawi, aquatic habitats are extremely valuable in non-economic terms and are intricately linked to aspects of culture, society, recreation, science, spirituality, and the arts. Lakes and rivers serve as cultural hubs for many communities, serving as sources of identity and tradition for customs and festivities. Socially, they act as hubs, encouraging communication and a feeling of oneness among the community (Makwinja et al., 2022). These habitats provide chances for recreational pursuits like swimming, boating, and fishing, improving locals' quality of life and drawing visitors (Ghermandi et al., 2010).

From a scientific standpoint, they offer excellent research locations for investigating ecological processes, biodiversity, and the effects of climate change (Jeppesen et al., 2014; Poff et al., 2002). Water bodies are revered in many belief systems and are used for rituals, introspection, and acts of homage. Aesthetically, Malawi's lakes and rivers are visually stunning and serene, enhancing the country's cultural landscape and fostering a sense of oneness with the natural world (Ngwira, 2021).

3.6 Multiple benefits of ILK in aquatic resource management

Generally, there has been noticeable increase in the adoption of the protected areas especially by various fishing communities in Malawi (FISH, 2018). These community-owned protected areas have revealed their effectiveness in restoring aquatic biodiversity (FISH, 2016). On a large-scale, marine protected areas (MPAs) have been hailed for improving degraded and overexploited ecosystems (Erisman et al., 2017; Rife et al., 2013). While Ban et al. (2017) added social benefits to large marine protected areas.

Empowerment of IPLCs ensures respect for their knowledge and management practices. It promotes more effective local participation in planning, decision-making and implementation. It advances scientific understandings, as it reveals the unknown intelligence to science imbibed in ILK and consequently increases awareness about local knowledge and local issues. Further, ILK enriches understanding of development opportunities within a cultural context, promoting culturally appropriate interventions relevant to people's needs. Appreciation of local ideas and practices encourages more sustainable development interventions and helps avoid expensive mistakes by preventing research and development initiatives that start from false premises through failing to show respect for their indigenous and local views.

ILK facilitates communication across the interface between development projects and the local community by raising awareness of scope of research and possible development alternatives. ILK discourages imposition of foreign ideas and helps reconcile different and potentially conflicting cultural perspectives regarding development.

3.7 Multiple values of aquatic biodiversity to indigenous people and local communities

A review of literature coupled with the field data collected from Lake Kazuni and Lake Chilwa basin and Mbenji Island in Salima District, highlights the diverse benefits that aquatic biodiversity and resources provide to Indigenous People and Local Communities (IPLCs). These benefits include: Economic gains are realised through the sale of fish, which generates income, and supports local livelihood and household economies. The IPLCs, particularly women and youth, also find employment opportunities through fisheries-related activities, such as fish processing, drying, and trading.

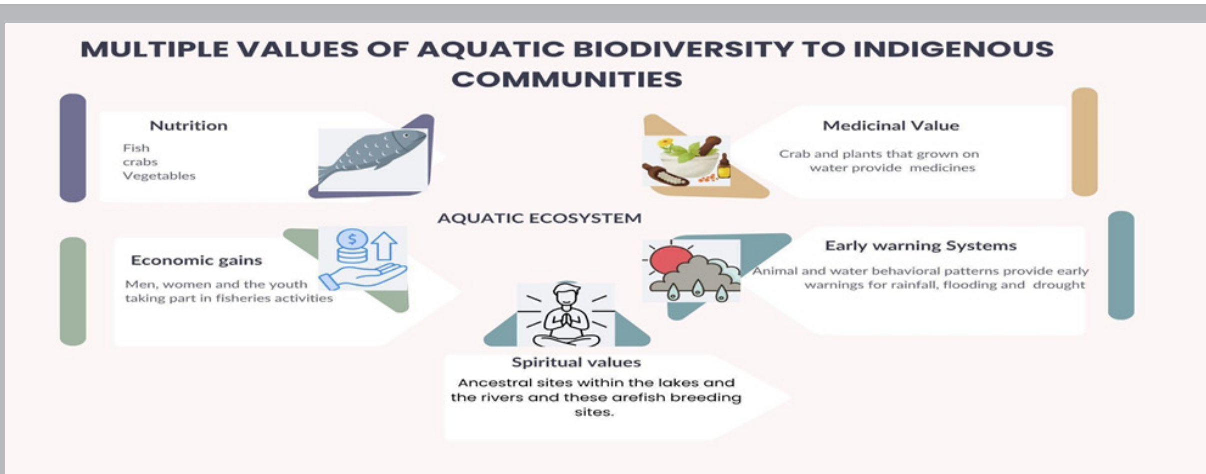


Figure 3-18: Multiple Values of Aquatic Biodiversity to Indigenous Communities

Indigenous and local communities around Lake Kazuni rely on traditional ecological knowledge to observe water waves and cloud movements, enabling them to predict weather patterns, receive early warnings of potential floods, and build resilience in their fishing practices. Their indigenous and local knowledge also supports sustainable fisheries management by helping them understand water currents, cloud formations, and fish movement patterns, which in turn allows them to regulate fishing activities, optimise catch volumes, and ensure long-term sustainability. Beyond these practices, the lake serves as a vital source of livelihood and nutrition, providing a sustainable supply of fish that meets household protein needs for the surrounding communities.

3.8 Policy and Institutional Analysis for Aquatic Ecosystems Conservation

Many habitats have an astonishing diversity of fish and other aquatic fauna and flora, while their ecosystems are facing enormous conservation challenges. Some ecosystems are considered to be in a state of collapse or near collapse. Policies, legislation, and institutional frameworks can play a crucial role in resource conservation; as they establish the rules, guidelines, and organizational structures necessary for managing and protecting natural resources.

Aquatic Ecosystems management falls in the Natural Resources sector in Malawi, as such, despite having dedicated policies and/or legislation, most of the Natural Resources related policies and legislation integrates issues of aquatic ecosystems and its respective impacts. The other sectoral policies inclusion of aquatic systems is based on the interlinkages between and among the natural resources systems, that they affect each other.

Following this, the section discusses the policies and legislation that exclusively or in part addressed issues of aquatic ecosystems in their implementation.

The focus is on the actual and potential impacts of various policies and interventions on the contribution of aquatic biodiversity and ecosystem functions and services to the sustainability of the national economy, local livelihoods. The section also extends to discuss how local, national level institutions have contributed to the conservation of aquatic resources for the last fifty years in Malawi. National policies/ legislation addressing Aquatic Ecosystems Conservation for Malawi.

Table 3-16: Policies/ legislation addressing Aquatic Ecosystems Conservation for Malawi

Name of policy/ legislation	Main Focus/ Specific Aquatic Ecosystems clause(s)	Responsible Institution	Actual and /or potential impacts	Policy Gap(s)
Water Resources Management Policy (2004)	To ensure sustainable management and utilization of water resources in order to provide water of acceptable quality and of sufficient and effective water and sanitation services that satisfy the basic requirements of every Malawian and for the enhancement of the country's natural ecosystems. Specific clauses on aquatic ecosystems being section 3 which emphasizes on restoration and maintenance of ecosystems and promote sustainable utilization and management of natural resources and section 4 on controlling pollution from point and non-point sources to protect water quality.	Water Resources Department	Promotes the Integrated Water Resources Management (IWRM) approach, a holistic water resources management approach, and this can be beneficial for aquatic ecosystems -Provides for protecting water quality from pollution. This is crucial for the health of aquatic ecosystems -Emphasizes on local communities involvement in water resource management, and this is important in conserving aquatic ecosystems	Does not provide guidelines for the conservation and sustainable use of aquatic biodiversity. -Policy's enforcement mechanisms are often weak, leading to challenges in implementing water quality standards, regulating water use, and controlling pollution. -Policy does not sufficiently address the impacts of climate change on water resources and aquatic ecosystems. -Lacks specific mention of aquatic species and habitat needs; - Limited integration with fisheries policies.

Table 3-16 Conti.: Policies/ legislation addressing Aquatic Ecosystems Conservation for Malawi

Name of policy/ legislation	Main Focus/ Specific Aquatic Ecosystems clause(s)	Responsible Institution	Actual and /or potential impacts	Policy Gap(s)
Water Resources Act (2013)	Regulates the use, management, and conservation of water resources in Malawi, including rivers, lakes, and groundwater. Specific clauses on aquatic ecosystems includes Part VIII which prohibits pollution of water resources [Section 88] and requires standards for effluent quality and [Section 91], which are essential for maintaining healthy aquatic ecosystems.	Water Resources Department	-Contribute to ensuring equitable water allocation and maintain water quality, which are crucial for sustaining aquatic ecosystems. -Provides for Flood and Drought Management i.e. managing water-related disasters, potentially protecting aquatic ecosystems from extreme events.	-The strategy for implementation is complicated by the need for coordination among multiple agencies, which can lead to inefficiencies. -Does not adequately enforce reliable data collection on water resources, which hampers effective management and conservation efforts. -Treats aquatic life as a secondary consideration to human use; -Lacks biodiversity-specific water quality standards.
Fisheries Conservation and Management Act (1997)	Governs the management of fisheries resources, focusing on sustainable practices, the regulation of fishing activities, and the protection of fish habitats. It strengthens institutional capacity by involving various stakeholders in the management of fisheries; promotes community participation and protection of fish; and provides for establishment and operation of aquaculture. Relevant sections to aquatic ecosystems include; Section 3(1)(a) which establishes the foundational mandate for fish stock conservation, though framed around "stocks" rather than ecosystems. Section 3(1)(b) Relevant sections to aquatic ecosystems include; Section 3(1)(a) which establishes the foundational mandate for fish stock conservation, though framed around "stocks" rather than ecosystems. Section 3(1)(b) explicitly recognizes that pollution and siltation (key threats to aquatic ecosystem health) must be addressed to protect fish, creating a legal basis for habitat protection and section 3(1)(c) provides for monitoring and data collection, which is fundamental to understanding ecosystem health.	Department of Fisheries	- Contribute to preventing overfishing by setting regulations on fishing practices, including licensing, closed seasons, and gear restrictions. -Contribute to Habitat Protection through implementing provisions to protect fish habitats from degradation, helping to maintain biodiversity and ecosystem services.	Weak enforcement mechanisms often lead to illegal fishing practices continuing unchecked. -Focuses on single species (fish) , with less emphasis on the broader aquatic ecosystem, including water quality and non-fish species. -Weak on habitat protection.

Table 3-16 Conti.: Policies/ legislation addressing Aquatic Ecosystems Conservation for Malawi

Name of policy/ legislation	Main Focus/ Specific Aquatic Ecosystems clause(s)	Responsible Institution	Actual and /or potential impacts	Policy Gap(s)
National Biodiversity Strategy and Action Plan (NBSAP) (2015-2025)	Outlines strategies to conserve Malawi's biodiversity, including aquatic ecosystems, through sustainable management and protection of habitats. Target 9: directly addresses the threat of invasive species to native biodiversity, which is critical for aquatic ecosystems vulnerable to introductions through aquaculture, ballast water, or other pathways; while among the strategies provides for the protection of threatened species, many of which are aquatic (e.g., Lake Malawi's endemic fish species, molluscs, and amphibians).	Environmental Affairs Department	-Focuses on protecting species and habitats, which directly benefits aquatic ecosystems by preserving ecological integrity. -Encourages community participation in biodiversity conservation, potentially leading to more effective and locally supported initiatives.	- The plan lacks robust mechanisms for monitoring and evaluating progress, which hinders adaptive management. -Implementation is weak and lacks a specific, funded action plan for freshwater and aquatic ecosystems.
National Environmental Policy (2004)	Promotes sustainable social and economic development through the sound management of the environment and natural resources. Provides a comprehensive framework for environmental management, including the protection of aquatic ecosystems. Policy Objectives provides the foundational mandate for protecting all ecosystems, including aquatic systems, by requiring their restoration, maintenance, and enhancement. Guiding Principles - Land Tenure and Land Use also recognizes that water, fisheries, and wetlands are integral components of natural resources that must be addressed in land policy, acknowledging the connectivity between terrestrial and aquatic systems.	Environmental Affairs Department	-Promotes sustainable management of natural resources, including water bodies, to ensure long-term ecological balance. -Sets guidelines for controlling pollution from agricultural, industrial, and urban sources, which can improve water quality in aquatic ecosystems.	-The policy is broad and leads to challenges in translating objectives into specific, actionable measures. -Policy insufficiently recognize local communities' involvement in the implementation of policy measures. -Lacks specific, enforceable mechanisms to protect aquatic ecosystems from sectoral pressures.
National Fisheries & Aquaculture Policy (2016)	Guides sustainable fisheries management & aquaculture development.	Department of Fisheries	Promotion of community participation in the fisheries sector,, biodiversity conservation, climate resilience, governance and institutional development	Focus remains on production ("increasing fish production") rather than holistic ecosystem health.

Policies and legal frameworks that can lead to sustainable management of the aquatic ecosystems (water bodies and its fish resources) exist though points of focus are different. This is also the same with the institutions that are mandated and contributes to the management and conservation of surface water resources and fishery i.e. Water Resources Department, Department of Fisheries and Environmental Affairs Department. However, despite the existence of policy and institutional arrangements to facilitate management of water resources and its fishery, gaps exist in these frameworks leading to reduced successes in the general management of water resources and the fishery they host. For instance, gaps associated with Water Resources Management Policy (2004) includes not being able to provide guidelines for the conservation and sustainable use of aquatic biodiversity, weak policy enforcement mechanisms leading to challenges in implementing water quality standards, regulating water use, and controlling pollution and not sufficiently addressing the impacts of climate change on water resources and aquatic ecosystems. Water Resources Act of 2013, however, has the complicated implementation strategy requiring need for coordination among multiple agencies, which leads to inefficiencies, and the act also does not adequately enforce reliable data collection on water resources, which hampers effective management and conservation efforts.

Fisheries Conservation and Management Act (1997) as among the policies, however, focuses on fish resources, with less emphasis on the broader aquatic ecosystem, including water quality and non-fish species apart from being mired with weak enforcement issues. National Biodiversity Strategy and Action Plan (NBSAP) (2015-2025) and National Environmental Policy (2004) which are hosted by Environmental affairs Department, have also gaps with the former lacking robust mechanisms for monitoring and evaluating progress of ecosystems management including aquatic ecosystems and hence hindering adaptive management while the latter is broad, leading to challenges in translating objectives into specific, actionable measures and insufficiently recognize local communities involvement in the implementation of policy measures including those that concern aquatic ecosystems.

Additionally, while gaps have been identified for each policy and/or legal frameworks, other major gaps and drawbacks in effective implementation of most of these policies including the generic natural resources policies, has been lack of inclusion of ILK. These policies fall short therefore because these are the people who live with nature and are the direct beneficiaries. It is therefore of utmost importance that the government should consider their knowledge systems and understanding of aquatic biodiversity.

3.8.1 Local/Community Policies and institutional frameworks for Aquatic Ecosystems Management and Conservation

In Malawi, policies and frameworks on aquatic ecosystems conservation and management also exist and primarily emerge to advance the policy strategies. These are majorly in form of local by-laws, and community-based natural resource management (CBNRM) initiatives. These policies and frameworks aim to contribute to community efforts to protect and sustainably manage aquatic resources, including lakes, rivers, wetlands, and fisheries. Key to these include:

Beach village committees (BVCs): Community-management frameworks which are locally established at village level and aligned with local decentralized village development committees and linked to District Councils (Jamu et al., 2023). BVC constitutes a local unit within decentralized ecosystem-based management of fishery resources which uses BVC bylaws, traditional sanctions and other binding measures to support restoration of degraded aquatic environments (through establishing among other fish sanctuaries/ Freshwater protected areas and protecting fisheries' biodiversity. Thus, BVCs establish sanctuaries to conserve exploited stocks, preserve biodiversity richness, and enhance fisheries' yield. Jamu et al (2023) points to that through BVCs, sanctuaries have been established throughout Lake Malawi, Lake Malombe, Lake Chilwa and Lake Chiuta, and results showed that community-managed sanctuaries between 2016–2019, contributed to a 24% increase in the total number of observed species from a total of 56 sanctuaries covering 1022ha that were established.

Ecosystem approach to fisheries management (EAFM): is a district level fishery management structure. Through the Malawi Government, EAFM was adopted within which the concept of participatory fisheries management is applied to manage fisheries resources through district bylaws;. This is practiced under a decentralized fisheries management structure (see Figure 3-17) with local fisheries management authorities operating as fisheries associations (FAs) at the district level while beach village committees (BVCs) operate at the village level. The FAs are linked to the district level structures i.e. the district council, while BVCs are linked to area and village development committees. Linking the BVCs to local decentralized structures ensures that the interconnectedness between ecosystem uses, including agriculture, forestry, and tourism, which impinge on fish productivity, are addressed holistically.

It is within this context that community-managed fish sanctuaries are also being promoted to enhance fisheries' biodiversity conservation and productivity (Jamu et al, 2023). However, while community structures and bylaws exist to conserve and manage the fishery, community-based structures and/or Community-based monitoring systems and structures that can track water quality and usage for timely responses to challenges, do not exist for water bodies/ resources other than fisheries.

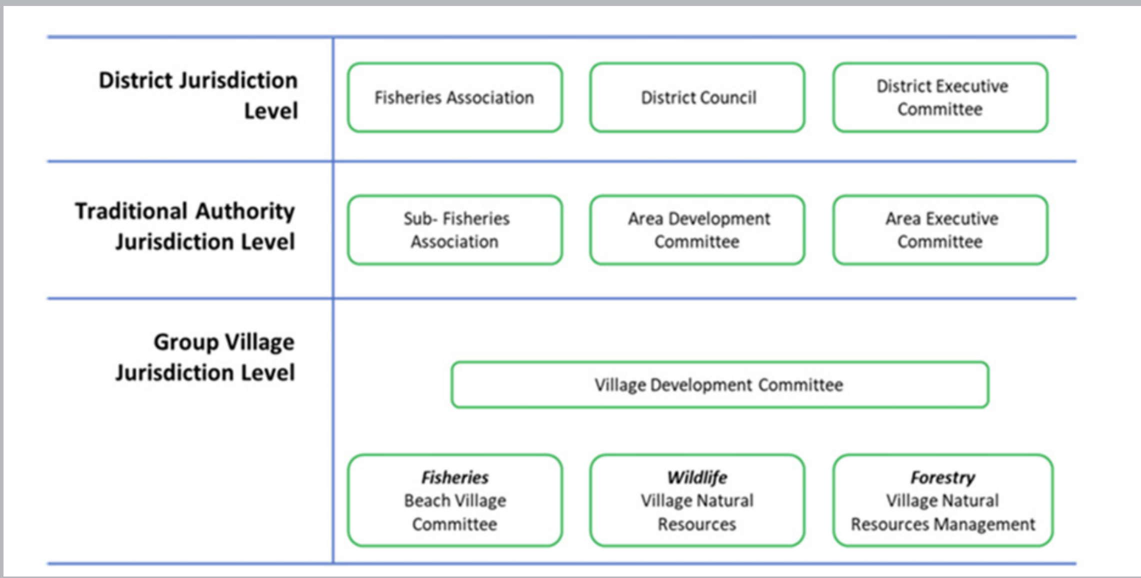


Figure 3-19: Decentralized structure of Ecosystem approach to fisheries management in Malawi.
(Source: Jamu et al., 2023)

3.8.2 Status of ILK in co-management and governance of aquatic resources

During the scoping phase and through policy analysis, it is noted that local communities in Malawi traditionally manage aquatic resources through a set of community by-laws and practices. Studies, from IPBES global assessments however, highlight the importance of weaving indigenous and local knowledge and traditional local logic with scientific logic for sustainable resource utilization and co-production of new conservation and management ideas which contribute to ecological sustainability. In 1993, Malawi government adopted Community Based Natural Resources Management (CBNRM) models and policies, an approach that involves the participation and engagement of the local communities (GoM 1995, 2002, Community Partnerships for Sustainable Resource Management in Malawi (COMPASS) 2000). CBNRM is a central element of co-management. Previously, conservation of fish was done through application of traditional practices and religious taboos or beliefs or myths. The observance of most of the practices was not meant for conserving the aquatic resources although they played that role for sustainable management of aquatic resources. Co-management initiatives in the fisheries sector, introduced and formalized by the Government in the mid1990s, started to strengthen the importance of fishers' knowledge in the effective management of the fisheries in Malawi, though technical areas such as monitoring of the fisheries can benefit from traditional practices and knowledge.

However, fisheries management requires a mutually agreed system of controls with appropriate forms of enforcement to ensure responsible use of the resource (FAO 1986; Tailor and Alden 1998). When sustained dialogues are in place and functional co-management is developed and ILK issues discussed in an appropriate base and be used effectively. A fully-fledged Fisheries Department (FD) was established by an Act of Parliament in 1971 to manage fisheries in the country. In spite of the long Government involvement, the majority of the fishers, who are artisanal, continued to be guided by traditional knowledge. This covered all steps of fish resource production including harvesting, processing, marketing or distribution and consumption. The influence or impact of the Government policies on fisheries development has been somewhat limited (GOM 1989; ICLARM/GTZ 1991; Hara 1993; Chirwa 1996; Banda and Tomasson 1997; Dawson 1997; Scholz et al. 1998).

Findings from ILK data collection in Mbenje Island located within Traditional Authority Makanjira in Salima has registered a great success story on co-management. In 1989 the government showed interest in co-managing with local leadership for conservation of fisheries resources. The fisheries and aquatic resources are being effectively managed by local leadership in collaboration with the government through the Department of Fisheries is an effective co-management system. To that effect, in 1995, arrangements were made for the establishment of Chikombe Beach Village Committee (BVC) to regulate the closing and opening of fishing around Mbenje Island. They took over responsibility as follows: Monitoring and enforcement of the use of legal fishing gear supported by the BVC, Fishery monitoring, control and surveillance during the closed and opened fishing seasons around Mbenje Island, conservation of forest resources and wildlife, especially birds besides the fish and Senior Chief Makanjila No7 was made champion in Malawi for fisheries management.

Co-management practices give the local and indigenous people an opportunity to safeguard ILK on conservation of aquatic resources. T/A Makanjira and some other chiefs, appointed Senior Chief Nyanguru to be responsible for opening and closing of the Island. The locals follow the instructions as directed by the senior chief to go patrol the Island. The closed season runs every year from December to April. This allows time for the fish to replenish and help to avoid overfishing and degradation of the resources at the Island. Most importantly is that the closing season juxtaposes with the rainy season which enables the fishers to concentrate on farming enabling them to improve on food security. A set of community by-laws, customary management systems, sustainable fishery use and conservation practices have led to fish diversity, abundant stocks and unique fish taste and size.

3.8.2.1 Co-management practices in selected areas

Similar co-management practices observed at Mbenji Island were also noted at Lake Chilwa basin through the coordination of Beach Village Committee (BVC), Area Development Committee (ADC), Riverline Village Committees (RVC) Fisheries Department, Forestry Department, and Traditional Leaders (Chiefs). These committees are guided by the Fisheries Act (1997) and with by-laws that regulate fishing activities. Co-management at Lake Chilwa basin started in 2000 while the use of by-laws came into effect in 2012. According to the by-laws, Lake Chilwa is open to fishing business between the months of April and November each year. It becomes closed to any fishing activities between 1st December and 1st March every year. During the period, only accepted types of fishing gears are permitted on the lake and it is prohibited to cut down any tree at Chisi Island, especially at Chaone.

For Lake Kazuni and Zolokere on Vwaza game reserve, in a bid to promote co-management and co-governance there is a Natural Resource management committee at village level (VNRMC), a Zone committee at group village level, Nyika-Vwaza Association (NVA) and the department of Parks and Wildlife takes the lead. The VNMRC has an executive committee of 10 members; six females and four males which include the youths who undergo training in the management of natural resources. This allows the local communities to be involved and engaged in the process of managing of the aquatic resources by reporting poaching activities and conducting patrols in the game reserve. There are a set of by-laws that govern the open and closed season for fishing to manage the population of fish. However, fishing is tough as they are only allowed to use mbedza (handline) and not any other tools such as nets.

There are several success stories of co-management of aquatic resources. Firstly , the breeding sites of fish are preserved, hence increasing the population of fish and their diversity in varieties. For example, as reported from Mbenje. The joint patrol efforts from communities and enforcers enhance ownership of aquatic resources leading to accountability through reporting and apprehending poachers. Thirdly, women and the youth are given roles in decision-making and leadership through committees that manage the aquatic resources. The committees compose of men, women and the youth.

BVCs and VNRMCs collaborate with the Fisheries department and departments of Parks and Wildlife to enforce regulations hence protecting crucial fish breeding grounds by preventing the cutting of lake grass and fishing in deep pools during the lean season. There is also adherence to closed fishing seasons and community education on promotion of sustainable fishing methods and gear. The co-management allows that each group benefits from the rich resources and technicalities of handling the aquatic resources for sustainability.

Figure 3-20: VNMRC Wetland management (left) & Ecotoursm potential in wetlands (right) (@Davies Chogawana)

3.8.2.2 Challenges faced by communities during co-management

Field data collection revealed several threats to the use of ILK in the co-management of aquatic resources. First, much of the ILK remains undocumented and is transmitted orally from one generation to another. The loss of knowledgeable custodians therefore poses a significant risk to co-management, as important practices and reference points for resource governance may disappear.

Second, there is no compensation mechanism for human–wildlife conflict. As an alternative, communities are encouraged to cultivate cash crops such as pepper and soya beans that are less susceptible to damage by wildlife. However, the distribution of certified seedlings of these crops needs to be accompanied by reliable and organized market access. In the absence of viable markets, communities become discouraged from cultivating these crops. Promoting alternative income-generating activities is important, as it can help reduce pressure on fisheries and limit the overexploitation of aquatic resources.

Another threat related to access to aquatic resources within parks and wildlife reserve areas is the restriction of permits to specified locations and distances. This poses a challenge for many fishers, particularly in the context of rapid population growth, which has increased demand for limited resources within designated zones.

In addition, the effects of climate change and unsustainable agricultural practices have contributed to the siltation of rivers and lakes. As a result, some authorized fishing areas and some recommended fishing gears are no longer suitable for fishing. However, permit conditions are rarely revised to reflect these ecological changes, limiting fishers' ability to operate within appropriate areas and potentially encouraging non-compliant practices."

There has also been damage to some breeding sites during cyclone Freddy in the year 2023. This means the barriers are not easily recognized and observed which poses a huge risk to both the human law enforcing personnel and the aquatic resources (GOM, 2023). For example, at Lake Chilwa, the Department of Fisheries established a sanctuary and installed floating beacons to mark the breeding area. However, the sanctuary was washed during cyclone Freddy.

The community committees also bemoan the corrupt practices by law enforcers who release offenders without proper corrective measures. For example, if committees confiscate illegal fishing gears those involved in illegal acts are taken to police or fined within the by-laws. Oftentimes the committees are not involved further than the arrests, so the process of policing and law are not involved. They only find the offenders released back into communities without being deterred from their illegal fishing. This frustrates them because the law enforcers do not abide by the law. Most rich fishers practice corruption.

Furthermore, Chief Makanjila the 7th, also indicated that there are some conflicts with pair trawlers because these trawlers are allowed to do fishing throughout the year, while artisanal fisherfolk get subjected to closed season and as such the pair trawlers are not allowed to do fishing around Mbenje Island.

3.8.2.3 Threats to co-management of ILK in aquatic biodiversity

Field data collection has also exposed a number of threats to ILK in co-management of aquatic resources. First, ILK is not documented for future referencing. Most of the ILK is orally passed on from one generation to another. Therefore, when there are no human custodians of ILK, it becomes a threat to co-management because custodians of such ideas and practices are not available, hence no point of reference. Second, there is no compensation for human wildlife conflicts but there is an alternative solution where people are encouraged to grow cash crops, for example, pepper and soya beans which the wild animals do not consume or destroy. However, the provision of certified seedlings need to be accompanied by provision of an organized good market in the areas. Otherwise, communities are frustrated from growing the crops because markets are not readily available. The alternative cash crops need to be encouraged because that is an alternative income generating activity for communities to deter overfishing and exploitation of aquatic resources

Another threat mostly related to accessing aquatic resourcing within Parks and Wildlife, is that the permits are given within specified areas and distances. This is a challenge to most fishermen because there has been a rapid population growth leading to high demand over fewer resources within the areas. Secondly, effects of climate change and bad agricultural practices has led to siltation of rivers and lakes making the accessed areas not good grounds for fishing and recommended fishing gears yet the permits are not revised to allow the fishers to fish within acceptable ranges this may easily lead to malpractices.

In addition, the revision of approved fishing gear has limited women's participation in fishing at Zolokere. The recommended gear requires skills and physical capacity that many women do not possess or have not been trained to use. Previously, women commonly fished using baskets, which enabled their active involvement. The change has therefore reduced their access to fishing grounds and affected their livelihoods and income-generating opportunities, consequently diminishing their motivation to participate in co-management activities.

Another threat relates to enforcement and monitoring. Committees tend to be more active during the closed fishing season, but enforcement weakens during the open season, contributing to overexploitation and opportunities for corrupt practices. There was substantial evidence that some fishers use unauthorized gear during the normal fishing season. This situation places co-management committee members in a difficult position, as they serve on a voluntary basis. Conducting patrols often requires them to forgo their own livelihood activities, making them more vulnerable to inducements from fishers who benefit financially from non-compliant fishing practices.

Despite these challenges, co-management and co-governance remain among the most effective approaches for managing aquatic resources. Community involvement fosters a sense of ownership and accountability, which supports efforts to prevent overexploitation and encourages sustainable resource use. Furthermore, the combination of ILK with scientific approaches contributes to improved stewardship of aquatic ecosystems while also supporting the preservation and transmission of ILK.

3.8.3 Policy assessment on inclusion of ILK

The following are some of the policy recommendations on the inclusion of ILK in aquatic biodiversity management: First, co-management should incorporate ILK into conservation policies through co-management arrangements which can lead to more effective and culturally appropriate conservation strategies. Recognizing the land rights of indigenous people often leads to better conservation outcomes because these communities have a vested interest in preserving their environment. Further empowering local communities to manage their natural resources sustainably can help preserve ILK. This can be enhanced by protecting the intellectual property rights of indigenous knowledge is crucial in ensuring fair benefit-sharing.

Second, promoting participatory research by engaging indigenous communities in biodiversity research enhances the quality of data and ensures that research priorities align with local conservation needs. Facilitating exchanges between scientists and indigenous communities promotes mutual learning and more holistic approaches to conservation. Therefore, recording and researching ILK can help preserve ILK for future generations.

Third, weaving ILK into national policies, educational curricula, and development programs can ensure its recognition and preservation. This can bridge the gap between ILK and scientific knowledge systems through respect, dialogue, and collaboration to create integrated conservation strategies through co-production of knowledge.

Fourth, overall, the interlinkages between ILK and biodiversity conservation emphasize the need for inclusive and respectful approaches that recognize the value of traditional knowledge in safeguarding the planet's biodiversity. Encouraging the revival and practice of traditional cultural activities can help maintain ILK.

3.9 Cross-cutting issues

3.9.1 Climate change and Disaster Risk management

Climate change refers to the long-term alteration of temperature and typical weather patterns in a place (Nations, 1992; Riedy, 2016). Just like any other country all over the world, Malawi have had changes in the weather patterns for the past 3-4 decades. This has been evident in the aquatic ecosystems of Malawi. Malawi has a vast network of surface water bodies, covering about 21% of the country's area. The country experiences different micro-climates due to terrain-induced rainfall variation. It's major aquatic ecosystems include wetlands, various small bodies of water, rivers (Songwe, South Rukuru, North Rukuru, Dwangwa, Linthipe, Shire, and Bua River), lakes (Malawi, Malombe, Chilwa, Kazuni, and Chiuta). Malawi's aquatic ecosystems are vital because they support a variety of industries and services, including transportation, agriculture, grazing animals, fisheries, water supply, water purification, and carbon sequestration (GoM, 2015).

Figure 3-21: Aquatic Ecosystem supporting Transportation (@africanlanders.com)

In regard to climate patterns, the northern region has the highest rainfall around the lakeshore, while the central and southern regions are characterized by higher temperatures. These changes have had effects on the aquatic ecosystem (Global Water Partnership, 2024). Malawi is vulnerable to adverse effects of climate change. The most frequent natural disasters that impact the nation's biodiversity are floods and droughts. Low fish output is caused by decreasing water levels or even drying up of water bodies, which is caused by climate change in conjunction with other factors like siltation. Over time, severe droughts have dried up important fish habitats, such as the marsh at Lake Chilwa, which has resulted in a decline in fish populations (GoM, 2015).

The impact is observed in precipitation variability, water security, agricultural dependence, energy production through hydropower (Global Water Partnership, 2024).

Precipitation Variability: Climate change has altered precipitation patterns, which is crucial for agriculture and water security. For the past decades, Malawi has experienced an increase in tropical cyclones, leading to the loss of lives and destruction of homes and crops. According to the Department of Disaster Management Affairs, between 7 and 9 March 2019, Malawi experienced devastating floods associated with Tropical Cyclone Idai. Approximately 870,000 people from 15 of the country's 28 districts were affected, including 60 dead, 3 missing, 672 injured, and over 87,000 displaced. Concurrently, droughts have reduced food production and threatened biodiversity and livelihoods in Malawi's lakes and rivers (USAID & Malawi, 2023).

Water security: Climate change has significantly impacted water security in semiarid Africa, including Malawi. This has affected livelihoods, especially as they are largely dependent on rain-fed agriculture. There is evidence of negative impacts on water security due to climate change, with projections indicating a worsening trend (Kosamu, 2011).

Agricultural dependence: Malawi's economy is largely agro-based, with the agricultural sector accounting for about 42% of GDP and 81% of export earnings during late 1900s to early 2000s period. (FAO, 2002).

However, changes in climate have led to alterations in the start, length, and quality of the growing season, increasing the frequency and intensity of climate-related disasters.

Energy Production: Hydropower, which constitutes 98% of Malawi's electricity, is at risk due to changing water levels in Lake Malawi and the Shire River. The river flow rates are heavily dependent on water levels in Lake Malawi. However, climate change has led to significant drops in the lake's level, posing a threat to the river's flow and, consequently, the country's power supply.

3.9.1.1 What are the climate change drivers in aquatic ecosystems?

There are so many drivers of climate change impacts on aquatic ecosystems in Malawi:
Malawi's population is growing quickly having increased from just under 3 million in 1950 to over 18 million in 2017. At current rates, it is projected to more than double to over 40 million by 2050.10 This growth is creating an ever-larger demand for agricultural land and natural resources, which is driving the rapid degradation of Malawi's land and natural resources. Unsustainable agriculture and land use practices and climate change create and exacerbate further environ- mental vulnerabilities (World Bank, 2019).

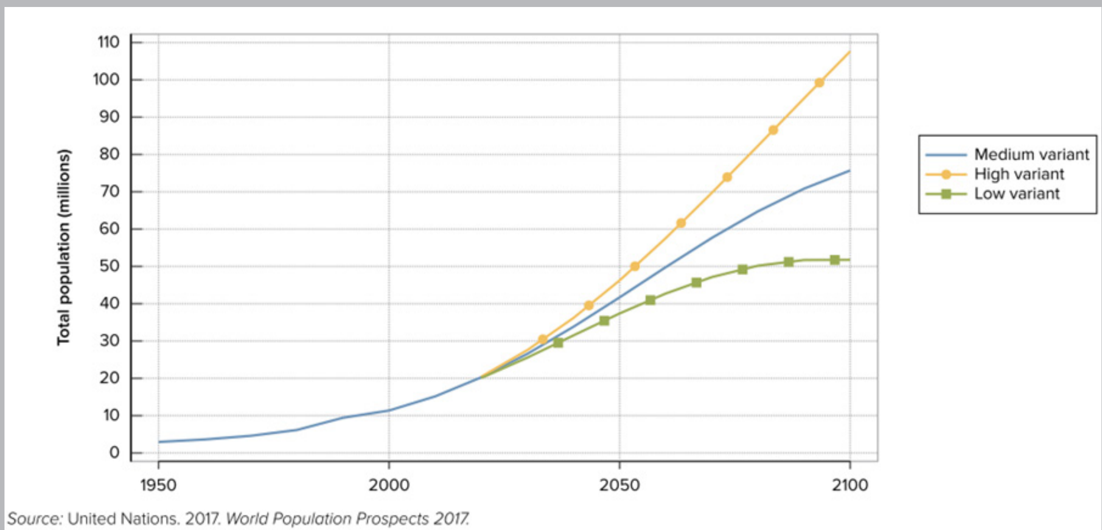


Figure 3-22: Malawi total population by variant

This rapid increase in population also lead to overexploitation of aquatic resources. The increased demand for food and livelihoods has led to intensified agricultural activities, which in turn have caused considerable degradation of water resources due to increased siltation in rivers and reservoirs. The Malawi Country Environmental Analysis also highlights that population growth is the underlying driver of environmental challenges, affecting not only biodiversity particularly through declines in species richness and ecosystem diversity and fisheries.

Changes in climate patterns: Shifter in the start, length, and quality of the growing season, along with increased frequency and intensity of climate-related disasters like prolonged droughts and flooding, significantly affect aquatic ecosystems (Melese, 2016). Malawi is susceptible to the detrimental effects of climate change. The most frequent events that have an impact on the nation's biodiversity are floods and droughts. These events impact species richness, abundance and the conservation status of aquatic species (World Bank, 2019). Low fish output is caused by decreasing water levels or even drying up of water bodies, which is caused by climate change in conjunction with other factors like siltation. Fish stocks have decreased as a result of severe droughts that have happened throughout time, drying up important fish habitats like the Lake Chilwa wetland.

Extreme Weather Events: Since 2019, tropical cyclones have caused extensive damage, killing more than 1000 Malawians and destroying countless homes and crops. These events also threaten biodiversity and livelihoods in Malawi's lakes and rivers (USAID, 2023).

Invasive Species: The introduction of non-native species can disrupt local ecosystems and lead to the loss of biodiversity. Climate change can interact with invasive species in freshwater ecosystems, influencing how aquatic ecosystems and their biota respond to new environmental conditions. This interaction can lead to significant changes in the ecosystem. Invasive Alien Species in Malawi cover both terrestrial and aquatic ecosystems and are in the form of plants, animals and microorganisms. One of the most notable Invasive Alien Species in Malawi is Water Hyacinth (Eichhornia crassipes) notable for its economic implications and detrimental effect on biodiversity by reducing oxygen content in the aquatic ecosystems (Liu et al., 2011).

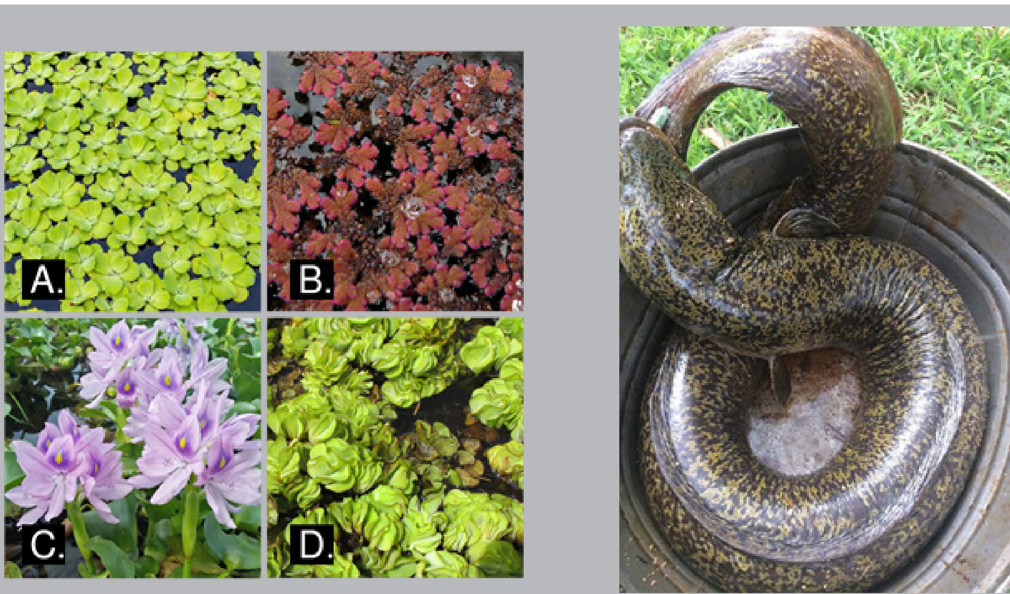


Figure 3-23: Most notable Aquatic Invasive Alien Species (Left) (A: Water Lettuce (Pistia stratiotes), B: Red Water Fern (Azolla filiculoides), C: Water Hyacinth (Eichhornia crassipes) & D: Water Spangles or Floating Fern (Salvinia); (Right) Giant Mottled Eel (Anguilla marmorata).

This IAS is widely spread in Shire River where it affects the generation of hydroelectric power and irrigation programs hindering economic development of the country in the process (GoM, 2015). The Malawi Compact Environment and Natural Resource Management Project estimates that power shut downs resulting from weeds including water hyacinth are estimated to cost $27,000 per day and lead to industrial losses worth ten times this amount. In addition, damage to infrastructure in 2001 due to invasive alien species and debris costed $12 million to repair. Measures to control water hyacinth started in the 1990s, when its impacts on the country's watercourses became serious. The Environmental Management Project, with funding from the World Bank, provided inputs into the control of water hyacinth in the Shire River, Lake Malawi and Lake Malombe. The programme provided resources to acquire and raise bio-control organisms, to train members of local communities in the release of these agents in infested areas, to manually remove the alien plant where it was abundant, and to conduct awareness campaigns through the production of posters. While this and several other initiatives have succeeded in minimizing water hyacinth infestations in major watercourses, infestation of the alien plant in localized areas and private dams is still prevalent.

Pollution: Both water and land-derived pollution can have detrimental effects on aquatic ecosystems. Pollution from agricultural run-off, sewage and industrial wastes threatens biodiversity in Malawi. Currently over 70% of the farming population in Malawi uses inorganic fertilizers to enhance agriculture productivity. This type of reliance on agriculture chemicals has a negative ecological impact on habitats like water and soil, which are continuously being contaminated.

Figure 3-24: Acquatic Ecosystem Pollution (@Environmental Care Initiative)

Toxic substances and domestic or commercial sewage have also affected biodiversity in Malawi. Previous research on stream water and effluent from wastewater treatment plants in Blantyre, revealed high phosphate levels ranging from 50 mg/l to 250 mg/l, (GoM, NBSAP II, 2015), phosphate levels, which are likely to be higher now, stimulate excessive growth of plants and toxic cyanobacteria in stagnant receiving water bodies hence posing a threat to aquatic life and water quality. A study to monitor the concentrations of sulphate, sodium, magnesium, calcium, chloride, iron, nitrate and total dissolved solids in some rivers in Malawi showed that the concentration of these parameters increased towards the dry season and that these chemicals were more pronounced in the intestines and the liver of most fish thereby threatening their survival (GoM, 2020).

Pollution of rivers and other water bodies is also as a result of poor waste management in the cities. For example, only 30 percent of the total wastes generated (20,754 tonnes) in Lilongwe city is collected (UN Habitat, 2010) and the rest ends up in rivers or land where it is washed away when it rains. In some places like Kauma in Lilongwe, sewer wastes have been reportedly discharged into the rivers.

Although air pollution is not yet a big environmental problem in Malawi, generally in major urban areas gaseous emissions from industries, car exhaust fumes as well as burning of old tires pollute the air. In the rural areas, uncontrolled bush-fires also pollute the air apart from destroying vegetative cover. Air pollution also arises from quarrying and coal mining activities (Helferich, 2020). With the increased scope of these activities, air pollution could be a serious problem for biodiversity in Malawi. Government has been implementing several programs to control pollution in the country. The notable ones include the setting up of standards on pollution control land waste management and reduction in the tonnage of ozone depleting substances such as chlorofluorocarbons from 5.9 tonnes in 2005 to almost zero in 2010 (UNEP, 2020).

3.9.1.2 Pressure on aquatic ecosystems in Malawi due to climate change include:

i. Reduction in average annual precipitation (Dinko & Bahati, 2023).
ii. Increase in average annual temperatures (Dinko & Bahati, 2023)
iii. Delays in the onset of the rainfall season
iv. Decrease in the length of the rainfall season
v. Longer dry season
vi. Increased frequency and intensity of climate-related disasters, especially prolonged droughts and flooding (USAID, 2011).

Trend Impacts: The impacts of these changes are already evident in Malawi. For instance, there has been a greater incidence of dry spells and intense rainfall events over the last two decades. These changes have led to an increase in the frequency of floods, droughts, and pest and disease outbreaks, with severe economic and social consequences. Additionally, rising temperatures, changes in rainfall, and more frequent and intense droughts and floods are reducing water levels of the lake, affecting fish populations, and disrupting local farming.

3.9.1.3 Human interventions that result in environmental changes include

Hunting and harvesting of organisms: Overhunting and overharvesting can lead to a decrease in biodiversity
Pollution: Human activities often result in pollution, which can harm aquatic ecosystems. The damage of aquatic ecosystems can destroy habitats and alter the balance of ecosystems, which can lead to the extinction of species and loss of biodiversity. Contaminated water carry diseases and harmful substances which pose health risks to humans and animals through consumption or contact. Pollution also affects industries such as fishing and tourism, leading to economic losses. Apart from that, pollutants can accumulate in the bodies of aquatic organisms, affecting their health and those of other organisms higher up the food chain including humans (Dar et al., 2021).
In response to these drivers, several adaptation strategies have been implemented:

Strengthening Local and District Institutions: Efforts have been made to better manage natural resources and build resilience to climate change. For instance, Climate Resilient Initiative in Malawi (CRIM) Project which aims to enhance the adaptive capacity of vulnerable communities and the capacity of district councils to better manage, monitor, and respond to climate shocks in Mzimba and Kasungu district (UNDP, 2022).

Policy Interventions: Policies that promote pro-environmental behavior which help in mitigation of the impacts of climate change. These interventions help target key determinants of environmental behavior, such as environmental self-identity (Bank, 2019). For example, the 2017 Environmental Management Act which provides every person the right to a clean and healthy environment and imposes a duty upon people to safeguard and enhance the environment. It also seeks to ensure that every person has a right to access environ- mental information. Lead agencies, the private sector, and nongovernmental organizations (NGOs) also have a duty to provide such information in a timely manner. This is a major step forward and, if well implemented, will place Malawi at the forefront of transparency and governance with regard to environmental management.

Improved Conservation Policies and Monitoring: Conservation policies have been improved, and monitoring of climate-related changes has been increased. Here is how they work: Active Vegetation and Animal Management: This involves the direct manipulation of species or habitats to ensure their survival. It could include actions like the relocation of species, control of invasive species, or restoration of habitats. Improves conservation policies: These are strategies designed to protect and preserve biodiversity. They could involve the establishment of protected areas, restrictions on certain activities or laws to protect endangered species. Monitoring: Regular monitoring of ecosystems can help detect changes, assess the effectiveness of conservation strategies, and inform future actions. It can highlight severe data limitations, lacking coordination of conservation policies, and insufficient consideration of transient environmental conditions in management and policy planning (Kapuka & Hlásny, 2021).

Building Adaptive Capacity: Adaptive capacity in Basin hotspots has been built to help households and enterprises cope with the impact of climate change. For instance, the Malawi's National Adaptation Programme of Action (NAPA) which identifies adverse climatic hazards like dry spells, seasonal droughts, intense rainfall, and floods.

Another one is that of The Lake Chilwa Basin Climate Change Adaptation Programme which was a seven-year research and development programme in Malawi that concluded in March 2017. The programme was designed to protect the livelihoods of the population and enhance resilience of the natural resource base upon which it depends. And currently, the Transformational Adaptation for Climate Resilience in lake Chilwa Basin of Malawi (TRANSFORM)' project aims to build on exixting initiatives for the sustainable and equitable use of natural resources within the Lake Chilwa basin (Chiotha et al., 2020).

Improved Forest Management and governance: Improved forest management and governance have contributed to mitigating the effects of climate change.

3.9.1.4 The role of ILK in Disaster Risk Reduction (DRR), Disaster Risk management (DRM) and climate change

One of the major natural disasters that drew the attention of scientists to the issue of the relevance of ILK in relation to extreme weather conditions such as the 2004 tsunamis in the Indian Ocean. It is reported that the IPLCs drew on their ILK to deal with it with minimal human casualties and damage (Hiwasaki, Luna, Syamsidik, & Shaw, 2014), (Orlove, Roncoli, Kabugo, & Majugu, 2010).

Fishers' ecological knowledge of fish resources and geo-climatic conditions of the local areas enhance conservation on aquatic resources. Msiska (1991) reports that fishers learn to take into account details of fish behavior and relationships with the environment. For example, rain or flooding is sometimes followed by an increase in fish food (algal or plankton blooms), which may in turn be followed by an increase in the presence of crocodiles, which restrict fishing grounds in some areas leading to conservation of fish stocks.

In Malawi, indigenous and local communities have acquired the ability to interpret geo-climatic signs and thereby enhance the effectiveness of their fishing operations over time. Local people have detailed knowledge on how to interpret climate and other factors such as wind, rain, clouds, temperature, vegetation and animal life to determine suitable times and places to fish.
Some of the specific skill areas are as follows; in northern Lake Malawi, the combination of rising clouds and winds from the western mountains that follows a period of chimphungu (absolute calmness) is a sure sign of an impending heavy downpour or windstorm. Mupungu refers to a local weather pattern characterised by evening winds (approximately 17:00–20:00) and early-morning rainfall (from sunrise to about 10:00), associated with easterly winds originating from the Mozambican shore of Lake Malawi. The winds may be short-lived; blowing for an hour or less. Winds that blow in the direction of home are studied carefully. If they are not too fierce, the fishers continue their work and 'ride on the winds' as they paddle home exerting little or no effort. If the winds are strong or blow away from home, the fishers rush for safety. Rising water level in swamps or water level in wells, particularly in areas of clay soils, which usually crack during the dry season, indicates the onset of 'm(u)wera' (southerly trade winds) which can bring rains for several weeks (Nyirenda, pers. Comm, 1994).

There are no special groups of people assigned with predicting disasters and interpreting early warning signs but indigenous and local people learn from the elders within the community on these warnings. From empirical knowledge, the indigenous and local communities know the results of not adhering to the ILK on early warning signs. Some people have found themselves unprepared for disaster or lean supply because they did not consider preserving stocks for lean months or the aftermath of natural disasters. The knowledge from ILK on early warning signs regarding the low supply of fish in a particular season may guide the fishers to diversify into subsistence agriculture and other cash crops for their livelihood.

At Chaone on Lake Chilwa, the local community relies on a range of natural indicators to anticipate weather conditions and prepare accordingly. Early warning signs of the Mwera winds include unusual abdominal pains reported among some men and children, an increased prevalence of asthma symptoms, and the occurrence of dense morning fog.

Weather conditions are also used to anticipate the abundance of certain fish species. For example, during hot or warm periods, fishers expect a high catch of chambo. In contrast, during Mwera and Mpoto winds, typically at the onset of the rainy season, milamba are caught in greater quantities than chambo. Additionally, during Mpoto winds, milamba are usually found in shallow waters, whereas during Mwera winds they are caught in deeper waters.

Although ILK alone is not sufficient for predicting disasters, it remains a critical component of community-based early warning systems. ILK complements scientific forecasting by providing locally grounded observations that are based on long-term interaction with the environment. In many rural areas where access to formal meteorological information is limited or delayed, ILK serves as the first line of awareness and preparedness, thereby strengthening collective vigilance, and prompting timely disaster response. As a result, even households without access to radio, television, or mobile-based weather updates are able to anticipate hazardous events and take precautionary measures, thereby reducing vulnerability to extreme weather conditions.

Furthermore, traditional practices informed by ILK contribute significantly to biodiversity conservation and sustainable resource management. However, ILK is not entirely sufficient on its own, as beliefs and practices may vary across communities and may not always account for rapidly changing climatic conditions. . For this reason, braiding ILK with scientific knowledge systems can strengthen both disaster risk reduction and biodiversity conservation outcomes. Scientific forecasting can provide broader spatial and temporal climate information, while ILK offers fine-scale environmental observations and locally appropriate response strategies. Such collaboration also improves community trust in early warning information and increases the likelihood that advisories will be acted upon. This complementary approach supports adaptive management and helps communities respond more effectively to increasing climate variability and extreme events.

The weaving of ILK and scientific knowledge should not just be seen as a combination of the two knowledge systems. It should be part of a more complex co-production process where climate scholars and indigenous and local communities interact effectively and are interested in questioning how local knowledge resonates in the scientific framing or vice-versa (Chilisa, Major, & Petersen, 2017). It is about co-generation of knowledge, a weaving of knowledge and not a category of stakeholder. It has been observed that often researchers pretend to know enough about Indigenous Peoples and local communities' needs and aspirations to be able to offer solutions that are sufficiently finished to require little or no subsequent local adaptation (Chilisa, Major, & Petersen, 2017). This weaving of knowledge calls for an ethical shift, humility from both 'scientists' and indigenous and local people and their communities for mutual learning with no 'asymmetry of power' that gives one group more power to determine the direction that the co-operation takes (Kant, L; Norman, E, 2019; (Liboiron, 2021).

Table 3-17: Explaination of natural elements by the ILPCs and their corresponding ILK deduced DRR/DRM/Climate change meanings.

Natural Elements	Explanation among ILPCs	ILK Deduced DRR/DRM/Climate change Meaning
Temperature	High temperatures in summer	Indicates the possibility of flooding on the onset of rain season
		Indicates rains will be associated with lightning
	Different temperatures of water (river or lake)	Indicates whether there shall be a big catch of fish or not
Fruit trees/ Trees (Msangu - Faidebia Albida, Mango & Matontho)	Produce more fruits	Indicates an impending hunger
	Greener leaves or new sprouts on trees	Indicates that rainy season is approaching
	Loss of all leaves	Indicates towards end of rain season
Sounds and Presence of certain animals	Sounds of crickets (Chenje), Nalipapara and Chakupompha	Indicates the onset of rainy season
	Large population of ants in an area	Indicates that there will be more rain in the season
	Presence of nthowa (caterpillars) on Mitowa trees	Indicates there is looming hunger.
	Birds (Nanzaze, Kakowa, Khutuwiwiri) flying in the skies	Indicates that it is about to rain
	Scarcity of termites	Indicates that there will be poor rains
	Cheche flies	Indicates an impending drying up of the lake.
	Nkhwazi bird makes sounds	Serves as a warning for destructive winds from the north (Mumbo)

Table 3-17 Conti.: Explaination of natural elements by the ILPCs and their corresponding ILK deduced DRR/DRM/Climate change meanings.

Natural Elements	Explanation among ILPCs	ILK Deduced DRR/DRM/Climate change Meaning
Rainbow	Sight of the rainbow	Indicates prevalent rains
		Indicates that the rain will stop if it just started
Size of the catch of fish	A very good catch of fish for a season	Indicates poor crop harvest or looming hunger
Clouds	Dark sinister clouds	Indicates imminent rainfall
	Certain loud sound from clouds (Kolilima)	Indicates that there shall be heavy rainfall
Whirlpools/Lake water patterns	Small whirlpools on the lake	Indicates that there would be strong winds
	Observing lake water patterns	Helps predict wind direction for safe fishing and navigation
Winds	Winds coming from different directions	Predict poor rains
	Consistent westerly and southerly winds	Predict good rains
	Easterly and Southerly winds signify good rains	Predict good rains
	Males and children experiencing abdominal pains (kakozi/Mwera)	Early warnings for Mwera winds
	Wind start to blow in sky then later on the surface of the waters	Predicts Mwera winds on the lake
Fog	When there is massive presence of fogs in the morning	Predicts Mwera winds later in the day
Prevalence of Asthmatic attacks	Several asthmatic attacks in a day	Predicts onset of Mwera winds on the lake the following day

3.9.2 Business and Aquatic biodiversity

Aquatic biodiversity plays a crucial role in the business world, and this is particularly true in Malawi. The aquatic biodiversity and business environment in Malawi present unique opportunities and challenges. Sustainable development in Malawi requires focused management of the freshwater ecosystems, which are currently at risk due to various pressures. At the same time, there are numerous business opportunities that are being explored for economic growth.

Water Supply Services: Entities like the Lilongwe Water Board, Northern Region Water Board, and Southern Region Water Board gets water from the wetlands of Malawi and provide potable water and sanitation services to the public. As water utility entities, they are responsible for managing water resources, treatment plants, distribution networks, and wastewater services. These entities ensure a reliable supply of clean and safe drinking water to residents, businesses, and institutions in Lilongwe.

Aquaculture: Aquaculture is a growing sector in Malawi. It involves the farming of aquatic organisms such as fish, crustaceans, mollusks, and aquatic plants. The sector has seen considerable growth, with production increasing from 813 metric tonnes in 2005 to 9,399 metric tonnes in 2020 (Munthali et al., 2024). This growth is attributed to factors such as rising demand for protein and a decline in capture fisheries (Commercial Agriculture for Smallholder and Agribusiness, 2020).

Eco-Friendly Businesses: There are also eco-friendly businesses that operate within the aquatic environment. The beautiful Lake Malawi and other water bodies, offers opportunities for eco-friendly businesses that contribute to environmental conservation. These, for instance, some notable initiatives and companies operating within the aquatic environment in Malawi:

a) Eco-Tourism and Conservation: Malawi's pristine lakes and national parks attract tourists interested in wildlife and aquatic ecosystems. Eco-friendly lodges, guided tours, and conservation efforts contribute to both economic development and environmental protection.

b) Fish Farming and Hatcheries: Sustainable fish farming practices alleviate pressure on wild fish stocks. Businesses that focus on breeding and raising fish in controlled environments contribute to food security and biodiversity conservation.

Eco-friendly businesses not only benefit the environment but also contribute to sustainable development and community well-being (Orlando, 2016).

3.9.3 Gender and human rights interactions in Aquatic biodiversity

Gender refers to the roles, behaviors, activities, and attributes that a given society considers appropriate for men and women (USAID, 2007). Other scholars like Muigua, (2021) define the term "gender" to refer to the set of social norms, practices and institutions that regulate the relations between women and men (also known as "gender relations"). In addition, the term 'gender' is also used to refer to the socially-constructed expectations about the characteristics, aptitudes and behaviours associated with being a woman or a man, and while gender defines what is feminine and masculine, it shapes the social roles that men and women play and the power relations between them, which can have a profound effect on the use and management of natural resources (Muigua,2021).

All the definitions above have similar connotation as a social construct that ascribes different qualities and rights to women and men regardless of competence or desires. However, social constructs vary from culture to culture and can change over time (FAO, 2023). The interactions between gender, human rights, and aquatic biodiversity in Malawi are complex and multifaceted. Here are some key points based on recent findings:

Women's inclusion: Women's inclusivity is crucial for the sustainability of outcomes in aquatic biodiversity conservation and environmental management. However, gender norms often undermine the role of women in conservation efforts, and their day-to-day livelihood activities may further aggravate gender inequality.

Challenges and Opportunities: Women face challenges in aquatic biodiversity conservation due to limited access to resources, decision-making processes, and constraining gender norms. Despite these challenges, there are opportunities for women's inclusion in aquatic biodiversity.

3.9.3.1 Drivers and Pressures:

Gender roles significantly influence how resources are used and managed. Women often have less access to resources and decision-making processes, affecting their ability to contribute to and benefit from biodiversity conservation efforts. Arguably, considering gender issues in relation to biodiversity involves identifying the influence of gender roles and relations on the use, management and conservation of biodiversity, where gender roles of women and men include different labour responsibilities, priorities, decision-making power, and knowledge, which affect how women and men use and manage biological resources (Rocheleau, 2016). It has also been opined that biodiversity is closely connected to development, access to resources, income-generating activities, food, and essential household products, and from this perspective, the disciplines of biodiversity and gender overlap, and certainly are intrinsically linked (Krehbiel et al., 2017).

It is worth pointing out that commentators in the last two decades observed that most sustainable development efforts, including biodiversity initiatives, derived from a gendered vision of segmented sustainability that divides home, habitat and workplace into separate domains, with women at 'home', men in the 'workplace' and protected 'habitats' devoid of humans (Muigua, 2021). However, over the years, there has been a paradigm shift, at least theoretically on the relationship between men and women in relation to biodiversity as well as the general relationship between man's day to day life and the natural habitats, in light of the United Nations 2030 Agenda on Sustainable Development (SDGs Agenda). The SDGs Agenda seeks to adopt a holistic approach to sustainability that not only includes both men and women but also recognises the interconnectivity between human life and the natural habitats (CBD, 2020).

Economic pressures, such as poverty and the need for income, can lead to overexploitation of aquatic resources, disproportionately affecting women who rely on these resources for their livelihoods.

3.9.3.2 Trends:

The trends of declining biodiversity due to overfishing, pollution, and habitat destruction has a direct impact on the livelihoods of communities, especially on women who are often responsible for gathering food and water. Climate change exacerbates these trends, altering aquatic ecosystems and the availability of resources, further challenging the livelihoods of vulnerable populations (Muigua, 2021).

3.9.3.3 Responses:

Policy responses include the development of national strategies for the gender mainstreaming in aquatic biodiversity conservation and integrated environmental management and the overall Malawi National Biodiversity Strategy and Action Plan II (2015-2025).

Community-based initiatives, such as fish sanctuaries, have shown positive impacts on biodiversity and can empower local communities, including women, in conservation efforts.

Policy reforms: Policy reform is a priority area for women's inclusion in aquatic biodiversity conservation. This includes developing strategic measures to enhance women's involvement, especially in regions where exclusive gender norms prevail.

3.10 National Policies related to Aquatic ecosystems and Biodiversity in Malawi

Table 3-18: Provisions and Gaps on Aquatic ecosystems and Biodiversity in Some ENRM Policies in Malawi

Policy	Provision for Biodiversity	Gaps/Area of Conflict in Policy
The National Herbarium and Botanic Gardens Act (1987)	The Act provides for the development and management of herbarium and botanic gardens as national heritage for Malawi and the establishment of the National Herbarium and Botanic Gardens of Malawi	
Museums Act (1989)	Provides for the establishment of museums. It also provides for the collection, conservation, safeguarding, documentation, interpretation and communication on the tangible and intangible heritage of people and their environment for the purposes of study, education and enjoyment	The role of museums in conserving natural history in and ex situ is not clearly explained.
Environmental Management Act (2017)	The Act provides for the establishment of environmental protection areas and conservation of biological diversity and access to genetic resources. It also makes the provision preparation of the National Environment Actions Plans (NEAPs), conducting EIA, pollution control and waste management.	The Act does not have regulations to enforce its provisions on access to genetic resources.

Table 3-18: Provisions and Gaps on Aquatic ecosystems and Biodiversity in Some ENRM Policies in Malawi

Policy	Provision for Biodiversity	Gaps/Area of Conflict in Policy
Fisheries Conservation and Management Act (1997)	To strengthen institutional capacity by involving various stakeholders in the management of fisheries; promotes community participation and protection of fish; and provides for establishment and operation of aquaculture.	Section 3(7) of the fisheries Conservation and Management Act does not recognize water officials as fisheries protection officers. Section 20 and 21 of the fisheries Conservation and Management Act are silent on EIA in granting of an aquaculture permit. The Act is being revised
Land Policy (2002)	Promotes community participation and public awareness at all levels to ensure environmentally sustainable land use practices and good land stewardship; advocates for protection of sensitive areas and waste management	
The Science and Technology Act (2003)	The Act provides for the advancement of science and technology in Malawi, which includes research in biodiversity and biotechnology	There are no regulations to implement the Act
National Parks and Wildlife Act (2017)	The Act provides for wildlife management, including identification of species that should be designated for protection.	
Water Resources Management Policy (2004)	The overall policy goal is to ensure sustainable management and utilization of water resources in order to provide water of acceptable quality and of sufficient and effective water and sanitation services that satisfy the basic requirements of every Malawian and for the enhancement of the country's natural ecosystems.	The policy does not provide guidelines for the conservation and sustainable use of aquatic biodiversity.
National Environmental Policy (NEP, 2004)	Seeks to manage, conserve and utilize biological diversity for the preservation of national heritage.	The policy does not specifically address the issue of fair and equitable sharing of benefits arising from use of biological and genetic resources.

3.11 Status of Community Intergenerational Knowledge Transfer and Gender integration

ILK is neither rigid nor static, but rather it is dynamically shaped by external influences and socio-cultural transformation (Theodory, 2021). Thus intergenerational knowledge transfer in fisheries refers to the process by which fishing communities pass down and preserve valuable information, skills, and practices related to fishing from one generation to another. This is crucial for the sustainability and resilience of fisheries, because it helps preserve traditional ecological knowledge, cultural heritage, and adaptive strategies essential for managing fish stocks and ecosystems. Fishing is thus learnt informally, as is common with the livelihoods of rural communities, and passed on to subsequent generations through practice (Berlin, 1992); (Matowanyika, 1994); (Dawson, 1997). In shoreline communities, fishing has strong links to transition into adulthood. Hoole (1955) describes one such form of instruction for the Tonga people of Nkhata Bay District where local communities share with their younger generation on the use of ILK on aquatic resource management.

The following are some key aspects of intergenerational knowledge transfer systems in fishers' local communities that preserve and promote ILK in aquatic resources as noted among fisher communities and youths of Lakes Chilwa and Kazuni. Field data collection has revealed that there is traditional ecological knowledge (TEK) that the elders share with the younger generation of the communities in managing aquatic resources. This includes knowledge about fishing grounds, breeding areas, and migration patterns of fish, which are crucial for sustainable fishing practices. The youths from Lake Chilwa and Lake Kazuni shared that they learn traditional ecological knowledge on aquatic resource management from their elders. Fishing is a non formal activity so each community endeavors to train their young generation. Traditional practices like using different fishing gear seasonally and imposing restrictions on fishing during breeding seasons have been documented which means that from generation to generation fishers pass on this vital knowledge to the next generation.
Literature noted that chiefs were inspecting fishing gear and enforcing rules helped maintain fish stocks at Mbenje Island, that means communities were aware of the sustainable fishing and adhered from generation to generation.

Secondly, there are fishing techniques and skills that are built over time through practice and perfection which are part of the intergenerational transfer system. In this case, the older generations pass down practical skills such as net making, boat handling, and specific fishing methods tailored to local conditions and accepted fishing gears for sustainable use. These techniques often reflect a deep understanding of the local environment and are adapted to ensure minimal impact on the aquatic ecosystem. The indigenous and local people understand that the lake and rivers are their main source of livelihood and income generation hence to ensure sustainability, the fishers communities pass on fishing techniques and skills

Thirdly, cultural practices and values are also passed from one generation to another in the indigenous and local communities in the aquatic ecosystem. However, field data collection revealed that the youth have different perspectives on this issue. Some do not accept these traditional beliefs. They look at them as archaic. Still, some of the cultural traditions and community values associated with fishing that are transmitted across generations include the taboos of how a fisherman should conduct himself and his family. These cultural aspects often emphasize the need for those operating within the fishing to respect nature, community cooperation even including how a husband handles his family members, and sustainable resource use; no exploitation of natural resources and reinforcing the importance of responsible fishing practices.

Fourthly, the indigenous and local communities also share adaptive strategies. Fishing communities develop adaptive strategies to cope with environmental changes, economic pressures, and regulatory shifts. These strategies, informed by historical experiences and lessons learned, are shared across generations to help communities navigate challenges and uncertainties. It is also noted that knowledge systems such as restricted cutting of vegetation and fishing in sacred sites, as observed at Lake Chilwa, promoted sustainable utilization, this also indicates that there is intergenerational knowledge transfer.
Fifthly, there is unstructured mentorship and apprenticeship that is offered to the younger generations under the guidance of parents and other elders of the community who have a record of successful fisherman. Similar to the structured mentorship and apprenticeship in other technical and vocation skills training, these intergenerational knowledge transfers often occur where experienced fishers train younger members of the community. This hands-on learning approach ensures that practical skills and nuanced knowledge are effectively conveyed to the trainees.

Lastly, the custodians of empirical knowledge and oral traditions, mostly elders and community leaders, play a role in intergenerational knowledge transfer of ILK. The elders and community leaders play a pivotal role in guiding younger generations.

Figure 3-25: Intergenerational Knowledge transfer (@NyasaTimes)

Their involvement is crucial for maintaining the continuity and integrity of cultural and ecological wisdom. At Lake Kazuni and Lake Chilwa there is mentoring of youths through family interactions and community gatherings, helping preserve traditional fishing practices and ecological knowledge. Storytelling and oral traditions are significant methods for transmitting indigenous knowledge from elders to younger generations. This includes sharing stories about traditional fishing methods, predicting weather patterns like the Mwera winds, and the ecological significance of certain plants.

3.11.1 Challenges of ILK Intergenerational Knowledge transfer

There are a number of challenges and threats relating to ILK intergenerational knowledge transfer and systems in aquatic resource management. In Malawi, modernization, urbanization, and global environmental changes are some of the challenges. For example, as discovered at Lake Kazuni, younger generations migrate to urban areas, leading to a loss of interest in traditional fishing practices. Additionally, climate change and overfishing has disrupted aquatic ecosystems, making traditional knowledge less applicable or harder to pass down.

Most of the youths regard traditional knowledge as outdated or irrelevant, influenced by formal education and modern beliefs. For instance, some youths do not participate in ILK activities and practices due to the fear of ridicule from peers or due to religious beliefs that associate traditional practices with demonism.

In some communities, there are organized efforts to engage youth in traditional practices through youth clubs and family-based mentoring. However, the effectiveness of these efforts are limited by the youths' lack of interest. Furthermore, the adoption of co-management initiatives involving local communities and the government aims to mainstream traditional knowledge into modern resource management. These initiatives emphasize the importance of including fishers' knowledge in sustainable fisheries management and the involvement of the youths. For example, in Lake Chilwa basin, there are vibrant intergenerational knowledge transfer systems where youth are knowledgeable about traditional fishing methods and ecological indicators, although there are also challenges due to conflicting religious beliefs and disinterest among some youths. Even at Lake Kazuni, some youths participate in annual ceremonies and rituals but are selective about engaging in other traditional practices that relate to worship. This reveals the selective broader trends where younger generations may respect but not fully adopt ILK practices.

These observations among the youths illustrate the complexity of maintaining and transferring indigenous knowledge across generations in the context of fisheries and environmental management. The effectiveness of these transfers depends on the interplay between traditional practices and modern influences, highlighting the need for adaptive and inclusive approaches to knowledge preservation. The Senior Chief Makanjila No. 7 at Mbenji Island reiterated the need to document the ILK and conservation practices as a way of knowledge transfer so that future generations can continue using the knowledge.

To conclude, promoting and supporting intergenerational knowledge transfer in fisheries is essential for preserving the cultural heritage and ecological sustainability of fishing communities. Efforts such as documentation of traditional knowledge, community-based management practices, and educational programs can help ensure that valuable knowledge is passed down and adapted to contemporary challenges.

3.11.2 Gender Integration in ILK

A World Bank report 2019 established that about 24% of households in Malawi are headed by women, making them beneficiaries of biodiversity and the different ecosystems such as lakes and rivers for aquatic resources. The information on the dependency of households and the benefits they generate from different types of ecosystems is not determined but as key beneficiaries, that makes gender equality and social inclusion a critical consideration. Indigenous Peoples and local communities which include women and girls have in-depth knowledge of their environments. They are key actors in biodiversity conservation while also being directly impacted by the degradation of ecosystems.

Gender mainstreaming and women empowerment is therefore critical in achieving biodiversity conservation. Gender responsive environmental guidelines, policies and planning delivers multiple benefits for women and biodiversity. Women are involved in aquatic resource management, in caring for their families and co-management and they are custodians of indigenous and local knowledge that relate to the areas of concerns. Gender dynamics consideration is mostly important in working with and understanding ILK. As caregivers and homemakers, women are key in passing on ILK to the younger generation within their homes and villages. Local communities revealed that changes in climate have contributed to changes in gender patterns, hence the need to take gender dynamics into consideration.

Women and girls have a high potential to lead knowledge production and implementation of the solutions on the ground. During the scoping exercise, it was revealed that women and girls from indigenous and local communities have a high potential to lead and hold a distinctive set of capacities and practices due to their special relationship with nature. This makes them unique knowledge holders mostly needed in the assessment. NEA recognizes the contribution of all gender groups especially women and girls at all levels of the assessment. Modern science by itself seems inadequate to halt and reverse the depletion of aquatic ecosystem resources and the degradation of the environment. Resource management has not been designed for the sustainable use of resources, but for their efficient utilization, as if they were boundless. There is a need to develop a new resource management science that is better adapted to serve the needs of ecological sustainability. This could be achieved by including strategies derived from ethnographic traditions.

The concept of 'people's participation' in national resources management is being voiced and increasingly recognized in international fora. Diversity of traditional resource management practices and systems can achieve the task of reconstructing this new resource management science. Over many generations, the culture of indigenous and local people living in or occurring naturally in a particular area has been influenced by the environment. Indigenous Peoples and local communities' knowledge depends on a number of historical, social, and ecological factors, birthing an extraordinary store of knowledge about the local natural resource base and natural ecosystem functioning and responses to various uses. Many societies have developed complex management patterns for biological resources, and this local knowledge may yield new ideas about the conservation and management of natural resources which include aquatic resources (Leveque, 2010).

3.12 Existing interlinkages between cultural practices and aquatic resources biodiversity conservation

Msiska (1991) reports that fishers learn to take into account details of fish behavior and relationships with the environment. Rain or flooding is sometimes followed by an increase in fish food (algal or plankton blooms), which may in turn be followed by an increase in the presence of crocodiles, which restrict fishing grounds in some areas (F.M Nyirenda pers. comm.). Indigenous communities often have rules and taboos that regulate the use of natural resources, contributing to aquatic resource conservation. These taboos and their guidelines are regarded as customary laws. The adherence to cultural taboos by the indigenous and local people and communities promote conservation of aquatic resources.

For example, in the past, communities at Lake Chilwa used to believe that when a fisherman's wife is pregnant, the husband should not go out fishing for the hippopotamus would attack/or kill him.

It used to be a common practice that a man whose wife is expectant does not go fishing to avoid bringing bad luck to the fishing group. This also regulated the number of fishermen that could be at the fishing site.

Thirdly, the conservation practices such as sacred sites directly contribute to biodiversity conservation. Many indigenous cultures protect certain areas for spiritual or cultural reasons, which incidentally preserves biodiversity. For decades, traditional leaders restricted fishing in sacred sites. The practice originated from their ancestors and this was not meant primarily for fish conservation. No fishing was done around Chaone and Chidyamphiri Islands in fear of spirits. For instance, Chaone was visited only when the chiefs led by Village headmen Khumali and Sonkho went to offer sacrifices to their ancestors when fish was scarce. If fishermen dared to go there, they got lost mysteriously which prevented overfishing and allowed fish species to repopulate. These traditionally protected sites served as undisturbed fish breeding and growth sanctuaries. They acted as replenishment zones from which stock might migrate into adjacent areas and had the potential to provide insurance against management and or recruitment failures elsewhere. Village headman Khumali further reported that breaking the taboos against over fishing led to expulsion from the Island. This sanction acted as a severe incentive to force people to follow the rules and regulations. Kabwazi and Wilson (1998) report that the extensive Typha swamp which comprises 1/3 of the lake also provided a safe refuge for fish especially juveniles. However, at present these sites are encroached; the restrictions no longer form the basis of fisheries management.

In the past, community elders conducted ritual offerings at Chaone Hill, particularly in caves that have since been submerged following flooding associated with Cyclone Freddy. During these ceremonies, maize flour was placed as an offering. It was reported that a snake or a hen accompanied by chicks would appear and consume the flour, which community members interpreted as a sign that the ancestors had accepted the sacrifice. Shortly thereafter, rainfall was expected to begin, sometimes even as participants were returning to the village.

Figure 3-26: Milola Hotspring-Spiritual healing water (@NEA)

Despite that most people no longer believe in the traditional beliefs of their foreparents, people in Chaone remain hesitant to fish around Chaone due to fears of past mysterious encounters. It is said that those who attempt to fish in the area experience strange phenomena such as seeing white people who will vanish in a twinkle of the eye, and they would paddle their boats to run away without making any progress. This deep-seated fear has, in turn, contributed to biodiversity conservation, as fewer people venture into the waters.

Additionally, the local community continues to honour sites where their ancestors once offered sacrifices, referring to them as malo opaulika, meaning holy land. The name Chaone is derived from the Lhomwe tribe word zaone meaning come and see what has happened to me, reflecting the awe and mystery surrounding area.
The people are still scared to go fishing around Chaone although they no longer believe in what their foreparents believed in. It is believed that people used to experience mysterious encounters when they tried to go fishing around the Chaone area. For example, they used to meet White people who instantly disappeared if they just looked away for a second, they would peddle a boat but could not move. Their fear of experiencing the mysterious encounters has contributed to biodiversity conservation. The local people also respect the areas where their forefathers offered sacrifices and label them “malo opatulika” – holy land. The name Chaone originated from the Lhomwe word ‘Dzaone” which means come and see what has happened to me.

Another site is Bowo, the mouth of Domasi River on the shores of Lake Chilwa, provides a rich ground for ILK practices. The place is a rich fish-breeding ground with a lot of fishing activities. It is, however, revered for its historic significance. Many people claim that Bowo is an ancestral home. In the past, residents of the area would offer sacrifice to their ancestral spirits and the people’s plight could be responded to. Being a sacred place, it was not frequently visited by ordinary citizens of the area. It was also a feared place as it is connected with the presence of crocodiles, hippopotamus and a variety of snakes. Local fishermen in the area make baskets (mimono) and donga (tchingira) that guide fish into the designated spots where mimono have been set. Most of the fish caught using this method include: Milamba, Matembo plus any other fish.

Fishermen around Lake Chilwa are encouraged to use ’pond’ or paddler which means that fishing cannot be done in places with deep waters. This regulatory practice ensures that fishing is not done in fish bleeding areas. Different types of lighting are called upon when the fishing season begins. While some fishermen use tilley lamps to lure fish to enter the traps, some use grass, dry wood, and torches. In the past, traditional leaders used to advise their subjects to catch fish during the day, not at night, so that only the right sizes of fish were being targeted. This time many fishermen catch fish at night which is destructive to fish (Nahgoli, et. al., 2016)
There is also the Milola hot spring, located near Lake Chilwa, which holds both medicinal and spiritual significance for the surrounding communities. The site is currently used for certain agricultural activities and is officially recognized by the government. Although the spring contains catfish, local residents do not consume them, considering them sacred and noting their unusually dark coloration. This cultural belief effectively functions as a conservation measure for the fish species found in the spring.

The site is also known for the presence of snakes, which are believed not to harm people who bathe in or cultivate around the spring. Consequently, these snakes are not killed, as they are regarded as harmless and associated with ancestral spirits.

In the discussion with the youth at the Milola hotspring, it revealed a fascinating link between cultural practices and biodiversity conservation. However, these ILK practices play a critical role in biodiversity conservation due to its deep-rooted understanding of local ecosystems and sustainable practices honed over generations.

CHAPTER 4

TERRESTRIAL ECOSYSTEMS

CHAPTER 4 - **TERRESTRIAL ECOSYSTEMS**

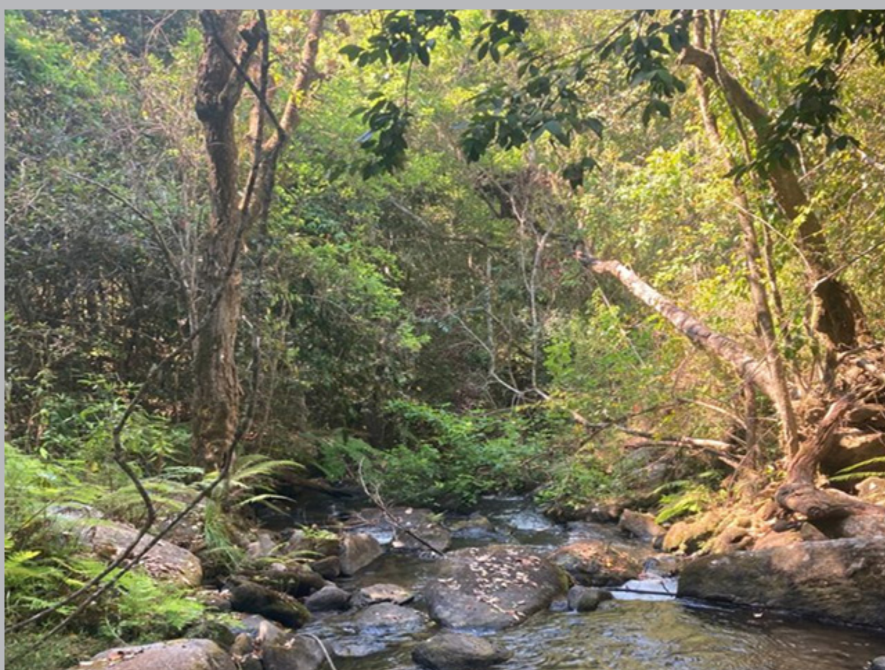
4.1 Introduction

Malawi's terrestrial ecosystems encompass forests, mountains, grasslands and agricultural landscapes, each playing a vital role in sustaining biodiversity and providing essential contributions to nature and people. These ecosystems are mainly found in protected areas (PAs) such as National parks, Wildlife reserves and Forest reserves, where the majority of species are also concentrated. They support complex ecological assemblages, regulate hydrological cycles and impact the livelihoods of communities living nearby.

According to the Malawi National Ecosystem Assessment Scoping Report, approximately 85% of Malawi's population directly relies on biodiversity and ecosystem services for their livelihoods and well-being. The country is home to 87 forest reserves, 5 national parks, 4 wildlife reserves and 3 nature sanctuaries (**Figure 4-2**). These areas protect a significant portion of Malawi's documented terrestrial species, including around 6,000 plants, 8,770 insects, 862 vertebrates, and 192 mammals, with e likely higher numbers due to under-documented taxa (EAD, 2006; GoM, 2014). However, Malawi's terrestrial ecosystems are increasingly facing various anthropogenic and environmental pressures such as climate change, land-use change, deforestation, land degradation, agricultural expansion, invasive alien species, unsustainable agricultural practices and encroachment (Lee, Batero, & Novotny, 2016). For example, land-use change, primarily for agriculture, has reduced national forest cover from 47% in 1975 to 24% in 2020 (World Bank, 2023).

Malawi's diverse topography, from the high peaks of Mulanje mountain (3000 metres) and Zomba (2087 m) to the extensive Nyika (2605 m) and Viphya plateaus (2000 m), shapes ecological variations across the country. The terrestrial ecosystems are further distinguished by four agro-ecological zones (Lower Shire Valley; Lakeshore Plains and Upper Shire; Mid-altitude Plateau; and Highlands), which differ in soils, altitude, rainfall and temperature regimes (Matchaya et al 2018). These zones not only support the wide array of biodiversity but also serve as the backbone of Malawi's predominantly agriculture-based economy. Nyika and Viphya plateaus cover large areas in the northern region, while Dedza, Ntchisi and Dzalanyama ranges are notable mountains in the central region (EAD, 2006). These mountain ecosystems range from dry miombo to Afromontane peaks that support an extensive range of flora and fauna. While protected areas have the richest biodiversity, public and community areas, on the other hand, are characterized by general degradation of natural resources and landscapes. Mountain ecosystems are important sources of rivers and are biodiversity hotspots (**Figure. 4-1**). As such, protected areas including Mulanje Mountain Forest Reserve, Nyika National Park, Dzalanyama Forest Reserve, were established to reduce extensive encroachment and deforestation of these mountains (EAD, 2006).

Figure 4-1: South Viphya Forest Reserve is a catchment area to many rivers and streams that drain into Lake Malawi



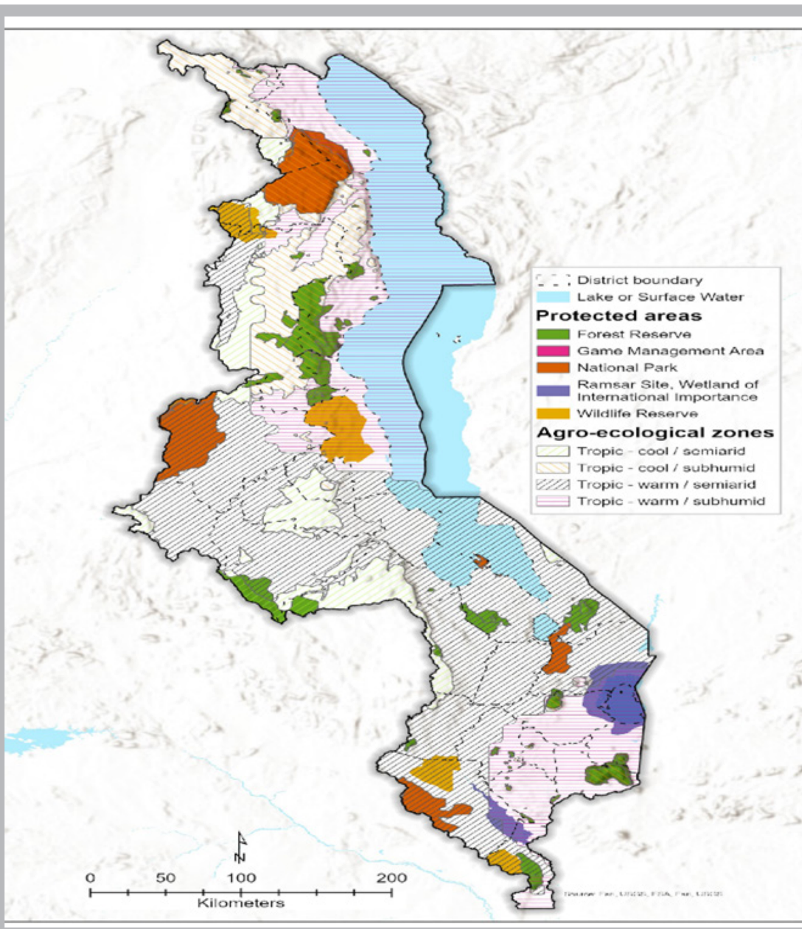


Figure 4-2: Protected areas and agro-ecological zones of Malawi Source: MUST and EAD Spatial Biodiversity Assessment, Prioritisation and Planning (SBAPP) regional project.

Grasslands in Malawi are an important component of the country's terrestrial ecosystems and contribute significantly to terrestrial biodiversity. They occur mainly in highland plateaus, dambos (seasonally waterlogged grasslands), and open savanna landscapes, often forming mosaics with woodlands such as Miombo Woodland. These grasslands support a wide variety of plant species dominated by perennial grasses such as Hyparrhenia, Andropogon, and Themeda species, which provide habitat and food resources for insects, birds, small mammals, and grazing wildlife. Grasslands also serve as important grazing areas for livestock and wild herbivores, thereby supporting ecosystem functions such as nutrient cycling and soil conservation (FAO, 2020).

Approximately 70% of the land area of Malawi is covered by human-modified landscapes primarily for agriculture (GoM, 2009), a source of sustaining more than 90% of the population. Agriculture contributes more than 80% of national export earnings, with tobacco being the dominant cash crop (FAO, 2014; World Bank, 2017). In terms of agricultural land, Malawi is classified into three agro-ecological zones (AEZs) based on soil factors, altitude, amount, duration, and variability of rainfall, and temperature regimes (Matchaya et al 2018). The AEZs include the Lower Shire valley; the lakeshore plains and Upper Shire valley; and the mid-altitude plateau, and the highlands (**Figure 4.2**).

These ecosystems vary from small-scale subsistence farms to large commercial tea and tobacco plantations, which account for approximately 67% of the export earnings (World Bank, 2011; World Bank, 2017). While providing economic benefits, they also pose challenges for conservation and sustainability since some agricultural practices, like tobacco farming, significantly contribute to deforestation (26% by early 2000s) (Lee, Batero, & Novotny, 2016).

Indigenous and local knowledge (ILK) systems play an important role in the management, protection and conservation of terrestrial ecosystems. In Malawi' s cultural landscape, ILK informs conservation practices, resource governance and ecological resilience (Mazibuko et al., 2007; Ntupanyama et al., 2008; Moyo & Moyo, 2014; Kanyangale & Lee, 2023). Field evidence from the NEA project demonstrates how ILK contributes to forest conservation, invasive species management, and agrobiodiversity preservation. For example, ILK systems in Malawi have been used to assess the use, value and ecology of fruit species like Uapaca kirkiana (Ntupanyama et al., 2008); improving food systems (Moyo & Moyo, 2014);

and management of Invasive and Alien Species (Kanyangale & Lee, 2023). It is increasingly recognized that ILK systems are fundamental to achieving equitable and effective biodiversity governance, as reflected in global frameworks such as the Convention on Biological Diversity (CBD) and the IPBES Global Assessment. Despite their immense value, ILK systems continue to face erosion driven by modernization, policy neglect, and generational transitions. Strengthening the interface between ILK and formal conservation strategies is therefore essential for fostering inclusive, resilient, and sustainable ecosystem management.

In recognition of mounting pressures on terrestrial ecosystems, the Government of Malawi has implemented a number of policy, legal, and institutional reforms.

These include enacting strengthened forestry legislation, promoting participatory management and strict enforcement, alongside national strategies for biodiversity (NBSAP) and climate change that prioritize habitat restoration and ecosystem-based adaptation. The government has also established co-management models for protected areas and supports ex-situ conservation. Internationally, Malawi reinforces these efforts through commitments to major environmental conventions such as the CBD, UNCCD and UNFCCC as well as regional initiatives. Notably, the country has pledged to restore 4.5 million hectares of degraded land by 2030 under the AFR100 initiative and aligns its actions with Sustainable Development Goal 15 (Life on Land). These concerted efforts at all levels demonstrate Malawi's recognition of healthy terrestrial ecosystems as critical to its sustainable development and climate resilience.

Indigenous and Local Knowledge (ILK) systems have played a vital role in maintaining sustainable relationships between people and their environments worldwide. Numerous studies have highlighted the positive connections between ILK and the conservation of terrestrial ecosystems (Selemani, 2020; Shoemaker, 2019; Virtanen, 2002; Nonhome & Boko, 2019). Such a sophisticated ecological understanding is not limited to the realm of formal science. Human societies have developed rich sets of experiences, practices, and explanations that guide their interactions with the natural world.

These "other knowledge systems" are variously described as Indigenous and Local Knowledge, Folk Knowledge, People's Knowledge, Traditional Wisdom, Traditional Science, or Traditional Ecological Knowledge (TEK). According to Kaniki and Mphahlele (2002), ILK reflects a community's beliefs, cultural values, and spiritual relationships with nature. It is transmitted orally and through rituals from one generation to another, serving as the foundation for environmental stewardship and the sustainable use of natural resources.

In Africa, ILK systems are traditionally applied in harmony with both the natural and spiritual worlds. They are intricately designed to address local ecological challenges, ensuring sustainable use and protection of commonly shared natural resources (Chisenga, 2002). These systems are not static but evolve with experience, social learning, and environmental change, reinforcing their resilience and relevance in modern conservation contexts.

As in other parts of Africa, Malawi's diverse ethnic communities possess rich reservoirs of Indigenous and Local Knowledge systems, as documented in the UNESCO Inventory of Intangible Cultural Heritage in Malawi (Mazibuko, Magomelo & Thole, 2007). ILK practices in the country encompass a wide range of conservation-oriented traditions, including sacred forests, taboos against resource overuse, rotational farming, and customary forest governance.

Findings from the Malawi National Ecosystem Assessment (NEA) field research reveal that ILK continues to play a vital role in conserving terrestrial ecosystems such as forests, woodlands, and community-managed landscapes (Approved Scoping Report, 2024). Sites like Khulubvi Sacred Forest illustrate how cultural beliefs, traditional authority, and ecological stewardship coexist to protect biodiversity and maintain spiritual integrity (**Figure 4-3**).

Figure 4-3. Community members at Khulubvi Sacred Forest, a site of spiritual and ecological significance where traditional beliefs have safeguarded biodiversity for generations (@NEA)

This chapter provides a comprehensive assessment of the status, trends and future prospects of Malawi's terrestrial ecosystems. It analyzes the direct and indirect drivers of biodiversity loss, evaluates the economic and cultural contributions of these ecosystems, and reviews the policy and institutional frameworks governing their management. It further highlights the role of protected areas, agricultural systems, and ILK in shaping biodiversity outcomes and ecosystem service delivery in the face of escalating social and environmental change.

The assessment will apply standardized ecosystem typologies to classify terrestrial units (including forests, mountains, grassland and human-modified agricultural landscapes), and evaluated them against explicit criteria: (i) ecosystem extent and spatial distribution; (ii) ecological condition and integrity; (iii) biodiversity status, including species richness and threat levels; (iv) trends and drivers of change (direct and indirect); (v) nature's contributions to people , particularly provisioning, regulating, and cultural services; and (vi) governance, policy, and management effectiveness, including the role of Indigenous and Local Knowledge (ILK).

4.2 Situation Analysis

This section provides the status, trends and challenges in the components of terrestrial ecosystems namely; forests, parks and wildlife, mountains, grassland, and agriculture ecosystems.

4.2.1 Status of Biodiversity in Terrestrial Ecosystem

Malawi's terrestrial ecosystems including forests, mountains, grasslands, and agricultural landscapes exhibit varying levels of ecological integrity and threat. Forest ecosystems, dominated by miombo woodlands, are largely confined to protected areas such as forest reserves and national parks, but outside these areas they face pressures from logging, charcoal production, and agricultural expansion. Mountain ecosystems, including Mulanje Mountain and the Nyika Plateau, harbor unique biodiversity and provide critical water catchments, yet they are increasingly threatened by forest clearing, invasive species, and climate-related changes. The current status of grasslands in Malawi is mixed. While some relatively intact grassland ecosystems remain in protected areas and highland plateaus, many grasslands outside protected areas have been significantly altered by human activities. Expansion of agriculture, cultivation of dambo margins, overgrazing by livestock, and uncontrolled burning have led to degradation and loss of natural grass cover in many regions. In some cases, formerly grass-covered dambos have been overgrazed or converted to cropland, leaving areas exposed to erosion and reducing vegetation cover (Roberts, 1988). Agricultural landscapes cover much of the lowlands, supporting livelihoods and food security, but unsustainable practices such as shifting cultivation and monocropping contribute to soil degradation and biodiversity loss. The Ecosystem Threat Status map for 2025 (**Figure 4-4**) highlights these patterns, showing that forests and mountains in the Northern and Southern regions face the highest threat levels, while agricultural areas generally experience moderate threat from land-use pressures. These spatial insights underscore the need for targeted conservation and sustainable management interventions to mitigate ongoing ecosystem degradation.

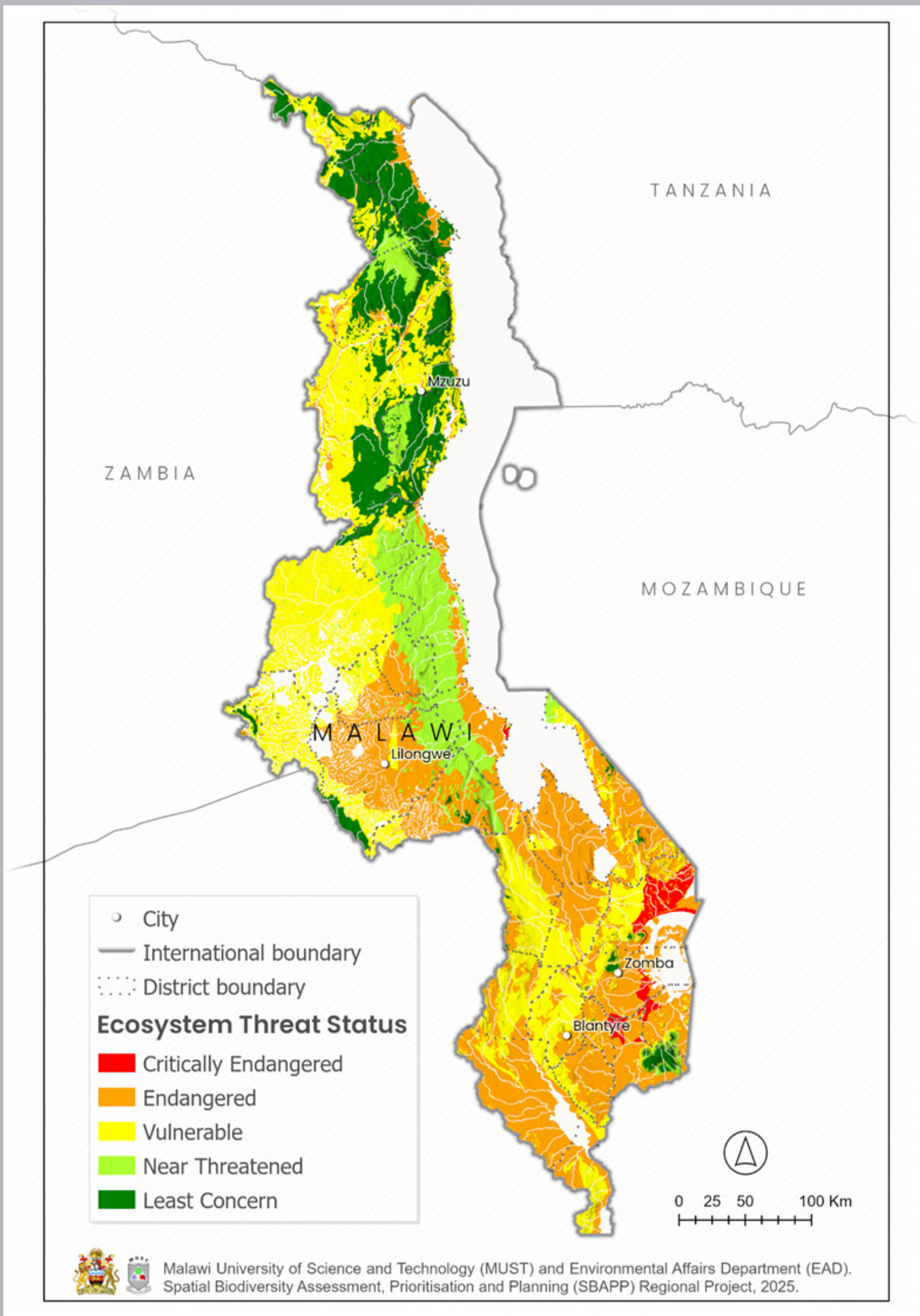


Figure 4-4. Map showing the 2025 Malawi's Terrestrial Ecosystem Threat Status. Source: MUST and EAD Spatial Biodiversity Assessment, Prioritisation and Planning (SBAPP) regional project.

4.2.2 Forests Ecosystem

The forest ecosystem in Malawi comprises eighty-seven (87) forest reserves, five (5) national parks, four (4) wildlife reserves and three (3) nature sanctuaries. The dominant forest type is miombo, an open-canopy woodland characterized by the presence of leguminous trees in the genus Brachystegia and Julbernadia. The miombo woodlands together with similar woodland types account for a greater percentage of Malawi`s forested area (FAO, 2025). The remainder consist of closed canopy broadleaved forests and small areas of montane forest. Data shows that land under protected areas has increased by 8% to 148,224 hectares (FAO, 2010).

However, enormous pressure exerted on forest resources (**Figure 4-4**) reduced the country's forest cover from 47% in 1975 to 24% in 2020 (World Bank, 2023). Furthermore as reported by the Global Forest Watch (2022), in 2010, Malawi had 1.39 million hectares of natural forest, covering over 12% of its land area but, in 2021, the country had lost 14,700 hectares of natural forest. Examples of key forest reserves which are still rich in biodiversity include Mulanje Mountain, Dzalanyama, Thuma, Ntchisi, Misuku and Matandwe forest reserves.

Nyika, Kasungu, Liwonde, Lake Malawi and Lengwe National Parks, four Wildlife Reserves (Vwaza, Nkhotakota, Majete and Mwabvi), and three Nature Sanctuaries (Lilongwe, Mzuzu and Michiru) cover 11.6 % of the country's land area. In addition, there are several private wildlife ranches such as Kuti Community Wildlife Ranch, Nyala Park, Game Haven, Kaombe Wildlife Ranch among others. Annual costs from forest depletion are estimated at US $66 million (NFPM 2016).

Figure 4-5: Forest encroachment for agricultural production in South Viphya Forest Reserve (@Willie Sagona)

4.2.2.1 Living Tree Biomass

Living tree biomass in Forest Reserves in Malawi varies significantly. For example, based on a case study of seven forest reserves (Bunganya, Dedza-Salima, Dzalanyama, Kaning'ina, Mua-Livulezi, Perekezi, and Thuma), the average living tree dry mass is 99.8 t dry mass ha-1. It ranges from 68.6 ± 8.4 t DM ha-1 in Dzalanyama to 258.4 ± 22.6 t DM ha-1 in Kaning'ina (MCHF, 2021). The species of the living trees monitored in the field recorded a total of 176 different species with heights ranging from 4.5 to 22 m and DBH of 5.1 to 67.5 cm. Figure 4-5 shows the tree size distribution of the 15 tree species with the highest living biomass stocks (t dry mass ha-1).

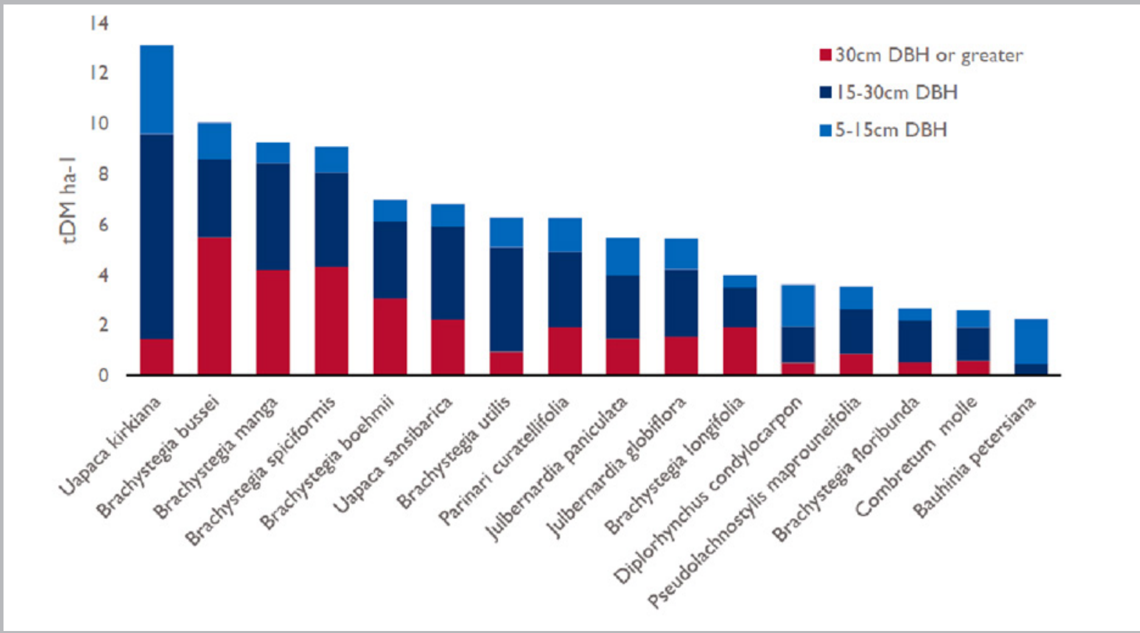


Figure 4-6: Total Biomass Density and Distribution of Biomass among Three Measured DBH Classes (5-15 cm, 15-30 cm, And 30 cm or Greater) in the Fifteen Tree Species with Highest Biomass Stock, T Dry Mass (Dm) Ha-1

4.2.2.2 Regeneration and Population Structure

Over 5,270 regeneration trees were inventoried across the Bunganya, Dedza-Salima, Dzalanyama, Kaning'ina, Mua-Livulezi, Perekezi, and Thuma Forest Reserves. The majority were small (71 percent) and medium (23 percent), with a few classified as large (7 percent) (**Figure. 4.6**).

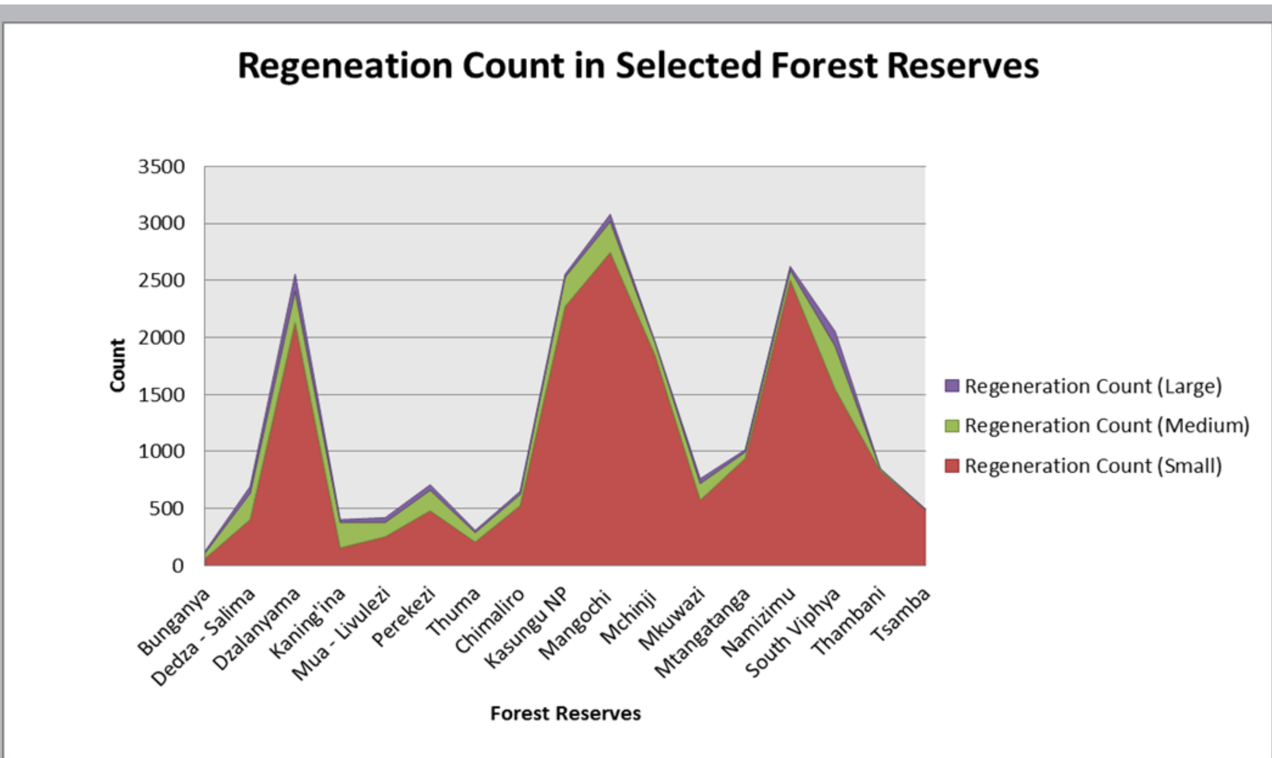


Figure 4-7: Regeneration Inventoried in the Seventeen (17) Forest Reserves, by Regeneration Classes: Small (20–49.9 cm Tall), Medium (50–149.9 cm Tall), and Large (Over 150 cm Tall and with DBH Below 5 cm)

The average stocking for the forest reserves ranged between 1,451 stems ha-1 for Dzalanyama to 2,592 stems ha-1 for Kaning'ina (**Figure 4-7**; **Table 4-1**). Charcoal production and wood extraction might be the reason for low stem density in the former, while conducive environmental conditions for tree growth complemented by relatively low wood extraction might be attributed to high stem density in the latter.

The highest tree density was registered in Kaning'ina (average of 864 stems per hectare). The rest of the forest reserves inventoried ranged from 417 to 680 trees per hectare, with the lowest density registered in Mua-Livulezi (**Table 4-1**). Appendix 1 has a complete list of species inventoried in each of the forest reserves and their count.

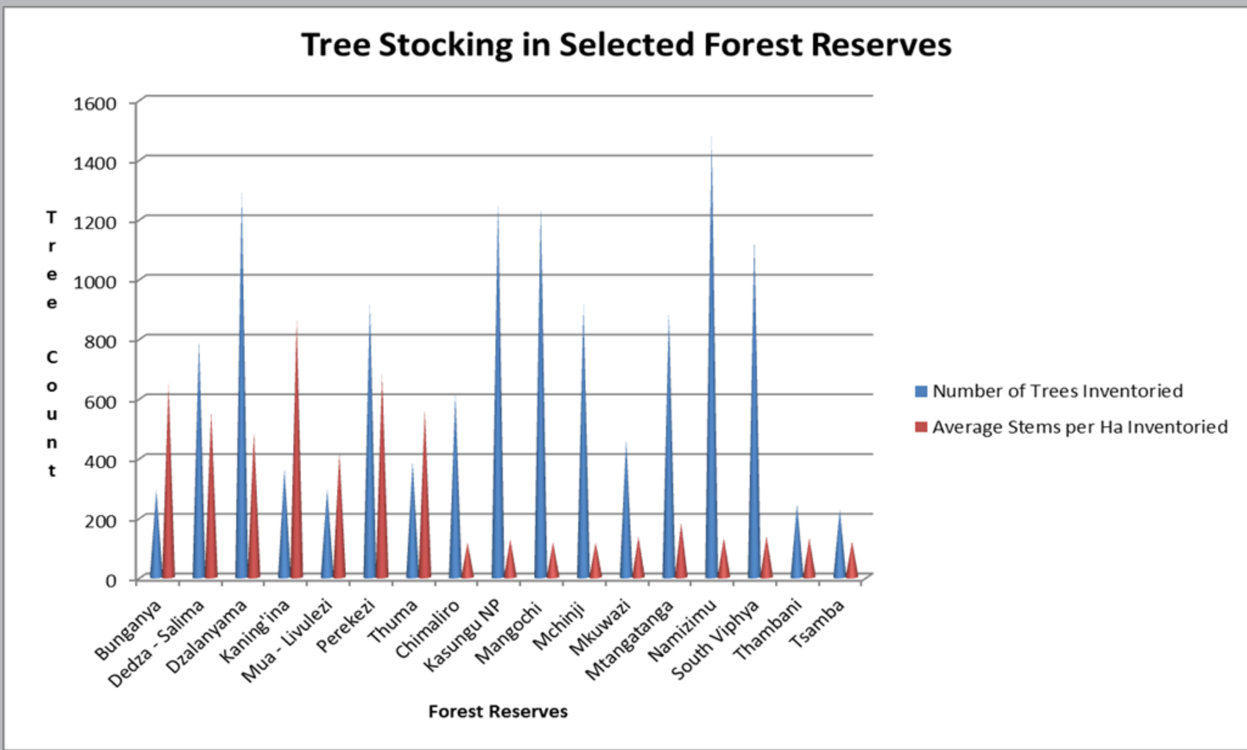


Figure 4-8: Number of Trees and Average Stems per Hectare in the Seventeen) Forest Reserves Inventoried in 2020

Stem distribution by DBH class indicates that Kaning'ina generally has a stable population that can successionally replenish itself if effectively managed. Dedza-Salima, Dzalanyama, Mua-Livulezi, and Thuma, while showing population structures that can succeed themselves since they have greater populations in the small DBH classes, show some considerable decline from DBH class 15–19.9 cm (Figure 4-8). While all inventoried forest reserves show potential to regenerate based on the number of small DBH class stems recorded. A predominantly low DBH population (below 20 cm) might suggest sustained forest degradation that is not allowing for continued tree maturity. This population structure analysis, however, does not capture the gravity of forest loss in these miombo estates.

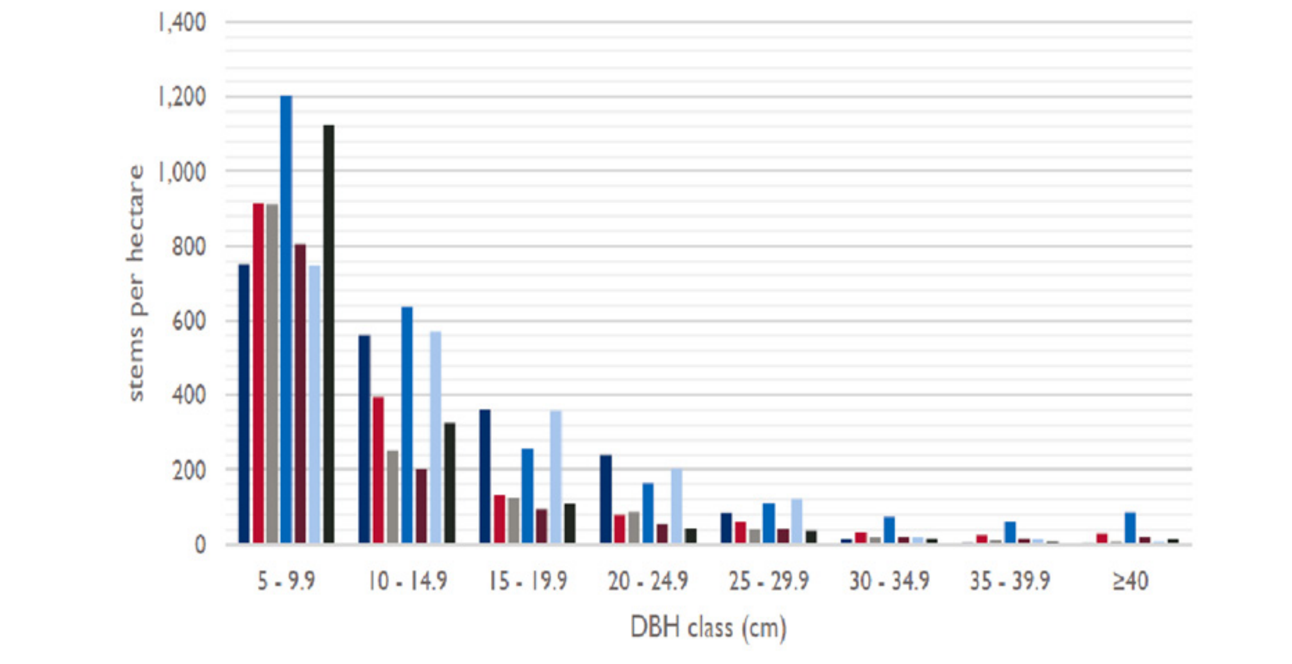


Figure 4-9: Stem Distribution for the Seventeen (17) Forest Reserves Inventoried in 2020

Mean tree DBH ranged between 21.7cm (Bunganya) and 30.9cm (Kaning'ina); tree heights ranged between 10.7m (Perekezi) and 15.5m (Kaning'ina). Site conditions are a possible contributing factor to this variation, mainly for height, as Perekezi has shallow, rocky soils and Kaning'ina has deep, friable soil.

Table 4-1: Mean Diameter and Height ± 90% Half Confidence Interval to the Mean of Trees in the Seventeen Forest Reserves Inventoried in 2020

Forest Reserve	Mean DBH (cm)	Mean Height (m)
Bunganya	21.7 ± 1.3	12.6 ± 0.6
Dedza - Salima	29.9 ± 1.3	12.9 ± 0.6
Dzalanyama	25.5 ± 0.8	11.0 ± 0.4
Kaning'ina	30.9 ± 2.3	15.5 ± 1.1
Mua - Livulezi	28.9 ± 1.9	12.0 ± 0.8
Perekezi	23.0 ± 0.8	10.7 ± 0.3
Thuma	28.6 ± 2.1	13.3 ± 0.9
Chimaliro	20.0± 0.6	10.6 ± 0.3
Kasungu NP	14.9 ± 0.5	13.6 ± 0.3
Mangochi	23.6 ± 0.7	14.1 ± 0.3
Mchinji	21.9 ± 0.6	13.6 ± 0.4
Mkuwazi	23.8 ± 1.5	19.4 ± 0.7
Mtangatanga	15.4 ± 0.5	8.9 ± 0.2
Namizimu	22.7 ± 0.6	14.2 ± 0.3
South Viphya	20.4 ± 0.6	14.3 ± 0.3
Thambani	25.6 ± 1.7	14.3 ± 0.7
Tsamba	20.3 ± 1.1	10.2 ± 0.5

4.2.2.3 Wood Volumes

Matching the biomass stocks, the highest volumes per hectare (Table 4-2) were found at Kaning'ina forest reserve (383 ± 37 m3 ha-1), while Dzalanyama had the lowest (119 ± 13m3 ha-1).

Table 4-2: Average Stem Wood Volume (M3 Ha-1) ± 90% Half Confidence Interval to the Mean and Uncertainty of the Estimate (%), for the Seventeen Forest Reserves Inventoried in 2020

Table 4-1: Mean Diameter and Height ± 90% Half Confidence Interval to the Mean of Trees in the Seventeen Forest Reserves Inventoried in 2020

Forest Reserve	Average Total Tree Volume (m3Ha-1)	Uncertainty (%)
Bunganya	222 ± 32	14.5
Dedza - Salima	187 ± 28	14.8
Dzalanyama	119 ± 13	10.6
Kaning'ina	383 ± 37	9.5
Mua - Livulezi	122 ± 31	25.5
Perekezi	234 ± 25	10.7
Thuma	149 ± 35	23.2
Chimaliro	408 ± 46	11.2
Kasungu NP	341 ± 35	10.1
Mangochi	482 ± 53	10.9
Mchinji	414 ± 43	10.4
Mkuwazi	644 ± 137	21.3
Mtangatanga	524 ± 40	7.7
Namizimu	513 ± 47	9.1
South Viphya	489 ± 65	13.2
Thambani	589 ± 123	21.1
Tsamba	492 ± 137	27.9

4.2.2.4 Forest Governance

The National Forestry Policy of Malawi adopted in 2016 promotes participatory forest management as one of its key policy outcomes aiming to achieve "increased participation of all stakeholders in forest conservation and management" (Government of Malawi 2016, p.13). In 2020, the Government of Malawi enacted the Forestry Act Amendment which includes clear guidelines for regulating forest products such as charcoal. The amendment also emphasizes increased collaboration, and participation of stakeholders in forestry-related decision-making processes, strengthened law enforcement, and the implementation of stiffer fines and penalties. Just like many African countries, Malawi has evolved its forest management policies from the pre-colonial era where communities managed their forests under traditional leadership, to the colonial and post-colonial era where fences and fines were used to exclude local communities after taking away their rights to utilise forests, and finally to the current era of co-management policies developed from the 1990s (Zulu 2013). The 1996 Forest Policy and the proceeding Forest Act of 1997 marked a paradigm shift which allowed people to return to forest reserves legally. Before the forest devolution policies, local people living next to protected forests in Malawi had been marginalised and did not benefit from the centralised government system of managing forests (Kamoto et al. 2008).

Local people were often excluded from decision-making processes, had limited access to forest resources, and did not receive economic or livelihood benefits from the forests despite depending on them for fuelwood, food, and other ecosystem services. Much as the current articipatory forest management model has played a direct and crucial role in structuring the roles and responsibilities regarding local people's involvement, it has been criticised for sending contradictory signals resulting from the way the policy has been framed and interpreted by the bureaucracy (Kamoto et al. 2008).

District-level forest governance in Malawi is anchored in the decentralization framework established under the Forestry Act and the Local Government Act. District Councils coordinate natural resource management through the District Executive Committee, while the District Forestry Office, representing the national Department of Forestry, provides technical oversight, enforcement, and support for participatory forest management. At community level, structures such as Village Natural Resource Management Committees (VNRMC) work alongside traditional leaders to manage Village Forest Areas, and enforce by-laws, thereby integrating forest conservation into broader district development planning. In addition to VNRMCs, Block Management Committees (BMCs) also support community-level forest management. BMCs are community-based structures established under the Forestry Act to manage specific forest blocks within reserves. They work in collaboration with the District Forestry Office to implement participatory forest management plans. Their roles include regulating forest use, monitoring illegal activities, managing fires, and overseeing benefit-sharing among communities.

Co-management is one of the institutional arrangements under the participatory forest management approach which provides a framework for managing common pool resources, such as public forest, where communities and state agencies share the responsibilities (costs) and benefits of forest management through clearly agreed collaboration guidelines.

These community-level institutions also apply traditional management systems for forest resource management. It has been shown that in communities where traditional management systems informed by indigenous local knowledge are followed and enforced, there is impressive conservation and management of terrestrial ecosystems. These sites shelter a rich diversity that contributes to ecological safety. For example, at Khulubvi sacred forest where they integrate ILK into its management, the ecosystem and biodiversity are well conserved.

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Weak governance are deficiencies in capacity to manage and/or disparities in power, influence, and wealth that lead to mismanagement, lack of accountability, and inability of individuals, communities, legal entities and groups to act upon and defend their rights in land, resources and property. Weak governance of forest resources is prevalent in forest reserves (even those under co-management) and Village Forest Areas (PERFORM 2016). Areas of particular prominence are concerns about the state of forest resources since the onset of co-management between the Department of Forestry on the one hand and Local Forestry Organizations (LFOs) on the other. Deficiencies in the capacity to manage across the spectrum of key actors; the tendency of some community-based governance institutions to concentrate power and influence and the power differences between community-based institutions and powerful interests are reported. While the intentions for co-management have always been good, participatory forest management has had its weaknesses and strengths. The strengths and weaknesses are presented in **Table 4-3**.

Table 4-3: Strengths and weaknesses of participatory forest management

Issue	Strengths	Weaknesses
Capacity	▪ Capacity development and training is available for communities ▪ Government extension staff is well trained ▪ Indigenous knowledge exists on how to manage forest resources ▪ Communities and DoF have been trained by IFMSLP ▪ Staff is available in DoF and DFO	▪ Poor understanding of communities and service providers of PFM ▪ Gaps exists in district level extension skills
Forest management policies	▪ Enabling policies and legislation exist (Forestry Policy, Forestry Act, Decentralization Policy, CBFM supplement policy) ▪ Tenure arrangements for customary forests are supported	▪ Poor coordination and harmonization of policies ▪ Policy level participation is weak ▪ Weak implementation of policies ▪ Communities see PFM as a top down approach ▪ Land tenure issues not always clear ▪ In some forest areas there is common access ▪ Tree ownership is sometimes unclear
Forest management practices	▪ Procedures for PFM are in place ▪ Forests on public and customary land are still available	▪ PFM is time consuming ▪ Labor demand on communities is high ▪ PFM is costly

		▪ Lack of energy alternatives for charcoal and firewood ▪ High rates of deforestation and poverty still exist ▪ Over dependency on forest resources
Institutions and accountability	▪ Existing local traditional governance structures and institutions ▪ Local leader are involved in PFM ▪ Cohesions at community level ▪ Presence of functional local forest organizations ▪ A long history of PFM exists	▪ Corruption and bribery exist ▪ Political interference in PFM ▪ Forest resources are used for other purposes than intended ▪ Weak prosecution
Participation and empowerment	▪ Transparency and accountability are promoted ▪ Active participation of communities is promoted ▪ Grassroots organizations are involved	▪ Men dominate forest management ▪ Youth is excluded
Financial resources	▪ Funds are available through international cooperation	▪ Access and benefit sharing not clear ▪ Dependency on forests for income ▪ State control of forest reserves may limit co-management incentives
Information		▪ No adequate research and science available ▪ Not enough knowledge on indigenous forests ▪ Inadequate knowledge and management of forest resources

Table 4-3 Conti.: Strengths and weaknesses of participatory forest management

4.2.2.5 Measures to improve forest co-management

Effective participatory forest management requires the active engagement of governmental officials, local leaders (e.g., village headmen), community-based organizations and, to some extent, private sector actors. In cases where these key actors have clear roles and responsibilities and where they work in coordination with each other, the sharing of management functions can be quite effective. The following are some of the measures to be taken towards the improvement of forest co-management in Malawi:

1. Clarify key property rights, terms and definitions to assure shared understanding and legal basis, including: “The Government, hereby, wishes to make an agreement with the LFO to provide for the transfer of management authority and ownership of forest resource in order to promote forest management and the enhancement of livelihoods of the forest adjacent communities” (IFMSLP 2013), as well as “The Director of Forestry shall have the right to terminate this agreement and revoke authority to protect, manage, control and utilize forest resources, in any of the following events: Negligence or failure to protect, manage and control the co-management block. If the LFO commits any serious breach of the agreement” (IFMSLP 2013).

2. Review role expectations and make them realistic and achievable. Examine the roles and responsibilities of each key actor and clearly define the necessary capacities and resources needed for successful completion. Distribute responsibilities in a way that reflects the constraints faced by the Department of Forestry and Block Management Committees. Consider creative alternatives to achieve goals, including use of social media for communicating incidents, drawing on neighboring universities for interns or area schools for volunteers. Also identify ways that the responsibilities can be broadened so that the burden is shared across the community - not only by a selected number of volunteers.

The perception that only BMCs or VNRMCs are responsible for managing the Forest Reserve and VFAs is a recipe for failure. Unfortunately, some BMCs seem to have embraced this idea as they receive certain benefits that they share among themselves. Teamwork and shared responsibility should be the cornerstone of co-management around the forest reserve.

3. Enhance consistency of fines between co-management plans across blocks and between reserve and VFAs. Due to varying fines for violations of forest rules from one block to another and between a community forest and a forest reserve, there is a risk that some blocks and VFAs are targeted for being more lenient on violations. Presently fines vary significantly from one area to another, with some fines being unrealistically high and others too low to serve as a deterrent . It is important to consider fines that are deterrent enough but also enforceable.

4. Broadly disseminate copies of and information on co-management plans in local languages. The contents of co-management plans need to be shared and discussed with the community at large. Not only do community members need to understand the expectations of the BMCs to help hold them accountable, but they also need to know how they can help protect the forest reserve and understand the benefits that accrue to them for its protection.

5. Agree on a regular schedule for review and updating plans to make them responsive to changing context. The co-management plans capture one snapshot in time and are meant to operate in a changing context influenced by a shift in demand for forest resources. Ensure that all plans are shared with the judiciary and the District Commissioner so that sanctions have legal support and to ensure legality of the plans. Many community members express frustrations at the difficulty they experience in enforcing sanctions in the co-management plans. To address the concern of leniency towards offenders, the judiciary suggested that the District Magistrate's office retain copies of all co-management plans so that they could refer to the stipulations during case prosecutions.

6. Revisit sanctions to render them more conservation/restoration focused. Creative approaches to sanctions can be an option to ensure that penalties help improve natural resources management. For instance, rather than paying a fine, those caught cutting trees can be ordered to plant and care for 100 seedlings.

7. Integrate and clarify the role of village leadership structures in forest management. In some instances, a village headman may need to be more integrated into the co-management process; in others the very village leader may be undermining conservation efforts.

8. Clarify the role and composition of the Forest Management Board. Advocate for a place from the Department of Forestry, a representative and other key stakeholders to monitor/participate in FMB activities. A special meeting of the FMB may be needed to check in on progress to date and try to determine what functions the board is fulfilling and what support it may need to increase its transparency and inclusion.

9. Review the roles and responsibilities of the Department of Forestry in the success of co-management and develop an action plan to address gaps. An action plan to address gaps can help pinpoint areas of potential partner assistance.

10. Consider offering training in collaborative decision-making/mediation. Seemingly out of frustration many BMCs are suggesting stiffer penalties for violations of co-management rules; however, these high fines exceed the capacity of most Malawians to pay, thereby becoming unenforceable. Through training in collaborative decision making and mediation, perhaps a broader range of restorative-focused solutions could be considered.

4.2.3 Mountains Ecosystem

In the Status of Mountain Development Strategy (SMDS) (UNEP-WCMC, 2000), mountains have been defined based on a topographic criterion that considers altitude above sea level, steepness of slope and local elevation range (LER). This classification was developed in 2000 by the United Nations Environment Programme – World Conservation Monitoring Center (UNEP-WCMC) to represent the environmental gradients that are crucial components of mountain environments. The classification indicates six elevation classes according to the following scheme:

- Class 1: elevation ≥ 4 500 m
- Class 2: elevation 3 500 – 4 500 m
- Class 3: elevation 2 500–3 500 m
- Class 4: elevation 1 500–2 500 m and slope ≥ 2°
- Class 5: elevation 1 000–1 500 m and slope ≥ 5° or LER > 300 m
- Class 6: elevation 300–1 000 m and LER > 300 m

Malawi's total land area is approximately 94,240 sq. km, and can be divided into four categories; of mountains, plateaus, escarpments and rift valley trough zones. The highlands and escarpment zones range from 900-3,000m above sea level consisting mainly of mountainous, plateaus areas and rugged terrain with steep slopes. Areas with steep slopes of 12% or more are found in the highlands and escarpment zones, covering about 23,670 sq. km which is more than 25 % of the country's land area.

Around 31 percent of the Malawian population lives in mountainous areas, with most residing at elevations below 1 500 m. Three out of Malawi's four main cities (Blantyre, Zomba and Mzuzu) are partially located in elevation Class 5 (elevation 1 000–1 500 m and slope ≥ 5° or Local Elevation Range (LER) > 300 m).

Mountain ecosystems in Malawi, including critical areas like Mount Mulanje, Zomba Plateau, Nyika Plateau, and the Misuku Hills. These are essential for water catchment, biodiversity, and local livelihoods, yet they are currently under severe, accelerating pressure from human activity (Chinangwa et al., 2017; Mauambeta et al., 2010; Smith et al., 2015; Baylis et al., 2024). While these regions are recognized for their high levels of endemism and unique Afro-montane forests, rapid degradation is leading to the loss of biodiversity and the critical reduction of key species like the Mulanje Cedar (Smith et al., 2015; Baylis et al., 20 24). The Thyolo Escarpments, Livingstonia and Mphompha Highlands, Nyika Plateau, Mulanje Mountain, Michiru, Soche Hills and Dedza Mountain are examples of how mountains have been encroached for settlement and cultivation thereby causing extensive deforestation. Mountainous regions are suffering from severe deforestation, with an estimated 3% of forest cover lost annually, according to older reports, while recent data indicates continued loss of over 250,000 hectares of forest cover between 2001 and 2023 across the country. Invasive alien species also pose a serious threat to Malawi's mountain ecosystems.
Mulanje Mountain, Nyika Plateau, and Zomba Plateau, which are key centres of biodiversity and water catchment are infested with invasive plants. Lantana camara and Black wattle outcompete native vegetation, suppress regeneration of endemic species, and alter habitat structure, thereby reducing biodiversity. Dense invasive stands increase fuel loads and fire intensity, disrupt natural hydrological processes by consuming large amounts of water, and accelerate soil erosion on steep slopes, leading to siltation of rivers and reservoirs downstream (Le Maitre et al., 2014; FAO, 2007). These ecological changes diminish the capacity of mountain forests to regulate water flow, support wildlife, and sustain local livelihoods, while also increasing management costs and undermining tourism potential. Together, invasive species significantly weaken the ecological integrity and resilience of Malawi's montane ecosystems, especially under growing pressures from climate change and human disturbance.

Mountain ecosystems supply a disproportionate share of ecosystem services (water regulation, erosion control, hydropower catchments), so national estimates of losses from unsustainable natural resource use cost about US$190–200 million per year (Yaron et al., 2011). Unsustainable cultivation practices in these mountain areas have also resulted in severe land degradation leading to soil erosion and the subsequent siltation of rivers and other water bodies downstream. This affects other sectors of the economy including electricity generation in the energy sector with direct costs (not including multiplier effects) of about $US 1.5 million/year; and investments required amounting to $13.7 million (National Climate Change Management Policy, 2016).

The absence or neglect of ILK in integrated conservation management is a factor for the rapid degradation of mountain ecosystems. For example, at Mulanje forest reserve such indigenous local knowledge were rampant and adhered to by the local communities in the past before external influences came to disrupt them. These differences are well reflected in terms of how biodiversity is almost intact at Khulubvi sacred forest unlike at Mulanje f orest reserve where cases of biodiversity degradation and toxic conflicts between the local community and government over forest resource management are common.

4.2.4 Grassland Ecosystem

Grasslands in Malawi form an important but often overlooked component of the country's terrestrial ecosystems. They occur mainly on high plateaus, valley bottoms, and seasonally waterlogged wetlands known as dambos, and are often interspersed with woodland ecosystems such as miombo (Roberts, 1988). Extensive grassland areas are particularly found on high-altitude plateaus like Nyika National Park and in dambo landscapes across central and northern Malawi. These grasslands are dominated by perennial grasses and sedges and provide important habitats for wildlife, birds, insects, and grazing animals. Highland grasslands in areas such as Nyika National Park are particularly rich in plant diversity and support several endemic and specialized species adapted to open habitats. In addition to biodiversity conservation, grassland ecosystems contribute to ecosystem services such as soil protection, water regulation in dambo wetlands, and provision of grazing resources for rural livelihoods.
In terms of biodiversity, Malawian grasslands provide habitats for several bird species, including ground-nesting and migratory birds such as the Denham's Bustard and the Secretarybird. These ecosystems also support reptiles, amphibians, and pollinators that play key ecological roles in maintaining ecosystem balance. Wet grasslands in dambos are particularly important for amphibian diversity and seasonal breeding habitats. However, these ecosystems are increasingly threatened by agricultural expansion, overgrazing, frequent burning,

and invasive plant species, which can reduce habitat quality and biodiversity if not sustainably managed (Government of Malawi, 2015; Roberts, 1988; White, 1983).

Despite these pressures, grasslands remain ecologically significant for maintaining landscape connectivity and supporting biodiversity outside protected areas such as Nyika National Park and Liwonde National Park, where natural grassland–woodland mosaics support diverse wildlife communities. Sustainable management practices including controlled burning, rotational grazing, and conservation of dambos, are therefore important for maintaining grassland biodiversity and ecosystem services in Malawi.

4.2.5 Agricultural Ecosystem

The driving force of Malawi's agricultural sector and its economy is agro-biodiversity defined as the variability among living organisms associated with cultivated crops and domesticated animals and the ecological complexes of which they are a part . It comprises the diversity of varieties and breeds used for food, fodder, fuel and pharmaceuticals and species that support production such as soil microorganisms and pollinators. The Malawi Plant Genetic Resource Centre is responsible for germplasm conservation activities in the country. As of 2004, the genebank had 2,514 accessions from 56 species including 2,074 seed samples and 440 vegetative materials from all regions in Malawi. Species in storage include cereals (Z. mays, Oryza sativa), legumes (Phaseolus vulgaris, Pisum sativa), root and tuber crops, vegetables and vegetative material (Musa species , Manihot esculenta, Plectranthus esculenta).

Malawians grow a wide variety of crops including cereals (maize, rice, sorghum), legumes (groundnuts, beans, pigeon peas, cowpea), roots and tubers (cassava, sweet potato and potato), horticultural (bananas, guava, oranges, tangerine, lemons), vegetables (cabbage, tomatoes, carrots, onions) as well as cash crops (tea, tobacco, cotton and sugarcane). Sorghum (Sorghum bicolor) and millet (Pennisetum spp. and Eleusine coracana) are indigenous cereals that were gradually replaced by the introduction of maize (Zea mays). Current agricultural policies favour maize production because it is the main staple food. However, there are efforts to promote production of the indigenous cereals because they are drought resistant. The local flint maize varieties have hybridized with new hybrids that have been released over the years hence what is termed local varieties nowadays are generally recycled hybrids. Beans (Phaseolus vulgaris) have high genetic diversity and the popular varieties include red kidney, white, and speckled/variegated beans. There have been initiatives to promote legume diversification and conservation of indigenous legumes among smallholder farmers. Examples of legumes promoted include bambara groundnut (Vigna subterranea). .

Malawi's agriculture is influenced by four major agro-ecological zones determined by altitude, rainfall, and temperature: the Lower Shire Valley, lakeshore/low-lying areas, medium-altitude plateau, and highland zones. The hot, semi-arid Lower Shire Valley (Nsanje and Chikwawa) receives less than 600 mm of rainfall annually and mainly grows drought-tolerant crops such as sorghum and millet, with limited irrigated maize and vegetables along riverine areas. On the other hand, the lakeshore and other low-altitude plains (400–1,000 m) have fertile alluvial soils and higher temperatures, which are ideal for crops like cassava, rice, maize, cotton, and groundnuts. Cassava is particularly significant in this region due to its ability to withstand heat and moisture fluctuations, while rice is predominant in floodplains and irrigated wetlands. Maize remains the primary staple food across most zones although its productivity is dependent on the reliability of rainfall (GoM, 2020; ReSAKSS, 2022).

The medium-altitude plateau (about 800–1,500 m), covers much of central Malawi and is considered the country's agricultural "breadbasket" because of moderate temperatures and reliable rainfall (800–1,200 mm). This zone produces most of the maize, tobacco, groundnuts, soybeans, and legumes that support both food security and export earnings. In the cooler highlands above 1,500 m such as the Nyika Plateau, Mulanje, and parts of Thyolo higher rainfall and lower temperatures favour temperate and plantation crops including tea, coffee, Irish potatoes, wheat, and horticultural vegetables. These ecological gradients create a distinct spatial pattern of crop specialization across the country, with drought-resistant cereals in the south, root and rice systems along lakeshores, maize-legume systems in the central plateau, and plantation or cool-climate crops in upland areas (GoM, 2016; FAO, 2015; World Bank, 2020).

4.2.5.1 Neglected and underutilized species (NUS)

The agriculture ecosystem hosts some crops that are considered neglected and underutilized. Neglected and underutilized species (NUS) in Malawi play a crucial role in enhancing agro-biodiversity, dietary diversity, and climate resilience. However, they receive limited research, policy, and market support compared to dominant crops such as maize and tobacco. Many of these crops are traditionally grown in marginal environments such as drylands, uplands, or poor soils, where they are well adapted to climatic variability.

Examples include small grains like finger millet (Eleusine coracana), sorghum (Sorghum bicolor), pearl millet (Pennisetum glaucum), and indigenous legumes such as bambara groundnut (Vigna subterranea) and cowpea (Vigna unguiculata). These crops are drought-tolerant, require low external inputs, and contribute to soil fertility and pest management, making them valuable components of diversified and resilient farming systems (FAO, 2019; Chivenge et al., 2015).

Root and tuber crops such as cassava (Manihot esculenta), sweet potato (Ipomoea batatas), and yams (Dioscorea spp.) are sometimes considered secondary to maize in policy focus. However,they are critical for food security, especially in lakeshore and low-rainfall areas.

Orange-fleshed sweet potato varieties, contribute to vitamin A nutrition, while cassava provides a reliable food buffer during drought years. Indigenous vegetables, including amaranth (Amaranthus spp.), spider plant (Cleome gynandra), African nightshade (Solanum spp.), and jute mallow (Corchorus olitorius), are rich in micronutrients and are often cultivated in small plots or collected from the wild. Their continued use conserves genetic diversity and supports ecosystem functions such as pollinator attraction and soil cover (FAO, 2019).

In relation to agro-biodiversity, neglected and underutilized crops enhance resilience by broadening the genetic base of farming systems, reducing dependence on a narrow range of staples, and supporting ecosystem services such as soil fertility, pest regulation, and climate adaptation. However, constraints include limited availability of improved seed; weak market linkages; low research investment; and policy bias toward major cereals. Strengthening community seed banks; integrating NUS into national seed policies; promoting value addition; and supporting farmer-managed seed systems would help conserve these species in situ while improving livelihoods. Promoting NUS is therefore not only a food security strategy but also a biodiversity conservation approach aligned with sustainable agricultural development goals.

4.2.6 Livestock Status in Malawi

Livestock in Malawi, representing roughly 7% of GDP and involving over half of smallholder families, focuses primarily on low-input, smallholder cattle, goats, pigs, and poultry, often facing low productivity, high disease rates, and significant climate-related challenges. Despite being crucial for rural livelihoods, the sector faces shortages, leading to reliance on imports for meat. Majority of the livestock (95%) are of the indigenous breed which are characterised by low fertility and growth performance, low milk yield (1 litre/day for cattle) and early maturity resulting in smaller mature body sizes. These species are at risk of genetic erosion due to indiscriminate cross-breeding, stock thefts and diseases. **Figure 4-10** presents livestock populations for 2023 and 2024.

Livestock production in Malawi is a crucial aspect of rural livelihoods, food security, and agricultural biodiversity. The sector contributes approximately 11–12 % of agricultural output and provides meat, milk, manure, draft power, income, and social assets for households. Malawi maintains a wide variety of species, with poultry, goats, cattle, pigs, and sheep being the most significant. Chickens are the most numerous, often found in over 60 % of households followed by cattle and goats. This distribution showcases their adaptability to smallholder farming systems. Livestock also plays a significant role in providing animal protein and complements crop production through nutrient cycling and traction services (FAO, 2005; DAHLD, 2015).

Cattle are the most prominent large livestock species and are especially concentrated in the northern and central regions where grazing land is more available. They are primarily indigenous zebu types managed under extensive systems, grazing communal rangelands and crop residues, with limited supplementation. Cattle provide beef, milk, manure, and draft power for ploughing, making them central to mixed crop–livestock systems. However, productivity remains low due to feed shortages, diseases, and shrinking grazing land. Goats, particularly the hardy East African type, are widely distributed across all agro-ecological zones because they tolerate drought and poor-quality forage. They are typically kept under free-range or tethering systems and serve as a key household asset that can be sold quickly for cash, thus enhancing resilience and maintaining local genetic diversity (FAO, 2005).

Small livestock species, especially poultry and pigs, play a crucial role in household nutrition and biodiversity conservation. Indigenous chickens account for more than 80 % of the national flock and are usually kept under scavenging free-range systems, feeding on insects, seeds, and household waste. This low-input system allows the birds to integrate with surrounding ecosystems while maintaining locally adapted genetic strains. Pigs are also widely kept by smallholders, either in free-range or semi-intensive systems, contributing significantly to meat production. Together with ducks, guinea fowl, rabbits, and other minor species, these animals diversify production systems, reduce risk, and enhance resilience to climate variability (FAO, 2005).

From a biodiversity perspective, Malawi's livestock systems are predominantly integrated, low-input, and based on indigenous breeds that are adapted to local climates, diseases, and feed resources. Animals recycle crop residues into manure, improving soil fertility and sustaining agro-ecosystem productivity without heavy reliance on synthetic inputs. Free-range grazing, while sometimes contributing to land degradation when unmanaged, also maintains open habitats and nutrient flows across landscapes. Consequently, livestock function not only as economic assets but also as components of agro-biodiversity, linking crop production, soil health, and ecosystem services. Strengthening sustainable management, such as improved grazing practices, fodder production, and animal health services, is essential to balance productivity with conservation of Malawi's biological resources (FAO Feed Inventory, undated; FAO Special Report, undated).

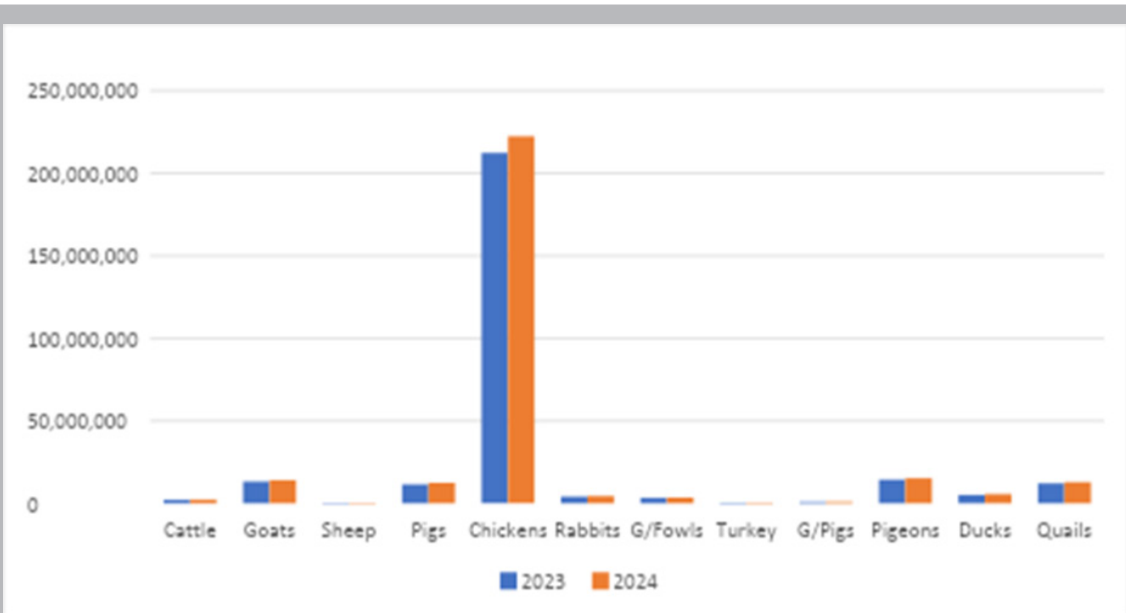


Figure 4-10: National Livestock Population in and 2023-2024

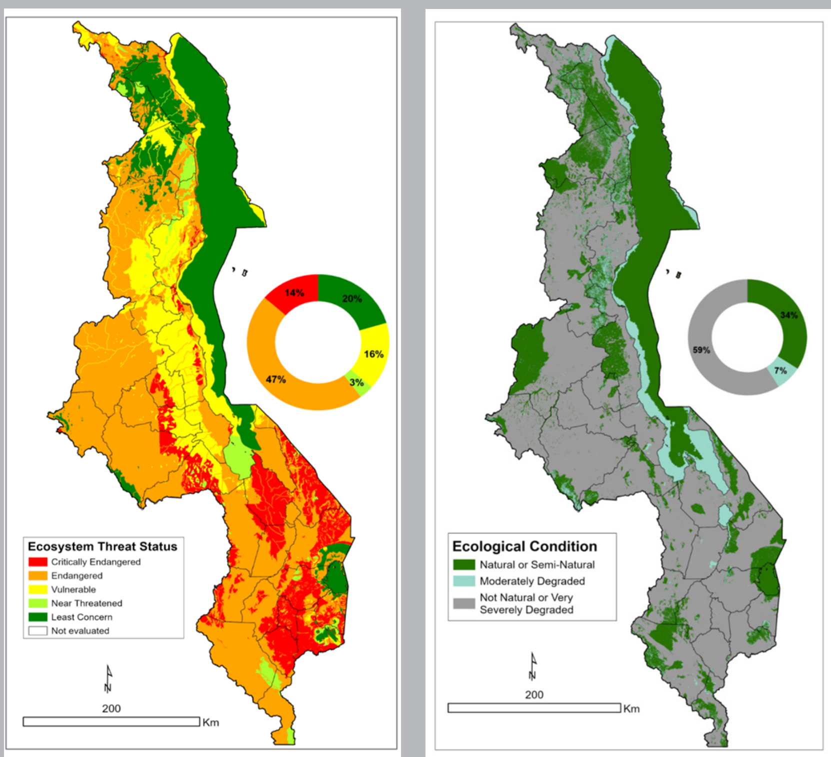


Figure 4-11: Status of Ecosystems (left) and Ecological condition (right) in Malawi

4.3 Biodiversity Trends in Terrestrial Ecosystem Forests Ecosystem

In 1975, 47% of the country was classified as forest. Presently, forests have experienced a high deforestation rate estimated at 2.8% representing an annual average loss of 250, 000 ha of forest cover which is highest in Southern Africa (Government of Malawi, 2016; Mauambeta, 2010). Out of the total land area of 94, 270, 000 ha classified as forest, only 3, 336, 000 ha is remaining representing 36% classified as forest. Of this area, 15% is under natural woodlands on customary lands, 11% under national parks and game reserves and 10% under forest reserves and protected hill slopes (**Figure 4-12**).

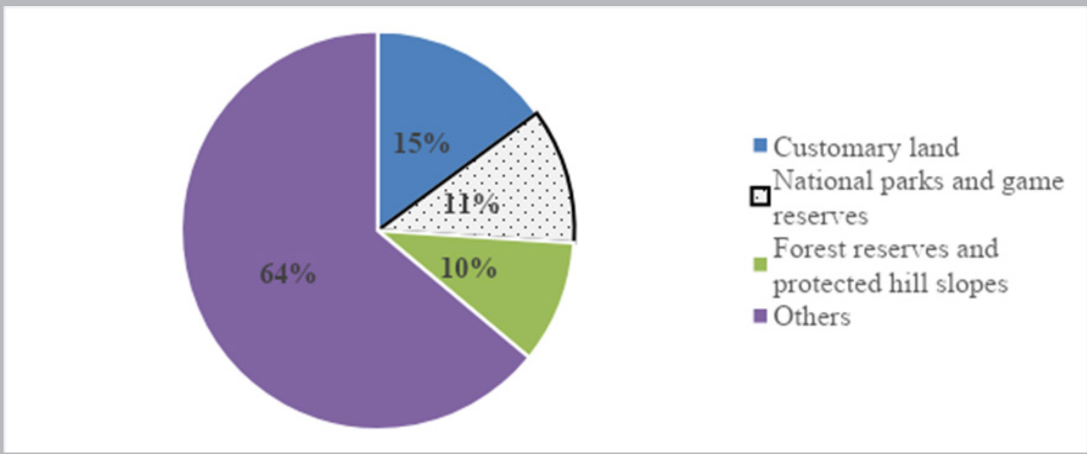


Figure 4-12: Current distribution of forest land

4.3.1 Forest Cover Trends

The rate of deforestation has increased from an average 2.3% to 2.8% since 1998. Malawi lost 2,501,571 ha of both indigenous and plantation forests between 1972-1992 and much higher values after this period. Between 1972 and 1990 the overall forest cover declined by 41% (**Figure 4-13**). Forest cover declined by 5% on public land mainly in protected areas and 61% on customary and private land. Much of the current deforestation occurs in indigenous forests and woodland on customary land

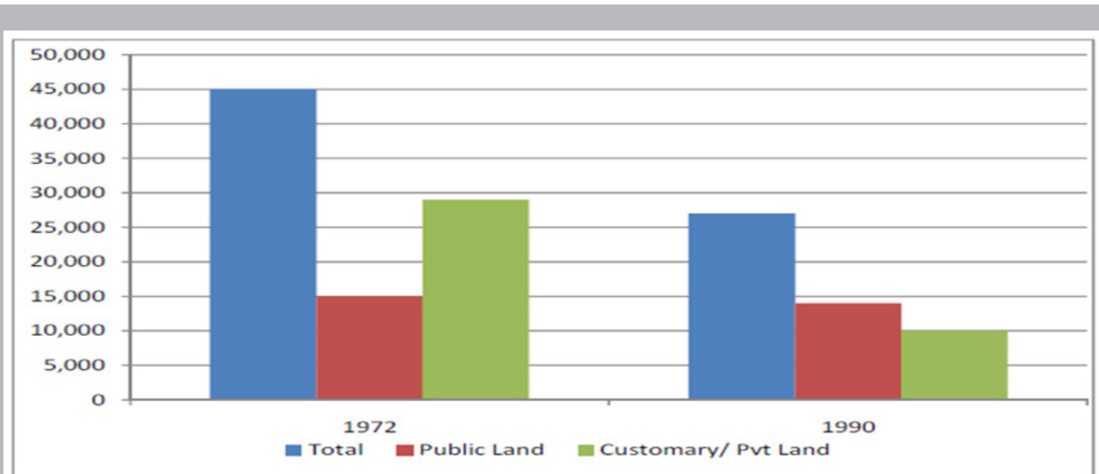


Figure 4-13: Land cover loss between 1972 and 1990 in Km^2

Deforestation in Malawi between 2010 and 2025 has remained severe and persistent, with significant implications for biodiversity. Satellite-based analyses indicate that between 2010 and 2020 the country lost forests at an average rate of about 11,500 ha per year (≈0.66 % annually), affecting both protected and non-protected areas. This loss reflects continued conversion of forests to agriculture, settlement, and fuelwood extraction. Earlier long-term trends show that Malawi has experienced sustained forest decline over decades, with forest resources heavily concentrated on customary land where regulation is weaker. Forests provide habitat for the country's rich assemblage of plants and animals, especially in miombo woodlands. Such losses directly threaten species survival and ecosystem integrity (FAO; undated).

During the 2010s and early 2020s, pressures on forests intensified due to population growth, poverty, and dependence on biomass energy. Estimates suggest Malawi loses roughly 30,000–40,000 ha of forest annually, one of the highest rates in Southern Africa. Agricultural expansion for subsistence crops and tobacco curing, along with charcoal production and fuelwood demand, are the dominant drivers. These activities fragment habitats, reduce wildlife corridors, and degrade ecosystem services such as pollination and soil protection, thereby undermining agricultural sustainability itself (Global Issues, 2025).

Recent evidence indicates that forest loss has continued into the 2020s, with alarming spikes in some years. Data compiled from Global Forest Watch show that Malawi lost nearly 23,000 ha of tree cover in 2023 alone, the highest annual loss recorded since 2001. Overall, the country has lost almost a quarter of a million hectares of tree cover since 2001, indicating cumulative degradation across the period leading up to 2025. Illegal logging, charcoal burning, and farmland expansion increasingly affect even gazetted forest reserves, eroding refuges for biodiversity and reducing carbon storage capacity (Global Issues, 2025).

From a biodiversity perspective, deforestation has profound consequences because Malawi's forests and woodlands support endemic species, watershed protection, and ecological stability. National assessments estimate that the country has lost about half of its forests over the past four decades, with continuing depletion leading to soil erosion, watershed degradation, and declining ecosystem productivity. Loss of forest cover directly reduces habitat availability, increases species vulnerability, and disrupts ecological processes such as nutrient cycling and hydrological regulation. Consequently, deforestation between 2010 and 2025 represents not only a land-use issue but a major driver of biodiversity loss and ecosystem decline in Malawi (United Nations Malawi, 2023).

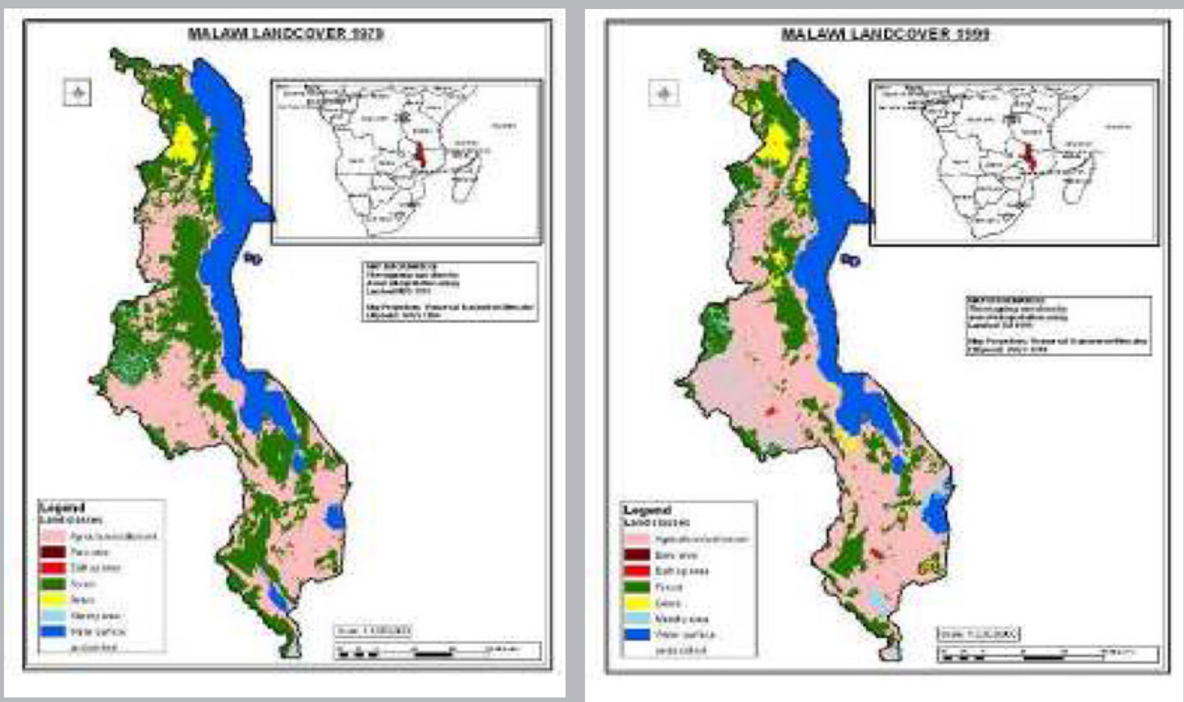


Figure 4-14: Malawi land cover change from 1979 (left) to 1999 (right) (Source: Malawi Department of Forestry)

4.3.2 Wild Animal Population Trends

Generally, mammal populations in most protected areas show a declining trend mainly due to poaching (Figure 4-15, 4-16). In Lengwe National Park (Figure 4-15 A&B), decrease in animal population from 2003 to 2009 can be linked to relocation of some animals to Majete Wildlife Reserve whose animal populations were locally extinct. The methodology for counting also contributed to low counts for mammals that normally hide in thickets such as Neotragus moschatus (Suni) and Kudu including nocturnal animals such as bush pigs as most surveys were conducted during the day. Figure 4-16 shows how animal population declined between 2017 and 2023 in Mwabvi Game Reserve. On the other hand, the decrease in the animal count for Vwaza (**Figure 4-17 A&B**) could be due to poaching and transboundary animal movement as the area shares boundaries with Zambia. The survey methodology and its timing could also be an issue.

According to the IUCN Red List (2017), ten mammal species including elephants and black rhinoceros are under threat. Other recorded taxonomic groups under threat include 18 bird species, 98 fish species, 24 plant species, 4 reptile species, 5 amphibian species, and 7 mollusc species. The decline in some protected mammal species has had a negative impact on the tourism industry, leading to a reduced contribution to the country's economy.

A.

B.

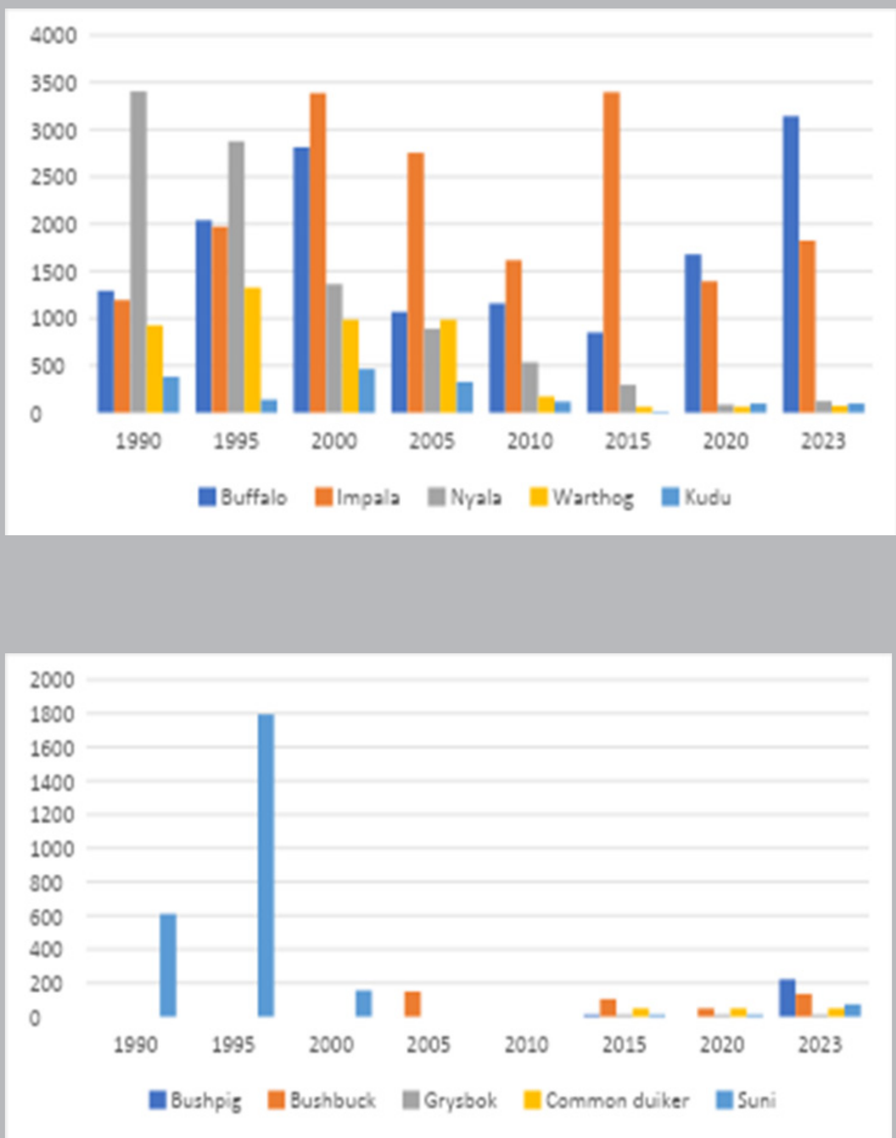


Figure 4-15 A and B: Animal Population in Lengwe National Park

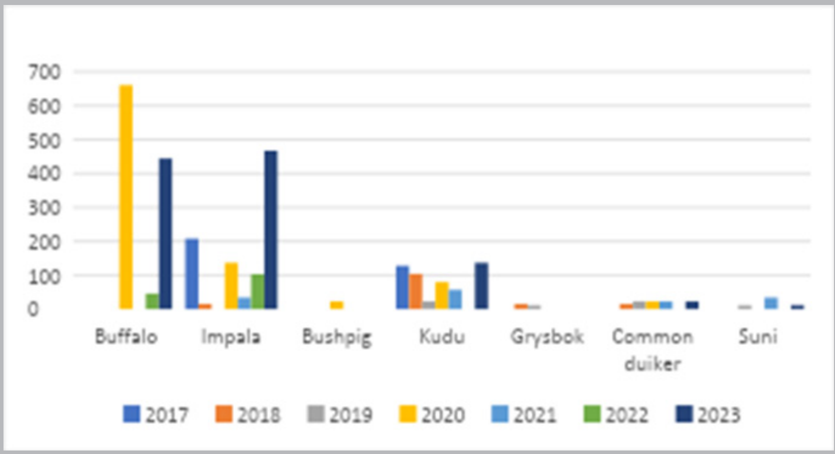
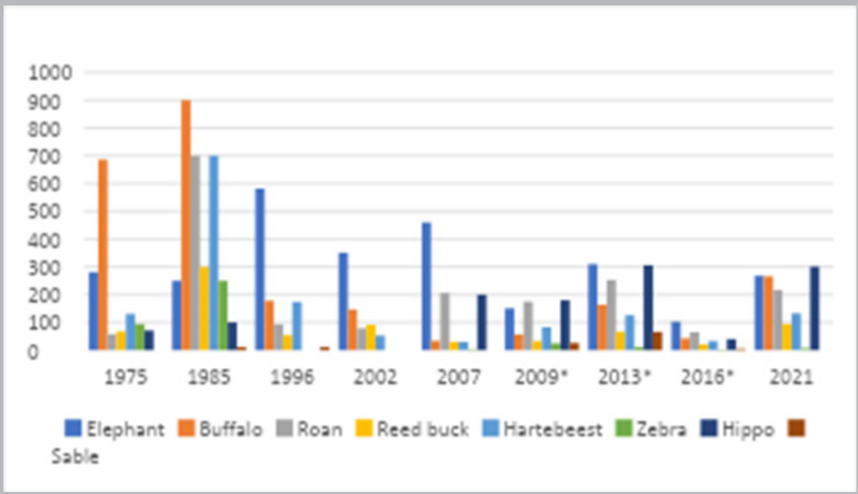


Figure 4-16: Animal population in Mwabvi Game Reserve

A.



B.

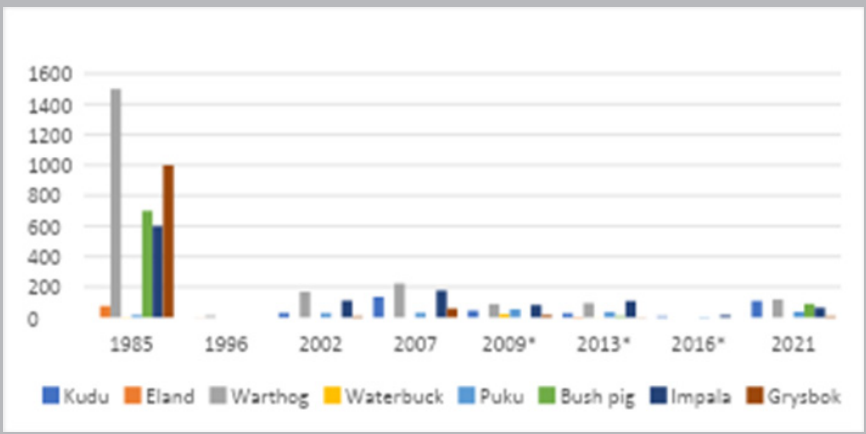


Figure 4-17: A and B Animal Population in Vwaza

Figure 4-18 provides the overview of animal population in Majete from 2003 when animals were initially reintroduced in the reserve, up until 2023.The population of elephants in the country in the 1970s-80s was estimated at over 4,000, while currently the population has reduced to slightly over 2,000. Black rhinos became locally extinct in the 1980s but were reintroduced in Liwonde National Park and Majete Wildlife Reserve where the population has been increasing. Out of the reported current elephant population, 13% is found in Majete Wildlife Reserve.

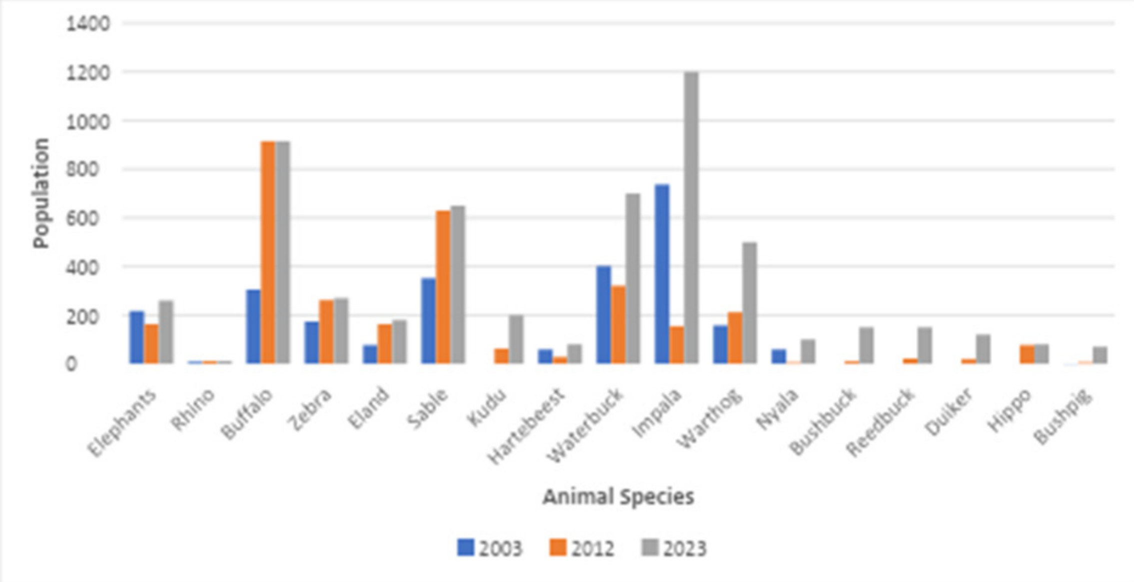


Figure 4-18: Animal Population in Majete Game Reserve between 2003 and 2023

4.3.3 Grasslands ecosystem trend

The trend of grassland ecosystems in Malawi shows a gradual decline and transformation driven mainly by land-use change, agricultural expansion, and population pressure. Natural grasslands occur in highland plateaus, montane landscapes, and seasonally wet valleys known as dambos, which are typically dominated by grasses and sedges and play an important role in water regulation and grazing systems. However, in recent decades many grassland areas have been converted to cropland or settlements as demand for food production and land increases. Studies on land-cover change in Malawi indicate that cropland and urban areas have expanded significantly, often at the expense of natural vegetation including grasslands (Frontiers in Environmental Science, 2025).

Another important trend is the intensification of land use in dambo grasslands, which are increasingly cultivated during dry seasons due to recurrent droughts and declining upland agricultural productivity. These wetlands and grasslands provide fertile soils and residual moisture, making them attractive for crop production and livestock grazing, but increased cultivation and grazing pressure can degrade natural vegetation and alter ecosystem functions (Chisinga & Kayuni 2011; Wood & Thawe 2013).

Additionally, grassland ecosystems remain important components of broader ecological systems such as the miombo woodland–grassland mosaic, which covers large parts of southern Africa including Malawi. These savanna landscapes support diverse plant species and wildlife but are increasingly vulnerable to habitat loss, uncontrolled burning, and unsustainable resource use.

Overall, the trend indicates that while grasslands still persist in protected areas and highland ecosystems, their extent and ecological integrity are declining in many unprotected landscapes, highlighting the need for improved land-use planning, sustainable grazing, and wetland conservation to maintain their role in supporting terrestrial biodiversity and ecosystem services in Malawi. The Wetland ecosystem chapter has some reflections on grasslands.

4.3.4 Agrobiodiversity trends

Malawi's food security lies in existing diversity (variation) in crops and that of their crop wild relatives. Crop genetic variation is the basis for crop improvement and fundamental to all breeding programs. Crop diversity is defined as the total variations of genetic and phenotypic characteristics of plants used in agriculture (Scheffers et al., 2016). Crop diversity is key to human and animal survival as it ensures food and nutritional security and adaptation to climate change.

Figure 4-19: A variety of crops grown on the terrestrial ecosystem

Since 2010, agrobiodiversity in Malawi has been influenced by a tension between increasing agricultural intensification and efforts to diversify production systems. The country's agriculture is primarily driven by smallholder farmers and maize cultivation, which occupies a significant portion of cultivated land. Studies show that approximately three-quarters of the cultivated area is dedicated to maize production, highlighting a consistent reliance on a single staple crop and a lack ofagricultural diversity. The emphasis on maize has been reinforced by input subsidy programmes that promote hybrid maize seeds and fertilizers, leading to a decline in the cultivation of traditional crops and landraces. Consequently, overall crop diversity on farms has remained limited despite policy recognition of diversification as a meansto achieve food security and resilience (FAO, 2019).

At the same time, monocropping trends have exposed farming systems to climatic and economic risks, prompting a renewed emphasis on diversification. Research shows that widespread maize monocropping increases vulnerability to climate variability and income instability, while mixed systems, especially those combining maize with legumes, can improve productivity, soil fertility, and resilience. However, the adoption of diversified systems has been constrained by limited landholdings, weak markets for non-maize crops, price volatility, and lack of access to inputs such as legume seeds. Consequently, although diversification initiatives have expanded since 2010, structural barriers have slowed large-scale transformation of cropping patterns (FAO, 2019).

Positive trends have emerged through conservation agriculture, agroforestry, and farmer-led innovations that enhance on-farm biodiversity. National biodiversity reporting highlights the promotion of indigenous crops (e.g., Bambara groundnuts, yams, sesame) and the establishment of community seed banks to conserve local varieties. Technologies such as agroforestry and farmer-managed natural regeneration have also increased the use of native tree species within agricultural landscapes, improving soil health, restoring degraded land, and maintaining genetic diversity of cultivated plants. These approaches reflect a shift toward climate-smart agriculture that integrates biodiversity conservation with productivity goals (Alliance of Bioversity International & CIAT, 2024).

In recent years, diversification has expanded within horticulture and mixed farming systems, particularly through innovations in vegetable production and intercropping . Vegetables now play a significant role in smallholder systems, contributing to dietary diversity, increasing micronutrient intake, and boosting household income (Mango, N. et al. 2024). Participatory innovations like strip cropping and integrated maize-legume systems have further improved ed nutritional diversity and land-use efficiency without compromising staple yields. Overall, agrobiodiversity trends in Malawi since 2010 show a gradual transition: maize-based systems continue to dominate, but there is a growing but uneven adoption of diversified, biodiversity-friendly farming practices aimed at enhancing resilience, nutrition, and sustainability (GoM, 2023).

4.3.5 Trends and Status of Indigenous Local Knowledge in relation to Terrestrial Ecosystems in Malawi

Cultural communities across all three regions have ancient indigenous knowledge and practices that thrived in a pre-colonial time. These practices ensured the sustainable utilization and conservation of terrestrial ecosystems such as mountains, woodlands and forests. These traditional management systems are rooted in indigenous local knowledge and practices, often influenced by specific belief systems and primarily supported by local custodians with the backing of community leaders (Boko,2019). Thus, cultural and community leaders in Malawi share stories and experiences of how they regulated the managedterrestrial resources in their communities through indigenous knowledge and practices (Indigenous and Local Knowledge Framing Workshops Report, 2021). However, like in many parts of Africa, colonization in Malawi introduced formal management of forests, mountains, woodlands and wildlife reserves.

This management was sometimes based on the identification, documentation and legislation of these resources while excluding the local knowledge systems of the cultural communities residing around these resources. In the post- independence era (after 1964) government bodies that inherited British colonial policies did not generally recognize the significance and role of traditional methods of conserving and protecting terrestrial ecosystems.

Questions regarding indigenous local knowledge and practices in the management of mountains, forests, wildlife reserves, groves and woodlands were often overlooked and not integrated into the country's post-colonial natural resources legal systems. Despite this, it has been discovered that in communities where traditional management systems influenced by indigenous local knowledge are followed and enforced there is impressive conservation and management of terrestrial ecosystems. These areas harbour a rich diversity thatcontributes to ecological safety particulary in forests considered sacred with strong cultural and religious significance.

Theseforests serve as sanctuariesfor deities, places of worship, rituals and other cultural ceremonies. Economically, they provide resources such as firewood, construction materials, medicinal plants all regulated bycustomary laws and traditions. Such forests also bear witness of the community's history and constitute the identity markers of the community (Varissou, 2019). By examining the six themes of ILK this section aims to providea situational analysis of how it relates to terrestrial ecosystems and biodiversity.

4.4 Contribution of Terrestrial Biodiversity to Malawi's Economy, Community Livelihood, Food Security and Quality Life

Terrestrial biodiversity is essential for human well-being, economic development, and ecological stability. In Malawi, diverse ecosystems play a crucial role in regulating climate, storing carbon, protecting soils from erosion, and maintaining water cycles that support agriculture and hydropower. Biodiversity offersdirect benefits such as food, fuelwood, timber, medicines, fibers, and genetic resources for crop improvement. Additionally, it supports pollination and natural pest control which are vitalfor food security. Furthermore,terrestrial species and landscapes have cultural, spiritual, educational, and recreational value, contributing to national heritage and identity. Healthy biodiversity enhances ecosystem resilience to disturbances like droughts, floods, pests, and climate change, thus safeguarding livelihoods and reducing disaster risks. Therefore, conserving terrestrial biodiversity is not only an environmental priority but also a cornerstone for sustainable development, poverty reduction, and intergenerational equity

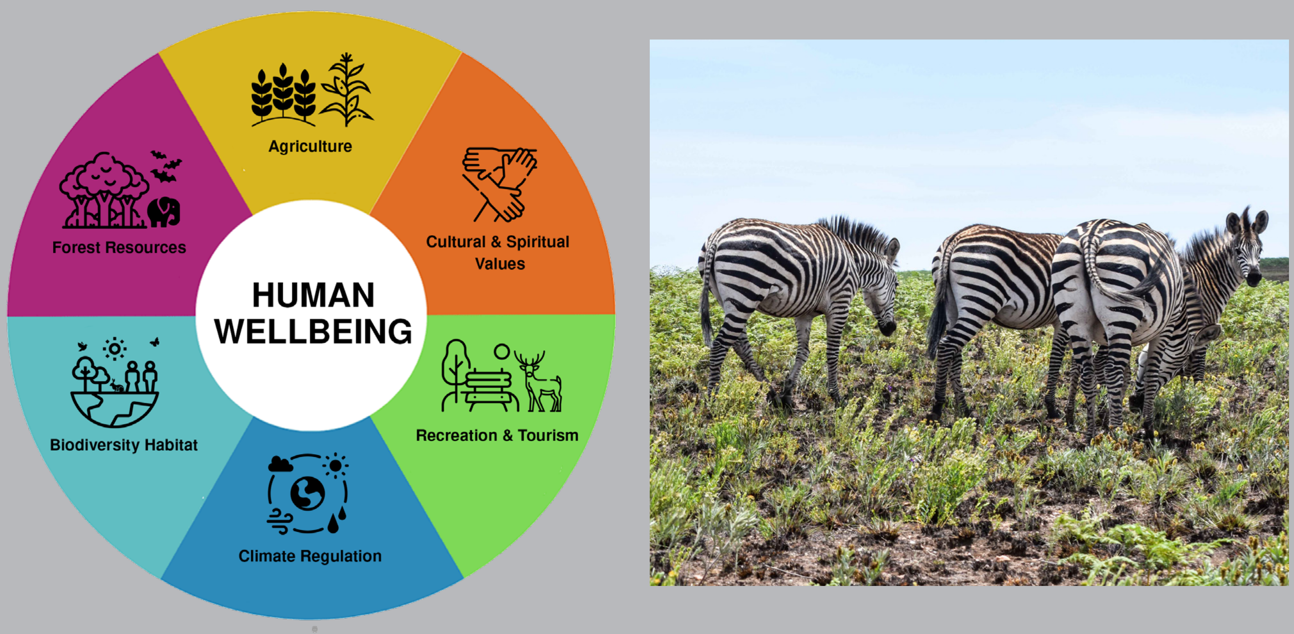
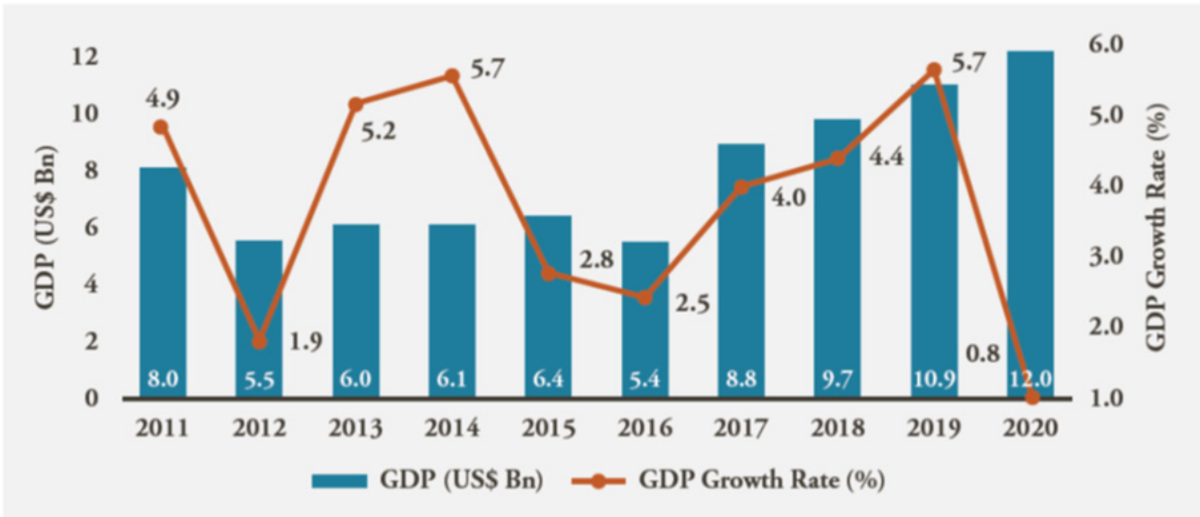


Figure 4-20: (left) Contributions of Terrestrical Ecosystem to the Human Wellbeing & (right) Recreation aservices from terrestrial ecosystem

The agriculture sector remains a crucial driver of the country's overall social and economic performance. The sector accounted for over 90% of the national exports and employed over 76 % of the country's workforce in 2019 and contributed to more than 22 % of the GDP in 2020. However, the sector has experienced mixed performance in the last decade with its contribution to GDP declining from 29 percent in 2011. The growth rate has also fluctuated, reaching its highest growth rate in 2013 (6.6 %) and its lowest in 2016 (-2.3 %). Figure 4-19 shows the top 10 crops in Malawi by production, area harvested and export value for 2019 while Figure 4-20 displays GDP and growth rate between 2011 and 2020 in Malawi.



Source: World Bank Development Indicators

Figure 4-21: Top 10 crops in Malawi by production, area harvested and export value, 2019

Figure 4-22: Malawi's GDP and growth rate, 2011-2020

Agriculture plays a major role in the economy of Malawi. The sector contributed approximately 30% to the national Gross Domestic Product (GDP) during the period 2012 - 2016 (Figure 4-20), employs over 80% of the economically active population (59% women and 41% men) (NSO 2018), and is the main source of livelihood for more than 2 million rural smallholder farmers.

Tobacco is the major national export accounting for 66% of agricultural exports. Other significant export products include raw sugar, tea, groundnut, and cotton lint, making up 11%, 9%, 3% and 2.7% of total exports, respectively. Malawian producers are primarily small-scale cultivating less than 1 hectare of land, with some large-scale producers cultivating more than 25 hectares. There is also an emergence of medium scale farmers cultivating between 5 and 25 hactares of land. Large scale producers are mainly involved in the production of tobacco, tea, sugar, and macadamia for export while small scale producers are mostly subsistence farmers growing maize, rice, cassava, legumes and sweet potatoes (AGRA Malawi 2017).

Smallholder farmers disproportionately produce crops for domestic consumption, accounting for approximately 80% of all food consumed in Malawi. In contrast, they onlys produce just 20% of agricultural exports. In Malawi, smallholder production contributes nearly 70% to the agricultural GDP in Malawi. The agriculture sector in Malawi experienced significant growth in recent years, meeting the 6% growth rate target set by the Comprehensive Africa Agriculture Development Programme (CAADP), of which Malawi is a signatory (CIAT; World Bank 2018). This growth can largely be attributed to land reforms that have improved tenure security and provided equal access to land for smallholder farmers. Additionally, increased investments in the agriculture sector such as the Farm Input Subsidy Program (FISP)) and Affordable Input Programme (AIP) has led to higher fertilizer use and increased crop productivity, especially for maize.

Malawi is a low-income country characterized by a high population growth rate (about 3.06%) and high poverty levels. Poverty levels could be linked to below potential productivity of the Malawian agricultural sector despite the apparent success of the FISP and AIP that reportedly increased maize productivity from 1480 kg/ha in 2006 to 2100 kg/ha in 2013 (CIAT; World Bank 2018). Agricultural productivity is low in Malawi especially for female-managed farms (25% lower than male-managed farms). This difference arises from disparities in resource endowment that puts female farmers at a disadvantage in terms of input use. Low productivity, market failures, (aggravated by some counter-effective trade policies), and climate vulnerability further challenge the agri-sector. Amid the socio-ecological challenges, Malawi has largely pursued an input-intensive agriculture policy for food production to address low productivity and food insecurity through subsidies for fertilizer and hybrid seed. However, this input-intensive approach does not address the underlying drivers of deforestation, biodiversity loss and land degradation (Lunduka 2013; Messina et al., 2017).

4.4.1 Forestry Contributions

Malawi`s forests may not be glamorous but they are of utmost value to the people. Nearly 90% of Malawians depend on wood fuel for energy (UNDP, 2004) and this percentage may be even higher due to inconsistent supply of other energy sources. On average, Malawians derive 30% of their income from forest products (Fisher, 2004). Economic valuation of forests has established that the forestry sector contributes 6.2% to Malawi`s Gross Domestic product (GDP). This contribution is mainly subsumed under agriculture and does not take into account the value of non-wood forest products, processed timber or the informal trade in fuel wood and charcoal (Government of Malawi, 2016).

Forests in Malawi provide a number of products and services and these can be classified as:

- Provisioning services such as forest fruits, wildlife and fibre are crucial resources (Chilongo, 2014). People rely on forest resources to obtain plants that can treat diseases and conditions such as asthma, bloody diarrhoea, human fertility issues, lactation problems, and many others.
- The assessment emphasized the significance of mountain forests and woodland ecosystems in Malawi as a source of food for surrounding communities. Forests contain trees that produce indigenous fruits such as Annona senegalensis (mapoza), Parinari curatellifolia (mfula) and Tamarindus indica (bwemba)including mushrooms and many others.

Since ancient times, terrestrial ecosystems like forests have served as valuable sources of traditional herbal medicine. These forests are rich with indigenous trees and shrub species that have medicinal properties and are used to treat various ailments. For instance, the communities surrounding Khulubvi, Mulanje mountain and Vwaza Wild Life Reserve Forests have access to herbal medicine for treating various ailments.

- Regulating services such as flood regulation, water purification, climate regulation.
- Supporting services through nutrient cycling, soil erosion control and primary production
- Cultural services which include spiritual, aesthetic, education and recreational services.

Other forests, woodlands and mountains provide shelter for cultural activities and rituals, for example, rainmaking ceremonies, chieftaincy ceremonies, cultural festivals and other religious related activities that are significant to the social wellbeing of the communities. Khulubvi Forest with its famous legend and myth of Mb'ona among the Manga'anja and Sena communities in Nsanje serves as a prominent example (Rangely 1953; Schoffeleers, 1966, 1992; Chikabadwa, 2018).

Table 4-4 : Summarises the ILK multiple values

ILK Value Dimension	Description of Value	Evidence from NEA ILK Field Visits	Policy / Management Implications
Ecological / Regulating Value	Biodiversity supports ecosystem functions such as soil fertility, water regulation, climate moderation, and species balance	Communities in Khulubvi, Mulanje and Vwaza highlighted the role of forests, wetlands, and customary species protection in regulating rainfall patterns, preventing floods, and maintaining soil productivity	Ecosystem-based management and restoration policies insufficiently recognize ILK-based conservation practices
Livelihood / Provisioning Value	Biodiversity provides food, medicine, fuelwood, and income	Across Zolokere and Khulubvi, communities rely on wild foods, fisheries, medicinal plants, and forest products for subsistence and coping during climate shocks	Current conservation models restrict access without offering viable livelihood alternatives
Cultural and Identity Value	Biodiversity is intertwined with cultural identity, traditions, and social cohesion	Sacred forests, taboo species, and customary harvesting rules were reported, especially in Khulubvi, Mulanje, Zolokere and Vwaza, as mechanisms for conservation and social regulation	Cultural values remain weakly reflected in protected area governance frameworks

Table 4-4 Conti.: Summarises the ILK multiple values

ILK Value Dimension	Description of Value	Evidence from NEA ILK Field Visits	Policy / Management Implications
Spiritual and Relational Value	Nature is viewed as a living entity with spiritual significance requiring respect and stewardship	Communities described ancestral connections to landscapes, rivers, mountains, and forests, with spiritual sanctions reinforcing conservation norms especially in Khulubvi and Zolokere	Statutory conservation approaches marginalize spiritual governance systems
Knowledge and Learning Value	Biodiversity serves as a foundation for intergenerational knowledge transfer and learning	ILK on seasonal calendars, species behavior, and ecological indicators was shared during FGDs and KIIs	Limited integration of ILK into formal monitoring, education, and decision-making systems
Governance and Stewardship Value	Customary institutions and rules regulate access, use, and conservation of resources	Traditional leadership structures and community norms were cited, but communities emphasized they are not meaningfully recognized in co-management arrangements	Weak legal recognition of customary governance undermines effective co-management
Equity and Rights-Based Value (HRBA)	Biodiversity governance should respect rights, inclusion, accountability, and participation	Findings from HRBA dialogues and ILK consultations revealed tokenistic participation, exclusion of women and youth, and limited feedback loops	Indicates policy gaps in operationalizing HRBA principles within biodiversity governance

4.4.2 Protected areas Values

Protected areas in Malawi have multiple values that contribute to the conservation and sustainable management of biodiversity. Some of these values include:

1. Biodiversity conservation: Protected areas are crucial for preserving the country's diverse flora, fauna, fungi, and other microorganisms. They provide habitats for a wide range of life including endemic and threatened species. By protecting these areas, Malawi can safeguard its unique biodiversity.

2. Ecosystem services: Protected areas play a vital role in providing essential ecosystem services. They help regulate climate, purify air and water, control erosion, and maintain soil fertility. These services are not only important for the functioning of ecosystems but also for the well-being of local communities.

3. Cultural and spiritual significance: Many protected areas in Malawi hold cultural and spiritual significance for local communities. They are often associated with traditional practices, sacred sites, and cultural heritage. Protecting these areas helps preserve cultural diversity, identity and traditional knowledge. For example, Lake Kaulime in Nyika National Park has a sacred connection with the Tumbuka people of Rumphi as it used to be a shrine for ancestral worship. Vwaza Wildlife Reserve has the Phopo Stone Age site as well as the Zolokere Chiefdom burial sites. Some cultural communities such as the Ngonde and Lambya consider Mbande Hill in Karonga as a sacred site because it is where their first Kings called Kyungus were buried. As a result Mbande Hill and its ecosystem is guarded and protected ensuring the conservation of the mountain ecosystem.

Figure 4-23: Images of Lake Kaulime in Nyika National Park

Figure 4-24: Zokokere chiefdom burial sites: Connecting people with their ancestors

4. Sustainable resource use: Protected areas can support sustainable resource use by providing opportunities for regulated activities such as fishing and collecting non-timber forest products. This allows local communities to make a living from natural resources while ensuring their long-term sustainability. In these protected areas, communities are allowed to collect resources under the Resource Use Program (RUP) with guidance from natural resources committees. Collection of resources such as honey, edible mushrooms, Uapaca fruits, mopane worms is allowed in almost all protected areas with a beekeeping enterprise in Nyika worth millions kwacha leading the RUPs. Simillary, Vwaza Wildlife Reserve allows seasonal fishing along its water bodies of South Rukuru and Vwaza marsh, with specific fishing gear regulations which do not include nets. Khulubvi forest is mainly protected by community by-laws enforced by chiefs and local spirits. People do not enterthe forest without the chief's permission. As mentioned earlier in the chapter Mbande hill and Hora mountain with their cultural significance are governed by customary traditions rooted in ILK.

5. Watershed protection: Protected areas contribute to the conservation of water catchment areas, ensuring a sustainable supply of freshwater for both humans and wildlife (xxx). Nyika National Park in northern Malawi is an important catchment area for Lake Malawi. Almost all rivers that originate from the park flow throughout the year in a sustained water supply for irrigation schemes in Karonga, Chitipa and Rumphi as well providing water to the surrounding towns. Electricity Generation Company (Malawi) Limited (EGENCO), the country's power generating company has its Wovwe hydro power station along the Wovwe River inside Nyika National Park. Currently, the station generates 4MW of power and is in the process of upgrading to about 9MW.

6. Tourism and recreation: Many protected areas in Malawi attract tourists and nature enthusiasts, contributing to the country's economy. Visitors can enjoy activities such as wildlife viewing, birdwatching, hiking, and camping.

Figure 4-25: Forest patches at Nyika Plateau

6. Biodiversity Conservation Progress: Biodiversity in Malawi is crucial for economic, socio-cultural and ecological purposes. It plays a significant role in the economy and poverty alleviation of the country. For instance, agro biodiversity was estimated to contribute approximately 40% of the Gross Domestic Product (GDP) and over 90% of employment and merchandise export earnings in 2010. The fisheries, forestry and wildlife sectors also contribute through Community Based Natural Resources Management. In National Parks and Forest Reserves, communities have successfully integrated biodiversity conservation and rural development to help alleviate rural poverty . These communities employ sustainable harvesting techniques for fish and wildlife, promote eco-tourism, and engage in income-generating activities such as mushroom production and bee- keeping. These efforts help reduce pressures on natural resources (NBSAP II, 2015 - 2025).

Malawi adopted its first NBSAP in 2006.Implementation has included the promotion of species and habitat restoration programs; increasing the population and distribution ranges of rare and threatened species; designing and implementing in situ and ex situ agricultural diversity conservation programmes with full participation of local communities; strengthening policies and legislation to enhance biodiversity conservation, sustainable use and benefit-sharing; developing cost-effective invasive species management programmes; strengthening the participation of communities and the private sector as equal partners in biodiversity conservation and sustainable use and equitable benefit-sharing. Additionally, capacity-building of institutions to collect, interpret, manage and disseminate quality and relevant biodiversity information and biological collections effectively and efficiently has been a focus. There has also been astrengthening of institutional capacity to manage biodiversity information.

Indigenous Tree Species Seed Collection

The Forestry Research Institute of Malawi (FRIM) established the National Tree Seed Centre (NTSC) to improve the quality and quantity of tree seeds supplied to tree growers and for research purposes. Among its responsibilities, the NTSC identifies and safeguards high quality seed sources and promotes the conservation of tree genetic resources. **Table 4-5** shows the tree species that have been collected, processed and distributed to different tree growers based on demand.

Table 4-5 : Indigenous Tree Species Seed Collected (2020 - 2024)

Year	Species name	Local name	Quantity (Kg)	
			Unprocessed	**Processed**
2023	Acacia nigrescens	Mkukhu	8.30	5.99
2020	Acacia polyacantha	Mthethe	170.47	147.50
2021	Acacia polyacantha	Mthethe	40.00	34.80
2022	Acacia polyacantha	Mthethe	133.30	129.50
2023	Acacia polyacantha	Mthethe	96.50	94.30
2020	Afzelia quanzensis	Msambamfumu	190.00	180.00
2021	Afzelia quanzensis	Msambamfumu	112.00	96.20
2022	Afzelia quanzensis	Msambamfumu	666.61	650.51
2023	Afzelia quanzensis	Msambamfumu	401.00	397.54
2023	Albizia adianthifolia	Mtangatanga wa mmadzi	9.10	6.30
2020	Bauhinia thonningii	Chitimbe	50.00	46.80
2021	Bauhinia thonningii	Chitimbe	11.00	8.60
2022	Bauhinia thonningii	Chitimbe	40.00	37.40
2023	Bauhinia thonningii	Chitimbe	70.00	68.00
2020	Burrt - davya nyasica	Mvule	52.40	5.00
2024	Burrt - davya nyasica	Mvule	11.40	0.89
2021	Colospermum mopane	Tsanya	15.00	6.80
2024	Colospermum mopane	Tsanya	14.90	12.80
2022	Erythrophleum sauveolens	Mwavi	15.00	14.40
2020	Faidherbia albida	Msangu	350.00	330.00
2021	Faidherbia albida	Msangu	262.80	218.60
2022	Faidherbia albida	Msangu	426.50	410.20
2023	Faidherbia albida	Msangu	193.20	184.60
2020	Khaya anthotheca	M'bawa	150.00	113.40
2021	Khaya anthotheca	M'bawa	172.70	133.10
2022	Khaya anthotheca	M'bawa	400.00	394.80
2023	Khaya anthotheca	M'bawa	501.70	491.70
2024	Lancocarpus capassa	Chimphakasa	33.00	14.25
2024	Syzygium cordatum	Nyowe	18.00	15.20

4.4.3 Progress in conserving biodiversity

4.4.3.1 A case of Millenium Seed Bank Project

The Millenium Seed Bank Project (MSBP) is a global conservation project conceived and developed by the Seed Conservation Department at the Royal Botanic Gardens, Kew (RBG-Kew). Globally, the MSBP comprises over 100 organizations in more than 40 countries, including Malawi where there the project was implemented through Forestry Research Institute of Malawi (FRIM)'s National Tree Seed Centre, National Herbarium and Botanic Gardens (NHBG), National Research Council of Malawi (NRCM) and National Plant Genetic Resource Centre (NPGRC) (Chilima et al, 2009). These organisations have been directly involved in seed conservation in collaboration with the Royal Botanic Gardens. So far, 18,000 species that appear on global or national lists of threatened species have been collected and safely stored in duplicate storage. Prior to the commencement of the main project activities in 2003, an Access and Benefit Sharing Agreement (ABSA) was established to address issues of biopiracy, ownership of seeds, equipment and facilities especially after the project period.

The overall objective of the MSBP in Malawi was to design and implement an ex-situ conservation plan for a minimum of 600 endangered, endemic and / or economically important wild plant species by 2010. This plan involved targeted seed collection and storage activities, propagation of species for management in living seed collection, capacity building, research and training. riority species were chosen based on their endemic status, level of threat in the wild and economic value. Information from Morris (1996) and the IUCN Red List Data for Malawi (Golding, 2000) informed the selection process.

4.4.3.2 MSBP Seed Collection

Seed collection was conductedby expedition teams of trained staff from the NTSC, NHBG, NPGRC and collaborators from Mulanje Mountain Conservation Trusat (MMCT) and the Department of Parks and Wildlife (DNPW). The goal was to collect20,000 seeds from as many different plants of the target species although this densitywas not always achieved. tHerbarium voucher specimens were also collected for each targeted species. Initially, seed collection expeditions were carried out randomly across the country but starting in 2023 , collections focussed on specific biospheres such as Mulanje Mountain, Nyika Plateau and Mkuwazi Forest Reserve in NkhataBay. All collected seeds were processed at NTSC and later dispatched for long term storage at the genebank in Chitedze, Lilongwe. Duplicate samples were also dispatched to London, for storage at the Millenium Seed Bank (MSB) - Kew genebank. These seeds are stored under conditions that are expected to preserve seed viability for many years.. Each seed batch that was sent to the Royal Botanical Gardens - Kew was accompanied by a collection form and unique MSB code. By the end of the project nine hundred fifty (950) species had been collected and banked. According to Morris (1996) and Golding (2002), the list of banked species includes those that are classified as endemic, not well known, medicinal and in various states of environmental threat. The quantities of species under the different classifications are presented in **Table 4-6**.

Table 4-6: Quantity of species collected for long term storage

Species Classification	Number of species
Endemic and endangered	2
Endemic and critically endangered	8
Endemic with insufficient data	15
Endemic and vulnerable	26
Endemic but not under immediate threat	3
Endemic and medicinal	1
Non-endemic and medicinal	142
Non-endemic, medicinal and vulnerable	1
Near Extinct	1
Non-endemic with insufficient data	3
Non-endemic and vulnerable	6
Non-endemic and critically endangered	1

4.4.3.3 The Useful Plants Project (UPP): A case of the Millenium Seed Bank Project

The useful Plants Project was a follow-up to the Conserving Malawi's Forest Plant Diversity supported by the MSBP (Chilima et al 2013). The UPP continued the effort through involvement of local communities and other stakeholders. The UPP had the following specific objectives:

- To collect priority useful plant species for long term storage in gene banks;
- To cultivate useful indigenous plants for domestic and commercial use in order to improve livelihoods of the communities involved in the project;
- To conserve useful plants in-situ and ex-situ through propagation by communities;
- To disseminate information on useful plants in order to promote project activities.

4.4.3.4 Seeds of useful plant species collected and conserved ex-situ

Just as in the case ofthe Conserving Malawi's Forest Plant Diversity project, seed collection expeditions were carried out targeting endangered, endemic and economically important species on Mulanje Mountain, the slopes of Michesi Mountain and other locations. One of the species collected was highly endangered , 'Mulanje cedar'- Widdringtonia whytei.. The seeds of this species were processed and stored at the National Plant Genetic Resource Centre (NPGRC) withduplicates also stored at the Millenium Seed Bank (MSB - Kew) in the United Kingdom.

Community groups in the project impact areas such as Mulanje and Dowa collected useful wild plant seeds to raise in the nurseries. Seeds of species such as Syzygium cordatum, Uapaca kirkiana, Landolphia kirkii, Newtonia buchananii, Aloe chabaudii and various wild vegetables were collected and planted in community woodlots, around homesteads and as enrichment planting in open corridors of Village Forest Areas (VFAs). In addition, community groups propagated wild medicinal and food plant species to enrich their herbal gardens.

4.4.3.5 Orchid distribution, abundance and tuber morphological characterization in Nyika National Park a Case study

Malawi is home to over 400 orchid species with some of these s being endemic (La Croix and La Croix, 1991; Illustrated World plants compendium of orchids, 2018). The habitat ranges from the high plateau areas of the Nyika and Mulanje ecosystems, to the hot-low lying areas of the Shire basin, including numerous intermediate habitats (La Croix and La Croix, 1991; Burrows and Willis, 2005).

Over 200 orchid species are found in the Nyika ecosystem (Burrows and Willis, 2005). The Nyika National Park is the largest protected area in Malawi covering 3140 km2 (Government of Malawi, 2014). The park has great ecological value consisting of a unique montane ecosystem of evergreen rainforests, montane grasslands, and low-lying wetlands and woodlands) which protect a wide range of animal life and numerous beautiful flowering plant species including orchids. Terrestrial orchids produce underground tubers, which are commonly referred to as "Chinaka or Chikande" in Malawi (Mwanyambo and Kananji, 2003; Namoto, 2018). The tubers have various morphological characteristics such as the number of tubers per plant, tuber shapes, tuber size, tuber weight, eye distributions and skin colour.
Orchids hold a unique position among flowering plants due to their long lasting and beautiful flowers, often valued for cut flower production or as potted plants in ornamental horticulture (WGBIS, 2018). In Malawi, several orchid species are edible, with seven (Satyrium buchannani, S. abylosaccos, S. carsonii, Disa engleriana, D. robusta, D. zombica and Habenaria clavata) considered economically important (Kasulo et al., 2009). However, Simkoko (2012) and Namoto (2018) have reported 20 wild edible orchid species growing in the Nyika National Park.

Nyika National Park is the largest protected area in Malawi and is home to numerous orchid species. Out of the 54 species inventoried, forty-three (43) species were edible by surrounding communities. The edible orchids identified belong to five genera; Disa (31%), Satyrium (26%), Habenaria (13%), Brachycorythis (5%) and Neobolosia (2%). Other associated orchid genera recorded were Reoperocharis, Brownlea, Cynorkis, Disperis and Eulophia. Results of a study by Namoto (2018) revealed an increase in the number of edible orchid species targeted by communities in the National Park than previously reported. The ecological habitats for these terrestrial orchids are montane grasslands; montane wetlands; pine plantation, broadleaf evergreen forests and the miombo woodlands. Simpsons' diversity indices show that montane wetlands and montane grasslands have the highest species diversity t, while the pine plantation has the lowest. In terms of abundances, the pine plantation (3600 orchids per hectare) and the montane wetlands (2360/ha) have the highest numbers, while the miombo woodland (390/ha) has the least.

Variations in orchid abundances and species richness are attributeded to differences in ecological characteristics that are partly influenced by environmental factors such as altitude and soil physio-chemical properties. Morphological traits of edible orchid tubers found in Nyika are, tuber size (breath, width and length), and the diversity of tuber shapes. Tuber lengths ranged from 7.3 to 106 mm while tuber widths ranged from 4.5 to 92.8 mm. Brachycorythis pleistophylla recorded the longest (103.2 mm) tuber length followed by Disa robusta (63mm), while D. ukingensis was the shortest. In terms of tuber width, D. robusta was the widest (40.9mm) followed by D. ochrostachya (30.7mm). Smallest diameter tubers were in B. pleistophylla (1.2mm). Heavier tubers were recorded from Disa robusta (46.2g) and Disa ochrostachya at34.6g while lighterweights were recorded from Satyrium carsonii at2.5g and Disa ukingensis at 1.8 g. The maximum number of mature tubers per plant showed that 62% of orchids had two underground tubers, 29% had a single tuber and 9% had averages of 4 tubers per individual plant. The maximum number of tubers per individual plant was found in B. pleistophylla and C. kassneriana with an average of 4 tubers. Thirteen (13) macro-morphological tuber-shapes were identified in Nyika National Park including elliptical, oblong, long-oblong, globose, compressed, ovoid, obovoid, cylindrical billobed, elongated, and irregular shapes. The irregular shapes were classified as heart-shaped, elephant-hooves and toothed-shape tubers. The high diversity of tuber morphological characteristics identified can be used in selecting of species for conservation and improvement programmes. It is anticipated that the information gathered could aid in formulating conservation, management and improvement strategies for the edible orchids of Nyika National Park.

Vegetation type	Field description of the orchid vegetation types	Collection site(s)	Altitude (m)	Forest type
1	**Miombo woodlands** On hills and rocky outcrops, Mostly with large trees such as Brachystegia, Uapaca, Joulbernadia	Kaperekezi, Thazima,	1600 – 1800m	Mid-altitude
2	**Montane wetland** Includes riverine; Mixed grasslands were soils are almost always moist and black. Lies along valleys or along streams in montane grasslands	Nganda, Chelinda Dam3, North Rukuru valley, North Rumphi bridge, Dembo valley, Chelinda, Kaulime dam	1900-2500m	Montane
3	**Montane grasslands** occupy about 60% of the montane area which lies between 2200 and 2500m the central plateau. Montane grasslands are mostly on gentle slopes above streams	Chelinda dam3, Zovochipolo, British army base near Chisanga falls, North Rukuru valley, North Rumphi river B,	2220-2500m	Montane
4	**Montane-evergreen forest** Found in patches in sheltered valleys. Vulnerable to wild fires started by lightning, poachers or accident. The southern limit of Hagenia sp	Mwanyenyezi forest; Chelinda	1900-2300m	Sub-montane
5	**Pine plantation** 0ver 40 years planted forest with mostly Pinus patula. Generally large trees with a closed canopy. No woody vegetation grows underneath	Chelinda camp	2200-2500m	Montane

Table 4-7 : Edible orchid collection sites with respect to vegetation types

Figure 4-26: Edible orchid collection sites with respect to vegetation types

Figure 4-27: Orchids in-situ on the Nyika plateau

SERIAL NO.	SPECIES	LOCAL NAME	LOCALITY OF COLLECTION	LOCAL USE
NYK01	*Brachycorythis pleistophylla* Reichb.f.	Joyisi	Kaperekezi, Thazima	Edible
NYK02	*Brachycorythis pubescens* Harv.	Joyisi	North Rumphi Bridge	Edible
NYK03	*Brownlea parviflora* Lindl.		Chelinda	Non-edible
NYK04	*Cynorkis anacomptoides* Kraenzl.		Chelinda	Non-edible
NYK05	*Cynorkis kassneriana* Kraenzl.	Chinaka chamu paini	Chelinda	Edible?
NYK06	*Disa celata* Summerh.	Chinaka	Dembo, Chelinda	Edible
NYK07	*Disa concinna N.E. Br.*	Chinaka	Dembo, Chelinda, Nganda, N. Rukuru R.	Edible
NYK08	*Disa engleriana* Kraenzl.	Chinaka cha sekelemo	Dembo, Kaulime, Chelinda, Thazima	Edible
NYK09	*Disa hicicornis* Reichb.f.	Chinaka	Dembo, Chelinda	Edible
NYK10	*Disa ochrostachya* Reichb.f.	Chinaka	Chelinda, British A.B	Edible
NYK11	*Disa onithantha* Schltr .	Chinaka cha sekelemo	Chelinda, Kaulime,	Edible
NYK12	*Disa perplexa* Lindl.	Chinaka	Dembo, Chelinda	Edible
NYK13	*Disa robusta* N.E.Br.	Chinaka	Dembo, Chelinda, Kaulime, Nganda, N. Rumphi R., N. Rukuku .	Edible
NYK14	*Disa satyriopsis* Kraenzl.	Chinaka	Chelinda	Edible
NYK15	*Disa saxicola* Schltr.	Chinaka	Vipiri	Edible
NYK16	*Disa stolzii* Schltr.	Chinaka	Chelinda, Kaulime	Edible
NYK17	*Disa ukingensis* Schltr.	Chinaka	Zovochipolo	Edible
NYK18	*Disa welwischii* Reichb.f.	Chinaka	Chelinda	Edible
NYK19	*Disa zombica* N.E.Br.	Chinaka	Kaperekezi, Thazima	Edible
NYK20	*Disperis anthoceros* Reichb.f.		Cheliinda	Edible
NYK21	*Eulophia coeloglossa* Schltr.		Chelinda	Non-edible
NYK22	*Eulophia milnei* Reichb.f.		Chelinda, N.Rukuru R.	Non-edible
NYK23	*Eulophia seleensis* (De wild.)		Chelinda dam 3	Non-edible
NYK24	*Eulophia speciosa* (R.Br. ex Lindl)		Dembo	Non-edible
NYK25	*Eulophia thomsonii* Rolfe.			Non-edible
NYK26	*Habenaria cornuta* (Lindl.)		Cheinda,Dembo, Dam3, N. Rukuru R,	Edible
NYK27	*Habenaria clavata* (Lindl.) Reichb.f	Chinaka	Thazima	Edible
NYK28	*Habenaria diselloides* Schltr.	Chinaka	North Rukuru	Edible

Table 4-8 : Diversity of orchids found at 16 sites and their use status in the Nyika National Park

SERIA L NO.	SPECIES	LOCAL NAME	LOCALITY OF COLLECTION	LOCAL USE
NYK29	*Habenaria filicornis* Lindl.	Chinaka	Dembo, Zovochipolo	Edible
NYK30	*Habenaria insolita* Summerh.	Chinaka	Chelinda dam 3	Edible
NYK31	*Habenaria kyimbilae* Schltr.	Chinaka	Dembo	Edible
NYK32	*Habenaria macrostele* Summerh.	Chinaka	Dembo	Edible
NYK33	*Habenaria praestans* Rendle.	Chinaka	Dembo	Edible
NYK34	*Habenaria shimperana* A.Rich.	Chinaka	Dembo, Chelinda East	Edible
NYK35	*Habenaria zambesina* Reichb.f		North Rukuru R.	Edible
NYK36	*Neobolusia stolzii* Schltr.	Chinaka	Dembo	Edible
NYK37	*Reoperocharis beunettiana* Reichb.f.		Dembo	Non-edible
NYK38	*Satyrium amblyosaccos* Schltr.	Chinaka	Zambia R area	Edible
NYK39	*Satyrium atherstonei* Reichb.f	Chinaka	N. Rukuku,Dembo, Chelinda,Mwanyenyezi	Edible
NYK40	*Satyrium breve* Rolfe.	Chinaka	Nganda, North Rumphi River, Chelinda, Kaulime, Dembo	Edible
NYK41	*Satyrium buchananii* Schltr.	Chinaka	Chelinda,Kaulime, British army base	Edible
NYK42	*Satyrium carsonii* Rolfe.	Kabatika	Thazima, Kaperekezi	Edible
NYK43	*Satyrium crassicaule* Rendle.	Chinaka	Jalawe	Edible
NYK44	*Satyrium chlorocorys* Rolfe.	Chinaka	Kaulime, North Rumphi Zovochipolo	Non-edible
NYK45	*Satyrium monadenum* Schltr	Kabatika wa mu Nyika	N. Rukuru, Kaulime, Chelinda	Edible
NYK46	*Satyrium orbiculare* Rolfe.	Kabatika wa mu Nyika	Chelinda, British army base	Edible
NYK47	*Satyrium princeae* Kraenzl.	Chinaka	British A.Base Chelinda, Zovochipolo, Kaulime,	Edible
NYK48	*Satyrium sacculatum* (Rendle)Rolfe.	Chinaka	Dembo, British army base, North Rumphi R. Chelinda, Zovochipolo	Edible
NYK49	*Satyrium sceptrum* Schltr.	Chinaka	Chelinda, Dembo	Edible
NYK50	*Satyrium rhynchatoides* Schltr.	Chinaka	Chlinda Dam 3	Edible
NYK51	*Satyrium trinerve* Lindl.	Chinaka	Dembo,British army base, Zovochipolo	Edible
NYK52	*Satyrium shirense* Rolfe.	Chinaka	North Rukuru, Airstrip	Edible
NYK53	*Satyrium sphaeranthum* Schltr.	Chinaka	North Rukuru River	Edible

Table 4-8 Conti. : Diversity of orchids found at 16 sites and their use status in the Nyika National Park

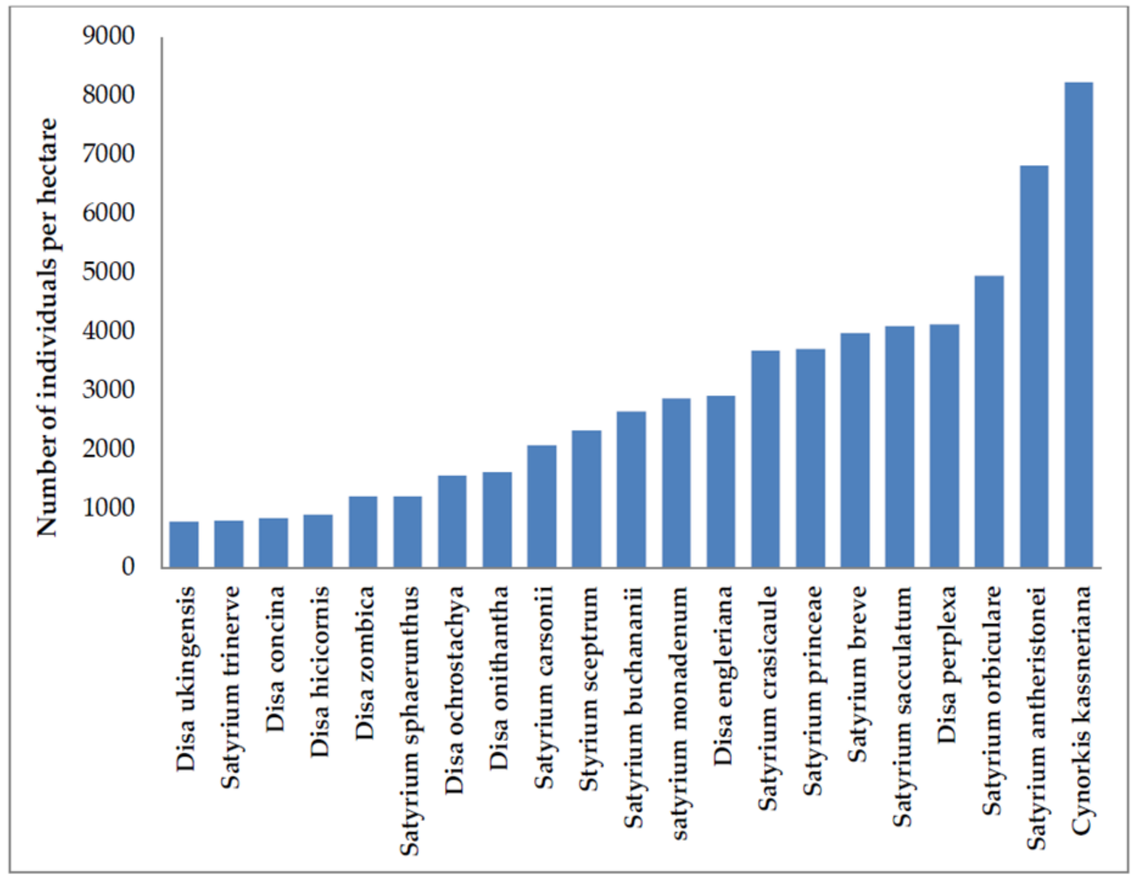


Figure 4-28: Top 20 abundant orchid species in the Nyika National Park

Figure 4-29: Freshly collected orchid tubers ready for sale at Thazima
Source: Namoto (2018)

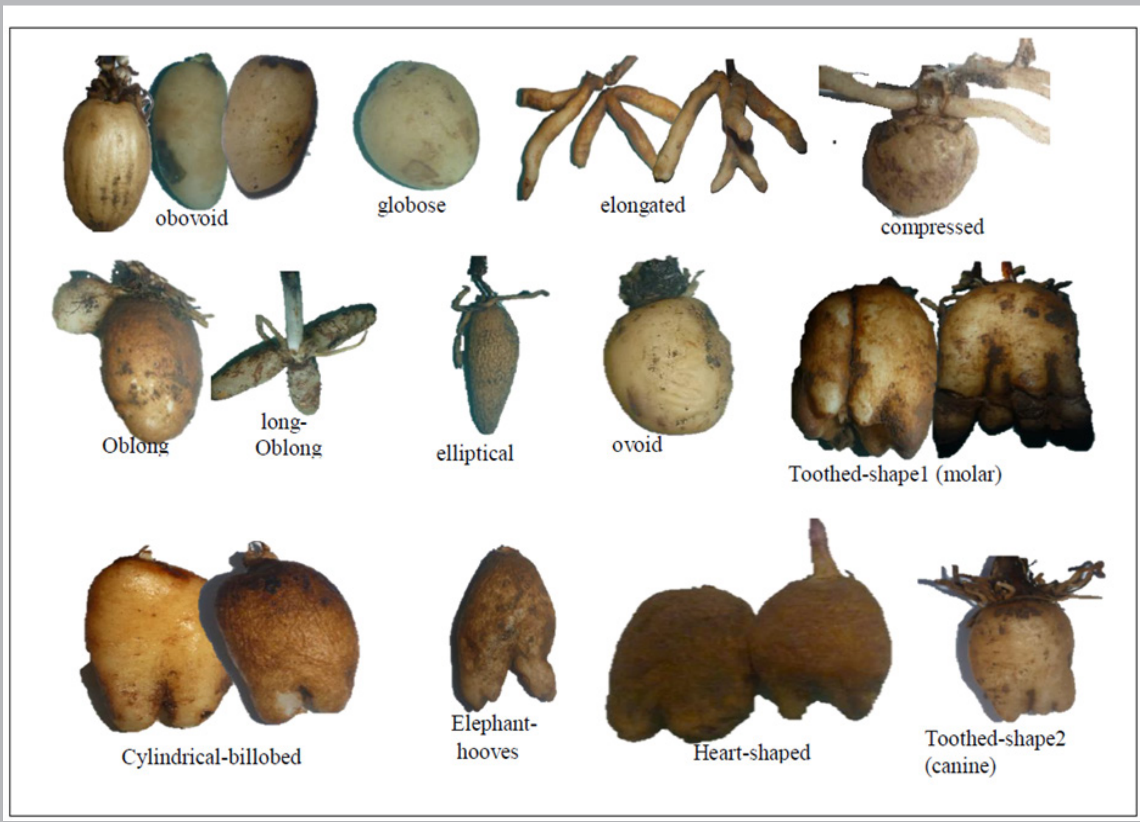


Figure 4-30: Diversity of orchid tuber shapes in the Nyika National Park

4.5 Ecosystem Services

Ecosystems provide services that are fundamental to human well-being (Millennium Ecosystem Assessment 2003). However, accelerating land-use change is eroding ecosystem service provision in many settings. This is being driven by the immediate food and energy needs of growing human populations (Pullanikkatil et al. 2020). Landscape transformation accompanies production, but these services come with trade-offs. This is because they alter the suite or magnitude of ecosystem services as a result of increased use of another ecosystem service bundle (Poppy et al. 2014). Ecosystem service trade-offs may compromise the well-being of future generations at the expense of immediate needs. This trend is increasing with competing demands on shrinking areas of suitable and available land. For example, agricultural expansion increases food production in the short term, but frequently at the long-term expense of soil fertility, biodiversity, and carbon storage (Millennium Ecosystem Assessment 2003).

The concept of ecosystem goods and services stems from viewing ecosystems as natural capital that contributes to economic production. Goods include harvested resources, such as fish, services are processes that contribute to economic production or save costs, such as water purification. Attributes relate to the structure and organisation of biodiversity, such as beauty, rarity or diversity, and generate less tangible values like spiritual, educational, cultural and recreational value. Goods, services and attributes are often collectively referred to as 'ecosystem services', or 'ecosystem goods and services. More recently, the Millennium Ecosystem Assessment (MEA) (2003) defined ecosystem services as "the benefits people obtain from ecosystems" and categorized these services into 'provisioning services such as food and water, 'regulating services' like flood and disease control, 'cultural services like spiritual, recreational, and cultural benefits, and 'supporting services', like nutrient cycling, which maintain conditions for life on Earth. The first three align well with the definitions of goods, services and attributes described above.

Ecosystems provide a variety of living resources such as firewood, fish, wild plants, and grass that are harvested for raw materials, food and medicine. The provisioning value of the landscape refers to the value of the sustainable output of natural resources. However, actual harvesting rates may not alwaysbe sustainable. In cases where they are not, estimates based on harvesting rates can either overestimate or underestimate the value of provisioning services, depending on the stage of exploitation and the resulting condition of the resource base (Forsythe & Turpie, 2016).

Ecosystems provide regulatory services. Seasonal high river flows and flooding are a frequent occurrence in Malawi during the rainy period (December-April). Under natural land cover and conditions, much of the rainfall is intercepted by natural vegetation, slowed down, anda large proportion is absorbed by the landscape. This water either slowly enters the river system through subsurface flow, or it is utilised by the natural vegetation. The remaining rainwater reaches the river more quickly via surface run-off. t is this portion that contributes most directly to the peak flow often leading to river flood. In Malawi, much of the natural vegetation within the river catchments has been cleared. This clearing decreases infiltration and increases the amount of surface flow. Consequently, the peak flow after a heavy rainstorm and the resultanting flooding is greater than it would be under natural conditions (Forsythe & Turpie, 2016).

There is more carbon stored in the earth' s biomass, soil and ecosystems than there is in the atmosphere (Lal 2002). Natural systems can therefore make a significant contribution to global climate regulation through the sequestration and storage of carbon. When natural systems are degraded or cleared, much of this carbon is released into the atmosphere. These emissions contribute to global climate change, which is expected to lead to changes in biodiversity and ecosystem functioning, changes in water availability, more frequent and severe droughts and floods, increases in heat-related illness, and impacts on agriculture and energy production (IPCC 2007). These impacts will affect economies and human wellbeing on a global scale.

Malawi also has a low Human Development Index of 0.476 (UNDP 2016), and ecosystem degradation disproportionately affects the poor (Millennium Ecosystem Assessment 2003). Many of the world's poor live near forests and depend on forest-based provisioning services for their livelihoods. They are the most affected people by natural forest degradation or reduction (Pullanikkatil et al. 2020).

Malawi's over dependence on rainfall for agro-production has consequences on environmental degradation (SADC National Vulnerability Assessment Committee, 2017). About 85% of Malawians live in remote areas and almost 80% depend on natural capital (Kambewa & Utila, 2008).
Many sectors in Malawi rely on biodiversity and ecosystem services including agriculture, forest resources, fisheries, water transport, tourism, and energy. – These sectors significantly contribute to poverty reduction and sustainable development. However, land use and land cover (LULC) changes are inevitable outcomes of socioeconomic changes and greatly affect ecosystem services (Nazombe et al., 2024).
A national analysis of LULC changes and their impacts on ecosystem service values (ESVs) revealed a significant increase in grasslands, croplands, and urban areas and a notable decline in forests, shrubs, wetlands, and water bodies. Grassland, cropland, and built-up areas expanded by 52%, 1%, and 23.2%, respectively. In contrast, permanent wetlands, barren land, and water bodies declined by 27.6%, 34.3%, and 1%, respectively. The ESV declined from US$90.87 billion in 2001 to US$85.60 billion in 2022, marking a 5.8% reduction. Provisioning services increased by 0.5% while regulating, supporting, and cultural ecosystem service functions declined by 12.2%, 3.16%, and 3.22%, respectively. The increase in provisioning services was due to the expansion of cropland. However, the loss of regulating, supporting, and cultural services was mainly due to the loss of natural ecosystems. Therefore, environmental policy should prioritise the conservation and restoration of natural ecosystems to enhance the ESV of Malawi. The Forestry Policy has been reviewed to integrate issues of biodiversity management, such as Reducing Emissions from Deforestation and Forest Degradation (REDD+) and Payment for Ecosystem Services (PES). Additionally, the Climate Change Policy has been developed to promote activities related to REDD+, PES, Biodiversity offset and Clean Development Mechanisms (CDM).

4.6 Drivers of biodiversity loss in the Terrestrial Ecosystem

Terrestrial biodiversity is under sustained pressure from multiple, interacting drivers, foremost among them deforestation and habitat conversion. Rapid population growth and high dependence on land-based livelihoods have led to widespread clearing of forests and woodlands, particularly miombo ecosystems, for agriculture, settlement expansion, and infrastructure development. National assessments indicate that Malawi has experienced significant forest cover decline over the past two decades, reducing habitat extent and fragmenting wildlife populations (GoM, 2015; FAO, 2020). This habitat loss directly threatens endemic and range-restricted species, especially in biodiversity-rich areas such as Mulanje Mountain Forest Reserve and Nyika National Park. Tree cover in most forest reserves has significantly decreased due to continuous degradation in surrounding areas.

Figure 4-31: Drivers of biodiversity loss in the Terrestrial Ecosystem

Biodiversity loss in Malawi's terrestrial ecosystems is influenced by a variety of factors that depend on the socioeconomic and biophysical environment of its location. The drivers of biodiversity loss can either be direct or indirect. Direct drivers (natural and anthropogenic) are the drivers that equivocally influence biodiversity and ecosystem processes and affect biodiversity and ecosystem change at a proximate level. Examples of the direct drivers are land-use change, climate change, pollution, natural resources use and exploitation and invasive species while indirect drivers include rapid population growth, poverty, dependency of biomass energy for cooking and heating, and weak enforcement of conservation laws.

4.6.1 Land-use change

Land-use change refers to the alteration of the original use or purpose of land including the conversion of forest into agricultural land, infrastructure development and other purposes. In many countries, most forest areas have been cleared to make way for agricultural land and settlemenst to accommodate the rapidly increasing human population (Chinangwa et al., 2017; Mauambeta et al., 2010).

Malawi has continued to experience a decline in forest cover over the past fewdecades. The country experienced an increase in forest cover loss from 22, 410 hectares per year between 2000 and 2009 to 38,947 hectares per year between 2009 and 2015(Skole et al., 2021). The loss of forest has also affectedthe country's protected areas, with studies showing ongoing deforestation in I protected areas like Dzalanyama Forest Reserve and Zomba-Malosa Forest Reserve (Chinangwa et al., 2017; GoM, 2019; Munthali & Muyarama, 2011; Smith et al, 2015).

For example, Blantyre City has experienced an annual population growth rate of up to 3.5 percent between 1998 and 2018. This growth has led to settlements in fragile hilly areas that were once covered by forest. This has not only led to a loss of biodiversity but has also exposed people to life threatening conditions as seen during cyclone Fredy in 2023 displaced over 126,000 households and claimed over 500 lives in 2023 in Blantyre Soche Hills. As an example, due to deforestation and forest encroachment, a number of protected areas that are Important Bird Areas (IBAs) and Key Biodiversity Areas (KBAs) have become totally deforested, with resultant loss of endemic species, ecosystems functions and values. These include Ndirande, Soche and Michiru Mountains in Blantyre (Bayliss, 2024).

Agricultural expansion and unsustainable farming practices constitute a major driver. Smallholder agriculture dominates Malawi's economy, and expansion into customary and marginal lands has led to encroachment into forest reserves and fragile ecosystems. Continuous cultivation without adequate soil conservation reduces soil fertility, prompting further land clearing in a cycle of degradation. Monocropping systems, particularly maize-based systems, also reduce on-farm agrobiodiversity and simplify landscapes, limiting habitat heterogeneity necessary for many terrestrial species (UNDP, 2019; FAO, 2020).

Figure 4-32: Agricultural expansion and unsustainable farming practices

4.6.2 Climate Change

Direct driver pathways of climate change are related to changes in climate and weather patterns impacting in situ ecosystem functioning and causing the migration of species and entire ecosystems and affect the distribution and survival of species. As such, climate change represents an emerging but increasingly significant driver. Rising temperatures, erratic rainfall patterns, prolonged droughts, and more intense floods affect species distribution, regeneration cycles, and ecosystem resilience. Montane ecosystems and miombo woodlands are particularly vulnerable to shifts in rainfall and temperature regimes, potentially leading to changes in species composition and increased susceptibility to pests and fire (IPCC, 2022; GoM, 2021).

4.6.3 Natural resource use and exploitation

The anthropogenic exploitation of wildlife is a common occurrence in Malawi. The most overexploited species include invertebrates, trees, tropical vertebrates hunted for bush meat and species harvested for the medicinal and trade. In Malawi, poaching has had a severe impact on the biodiversity of the country. It has led to the extinction and near extinction of some species such as rhino, cheetah, wild dog, giraffe populations in the early 1980s. Efforts are under way to recover these populations with some introductions in Liwonde, Majete as well as other private game reserves. The illegal harvesting of orchids, most of which are endemic and threatened with extinction at Nyika National Park has now been recognized by the Department of National Parks and Wildlife to be an important management issue, alongside the poaching of larger mammals (GoM, 2021).

Overexploitation of forest resources, especially for fuelwood and charcoal production, is another critical driver. Biomass accounts for the majority of household energy consumption in Malawi, leading to heavy harvesting pressure on indigenous tree species such as Brachystegia spp. and Julbernardia spp. Unsustainable timber extraction, pole cutting, and non-timber forest product harvesting further degrade forest structure and reduce species composition diversity. Weak enforcement capacity and limited livelihood alternatives intensify this pressure (GoM, 2015).

Trade in ornamental species, including vertebrates associated with traditional medicine such as Pangolin, has led to significant biodiversity losses.

As a direct driver, natural resource use and exploitation are heavily influenced by indirect drivers such as socio-economic and demographic trends, as well as societal and cultural influences. As it is, per capita consumption levels are emerging as a potentially more important driver of biodiversity and ecosystem change than population growth.

4.6.4 Invasive species

Invasive species may be indigenous and/or exotic/alien, and are primarily found in terrestrial and aquatic ecosystems, disrupting the natural ecological processes.. These species out-compete local and indigenous species for resources, leading to negative impacts on biodiversity. A number of invasive and alien species or weeds have been reported in Malawi (Figure 4-29), resulting in loss of biodiversity and causing significant economic harm. Examples of invasive speciesfound in Malawi include Rubus elipticus (Himalayan raspberry), Accacia mearnsii (Black wattle) and Pteridium aquillinum (Bracken fern) found on Mulanje Mountain and Nyika National Park. Bracken fern has spread widely in Nyika National Park, the largest National Park in Malawi, invading grasslands crucial for wildlife grazing and tourist attraction. Although bracken fern is invasive , it is not alien to Malawi (Akomolafe and Rahmad, 2018).

Invasive alien species (IAS), including non-native plants such as Lantana camara, Pinus patula, eucalyptus and aquatic weeds like water hyacinth, as well as other non-native organisms disrupt native ecosystems by outcompeting indigenous flora and fauna for space, nutrients and other resources, altering habitats, and reducing the abundance and diversity of native species; they can also change water availability and ecosystem functioning, displace endemic species, and contribute to the decline of valuable habitats in areas such as Nyika National Park and Mulanje Mountain Forest Reserve, thereby exacerbating biodiversity loss and threatening both ecological integrity and livelihoods that depend on healthy ecosystems (Kacheche, R.D. & Mzuza, M.K. 2021).

4.6.5 Institutional and governance challenges

Institutional and governance challenges indirectly drive biodiversity loss. Limited financial and technical capacity for forest monitoring, weak coordination among sectors, unclear land tenure arrangements, and insufficient incentives for community conservation reduce the effectiveness of biodiversity protection efforts. Although policies such as the National Biodiversity Strategy and Action Plan (NBSAP) provide a framework for conservation, implementation gaps persist, allowing continued degradation of terrestrial ecosystems (GoM, 2015; UNDP, 2019).

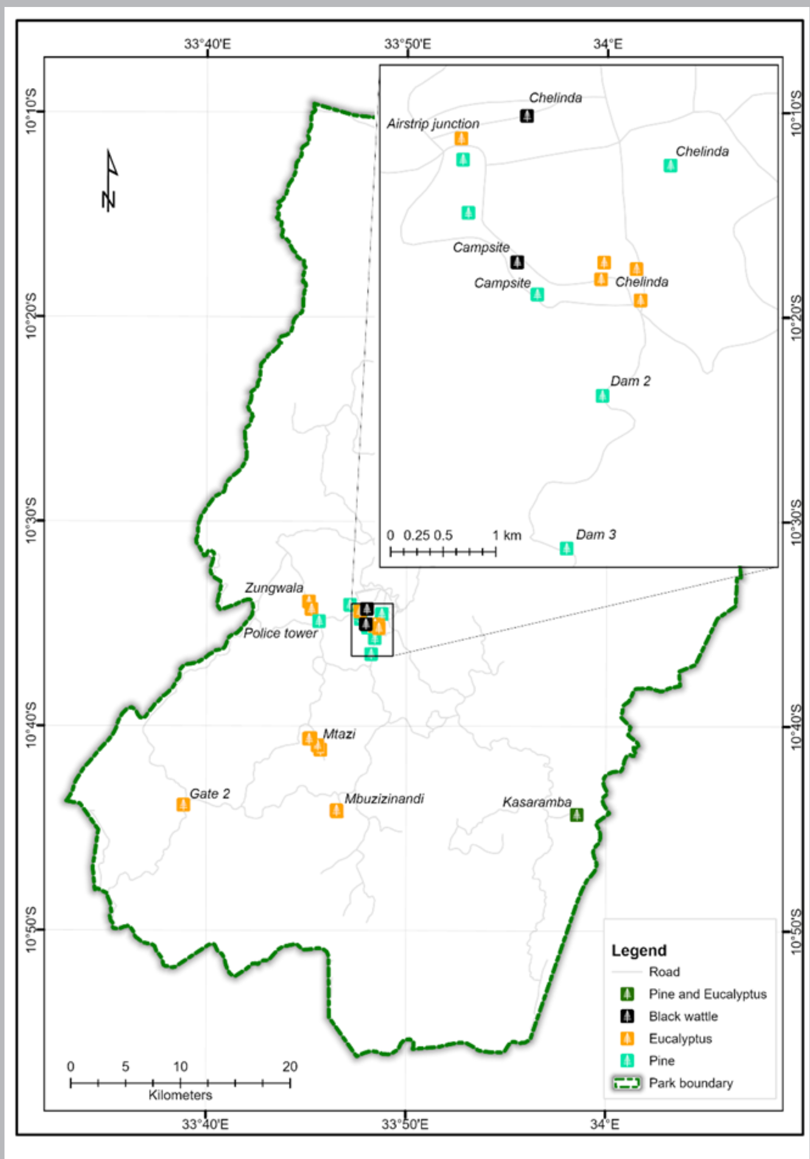


Figure 4-33: The map shows the location of Invasive and/or Alien Species in Nyika National Park.

4.7 DPSIR Framework for the Terrestrial Ecosystem in Malawi

The Driver–Pressure–State–Impact–Response (DPSIR) framework is a conceptual model used to analyze the relationship between human activities and environmental changes. It was developed to structure environmental problems and guide policy responses. The DPSIR framework provides a structured way to understand how socio-economic drivers in Malawi lead to environmental pressures such as deforestation and land degradation, which alter the state of terrestrial ecosystems and result in biodiversity loss and reduced ecosystem services, prompting policy and management responses to restore ecosystem health. The framework links socio-economic drivers, the pressures they create, the state of the environment, the impacts on ecosystems and human well-being, and the responses by society or government to address those impacts (EEA, 1999; Gabrielsen & Bosch, 2003).

In the context of the terrestrial ecosystems in Malawi, the DPSIR framework helps explain how socio-economic activities such as agriculture expansion, charcoal production, and population growth influence biodiversity and land resources (**Figure 4-30**).

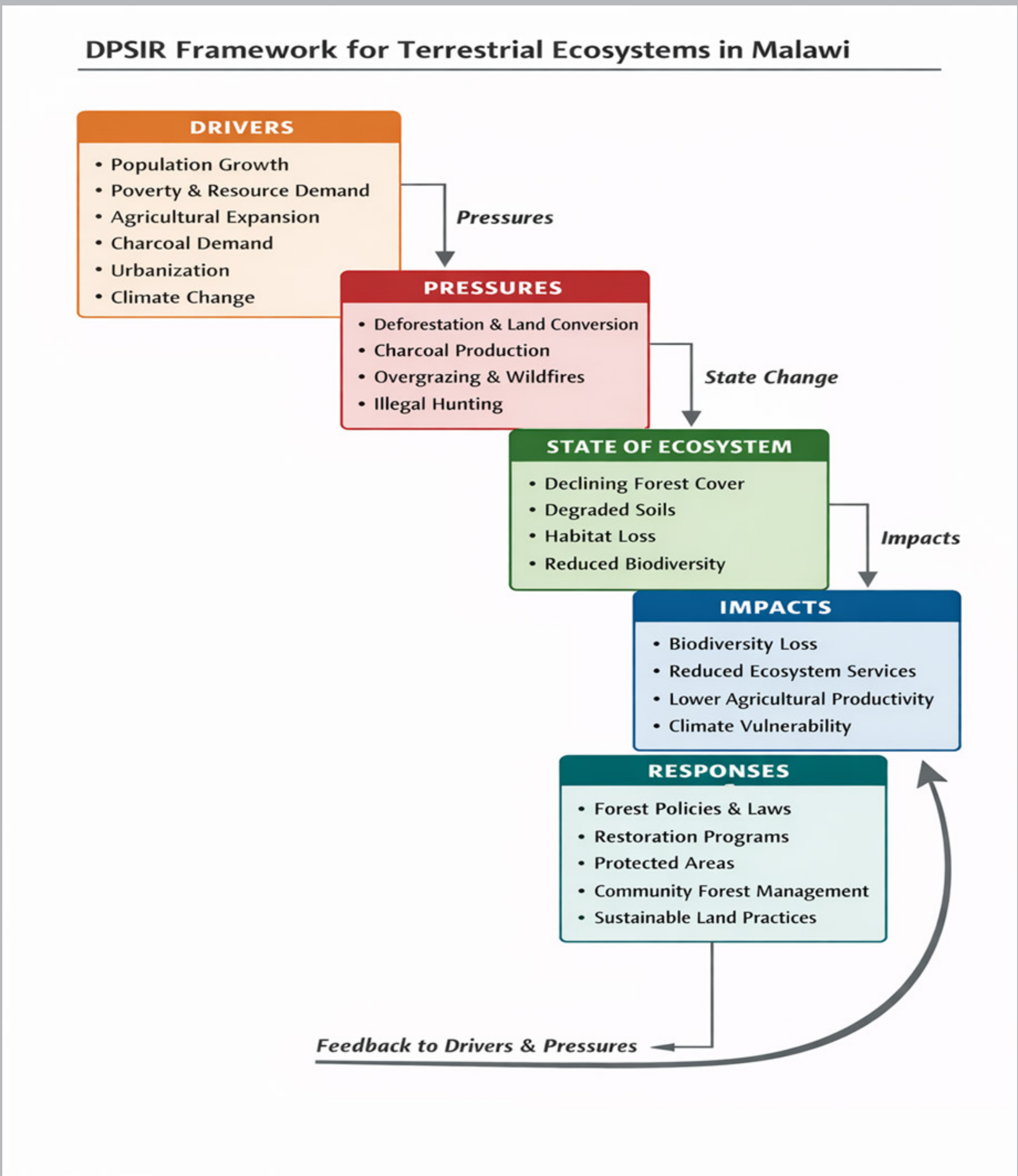


Figure 4-34 : DPSIR Framework for Terrestrial Ecosystems in Malawi
Source: Adapted from European Environment Agency (1999)

4.8 Loss of ILK related to terrestrial biodiversity conservation

A number of factors emerged during the assessment that have a negative impact on the viability of continued practice of and respect towards indigenous local knowledge systems in Malawi. And this raises concern on its future role to contribute towards conservation of the terrestrial ecosystems and other ecosystems in the country.

4.8.1 Globalisation and Modernity

All cultural communities consulted during the assessment indicated that globalization, through the introduction of new ideas, technologies, and lifestyles, has influenced different segments of society, particularly the youth, to adopt alternative value systems while abandoning ILK, which is often perceived as antiquated and no longer relevant. This trend raises concerns about the continuity of intergenerational knowledge transfer, especially as younger generations are increasingly exposed to modern education, communication technologies, and external practices.

The attraction of urban lifestyles further accelerates this shift, as many young people migrate to towns and cities in search of better economic opportunities. As a result, their engagement with customary practices declines and the social spaces through which ILK was traditionally transmitted are weakened. For example, at Vwaza Wildlife Reserve, intergenerational transfer of ILK was reported to be limited. Although ILK still exists in the area, it has been increasingly overshadowed by externally driven conservation approaches introduced by various conservation organizations operating in the landscape.
In addition, community-based organizations now implement locally agreed by-laws and regulations that are not always grounded in ILK. While these regulations support conservation objectives, they are sometimes disconnected from customary governance systems and instead reflect a shift toward formalized management structures, thereby further reducing the everyday use and transmission of traditional knowledge.

4.8.2 Social-political transition

Malawi has undergone rapid socio-political changes which have had a lot of influence on the important role ILK played in biodiversity conservation prior to the advent of the colonial system of governance and conservation. Similarly, the country transitioning from autocratic rule to a pluralistic system of governance guided by democratic principles have been perceived by ILK holders to be working in antagonism with traditional rules and regulations. The two phases of socio-political dispensation were commonly discussed in the FGDs to have changed the belief systems and traditional and cultural values to the extent that the traditional leaders are left with limited powers. Formal management systems was also related to this social-political transition. The local communities argued that government interference in the management led to degradation in some of the forests, mountains and woodlands. Thus when these resources were being managed by the local people they had abundant biodiversity because people had a sense of ownership and they were using the resource sustainably.

4.8.3 Influence of monotheist religions

One of the long-term threats to the continuity of ILK is the erosion of traditional belief systems and the expansion of exogenous religions, most of which are monotheistic. It was observed that, in many cultural communities across the country, the spread of Christianity has contributed to the decline of certain ILK practices. As increasing numbers of people convert to Christianity and other faiths, practices associated with ancestral veneration are often regarded as incompatible with religious teachings and are therefore less valued or practiced.

Some local chiefs demonstrated knowledge of ILK but expressed reservations about applying it, describing certain practices as demonic in reference to Christian doctrine (Malawi NEA ILK Technical Working Group Report, 2023). Consequently, many adherents, having distanced themselves from traditional spiritual values, no longer feel socially or morally obligated to observe customary norms and practices.

4.8.4 Education

Although formal education programmes provide important tools for human development, their prioritization of scientific disciplines has often led to the neglect of ILK, thereby weakening its transmission. ILK has much to contribute; however, most curricula at the primary, secondary, and tertiary levels do not adequately incorporate it. Participants noted that in earlier periods, elements of ILK were mainstreamed into educational content, but this is no longer common, a shift that has contributed significantly to the decline of traditional knowledge systems.

4.8.5 Perceived superiorities of science

Related to the educational drivers discussed above is the perceived superiority of science over other modes of knowledge production. Many scientists, including environmental scientists, appear insufficiently open or even suspicious toward this emerging discourse, to the point of hesitating to interrogate the foundations of their own knowledge systems. For the moment, the scientific community continues to regard ILK primarily as knowledge lacking scientific rigor, and therefore as unreliable or unworthy of trust.

Efforts to understand ILK often involve subjecting it to scientific validation procedures that rely exclusively on scientific criteria. These procedures claim to distinguish the 'useful' from the 'useless', the 'objective' from the 'subjective', and Indigenous "science" from Indigenous "belief." In doing so, only those elements that align with the dominant paradigm of Western science are extracted, while the rest are dismissed. Although this form of cognitive mining may enrich scientific knowledge, it simultaneously threatens ILK systems with fragmentation and dispossession.

Given the institutional authority of science, it is unsurprising that the supposedly "objective and rational" scientific method is repeatedly invoked to evaluate and judge other knowledge systems (Nakashima & Roué, 2005). Yet such hierarchical approaches risk undermining the integrity, continuity, and legitimacy of ILK.

In contrast to validation through scientific criteria, the Multiple Evidence Base approach recognizes ILK as a legitimate and valid knowledge system in its own right. It allows ILK and science to contribute complementary evidence without subordinating one to the other. This reduces selective extraction and helps safeguard the coherence and continuity of ILK systems while enabling meaningful cross knowledge collaboration and co-production.

Table 4-9: Main threats to biodiversity in protected areas

	Protected Area	Main Threat
1	Dzalanyama Forest Reserve	Significantly affected by fuelwood extraction for both charcoal and fuelwood, showing encroachment mainly on the eastern side of the Reserve (i.e., the Dedza side).
2	Bunganya Forest Reserve	Significant wood extraction
3	Dedza-Salima Escarpment Forest Reserve	Presents fuelwood extraction and encroachment.
4	Kaning'ina Forest Reserve	Extensive charcoal production mainly on the north-eastern side, while some illegal sawing due to the loss of timber resource for the country is evidenced in the north of the FR.
5	Mua-Livulezi Forest ReserveReserveReserce	Significant encroachment
6	Perekezi Forest Reserve	Threatened by the potential reintroduction of merchandized open-cast mining, while charcoal production was identified in two hotspot co-management blocks and along the main roads to Luwawa and Mzuzu.
7	Thuma Forest Reserve	Extensive charcoal production on the western side.
8	Kasungu National Park	Significantly affected by tree felling by elephants, poachers felling trees during poaching, encroachment for farming, livestock grazing, and forest fires.
9	Mkuwazi Forest Reserve	Significant illegal logging and sawing.
10	South Viphya Forest Reserve	Extensive encroachment for settlement and cropland, forest fires, and illegal logging.
11	Chimaliro Forest Reserve	Evidence of heavy charcoal production, mainly on the north-eastern side. Illegal sawing, livestock grazing, and forest fires are also evident.
12	Mchinji Forest Reserve	Significant encroachment along the Malawi-Zambia border, extraction of fuelwood for tobacco curing, and forest fires.

Table 4-9 Conti.: Main threats to biodiversity in protected areas

	Protected Area	Main Threat
13	Mtangatanga Forest Reserve	Threatened by a potential increase in charcoal production being replicated from nearby Perekezi Forest Reserve, illegal felling of trees for fuelwood, and livestock grazing.
14	Tsamba Forest Reserve	High charcoal production and illegal logging.
15	Thambani Forest Reserve	High charcoal production and illegal logging.
16	Namizimu Forest Reserve	Mostly shows illegal logging

These identified threats do not preclude the existence of present and future additional threats from other anthropogenic pressures.

4.9 Measures to address biodiversity loss

To curb the biodiversity loss, some measures have been employed in the country and they include the following;

4.9.1 Re-introductions and translocations

The country has seen the reintroduction of some species that got extinct in the country. For example, Rhinos have been introduced in Majete and Liwonde; Cheetah in Liwonde and Majete; Giraffe in Majete and Nyala Private Park; and Wild dogs in Liwonde and Majete. Some species have been translocated from areas of abundance to areas of decline so as to repopulate those areas as well. Liwonde National Park, which which was overpopulated with elephants that were threatening the local vegetation, translocated 250 elephants to Kasungu National Park; 34 elephants to Nyika; 332 elephants to Nkhotakota. In 2022, Sable antelopes, waterbucks and buffaloes were also translocated to Kasungu National Park.

4.9.2 Invasive alien species eradication programs

There are initiatives to control the spread of the alien invasive species in most protected areas. Currently there is a pilot project going on in Nyika National Park trying to manage the menace, with main focus on Pinus patula, R ubus ellipticus, Acacia mearnsii (black wattle) and Pteridium acquilinum (bracken fern). Strengthening law enforcement: government has for the past years been recruiting rangers annually to beef up the workforce. It has also established an interagency to combat wildlife trade, a multisector grouping that aims at assisting in combating illegal wildlife trade.

4.9.3 Community-based conservation initiatives

these are aimed to encourage community participation in conservation efforts and take a role in natural resources conservation. Community-based conservation initiatives, including collaborative management or co-management arrangements, are practiced in many protected areas such as national parks and wildlife reserves, with promising outcomes reported in some contexts (e.g., Manda et al., 2023).

4.9.4 Public Private Partnerships (PPP)

Conservation requires resources to have a meaningful impact. In order to tap the resources from the private sector, the government has been entering into PPP arrangements with various players to manage its protected areas sustainably. For example, currently, the African Parks (AP) manages Liwonde National Park, and Majete and Nkhotakota Wildlife Reserves; the Peace Parks Foundation (PPF) manages Nyika National and Vwaza Marsh Wildlife Reserve, and the International Fund for Animal Welfare (IFAW) is managing Kasungu National Park.

4.9.5 Establishment of Village Forest Areas (VFAs):

VFAs in Malawi have shown moderate but context-dependent effectiveness in addressing biodiversity loss by strengthening community stewardship over customary forest lands. Established under the Forest Act (2016) and managed through Village Natural Resource Management Committees (VNRMCs), VFAs empower local communities to regulate harvesting, control illegal logging, prevent bushfires, and promote natural regeneration and enrichment planting of indigenous species. Where governance structures are functional and supported by the Department of Forestry and NGOs, VFAs have contributed to improved forest cover, recovery of miombo woodlands, and protection of key species used for timber, fuelwood, food, and medicine. They also reinforce indigenous knowledge systems and local enforcement mechanisms, which enhance compliance compared to centrally managed reserves.

4.9.6 Forest regeneration management

Forest regeneration has demonstrated positive but variable effectiveness in addressing biodiversity loss by helping to stabilize and rebuild forest ecosystems that have been heavily degraded by deforestation and unsustainable land use. Remote-sensing studies of community-led regeneration efforts show substantial increases in tree cover and vegetation recovery over time, indicating that participatory approaches can restore habitats and improve ecological functions when encroachment is controlled and natural processes are supported. Large programs such as the Alliance for Restoration of Forest Landscapes and Ecosystems in Africa (AREECA) and related FLR projects have placed thousands of hectares

under restoration and integrated natural regeneration with agroforestry and livelihood activities, contributing to greater structural diversity and habitat availability for wildlife. Initiatives like community-based regeneration on Mt. Mulanje and other miombo woodlands show that protecting regenerating forests and involving local people in fire management and governance enhances recovery of indigenous species and reduces further habitat loss.

4.9.7 Effectiveness of proposed measures in reducing biodiversity loss

However, active engagement of Indigenous and Local Knowledge (ILK) holders in the conservation and management of biodiversity and ecosystems in Malawi remains weak. Although national policies and legal frameworks increasingly reference community participation, collaborative management, and inclusivity, evidence from National Ecosystem Assessment (NEA) ILK field visits in Mulanje, Vwaza, Zolokere, and Khulubvi reveals persistent gaps between policy commitments and implementation. In practice, co-management arrangements were found to be largely nominal, with limited meaningful participation of Indigenous Peoples and local communities in decision-making, weak recognition of customary institutions, and minimal integration of ILK into conservation planning and management processes.

Findings from the Human Rights-Based Approach (HRBA) dialogues and assessments further underscore these gaps. From an HRBA perspective, key principles of participation, accountability, non-discrimination, transparency, and empowerment are inadequately operationalized in biodiversity governance at local levels. Communities reported limited access to information, unclear roles and responsibilities within co-management structures, and insufficient mechanisms to hold duty bearers accountable. Women and youth, in particular, remain underrepresented in decision-making spaces, despite their central roles in natural resource use and stewardship.

These combined findings point to structural and institutional barriers that constrain the realization of rights-based, inclusive conservation. Policy transformation is therefore required to move beyond procedural participation towards substantive and equitable power-sharing, including the legal and institutional recognition of customary governance systems, clear operational guidelines for co-management, and sustained capacity-building for both rights holders and duty bearers.

Transdisciplinary approaches to knowledge production are essential to this transformation. By bringing together ILK holders, scientists, policymakers, and practitioners within a Multiple Evidence Base framework, such approaches can support the mainstreaming of ILK and the strategic implementation of rights-based measures to restore, conserve, and sustainably use biodiversity and ecosystem services.

4.10 Policy, legal, Institutional and technical frameworks ecosystems

4.10.1 Introduction to Policy Framework

Policies and legal instruments such as constitutions, laws, policies, and regulations are essential for the sustainable management of terrestrial ecosystems. These ecosystems encompass diverse environments like forests, mountains, agricultural landscapes and wildlife habitats. These frameworks are created to regulate human interactions with these ecosystems, ensuring that activities such as logging, mining, and farming do not harm their health and longevity. Policies provide clear guidelines and boundaries that are vital for preserving ecological balance and biodiversity. Policy coherence and integration across various sectors and levels of governance are crucial for effectively implementing these frameworks.

In Malawi, policies and legal frameworks serve as the cornerstone of efforts to manage, conserve, and protect terrestrial ecosystems. They provide the necessary structure and authority to regulate human activities, balancing the use of terrestrial ecosystems with conservation efforts. This is essential in defining rights such as who can use which resources and how—as well as outlining responsibilities and penalties for those who violate these regulations. By guiding behavior, these frameworks aim to ensure the sustainable management of terrestrial resources, preserving them for future generations.

4.10.2 Analysis of policy and legislation frameworks for governance of terrestrial ecosystems

Malawi has implemented several policies, strategies and plans (**Table 4-10**), enacted and amended legislation to help manage the country's terrestrial ecosystems sustainably. Additionally, Malawi has recently developed a long-term national multi-sectoral vision called Malawi 2063 (MW2063), which features seven enablers, including environmental sustainability. The National Planning Commission (NPC) has also developed the Malawi 2063 First 10-Year Implementation Plan (MIP-1) to operationalize the MW2063 national vision for the period 2021 to 2030.

Table 4-9 Conti.: Main threats to biodiversity in protected areas

Forest Ecosystem	Policy and Legislation
Parks and wildlife National parks and wildlife reserves Sanctuaries grassland	National wildlife policy (2000) National parks and wildlife Act (1994)
Forestry Reserves areas Plantations (Public and Private) Community forest areas grasslands	National Forest Policy (2016) National Charcoal Strategy (2017) Forest Landscape Restoration Strategy (2017) Forest Act (1997) Forest Amendment Act (2020)
Mountain Ecosystem	**Policy and Legislation**
Mountains	National Biodiversity Strategy and Action Plan (NBSAP) (2015–2025) National wildlife policy (2000) and National Forest Policy (2016)
Agricultural Ecosystem	**Policy and Legislation**
Tree crops Trees on farm Annual crops	Land Resources Conservation management Policy and Strategy (2024) National Agriculture Policy (2024) Food security policy (2006)
OVERARCHING POLICIES	**Policy and Legislation**
	Malawi2063
	National Environmental Policy (2004)
	Environment Management Act (2017)
	National Climate Change Management Policy (2016)
	National Biodiversity Strategy and Action Plan ((2015–2025)
	National Disaster Risk Management Policy (2015)
	Disaster Risk Management Act (2023)
	National Energy Policy (2018)
	Energy Regulation Act (2007)

4.10.2.1 National Forest Policy (2016)

The goal of Malawi's National Forest Policy (2016) is to promote the conservation, establishment, protection, and sustainable management of trees and forests to support the country's sustainable development. The policy aims to ensure that forest resources continue to provide environmental services, biodiversity conservation, and socio-economic benefits such as livelihoods, energy, and forest products for present and future generations.

4.10.2.2 Nation Forest Landscape Restoration Strategy (2017)

The goal of Malawi's National Forest Landscape Restoration Strategy is to restore degraded and deforested landscapes through sustainable land management and forest restoration practices to improve ecosystem services, livelihoods, and climate resilience. The strategy promotes large-scale restoration of degraded land (including Malawi's commitment to restore about 4.5 million hectares by 2030) while enhancing food security, biodiversity conservation, water resources, energy supply, and rural livelihoods through integrated landscape management approaches.

4.10.2.3 National Charcoal Strategy (2017–2027)

The Malawi National Charcoal Strategy (2017–2027) aims to provide a national framework for addressing the growing demand for charcoal and the resulting deforestation and forest degradation in Malawi while ensuring sustainable ecosystem management.

The strategy seeks to balance household energy needs with environmental conservation by promoting alternative cooking fuels, improving energy-efficient cookstoves, increasing sustainable wood production through plantations, and strengthening regulation of charcoal production and trade. Through these measures, the strategy intends to reduce pressure on natural forests, curb illegal charcoal production, and support livelihoods while maintaining ecosystem services such as soil fertility, water regulation, and biodiversity conservation.

4.10.2.4 Forest Act (1997) & Forest Amendment Act (2020)

The Forestry Act 1997 and the Forestry (Amendment) Act 2020 aim to promote the sustainable management, conservation, and utilization of Malawi's forest resources while ensuring environmental stability and socio-economic benefits. The 1997 Act establishes a legal framework for participatory forestry by promoting community involvement in forest conservation, sustainable harvesting of forest products, protection of fragile ecosystems such as riverbanks and water catchments, and the development of forestry research, education, and institutions. It also encourages agroforestry and sustainable forest use to meet local needs for fuelwood and other products. The 2020 Amendment strengthens the original law by improving regulation and enforcement of forestry activities, increasing penalties for forest offences, enhancing transparency and stakeholder participation, enabling partnerships in forest management, and aligning forestry governance with newer land laws and community structures to better protect forests and biodiversity.

4.10.2.5 National Wildlife Policy (2018)

The National Wildlife Policy (2018) of Malawi aims to guide the conservation, sustainable management, and utilization of wildlife resources while addressing emerging challenges affecting the wildlife sector. Its overall goal is to ensure that wildlife and associated ecosystems are protected and managed sustainably so that they contribute to biodiversity conservation, national development, and the well-being of present and future generations. Key objectives of the policy include reducing illegal wildlife use and trade, minimizing human–wildlife conflict, promoting stakeholder participation and community and private sector involvement in wildlife conservation, strengthening research and monitoring, improving protected area infrastructure and management, and addressing cross-cutting issues such as climate change impacts and social considerations in wildlife management.

4.10.2.6 National Energy Policy (2018)

The Malawi National Energy Policy (2018) aims to ensure a sustainable, reliable, and affordable supply of energy to support Malawi's socio-economic development while minimizing environmental degradation. Its overall goal is to increase access to modern energy services and improve energy security in a manner that promotes efficient resource use and environmental sustainability. Key objectives include diversifying energy sources beyond traditional biomass, promoting renewable energy such as solar, hydro, and wind, improving energy efficiency and conservation, strengthening institutional and regulatory frameworks in the energy sector, encouraging private sector investment, and reducing reliance on unsustainably harvested fuelwood and charcoal. Through these measures, the policy also contributes to ecosystem management by reducing pressure on forests and promoting cleaner and more sustainable energy alternatives.

4.10.3 Analysis of policy integration of Indigenous and Local Knowledge (ILK) in Malawi

The table below presents an assessment of the extent to which several policies, legal instruments, and strategic frameworks in Malawi integrate Indigenous and Local Knowledge (ILK) in environmental governance, biodiversity conservation, and climate resilience. It also identifies critical gaps and gives actionable recommendations for each policy or framework.

Table 4-11: Policy Integration of Indigenous and Local Knowledge (ILK)

No.	Policy/ Framework	ILK Integration	Gaps Identified	Recommendations
1	Constitution of Malawi	Limited	There is no explicit reference to ILK rights or recognition	Include ILK rights under environmental protection and community participation clauses
2	Malawi vision 2063	Limited	There is no clear reference to ILK rights or recognition.	Include ILK rights under environmental protection and community participation. This can include principles of the Human Rights Based Approach (HRBA).
3	Environmental Management Act	Moderate	It has general references to community participation and is not ILK-specific	The Act should add ILK safeguards and procedures in Environmental Impact Assessments (EIA)1
4	Land Act and National Land Policy	Limited	They both focus on land tenure and overlook cultural-land relationships	Need to recognize ILK in customary land governance and conflict resolution.
5	Water Resources Act and National Water Policy	Moderate	They both lack community co-management mechanisms informed by ILK	Include traditional water knowledge in catchment and wetland management plans.
6	Forest Act and National Forest Policy	They are both strong in participatory approaches	ILK is not clearly defined, recognized, or protected.	Need to embed ILK protocols in forest co-management models.
7	Wildlife Policy	Moderate	It recognizes communities but not their knowledge systems	Strengthen community-based conservation with ILK documentation tools.
8	Disaster Risk Management Act/ policy	Limited	ILK on early warning signs is not mainstreamedt integrated	Develop ILK-driven community disaster preparedness strategies
9	National Climate Change Management Policy	Emerging	Some sections mention vulnerable groups and not ILK	Promote climate resilience strategies derived from ILK
10	Gender Equality Act and National Gender Policy	Limited	There is no link between women's ILK and Environmental Knowledge	Highlight women's ILK in conservation and food security initiatives
11	Local Government Act and Decentralization Policy	Moderate	There are no clear ILK advisory structures	Need to formalize representation of ILK in District Environmental Subcommittees
12	Irrigation Act and National Irrigation Policy	Very Limited	There is the technical focus which ignores traditional irrigation knowledge	Promote ILK traditional water harvesting techniques
13	National Energy Policy	Minimal	It overlooks bioenergy knowledge systems	Incorporate ILK in biomass and charcoal alternatives search
14	National Resilience Strategy	There are some ILK applications	It mainly focuses on livelihood; it is weak on ILK systems	Link ILK to ecosystem-based adaptation strategies

Table 4-11 Conti.:Policy Integration of Indigenous and Local Knowledge (ILK)

No.	Policy/ Framework	ILK Integration	Gaps Identified	Recommendations
15	Fisheries and Aquaculture Policy	Moderate	Limited to co-management models	MainstreamIntegrate ILK into seasonal fishing bans and spawning practices
16	Mines and Minerals Policy	Very Limited	No ILK inclusion or cultural site protection	Protect sacred sites and traditional ecological zones in mining licenses
17	National Adaptation Plan and NDCs	Mentions Emerging ILK issues	Weak follow-through in implementation	Institutionalize ILK in climate adaptation planning and budgeting
18	Wetlands Guidelines and Ramsar Convention	Some alignment	Not localized enough to capture ILK practices	Need to co-develop local wetlands management plans using ILK, also consider ILK integration in wetlands policy development
19	National Charcoal Strategy National Charcoal Strategy	Limited	Focuses on regulation, and not on traditional fuel-saving methods	Promote ILK in energy-saving cooking practices
20	National Biodiversity Strategy and Action Plan (NBSAP)	Strong	It lacks operationalization of ILK mainstreaming	Ensure the revised NBSAP has ILK reflected in biodiversity indicators and monitoring tools
21	National Landscape and Restoration Strategy	Moderate	Implementation does not reflect ILK contributions	Use ILK in species reintroduction and soil conservation
22	National Seed Policy	Very limited	It emphasizes certified seed, marginalizing traditional seed systems	Need to recognize and protect traditional seed varieties and farmer knowledge
23	Urban Policy	Minimal	It overlooks the role of ILK in urban green space and food systems	Integrate ILK in urban planning, waste management, and community gardens
24	National Sanitation Policy	Very limited	Ignores traditional sanitation practices and beliefs	Promote ILK in culturally appropriate hygiene education and practices
25	National Fertilizer Policy	Limited	It focuses on chemical fertilizers with no reference to traditional soil practices	Support ILK in composting, organic fertilization, and soil fertility management
26	Decentralization Policy	Moderate	Focus on local governance without ILK integration	Ensure ILK holders have formal advisory roles in decentralized structures
27	Transport Policy	Minimal	It is focusing on Technical infrastructure and lacks ILK consideration	Consider ILK in rural access planning and transport impacts on sacred sites
28	Agriculture Land Resources Management Policy	Moderate	Focuses on conservation agriculture, missing cultural land-use knowledge	Incorporate ILK into sustainable land use and agrobiodiversity planning

Table 4-11 Conti.:Policy Integration of Indigenous and Local Knowledge (ILK)

No.	Policy/ Framework	ILK Integration	Gaps Identified	Recommendations
29	Renewable Energy Strategy	Very limited	It ignores traditional energy sources and community innovations	MainstreamIntegrate ILK into seasonal fishing bans and spawning practices
30	National Framework for Water and Climate	Limited	Focuses on technical data, community resilience practices	Protect sacred sites and traditional ecological zones in mining licenses
31	National herbarium & botanic garnens Act	Limited	Promotes the establishment of herbarium and botanical gardens	Institutionalize ILK in climate adaptation planning and budgeting
32	National Cultural Policy	Comprehensive	Covers promotion and preservation of intangible cultural heritage which is an aspect of ILK	Need to co-develop local wetlands management plans using ILK, also consider ILK integration in wetlands policy development

The above review reveals that while some policies and frameworks acknowledge the role of Indigenous Peoples and Local Communities, there remains a significant gap in clearly recognizing and institutionalizing ILK. Integrating ILK into national policies and frameworks is very essential for sustainable environmental management, climate adaptation, and protection of cultural heritage. Strategic interventions, such as revising policy language, incorporating ILK in implementation tools, and formalizing participation mechanisms, will significantly enhance the effectiveness and inclusiveness of these policies.

4.10.4 Analysis on mainstreaming of ILK in policy and legislation frameworks for the governance of terrestrial ecosystems

ILK is one of the important aspects to consider in making plans and interventions about conservation of biodiversity. In Malawi, ecosystems are governed by various framework legislations which have been well developed to support their sustainable management. Ecosystem management needs a strong cross-sector coordination to promote protection of biodiversity within the ecosystems. The National Ecosystems Assessment (NEA) project takes cognizance of the significance of incorporating Indigenous Local Knowledge in important policy documents related to conservation of ecosystems in all its manifestations.

The NEA also assesses the mainstreaming of ILK in legal instruments pertaining to ecosystem management in Malawi. The Legal instruments include the National Environmental Policy (NEP) of 1996; Fisheries Conservation and Management Act 1997; National Parks and Wildlife Act 2004; Wildlife policy 2000; National Fisheries Policy 2012-2017; National Water Policy 2005; National Agricultural Policy 2016; National Forestry Policy 2017; National Forestry Act 1997; National Land Resources Management Policy and Strategy 2000; the National Herbarium and Botanic Gardens Act 1987; National Cultural Policy 2015.

This policy review was guided by one key framing question; What policy responses, measures and processes exist for strengthening and improving the governance of nature and nature's contributions to people regarding indigenous knowledge and local practices of local communities?

4.10.4.1 National Environmental Policy, 2004

The National Environmental Policy frames its overarching policy goal as the 'promotion of sustainable social and economic development through the sound management of the environment and natural resources' (National Environmental Policy 2004, p.4). This policy through its various objectives and strategies acknowledges and recognises the role of local knowledge and customary laws in contributing towards the conservation of biodiversity. For instance, one of its specific policy goals is to 'promote the use and application of local knowledge and norms that facilitate sustainable environment and natural resources management'(National Environmental Policy 2004, p.4). . In terms of legislation, it acknowledges as its guideline the incorporation of customary laws as it asserts that it will 'incorporate customary law norms that promote sustainable utilization and management of the environment and natural resources into framework and sectoral legislation'(National Environmental Policy 2004, p.13). What remains to be seen therefore is to what extent are these objectives accomplished on the ground in order to conserve the ecosystems using local knowledge?

4.10.4.2 Environmental Management Act 2017

The Environmental Management Act of 2017 prescribes measures for the protection of traditional and indigenous interest and rights of local communities.

4.10.4.3 National Environmental Policy, 2004

The National Environmental Policy frames its overarching policy goal as the 'promotion of sustainable social and economic development through the sound management of the environment and natural resources' (National Environmental Policy 2004, p.4). This policy through its various objectives and strategies acknowledges and recognises the role of local knowledge and customary laws in contributing towards the conservation of biodiversity. For instance, one of its specific policy goals is to 'promote the use and application of local knowledge and norms that facilitate sustainable environment and natural resources management'(National Environmental Policy 2004, p.4). . In terms of legislation, it acknowledges as its guideline the incorporation of customary laws as it asserts that it will 'incorporate customary law norms that promote sustainable utilization and management of the environment and natural resources into framework and sectoral legislation'(National Environmental Policy 2004, p.13). What remains to be seen therefore is to what extent are these objectives accomplished on the ground in order to conserve the ecosystems using local knowledge?

4.10.4.4 Environmental Management Act 2017

The Environmental Management Act of 2017 prescribes measures for the protection of traditional and indigenous interest and rights of local communities.

4.10.4.5 National Forest Policy of Malawi 2016

The main goal of the National Forest Policy is 'to sustain the contribution of the national forest resources to the quality of life in the country by conserving the resources for the benefit of the nation'(National Forest Policy of Malawi 2016, p.5).While the National Forest Policy recognises the inclusion of the communities in the conservation efforts of the forests in Malawi the policy does not assert in clear terms with regard to incorporation of local knowledge as a strategy for conservation. Instances of rural community recognition include objectives such as 'empowering rural communities to manage the forest resources, fostering ownership or usufruct of trees, and ensuring that such trees are sustainably utilized for the benefit of both present and future generations' (National Forest Policy of Malawi 2016, p.7). In as much as the policy recognises the existence of indigenous knowledge this knowledge is not about the conservation of the forest per say but the knowledge that the community has with regard to medicinal properties of the forest products for their benefit. For example, one of the strategies to achieve the policy objectives is to' protect and promote the marketing of indigenous knowledge about the medicinal and other properties of Malawi's forest resources for the benefit of the custodians of the knowledge'((National Forest Policy of Malawi 2016, p.8). This recognition of indigenous knowledge or local knowledge has potential for the policy to include the recognition of local knowledge of the community in terms of how it may assist in the conservation of the forests in Malawi. The policy needs clarity on one of the strategies which intends to 'ensure that the rural communities' wealth of information regarding biodiversity and ecology is respected and taken into account'((National Forest Policy of Malawi 2016, p.8). What is this 'wealth of information regarding biodiversity and ecology?' If local knowledge or indigenous local knowledge is part of this then it needs to be stated clearly.

4.10.4.6 Fisheries Conservation and Management Act, 1997 and the National Fisheries Policy 2012 – 2017

Part III of the Fisheries and Conservation and Management Act, 1997 recognises the participation of the local community in 'conservation and management of fisheries in Malawi'(Fisheries Conservation and Management Act, 1997, p.10). In this regard it gives powers to the minister to 'provide for conservation and management of fisheries'(Fisheries Conservation and Management Act, 1997, p.10).

Perhaps because this is an act or law therefore there is not much to be expected in terms of strategies of conservation of fish resources by the authorities and the local communities. This can be strategically set out by the Ministry's policy framework. The National Fisheries Policy 2012-2017 sets its main goal to 'promote sustainable fisheries and aquaculture development in order to contribute to economic growth in Malawi'(National Fisheries Policy 2012 – 2017,p.6).

The Policy has seven priority areas including Capture Fisheries, Aquaculture Development, Fish Quality Control and Value Addition, Governance, Social Development and Decent Employment, Research and Information and Capacity Development. Several objectives and strategies have been outlined to achieve this. While the policy places a premium on the importance of involvement of local communities in protection and conservation of fish resources it does not identify or mention local knowledge as its key component in conservation of fish resources in Malawi. For example, on improved fisheries management and governance for both small- and large-scale sectors, the policy promises to ensure 'promotion of active participation of local fishing communities and fish farmers in the sustainable development of the fisheries sector' and 'provision and enabling environment for fishing communities to organize themselves at local and national level through member owned and member-controlled organizations'(National Fisheries Policy 2012 – 2017, p.11. While the communities are involved it is not clear if their local knowledge is also mainstreamed as part of strategy for conservation of the fish resources. However, through its Policy Priority area on Research and Information there is acceptance of 'establishment of an information system necessary for sustainable exploitation, management, conservation of biodiversity, utilization and marketing and investment in the fisheries sector through a participatory multi-stakeholder process'(National Fisheries Policy 2012 – 2017,p.12).This provides an opportunity and impetus for the Ministry to make research on how local knowledge or incorporation of local knowledge of the fishing communities may contribute to conservation and sustainable use of the fish resources in Malawi.

4.10.4.7 National Parks and Wildlife Act 1994

Part III of the National Parks and Wildlife Act, 1994 provides for local community participation and private sector involvement in conservation and management of wild life. It further provides for the establishment and management of community conservation areas outside the protected areas' National Parks and Wildlife Act 1994, p.18). Again, perhaps because it is an act or law there is not much to be expected in terms of strategies of conservation of wildlife resources by the authorities and the local communities. This again can be strategically set out by the Ministry's policy framework.

4.10.4.8 National Water Policy, 2005

The Overall policy goal of this document 'is sustainable management and utilization of water resources, in order to provide water of acceptable quality and of sufficient quantities, and ensure availability of efficient and effective water and sanitation services that satisfy the basic requirements of every Malawian and for the enhancement of the country's natural ecosystems' (National Water Policy, 2005 p.4). The policy clearly recognises the empowerment of 'communities to effectively and efficiently manage water resources'(National Water Policy, 2005, p.10). However, it is not clear if this empowerment of communities includes the acknowledgement of their local knowledge in the management of the water resources.

National Agriculture Policy 2016

The broad policy goal for the National Agricultural Policy 2016 is to 'achieve sustainable agricultural transformation that will result in significant growth of the agricultural sector, expanding incomes for farm households, improved food and nutrition security for all Malawians, and increased agricultural exports'(National Agriculture Policy 2016,p.10). The policy has identified eight critical priority areas which are; Sustainable Agricultural Production and Productivity; Sustainable Irrigation Development; Mechanisation of Agriculture; Agricultural Market Development, Agro-processing and Value Addition; Food and Nutrition Security; Agricultural Risk Management; Empowerment of Youth, Women and Vulnerable Groups in Agriculture; Institutional Development, Coordination and Capacity Strengthening. However, looking at the strategies deployed to achieve the objectives of these priority areas there is zero recognition of the role of indigenous local knowledge.

Policy priority area six which deals with Agricultural Risk Management could have acknowledged indigenous local knowledge especially in response to adverse climatic changes and food security. This priority area recognizes that fluctuations in agricultural production can result from various factors including climate change, weather variability, pests and disease. These factors can have devastating effects on food security and agricultural growth. Therefore, agricultural risk must be reduced in the face of climate change and soil nutrient losses, particularly to consistently meet the country's food security and nutritional needs. Climate change has increased biotic and abiotic constraints necessiating the continued development of improved crops that are tolerant of climate changes, while maintaining farmer and market preferred traits. Therefore, a resilience perspective that enables the country to prudently manage risk in the agriculture sector is necessary to prevent calamities'(National Agriculture Policy 2016,p.16).. When surveying the number of strategies employed to address agricultural risks in the context of these calamities one wonders about the absence of indigenous knowledge systems and practices that could be utilized to solve these risks and problems. Yet, important local knowledge systems related to climate adaptation and food security exist in Malawi.

4.10.4.9 National Land Resources Management Policy and Strategy 2000

The overall goal of the National Land Resources Management Policy 2000 is to promote efficient, diversified and sustainable use of land-based resources for both agriculture and other purposes to ensure socio-economic development. Agriculture remains the largest land use in Malawi and its activities have affected natural resources in both aquatic and terrestrial ecosystems.

This policy recognises the need to conserve and manage land resources as their depletion or degradation may affect food security and sustainable socio-economic growth. One objective of the policy is to promote the protection and preservation of environmentally fragile areas by identifying and mapping these areas, providing appropriate guidelines on their use and management; publicising ecological functions of these areas and proposing them for gazetting as protected areas. The policy also promotes the management, conservation and utilisation of natural resources for sustainable land and ecosystem productivity but has not included ILK in its policy and strategies.

4.10.4.10 National Herbarium and Botanic Gardens Act 1987

It promotes the establishment of a herbarium and botanical gardens for the assemblage, growth and classification of plants but it does not include specific provisions on how IK should be used to enhance the conservation of biodiversity.

4.10.4.11 National Cultural Policy 2015

The National Cultural Policy 2015 sets the tone for the promotion, conservation, safeguarding and sustainable use of Malawi's culture and heritage in all its manifestations (tangible or intangible, movable or immovable. Its policy goal is 'to identify, preserve, protect and promote Malawian Arts and Culture for national identity, unity in diversity, posterity and sustainable social economic development' (National Cultural Policy 2015, p.9). One of its policy goals calls for mainstreaming cultural heritage, of which indigenous local knowledge is part of, in different developmental policies and programmes. For instance, policy outcome 3.1 anticipates 'increased consideration of cultural heritage in developmental programmes and policies' (National Cultural Policy 2015, p.10).

This therefore suggests that all policy frameworks including those to do with biodiversity and ecosystem are invited and admonished to consider and recognise issues of cultural aspects in relation to their objectives and implementation. As the policy indicates in its objectives this is to 'ensure proper management and utilisation of resources' which include natural resources (National Cultural Policy 2015, p.11).

To conclude, in response to the initial question that framed this policy review, (What policy responses, measures and processes exist for strengthening and improving the governance of nature and nature's contributions to people with regard to Indigenous Peoples and local communities and their knowledge and practices?), we can safely contend that even though key policy documents on conservation of natural resources exist as indicated above only one document, The National Environmental Policy 2004, takes cognisance and acknowledges the pivotal role of ILK in conservation of Malawi's ecosystems . The rest are either not clear or don't acknowledge ILK's role in environmental and biodiversity conservation. This therefore has policy implications of working towards acknowledgement and recognition of ILK through mainstreaming in the policy documents. As the National Cultural Policy has advised it is important to ensure consideration of cultural heritage (that includes ILK) in all developmental programmes and policies in order to ensure proper management and utilisation of resources, including natural resources.

4.10.5 Challenges in Policy Implementation

Implementation of these policies face significant challenges, particularly in developing countries like Malawi. Several factors contribute to this including:

a. Lack of political will and interference: The success of policy implementation often hinges on strong political will, which may be lacking or inconsistent. Additionally, political interference can complicate enforcement efforts, leading to inconsistent and selective enforcement of laws and regulations.

b. Insufficient resources and capacity: Implementing and enforcing policies requires significant financial, human, and technical resources. Malawi, like many developing nations, struggles with limited financial and human resources, hindering effective management of terrestrial ecosystems.

c. In adequate intersectoral coordination: Effective ecosystem management requires coordination among various sectors and stakeholders, including government ministries, departments and agencies, NGOs, and local communities. Terrestrial ecosystem management often involves multiple sectors, such as agriculture, forestry, and water resources. Lack of coordination can lead to fragmented efforts and inefficiencies. Thus, lack of coordination among various stakeholders within the sector can lead to conflicting policies and fragmented management efforts.

d. Low levels of national budgetary allocations: The Ministry responsible for managing terrestrial ecosystems often faces a growing mandate without a corresponding increase in budget. This disparity makes it challenging to carry out necessary activities and initiatives.

e. Weak law enforcement: Weak law enforcement undermines the effectiveness of policies and legal frameworks. Without strong enforcement mechanisms, policies may be ignored or violated, leading to degradation of ecosystems and loss of biodiversity .

f. Lack of public awareness of the value of terrestrial ecosystems: Lack of awareness and understanding of the importance of terrestrial ecosystems among the public and policymakers results in the undervaluation of ecosystems and insufficient protection measures.
g.Socio-economic Factors: Poverty and over dependence on natural resources for livelihoods can lead to over-exploitation, making it difficult to enforce resource conservation and management laws.

4.11 International agreements, treaties and conventions

Over the years, Malawi has demonstrated a commitment to global and regional cooperation by acceding or becoming a signatory to various international agreements, treaties, and conventions, as shown in Table 4-12 . Malawi's participation in international agreements, treaties, and conventions is a testament to its proactive approach to governance and sustainable development. These commitments are not merely symbolic; they play a crucial role in shaping the nation's policies and legal frameworks, particularly concerning the governance of terrestrial ecosystems. The adherence to these international obligations ensures that Malawi aligns its conservation and sustainable development strategies with globally recognized standards and practices and remains an active and responsible member of the global community committed to the collective goal of preserving our planet for future generations.

The international agreements to which Malawi is a party cover a wide array of subjects, including human rights, environmental protection, trade, and more. For instance, Malawi has acceded to treaties that focus on biodiversity, climate change, and sustainable resource management, reflecting the country's dedication to environmental stewardship and its recognition of the intrinsic value of its natural heritage.

These international commitments have a direct impact on Malawi's management of its terrestrial ecosystems, which include forests, freshwater bodies, and wildlife habitats. By integrating the goals and targets of these agreements into national policies, Malawi ensures that its efforts to protect and sustainably use these ecosystems also contribute to the country's broader socioeconomic development. This includes fostering sustainable agriculture, promoting eco-tourism, and protecting biodiversity, all of which are vital for the well-being of its population and the health of the environment.

Furthermore, being a party to these agreements obligates Malawi to adhere to certain standards and to report on its progress, thereby fostering transparency and accountability in environmental governance. It also enables Malawi to access international support and cooperation, including technical and financial assistance, to help achieve its conservation and development objectives

Table 4-12 : Examples of MEA to which Malawi is party

Treaty	Objective and Malawi's Obligation	Ecosystem Type
UN Framework Convention on Climate Change (UNFCCC)	To stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system. Under its updated Nationally Determined Contribution (NDC) of July 2021, Malawi adopted economy-wide targets to reduce greenhouse gas (GHG) emissions by 2040: 6 percent unconditionally, with an additional 45 percent contingent on external support	Cross cutting
UN Convention on Biological Diversity (CBD)	Conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding	Cross cutting

Table 4-12 Conti.: Examples of MEA to which Malawi is party

Treaty	Objective and Malawi's Obligation	Ecosystem Type
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention)	To ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species	Terrestrial
UNESCO Convention on Wetlands of International Importance Mainly as Waterfowl Habitat (Ramsar Convention on Wetlands)	To halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain.	Terrestrial and Wetlands
UN Convention on Combating Desertification (UNCCD)	To combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach that is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas	Terrestrial
UNESCO Convention on the Protection of World Cultural and Natural Heritage	To promote cooperation among nations to protect heritage around the world that is of such outstanding universal value that its conservation is important for current and future generations	Terrestrial
Basel Convention	To protect human health and the environment against the adverse effects that may result from the generation, transboundary movements and management of hazardous and other wastes	Crosscutting
Minamata Convention	To protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compound	Crosscutting
WHO Framework Convention on Tobacco Control	To protect present and future generations from the devastating health, social, environmental and economic consequences of tobacco consumption and exposure to tobacco smoke	Crosscutting
Rotterdam Convention	To promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals, in order to protect human health and the environment from potential harm and contribute to their environmentally sound use.	Crosscutting
Bonn Convention or Convention on Migratory Species (CMS)	To conserve terrestrial, marine and avian migratory species throughout their range	Crosscutting
Stockholm Convention on Persistent Organic Pollutants (POPs)	To protect human health and the environment from persistent organic pollutants	Crosscutting
United Nations Convention on the Law of the Sea (UNCLOS)	To promote the peaceful use of the seas, regulate the use of marine resources and promote the conservation of living resources and the preservation of the marine environment	Aquatic
Vienna Convention	To preserve human health, and to protect the environment from any harmful effects of the depletion of the ozone layer	Crosscutting

Table 4-12 Conti.: Examples of MEA to which Malawi is party

Treaty	Objective and Malawi's Obligation	Ecosystem Type
African Convention on Conservation of Nature and Natural Resources	To encourage conservation, utilisation and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.	Crosscutting

4.12 Policy impacts on biodiversity and ecosystem functions

Various national policies and interventions in Malawi have had impacts on the conservation of biodiversity and the functioning of terrestrial ecosystem services, particularly through strengthening governance frameworks and integrating biodiversity considerations into development planning. The National Biodiversity Strategy and Action Plan II (2015–2025) provides a comprehensive framework aimed at reducing biodiversity loss, improving ecosystem resilience, and ensuring that ecosystems continue to provide essential services that support human well-being and poverty reduction (GoM 2015). Through actions such as safeguarding ecosystems, restoring degraded habitats, and mainstreaming biodiversity into sectoral development planning, the strategy seeks to enhance ecosystem functions such as carbon storage, soil fertility, and water regulation while sustaining the livelihoods that depend on these natural resources.

Forestry policies and landscape restoration initiatives have also contributed to improving ecosystem services in terrestrial ecosystems. The National Forest Policy (2016) and related restoration strategies promote the conservation and sustainable management of forests to maintain biodiversity and ecosystem functions such as watershed protection, climate regulation, and habitat provision. Forest ecosystem restoration and protection of forest reserves help maintain carbon sequestration and reduce soil erosion, thereby supporting agricultural productivity and water availability. However, Malawi continues to experience significant forest loss and land degradation, which undermines ecosystem services and highlights the need for stronger policy implementation and landscape restoration efforts (UNDP 2026; GEF 2025)

Policies that promote sustainable land use and community participation have also generated positive impacts on ecosystem services. Community-based natural resource management, participatory forest management, and emerging conservation initiatives such as Other Effective Area-Based Conservation Measures (OECMs) are designed to involve local communities in biodiversity conservation while supporting livelihoods. These interventions can enhance the sustainable use of biodiversity resources, improve ecosystem resilience, and secure ecosystem services such as provisioning of forest products, soil protection, and climate regulation. Conservation projects linked to national biodiversity goals aim to protect ecologically important areas while improving the livelihoods of thousands of people who depend on natural resources (Nazombe, et al. 2024).

Despite these efforts, the potential benefits of biodiversity policies are often constrained by ongoing land-use changes and socioeconomic pressures. Expansion of cropland, grasslands, and urban areas has reduced natural ecosystems such as forests and wetlands, resulting in a measurable decline in ecosystem service values over time. Studies show that while provisioning services such as food production have increased due to agricultural expansion, regulating, supporting, and cultural ecosystem services have declined as natural habitats are degraded. These trends indicate that future policy interventions must prioritize ecosystem conservation, restoration, and sustainable land-use planning to maintain biodiversity and ensure that terrestrial ecosystems continue to provide critical services for Malawi's economic development and environmental sustainability (United Nations Malawi, 2023).

4.13 Institutional framework for the governance of terrestrial ecosystems

Effective management and conservation of terrestrial ecosystems require sound institutional and governance frameworks. These frameworks comprise various structures, processes, and mechanisms that regulate the use, management, and protection of terrestrial ecosystems. In Malawi, the institutional and governance frameworks for terrestrial ecosystems are diverse and involve several policies, legal instruments, and institutions that work together to ensure the sustainable management and conservation of these ecosystems.

In Malawi, the institutional framework for the governance of terrestrial ecosystems has vertical and horizontal dimensions. The Malawi Government has established a comprehensive national planning process that includes coordination structures at the pillar, enabler, sector, and district levels.

These structures are managed by the National Planning Commission (NPC) and are responsible for developing medium to long-term plans and strategies. However, the responsibilities for matters related to specific terrestrial ecosystems are handled by the Department that deals with that particular ecosystem.

The Ministry responsible for natural resources and climate change holds the mandate to provide regulatory and policy direction for the conservation, development and management of forestry and natural resources for socioeconomic development of the country. Further, the Environmental Affairs Department (EAD) is the National Designated Authority for all environmental treaties and conventions.

The Department is mandated to promote, coordinate, monitor and oversee compliance with environmental and natural resources policies, programs and legislation in order to ensure sustainable development and poverty reduction. Recently, the government, through the Environment Management Act No. 19 of 2017, has also instituted the Malawi Environmental Protection Authority (MEPA) as a principal agency for the protection and sustainable management and utilization of the environment and natural resources. MEPA provides effective oversight on the operation of lead agencies, advisory committees, district environment sub-committees, and local environment and natural resource committees related to ENRM.

In terms of coordination, the National Planning Commission coordinates the implementation of medium to long-term plans and strategies related to terrestrial ecosystems. NPC has established a coordination framework to ensure that all the policies, strategies and plans are aligned to MW2063. The Enabler Coordination Group on Environmental Sustainability (ECGES) shall support Pillar Coordination Groups (PCGs), co-chaired by Ministry responsible for Finance and Public Service Reforms (PSR) and Ministry responsible for Natural Resources, with the secretariat. The ECGES shall bring together all relevant stakeholders (state and non-state) falling under the Environmental Sustainability enabler. The ECGES reports to each of the three Pillar Coordination Groups (PCGs) on matters relevant to emissions and progress on climate change mitigation, adaptation, and finance. The PCGs and ECGES work closely with the existing National Steering Committee on Climate Change (NSCCC) and the Joint Technical Committee on Climate Change and Disaster Risk Management (TCCC & DRM). The NSCCC serves as a platform for meaningful discussions on policy frameworks, establishing priorities, and fostering investment and technological advancements in climate change and terrestrial ecosystem projects within the country . Concurrently, the TCCC & DRM offers a structured setting for both domestic and global collaboration. It adopts an integrated strategy for climate change solutions, promoting the development of both adaptation and mitigation measures. This is achieved through collaborative efforts among government bodies, private sector entities, non-governmental organizations, community-based organizations, academic institutions, and local communities.

Other players in the natural resources sector, such as academia and research institutions, non-governmental organizations (NGOs), donors, and civil society organizations (CSOs), play a vital role in the governance of terrestrial ecosystems. Together, these groups contribute to a holistic approach to terrestrial ecosystem governance, ensuring that it is informed, inclusive, and effective. For instance:

(a) **Academia and research institutions:** These entities are crucial for generating scientific knowledge about terrestrial ecosystems. They conduct research that informs policy decisions, provides evidence for sustainable practices, and advances our understanding of ecosystem dynamics. Their work often leads to the development of new technologies and methodologies for conservation and resource management.

(b) **NGOs:** NGOs are active on the ground, implementing conservation projects, advocating for environmental protection, and engaging in public education campaigns. They often serve as a bridge between local communities, policymakers, and international bodies, ensuring that local concerns and knowledge are incorporated into governance processes.

(c) **Donor community**: Donors, which can include governments, private foundations, and international organizations, provide the necessary funding for research, conservation projects, and capacity-building initiatives. They play a pivotal role in enabling the work of NGOs and CSOs and often determine priorities based on funding availability.

(d) **CSOs:** CSOs represent the interests of the public, particularly those of marginalized communities. They advocate for policies that are equitable and sustainable, hold governments accountable, and ensure that the voices of the people most affected by ecosystem changes are heard. CSOs are also instrumental in mobilizing local action for ecosystem conservation and restoration.

Conclusion

This assessment has systematically evaluated the status, trends, drivers of change, and prospects of Malawi's terrestrial ecosystems. The evidence confirms that Malawi's terrestrial ecosystems, comprising forests, mountains, grasslands and agricultural landscapes largely concentrated within a network of protected areas, are essential to the country's biodiversity, cultural heritage, and socio-economic development. These ecosystems provide a wide range of nature's contributions to people, including provisioning, regulating, supporting, and cultural services. The assessment confirms that while the country's protected areas are vital for protecting rich biodiversity, significant pressures from anthropogenic and environmental drivers threaten the integrity of these systems, particularly in communal landscapes. They are increasingly under pressure from land-use change, deforestation, climate variability, invasive species, and unsustainable resource use. Forest cover has drastically declined from 47% in 1975 to 24% in 2020, with deforestation rates among the highest in Southern Africa. Wildlife populations in several reserves show declining trends, and agro-biodiversity faces erosion due to monoculture practices and policy biases toward hybrid varieties.

ILK systems have historically played and continue to play a vital role in the conservation and sustainable management of terrestrial ecosystems in Malawi. Like elsewhere, various ethnic communities have rich reservoirs of indigenous local knowledge systems and practices as shown by UNESCO research on the inventory of intangible cultural heritage. The countrywide field research conducted under the NEA project revealed how in some communities this indigenous local knowledge is contributing towards conservation of some terrestrial ecosystems such as forests and woodlands. Practices rooted in local knowledge contribute to forest management, agrobiodiversity preservation, and invasive species control. ILK systems have shown positive conservation outcomes, particularly in culturally significant forests like Khulubvi in Nsanje. However, ILK is increasingly eroded due to socio-economic changes, modernisation, educational shifts, and inadequate integration into formal policy and governance frameworks.

Despite these challenges, Malawi has established a suite of policies, laws, and institutional mechanisms aimed at conserving terrestrial ecosystems and promoting sustainable use. Notable efforts include the National Forestry Policy, Forestry Act amendments, National Biodiversity Strategy and Action Plan (NBSAP), coupled with participation in global initiatives like the Convention on Biological Diversity (CBD) and the African Forest Landscape Restoration Initiative (AFR100). Co-management models and community-based conservation initiatives have also demonstrated potential to improve conservation outcomes. However, implementation gaps persist, constraining the effectiveness of existing measures. These challenges include: weak governance, limited enforcement, insufficient resources, limited ILK integration, and inadequate cross-sectoral coordination.

To secure the future of Malawi's terrestrial ecosystems, there is need to:

- Strengthen cross-sectoral policy coherence and implementation capacity
- Institutionalise ILK in planning, monitoring and restoration frameworks
- Scale-up nature-based solutions and sustainable land-use practices
- Invest in ecosystem service valuation and biodiversity monitoring or data systems
- Enhance inclusive governance, with meaningful participation of youth, women, and marginalised communities
- Leverage international frameworks to mobilize finance, technology, and capacity for ecosystem restoration and climate resilience.

CHAPTER 5

WETLAND ECOSYSTEMS

CHAPTER 5 - **WETLAND ECOSYSTEMS**

5.1 Introduction

Malawi is endowed with diverse wetland ecosystems including floodplains, marshes, swamps, and dambos (Kosamu et al. 2012). Most of the wetlands exist on customary land with the central region inland flood plain considered as a wetland of high agricultural importance (Wood et al 2013). There are over 18 major wetlands in Malawi (Government of Malawi 2016) and several smaller wetlands spread across the country. Some of the major wetlands in the country include Elephant Marsh in the southern region, Lake Chilwa in the southeastern region, Kasungu inland flood plains in the central region and Vwaza Marshes in the northern region of Malawi (Chiotha 2017). Two of the major wetlands are designated RAMSAR sites, namely Elephant Marsh, covering 615,000 hectares (RAMSAR site 2308) and Lake Chilwa Wetland, also designated as a Man and Biosphere Reserve, covering 240,000ha (RAMSAR site 869). These RAMSAR sites are located in community lands (Chiotha 2017). Vwaza Marsh wetland in the northern part of Malawi is the only wetland being managed under the Protected Areas Management Regulations (Manda 2023). **Fig. 5-1** below shows the distribution of wetlands across the country.

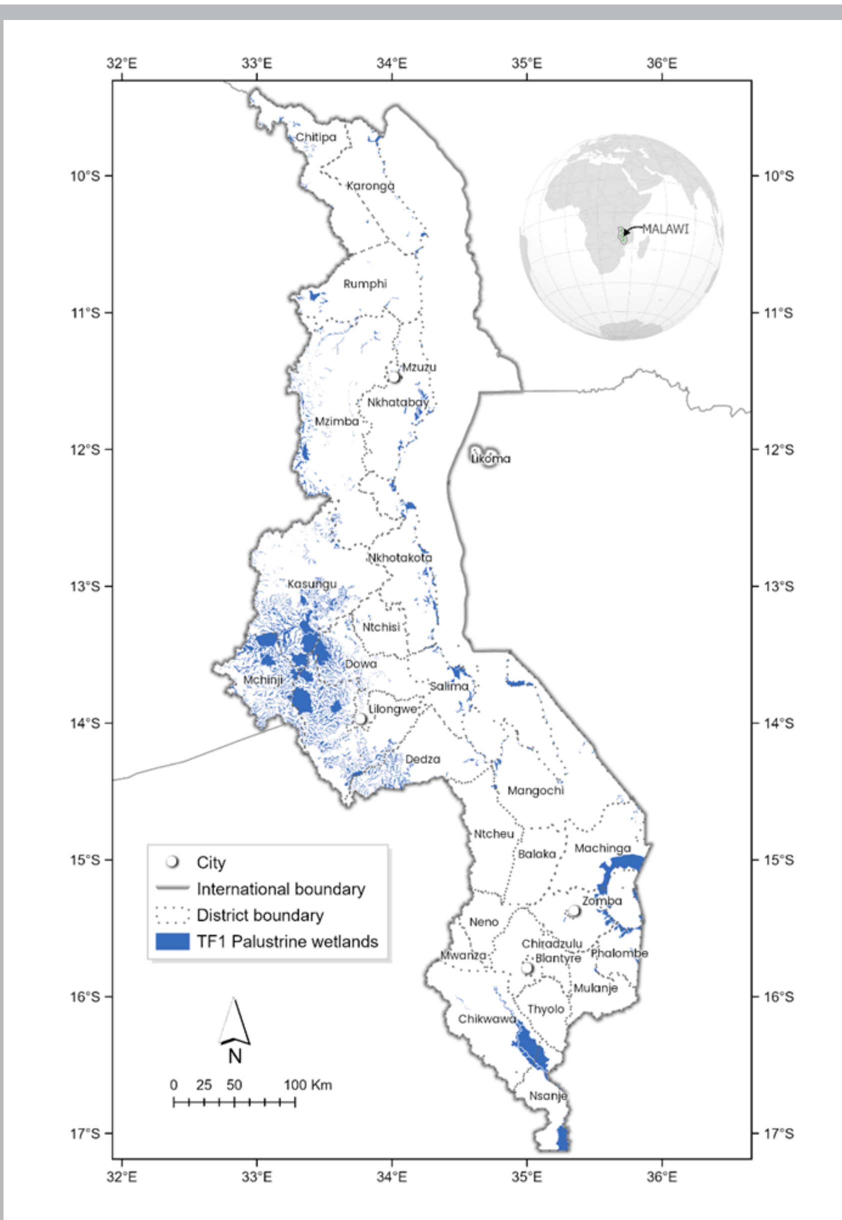


Figure 5-1: The distribution of wetlands across the country

Under Ramsar Convention (1971) and Malawi's Environmental Management Act (2017) wetlands are defined as: "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" The United States Fish and Wildlife Service definition has tended to be more specific as it considers wetlands as: "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water" in short, wetlands include lakes and rivers, swamps and marshes, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs and human-made sites (such as fish-ponds, rice paddies, reservoirs, and salt pans).

For the purposes of this assessment, wetlands will be categorized as inland wetlands and lake shore wetlands and will exclude lakes and rivers which have been discussed under the Aquatic Biodiversity Ecosystem Chapter.

5.2 Situation Analysis

Malawi wetlands contribution is of economic, ecological, social, and cultural importance (IPBES, 2019; Makwinja et al., 2021a) and represents a strategic asset reflected in the United Nations Sustainable Development Goals (UN SDGs) (Nerini, et al., 2018). They underpin the well-being and livelihood of rural population through income generation, energy, medicine, water, and food supply-contributions aligned to pro-economic development, such as zero hunger (SDG2), clean water and sanitation (SDG6), no poverty (SDG1), affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9) (UN, 2019). They further play a vital role in providing good health and well-being (SDG3), quality education (SDG4), and climate action (SDG13)-contributions linked to pro-conservation SDGs (Seifollahi-Aghmiuni et al. 2019; Dickens et al. 2020; Guo et al. 2021; Yin et al. 2021). Costanza et al. (2014), using a meta-analytical approach, estimated global wetland contribution of US$4.8 trillion (with US$1.82 billion contributed by Asia, US$677million by North America, Europe US$300 million, Australasia million, Africa, US$257 million, Latin America US$123 million, and other regions contribute the rest (WWF, 2004). In Malawi, there is limited data on Lake Chilwa, Lake Malombe, Lake Chiuta, and Elephant Marsh underscore the significance of the four wetlands to the local population and ecosystem integrity.

These studies indicate an overall contribution of US$ 24.36 million per year for Lake Chilwa (Schuyt, 2005), US$ 20.35 million for Lake Malombe (Makwinja et al. 2021a), for Elephant Marsh, US$268 million (Forsythe & Turpie, 2016) and Lake Chiuta US$17.2M (Mzuza, 2013). However, Malawi wetlands are facing multiple threats depicted in various situations which includes:

5.2.1 Inadequate Knowledge of Wetland Conditions

The Malawi wetlands are facing multiple threats depicted in various scenarios. The first scenario underpins the inadequate knowledge of wetland conditions and their contribution to local and national economy (Kosamu 2014). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report pointed out that about 20% of Africa's land surface (6.6 million km2) is degraded by soil erosion, pollution, vegetation loss, and salinization (IPBES, 2019). In Southern Africa, where Malawi is located, wetlands are severely degraded and lost due to inappropriate policies and socio-political and cultural pressures compromising wetland management efforts (Kotze, 2011).

Lake Malombe in Malawi has lost an average of US$ 45.58 million in ecosystem service values and US$ 8.65 million from fisheries from 1989 to 2019, with the highest (US$79.83 million) net loss recorded from 1999 to 2019 (Makwinja et al. 2021). Although studies linking the extent of wetland degradation to economic value loss are scarcely available, it is very apparent that Kasungu Plain, Vwaza Marsh, Elephant Marsh, Mpatsanjoka Dambo, Shire River, Bua River, Lake Chilwa, and Limphasa swamps also follow the same trend- situation also reflected in many countries across the globe where inappropriate policies and limited knowledge on lost values through degradation have significantly impacted the wetland and their ecological state (Geist, 2011; Yahdjian et al., 2015; Wangai et al., 2016; de Groot et al., 2010; Cen et al., 2015)

5.2.2 Lack of a Specific wetland Policy Instrument

Another situation points to the fact that Malawi does not have a specific wetland policy instrument. Many of the existing sectoral policies and legislation address issues of wetlands but not in specific terms. Though the policies touch on wetlands but their policy goals are silent resulting in wetlands issues being overpowered by the broader policy goal. This situation has resulted in lack of clarity in policy direction over the utilisation of wetlands. Hence, exploitation of wetlands becomes a political priority, bringing trade-offs among stakeholders. These trade-offs include increased wetland exploitation for short-term economic benefits (Xu et al., 2014; Makwinja et al., 2022a).

An excellent example is infrastructure development at Mpasanjoka, Salima, Central Malawi, Lunyangwa Dambo in Mzuzu (Wanda et al. 2016), and Elephant Marsh at the expense of structural and functional biodiversity, habitat integrity, carbon sequestration from natural wetlands and forests, and hydrological systems (Xu et al., 2014). Unless wetlands are recognized and prioritized in political debate and national development policy, there will always be poor investments in restoration programs, and unprecedented degradation trends will continue.

5.2.3 Wetland Transformation

There is unprecedented wetland landscape transformation driven by the need to increase food production and achieve SDG 2 (zero hunger). Rapid population growth threatens food, water, energy, and health security, negatively impacting local communities' livelihoods (Hanjra & Qureshi, 2010; Hernández-Delgado, 2015). Besada & Werner (2015) pointed out that most African countries rely heavily on agriculture, as reflected in their national development agenda. Malawi streamlined its development agenda in line with SDGs 1, 2, and 8 by encouraging agricultural production to achieve food security and economic growth (Malawi Government, 2004). It further states that almost 85% of Malawi's population are subsistence farmers- a scenario also depicted in Sub-Saharan Africa (Makoka, 2008). In most wetlands, landscape transformation has been driven primarily by agriculture, energy demand, and settlements (Njaya et al., 2011). This significant threat has increased biodiversity loss, forest degradation, doubling nitrogen fixation, tripling phosphorous concentration, increasing nutrient loading, widespread eutrophication, and creating hypoxic conditions (Gil et al., 2019; Makwinja et al., 2021b). Jogo & Hassan (2010) acknowledged that global wetland areas had declined by 90% in the past years. They attributed to the high rate of conversion as more households shift into the wetlands for agricultural activities initiated by moisture-fertile soils during the water recession period- a scenario depicted in Lake Chilwa basin, Chia lagoon, Lake Chiuta, and Elephant Marsh in Malawi (Kosamu, 2014; Nkhoma & Kayira, 2016; Makwinja et al. 2019), Lake Tana basin in Ethiopia (Abera, 2017; Minale, 2019), Lake Chad (Kolawole, 1988), and Zambezi flood plain (Chimweta et al., 2021).

It should be noted that Goal 2 of the UN SDGs suggested that agriculture is critical to achieving food security and human nutrition (UN, 2019). However, agriculture production must be done to support food and nutrition security without compromising wetland sustainability.

Climate change's impact on wetland sustainability in Malawi (Kosamu, et al., 2022) heavily affects the condition of wetlands. Severe impacts such as prolonged drought, floods, high temperatures, erratic rain, and high poverty rates have forced Malawi's rural population to over-depend on wetland ecosystems, resulting in over-exploitation. For example, Malawi has one rainfall season, making food production vulnerable to climate change. The severe impact of climate change, such as prolonged drought, floods, temperature, and rainfall fluctuations, has forced the country to over-exploit wetlands for winter farming. Wetlands, for example, in the shoreline of Lake Malawi districts such as Salima, Nkhotakota, Karonga, Mangochi, and Bwanje in Dedza, Lower Shire Valley such as Chikwawa and Nsanje, and Lake Chilwa basin in Zomba, Machinga and Phalombe and other districts such as Mchinji and Mzimba, have been converted into rice production in line with National Food Security Policy. Coe & Foley (2001) and Schuyt (2005) had similar observations in the Lake Chad basin in Central Africa and Yala Swamp in Kenya, where local communities converted natural wetlands into agricultural production to offset the impact of drought.

Literature has isolated several issues to establish the critical evidence of climate change's impact on wetlands. Talling (1992), for example, observed that some internal closed wetlands in Africa, such as Lake Chilwa, are more vulnerable to evaporation and surface area decline than those of opened or sem-opened nature. According to Eissa and Zaki (2011), the dynamic changes in the hydrologic cycle of water trigger a reliable number of aquatic species to migrate to alternative water bodies in case of opened and sem-opened types while leaving those in closed wetlands to live in danger of being threatened or even extinction. Jellison et al. (2008) demonstrated that high-temperature variation can cause closed wetlands to shrink, making them more saline. In arid Central Asia and the Middle East, broad swaths of Africa, and the Altiplano region of South America, a decrease in runoff has caused salt lakes to become more saline, resulting in biodiversity loss (Jellison et al. 2008). In Australia, Lake Corangamite shrank in 2002, and salinity exceeded 100g per litter, with a remarkable reduction in aquatic biota (Jellison et al. 2008). In Ethiopia, the evidence of climate change's impact on the aquatic ecosystem has been demonstrated by the loss of Lake Hiromasa from 1989 to 2005 (Yilma, 2010). In Kenya, Lake Naivasha, an official Ramsar Site - of 30,000 ha, turned into a shallow mud pool during the 2009 drought, resulting in a decline in the aquatic ecosystem (Ogola et al., 2012). Lake Chad, once the most significant freshwater lake in Africa, shrank dramatically in the last 40 years (Yilma, 2010); Pham-Duc et al., 2020).

Lake Chilwa in Malawi- an official Ramsar Site-has been experiencing severe water recessions due to prolonged dry spells and frequent droughts caused by climate change. Official documentation of Lake Chilwa indicates that the Lake has undergone twelve recession periods between 1900 and 2012, making it more saline, consequently leading to aquatic biodiversity loss. According to the Government of Malawi report, the Lake dried first in 1876, 1900, 1914-15,1922, 1931-32,1934,1954, 1960-61,1967, 1973, 1995, and 2012, resulting in the disruption of the entire aquatic ecosystem.

Another issue is that an increased precipitation regime could result in a heavy nutrient load entering the wetland, which may lead to seasonal plankton blooms (Whitehead et al., 2009). The accumulation of more organic materials than the capacity consumed at the bottom may lead to biochemical reactions that change the sulfates to sulfurs (Zhao, et al., 2023). The H2S is more toxic to aquatic organisms such as fish and may result in fish kill. The possible signs of H2S in water include an odor (rotten egg) and black, decaying organic matter on the windward shore. It should be noted that the future projection in Southern Africa, where Malawi is located, indicates that climate change's impact will be worse than in other regions (Nkhoma et al. 2021). The critical basin wetlands in southern Africa, such as Zambezi, Shire River, and Lake Chilwa, have already been experiencing increased air temperatures, and it is predicted that potential evaporation will increase (Hamududu & Killingtveit, 2016). At the same time, rainfall decreases, leading to a decline in river flows and increased reservoir losses (Hamududu & Killingtveit, 2016).

Wetland resource over-exploitation is another threat driven by rapid population growth and the impact of climate change. In Malawi, most of the riparian population depends on the fishery- a typical situation in the least developed regions such as Africa, Asia, and Latin America (Cilliers et al., 2013; Cumminng et al., 2017; IPBES, 2019). The high contribution of fishery in countries such as Malawi (Makwinja, et al., 2021c) indicates (i) its essential role in ensuring food security for the local population and (ii) the existential threat of over-exploitation (Youn et al., 2014). Beeton (2002) acknowledged that many endemic species in wetlands had been over-exploited and further predicted that by 2025, the species associations will have changed. On the other hand, the high contribution of agriculture production in wetlands could indicate the shifting of local communities' livelihood strategies as the wetland's fishery collapses (Makwinja et al. 2021f). Jogo & Hassan (2010) reported that extensive modification of wetland landscapes in Africa is linked to increased agricultural activities instigated by the collapsing of the fishery. In Lake Chilwa, Lake Malombe, Lake Chiuta, and Elephant Marsh, the decline in the fishery has led to intense hunting and trapping pressure on water birds, threatening their population (Makwinja et al., 2021e; Njaya et al., 2011). In the Zambezi flood plain, the Chelonia population has become under severe threat from exploitation, particularly for international trade, and this further extends to the Malawi population of the Zambezi soft shield (Forsythe & Turpie, 2016). The evidence of wetland riparian vegetation over-exploitation is scarcely available. However, it could be suggested that it follows a similar global trend, suggesting that about 64-71% of wetland riparian vegetation has been lost due to multiple threats ranging from climate change to over-exploitation (Davidson, 2014; Gule et al. 2021).

5.2.4 Climate Change Impact

Additionally, climate change threatens the long-term sustainability of wetlands in Malawi (Kosamu, et al., 2022). Severe impacts such as prolonged drought, floods, high temperatures, erratic rain, and high poverty rates have forced Malawi's rural population to over-depend on wetland ecosystems, resulting in over-exploitation. For example, Malawi has one rainfall season, making food production vulnerable to climate change. . Wetlands, for example, in the shoreline of Lake Malawi districts such as Salima, Nkhotakota, Karonga, Mangochi, and Bwanje in Dedza, Lower Shire Valley such as Chikwawa and Nsanje, and Lake Chilwa basin in Zomba, Machinga and Phalombe and other districts such as Mchinji and Mzimba, have been utilised into rice production in line with National Food Security Policy. Coe & Foley (2001) and Schuyt (2005) had similar observations in the Lake Chad basin in Central Africa and Yala Swamp in Kenya.

Literature has isolated several scenarios to establish the critical evidence of climate change's impact on wetlands. Talling (1992), for example, observed that some internal closed wetlands in Africa, such as Lake Chilwa, are more vulnerable to evaporation and surface area decline than those of opened or sem-opened nature. According to Eissa and Zaki (2011), the dynamic changes in the hydrologic cycle of water trigger a reliable number of aquatic species to migrate to alternative water bodies in case of opened and sem-opened types while leaving those in closed wetlands to live in danger of being threatened or even extinction. Jellison et al. (2008) demonstrated that high-temperature variation can cause closed wetlands to shrink, making them more saline. In arid Central Asia and the Middle East, broad swaths of Africa, and the Altiplano region of South America, a decrease in runoff has caused salt lakes to become more saline, resulting in biodiversity loss (Jellison et al. 2008). In Australia, Lake Corangamite shrank in 2002, and salinity exceeded 100g per litter, with a remarkable reduction in aquatic biota (Jellison et al. 2008).

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Another scenario within climate change impact is that an increased precipitation regime could result in increased soil erosion in cultivated wetlands causing heavy nutrient load to enter the wetland, which may lead to seasonal plankton blooms (Whitehead et al., 2009). The accumulation of more organic materials than the capacity consumed at the bottom may lead to biochemical reactions that change the sulfates to sulfurs (Zhao, et al., 2023). The H2S is more toxic to aquatic organisms such as fish and may result in fish kill. The possible signs of H2S in water include an odor (rotten egg) and black, decaying organic matter on the windward shore. It should be noted that the future projection in Southern Africa, where Malawi is located, indicates that climate change's impact will be worse than in other regions (Nkhoma et al. 2021). The critical basin wetlands in southern Africa, such as Zambezi, Shire River, and Lake Chilwa, have already been experiencing increased air temperatures, and it is predicted that potential evaporation will increase (Hamududu & Killingtveit, 2016). At the same time, rainfall decreases, leading to a decline in river flows and increased reservoir losses (Hamududu & Killingtveit, 2016).

5.2.5 Impact of Rapid Population Growth

Wetland resource over-exploitation is another threat driven by rapid population growth. In Malawi, most of the riparian population depends on wetland resources, especially fisheries, a typical situation in the least developed regions such as Africa, Asia, and Latin America (Cilliers et al., 2013; Cumminng et al., 2017; IPBES, 2019). The high contribution of fisheries resources in countries such as Malawi (Makwinja, et al., 2021c) indicates (i) its essential role in ensuring food security for the local population and (ii) the existential threat of over-exploitation (Youn et al., 2014). Beeton (2002) acknowledged that many endemic species in wetlands had been over-exploited and further predicted that by 2025, the species associations will have changed. On the other hand, the high contribution of agriculture production in wetlands could indicate the shifting of local communities' livelihood strategies as the wetland's fishery collapses (Makwinja et al. 2021f). Jogo & Hassan (2010) reported that extensive modification of wetland landscapes in Africa is linked to increased agricultural activities instigated by the collapsing of the fishery. In Lake Chilwa, Lake Malombe, Lake Chiuta, and Elephant Marsh, the decline in the fishery has led to intense hunting and trapping pressure on water birds, threatening their population (Makwinja et al., 2021e; Njaya et al., 2011).

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5.3 Drivers Pressures State and Trend Impact and Responses

The DPSIR's variables provide information on how an ideal riparian area is driven into degradation and the subsequent efforts done to restore the system.

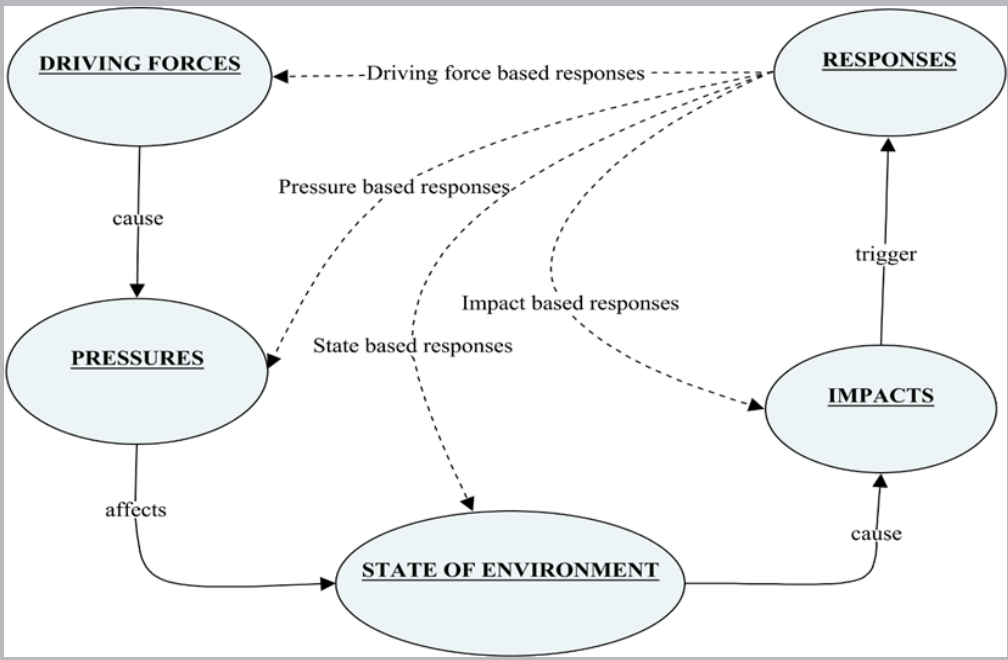

Figure 5-2: A conceptual diagram of the DPSIR model for Malawi wetlands (Source: Smeets and Weterings, 1999)

In agreement with Smeets and Weterings' (1999) who developed the DPSIR framework, Martins et al. (2012) identified driving forces as general human needs responsible for pressure on the wetland ecosystem. Pressure is the actual human activities that affect the wetland ecosystem. State changes describe the condition of the wetland ecosystem components affected by pressure. Impacts are human health risks, or socio-economic losses, and responses are feedback to driving forces, pressures, state changes, and impacts. This section described responses based on relevant literature, personal experiences, and consultation with experienced researchers and scientists. DPSIR was adopted to depict and visualize the actual situation of Malawi wetlands.

5.3.1 Wetland degradation drivers (Indirect causes)

Main land degradation drivers within wetland catchment have been population growth and climate change (Fig. 1). For instance, Malawi National statistics report has revealed that wetlands such as Lake Chilwa and Elephant Marsh are among the most densely populated areas in Africa with 321 persons per km2 (National Statistics Office, 2008) Sanchez, (2002) further noted that majority of the households are heavily reliant on low-input production of maize on small landholdings where soil is seriously degrading. Jamu et al. (2003) further noted that increase in population in wetlands forced many households to cultivate in marginal areas which significantly increased soil erosion rates within catchment. Climate change is also another evidence for wetland degradation. Evidently, Malawi government official documentation has demonstrated that Lake Chilwa wetland has been undergoing recessions since the 1900s and 2012 (Nagoli, 2016). The communities around have been facing water stress for both livestock, agriculture and domestic. Figure 5-2 shows the climate change impact on Lake Chilwa wetland.

Figure 5-4: Wetland degradation drivers (Source: NEA)

Figure 5-5: Sand Mining on Wetland (@Lilongwe city council)

Government policies and programs have also been noted as drivers of wetlands degradation in Malawi. In the year 2000/01 Malawi was hit by devastating droughts which led to food insecurity, as a result in the preceding years the government promoted irrigation farming to enhance food production (Wood, 2013). Wetlands were deemed as potential areas of irrigation, this resulted in conversion of wetlands to cultivation lands, in lake Chilwa wetland 2000 acres were allocated for irrigation in this era (Schuyt, 2005; Mvula and Haller, 2009).

The government has also introduced fertilizer subsidies for winter cropping to encourage more farmers to undertake winter irrigation farming, but this kind of farming is mostly done in wetland (Wood, 2013). Intensive agriculture in wetland impacts aquatic species through the release of agro-chemical from irrigation (Kosamu, 2014). The country's agriculture programs have not outlined measures to conserve ecosystems value provided by wetlands in their undertakings (Kosamu, 2014). Similar observation has also been made in Tanzania and Zimbabwe where government introduced poverty alleviation programs targeting wetlands for agriculture, but this has but this has resulted in degradation of wetlands (Materu, Urban and Heise, 2018; Mahlatini et al., 2020)

5.3.2 Pressure

Literature has documented that Malawi wetlands have been under pressure (Figure 5-2). For instance, there has been an increase in the rate of deforestation, over cultivation, overgrazing, and overexploitation of vegetation within the catchments (Jamu et al 2003). Makwinja et al (2014) observed increased siltation in the Likangala river and attributed it to cultivation along the marginal land. The watersheds of Domasi, Likangala and Thondwe within the catchment of Lake Chilwa wetland have also experienced a significant reduction of forest vegetation due to increase in cultivation (Wood et al. 2013). On the other hand, Jamu et al (2003) also reported an increase in burning of vegetation for hunting, increase in number of livestock grazing in Lake Chilwa, Elephant Marsh and other wetlands and high rate of land conversion for rice cultivation. Again, increased deforestation and cultivation without adequate soil within the catchment has further led to high soil erosion rates (113 tons per hectare per year) (Wood et al. 2013).

Upstream abstraction is another pressure of wetland, excessive abstraction of water from the stream reduces the extent of water in wetland and alters the flow regime (Brown et al, 2016). Reduced flow and extent of water in wetland impacts species which are reliant on water flows (Kafumbata, Jamu and Chiotha, 2014). Elephant Marsh is threatened by upstream abstraction; there are 3 hydropower plants along the Shire River, which flows into the Elephant Marsh Wetland (Brown et al 2016). The Government of Malawi is developing a fourth power station on the shire river and there is also an agricultural project under way to irrigate 43,000 hectares using water from the shire river (Shire Valley Transformation Program - 2023). It has further been widely perceived that the major threat to Lake Chilwa wetland is abstraction of water for various uses within and outside the catchment. Lake Chilwa Wetland has experienced reduced flow due to upstream cultivation (Kafumbata, Jamu and Chiotha, 2014). The estimate indicates that water abstraction per day in the 1990s was around 150,000m3 (Environmental Affairs Department, 2000).

Jamu et al. (2003) also noted that a total of 297ha of rocky outcrops within the catchment of Lake Chilwa wetland were stripped bare between 1982 and 1995 by combined effects of cultivation and soil erosion. Forest/woodland use cover lost 650ha to field crops and further 40ha of Lake Chilwa wetland were converted to wetland rice cultivation (Mzembe (1990) also noted that the most critical pressure on Lake Chilwa wetland emanates from traditional customary ownership system. Mzembe (1990) noted that immediately after harvesting, Lake Chilwa wetland becomes overstressed from animal (cattle, goats and sheep) grazing. Urban expansion and waste discharges have also led to an increase in sewage discharges and industry chemicals into the wetland resulting in water quality degradation.

Commercial agriculture threatens wetlands sustainability, Elephants Marsh wetland has the Illovo Sugar Plantations on its edges, there are threats of releases of agro-chemicals into the marsh though not yet documented but the possibility exists (Brown et al, 2016). Commercial agriculture uses machinery and there is threat of removing indigenous trees that are part of wetland ecosystems as they are clearing land (Mvula and Haller, 2009; Brown et al 2016). Commercial agriculture comes with employment which entices migration, population increase has been noted in areas where there is commercial agriculture at Elephant Marsh and Lake Chilwa wetland (Brown 2016).

Invasive alien species in the country's wetland has also been noted as an issue to wetlands conservation (Branch, 2016). Invasive alien species have been reported as abundant in the Elephant Marsh (Branch, 2016). Elephant Marsh has been impacted by Pistia stratiotes, Azolla filliculoides and Pontederia crassipes (Brown et al 2016). This invasion has reduced the habitat quality for bird species like the pygmy goose and it has been damaging to aquatic invertebrates and fish (Branch, 2016). Lake Chilwa wetland has been impacted by Prosopis juriflora and P. crassipes which reduces sunlight for terrestrial and aquatic species respectively (Schuyt,2005). Reduced lightning comprises the photosynthesis process resulting in death of some wetland species (Schuyt, 2005).

5.3.3 Wetland State of Change

The current state of catchment of wetlands is that there is increased soil erosion, nutrient depletion, soil acidification, physical depletion and decline in biological diversity. Mzembe (1990) noted a high rate of soil erosion problems in Lake Chilwa wetland due to high animal stocking density. Njaya, et al., (2011) noted that the resilience of Lake Chilwa fishery is threatened by land degradation. Macuiane et al (2011) further noted that Lake Chilwa is currently experiencing severe lower water levels and there is low dissolved oxygen, high silt loads, alkalinities, pH and temperatures which have direct linkage with mortalities of fishery. Jamu et al. (2003) also noted that there is overall increase in area under agriculture from 12.2% to 41.4% from 1973 to 1994 in the Lake Chilwa wetland- scenarios also reflected in other wetlands in Malawi.

Jamu et al further noted that as agriculture area increased, there has been reduction of forest, increase in bare land and reduction of wetland by 7.8% to 5.5% respectively. The Environmental Affairs Department (2001) report has further indicated that due to severe land degradation within Lake Chilwa wetland catchment, some important deep pools have been lost in just a few years. It is further reported that due to increased silt deposition, the wetland has become shallow (Nagoli, 2016).

5.3.4 Wetland impacts

The impact of land degradation observed in most Malawi wetlands have been habitat destruction, loss of biodiversity, water stress, downstream economic damage and poverty. Evidently, intensity of flash floods has increased in Lower Shire, Mzuzu, Karonga, Nkhotakota, and Lake Chilwa where catchments have experienced massive deforestation and wetland aquatic vegetations have been over-exploited resulting into increased erosion (Wood et al. 2013). Furthermore, it has been noted that damage to water intake and canals reduces the amount of water available for irrigation leading into water stress (Wood et al. 2013).

The impact of land degradation in the catchment of Lake Chilwa wetland was evidenced in 1991. Msilimba and Holmes (2005) reported large-scale damage from flash flood and landslide in Phalombe within the catchment of Lake Chilwa wetland in 1991 that led to loss of 700-1000 lives and destruction of 30,000ha of crop land. Again, increase in deforestation and cultivation without adequate soil within the catchment of Lake Chilwa wetland has led to high soil erosion rate which is currently estimated at 113 tons per hectare per year (Wood et al. 2013). High sediment load impacts wetlands bird species like the Rynchops flavirostris (African Skimmer) which breed on sand banks (Branch,2016) this species is commonly found in Lake Chilwa and Elephant Marsh wetland (Kosamu,2014).

Unsustainable fishing in wetlands has resulted in loss of biodiversity, fish species are at threat as fishers use gill nets and mosquito nets to catch all available fish, in Elephant Marsh the method has impacted the diving birds i.e (pygmy goose) which are easily caught by gill nets (Brown et al,2016). Overfishing results in reduction of food for species like the Haliaeetus vocifer (African fish eagle) and Crocodylus Niloticus(crocodiles) which have fish in their diets (Kosamu, 2014; Brown et al., 2022). Underprivileged people also poach wildlife as a means of survival, the hippo population in the Lake Chilwa Wetland has almost extirpated due to poaching, sighting of hippos is a rare occurrence in the wetland (Mvula and Haller, 2009a; Kafumbata, Jamu and Chiotha, 2014).

Calder, (2005) further noted that there has been decline in agricultural productivity, increasing siltation of the rivers and Lake Chilwa wetland as well as increased flooding throughout the catchment. Wood et al. (2013) further reported that failure of Lake Chilwa to seasonally inundate the extensive marsh and grassland has resulted into damage in fish breeding areas resulting into loss of biodiversity. Recently, Kambombe et al (2018) noted that continued degradation of the Lake Chilwa basin is likely to intensify floods and droughts during rainfall and dry seasons respectively. Disease oubreaks have been more frequent and fisheries resources have been lost. Conflicts are common among the fishing communities due to limited land and fisheries resources from the Lake.

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5.3.5 Responses to Wetland degradation

In response to wetland degradation, the government of Malawi formulated policies in line with both local and international environment to manage the wetlands (Mzembe, 1990). For instance, Malawi land policy encourages an open market in land that will cause land values to move towards their highest and most desirable uses (Malawi Government, 2002). Water policy, on the other hand, proposes the formation of catchment management committees to ensure sustainable utilization of water resources in the wetland (Government of Malawi, 2004). Malawi population policy promotes family planning to control the growing population. The irrigation policy adopted the thinking and proposed the establishment of farmer associations and farmer clubs as a pre-condition for supporting irrigation schemes and managing wetland farming respectively (Government of Malawi, 2000). Further the Water resources Act of 2013 has a provision that prohibits cultivation in the banks of water course this provision reduces the wetlands pressure from agriculture and land conversion (Government of Malawi 2013). The Act empowers the Water Authority to develop guidelines in water resources allocation thereby managing over utilisation of water from upstream (Government of Malawi 2013). Section 48 of the Environmental Management ACT of 2017 provides for wetland use and management. The Act empowers the Environmental Authority to establish guidelines on utilisation and management of wetlands; such guidelines will reduce the over utilisation of wetlands resources and harmonise implementation of government programs on wetlands. The Act prohibits reclaiming wetlands, prohibits excavation or drilling in wetlands thus deterring conversion of wetlands to other uses. The Act also prevents introduction of invasive alien species thereby ensuring sustainability indigenous species in wetlands.

Kambewa, (2005) also recommended that at a national level, the achievement of the goals to manage wetland is dependent on putting in place a policy and laws (Kambewa, 2005) Kambewa further reported that these policies and laws have to be sensitive to the social and power relations existing in the wetland. There are two modes of access to wetlands in Malawi, there is open access for wetland under chief's jurisdiction whilst restricted access in the protected areas (Kambewa, 2005). The RAMSAR sites which fall in customary areas fall under the authority of chiefs (Mvula and Haller, 2009). Even though there is open access to wetland in customary land, the Land Act regulates that wetlands are community public areas which should be protected, and their access should be limited to residents (Government of Malawi 2022). There is a disconnect between the provisions of the Act and what is being done on ground (Mvula and Haller, 2009a). The missing link in the most developing countries on wetlands governance is empowering the Local Authority to participate in the management of wetlands (Mahlatini et al., 2020). At the local level, enhancement of access is dependent on establishing governance practices that are transparent and accountable to the people in allocation of the gardens and dispute resolution (Kambewa, 2005). This would require formation of groups of local users to manage conflict resolution and land allocation systems, instead of leaving such systems in the hands of chiefs only (Kambewa, 2005). Kambombe et al. (2018) further noted that initiative taken by the communities to conserve Lake Chilwa catchment has led to an increase in grassland by 7.6%.

The Mulunguzi watershed, however, was well conserved with a significant proportion of at least 96% forest area between 1973 and 1994 (Jamu et al. 2003). Wood et al. (2013) further noted that promoting practices that improve crop yields within the catchment of Lake Chilwa wetland has the advantage of permitting communities to see tangible benefits within a cropping season, while indirectly reducing long-term soil loss and improving the health of the river ecosystem and the lake fishery.

Similarly, where high soil losses were predicted, effort has been targeted at practices that increase crop yields by improving soil nutrients and structure (Jamu et al. 2003). Again, health facilities and clean water have to be improved in the wetland communities. To reduce pressure from the wetland fisheries resources, the department of fisheries promotes integrated agriculture-aquaculture as alternative livelihoods for the communities.

5.4 Drivers of ILK Decline in Wetlands

The erosion of ILK concerning wetlands is a global phenomenon, with local, regional, and international factors contributing to its decline. The scholarly literature acknowledges various trends that can threaten the utility and transmission of local knowledge (Long & Long, 1992). These include migration patterns, population growth, rapid immigration, environmental shocks, climate change, and economic factors. For example, migration patterns play a particularly significant role in the dynamics of the Lake Chilwa Basin. Seasonal influxes of fishers equipped with unsustainable gear like open-water seine nets exacerbate pressure on fish stocks and disrupt established ILK-based management practices (Njaya, 2009). However, the literature also acknowledges the potential for co-evolution, where human societies and their environments adapt to changing circumstances. Field observations in the Lake Chilwa Basin paint a more concerning picture. The rapid influx of newcomers has rendered existing ILK systems, focused on environmental conservation, inadequate in the face of new opportunities and challenges. For instance, residents reported that traditional practices of preserving "mabawe" (Typha grass) were undermined by migrant fishers who introduced practices requiring its destruction for weir construction. While some residents disapprove, they have been compelled to adopt these practices to remain competitive. This situation is not, however, universally applicable.

Areas like Vwaza Marsh and Lake Kazuni face other broader challenges, primarily related to the influence of Western education, Christianity (the adoption of new belief systems has led to the devaluation or abandonment of traditional practices and knowledge associated with ILK.), globalisation (communities have embraced modernisation and shifted away from traditional ways of life, leading to the diminishing relevance of ILK), and the perceived superiority of modern science over traditional knowledge.

The decline of ILK in Malawian wetlands is a complex issue with various contributing factors. Recognising these drivers is crucial for developing effective strategies to preserve and revitalise this invaluable knowledge system.

5.5 Multiple Values of Wetlands

Wetlands provide valuable ecosystem services to the rural community and economy though most services are unknown to the people (Kosamu 2014). Knowledge of values is assumed to stimulate individual's consciousness in conserving the wetlands (Mulatu et al., 2022). Apart from being biodiversity hotspots, the wetland resources are equally crucial for income generation and a source of livelihood and well-being of communities. Furthermore, these wetlands play ecosystem functions including water purification, water storage, nutrients cycling, groundwater recharge and discharge, water flow regulation, flood mitigation, erosion control and provision of critical biodiversity habitats. Despite their importance, wetlands continue to be degraded through unsustainable utilization, encroachment, pollution and conversion to other land uses. This is exacerbated by the fact that a small proportion of Malawi's wetlands are protected whilst the rest are characterized by open access. Only Vwaza Marsh exists in a protected area, whilst the rest are under public land. Vwaza Marsh and Lake Kazuni, important wetland areas in Vwaza Wildlife Reserve provide food like mphalata (flying ants), nthowa (traditional drink), pumpkin, mapala mphalabungu (edible caterpillars), and mushrooms. The area has mathyokolo, maviru, mbula nthumbakalulu, matwatwa and many more to the community members which are either used for consumption and for sale. A similar observation was also made at Lake Chilwa basin where it was reported that communities grow food crops around the Lake Chilwa.such as rice, maize, vegetables and cassava.

The area around Lake Kazuni also provides grass essential for thatching their houses and tobacco sheds, which they also sell for income. and generating additional income through sales. The game reserve further provides water for tobacco nurseries as well as for domestic purposes like cooking, bathing and washing. Within the Lake Kazuni wetland, the communities have access to clay soil which is used for pottery and also source of a vast range of medicinal plants.

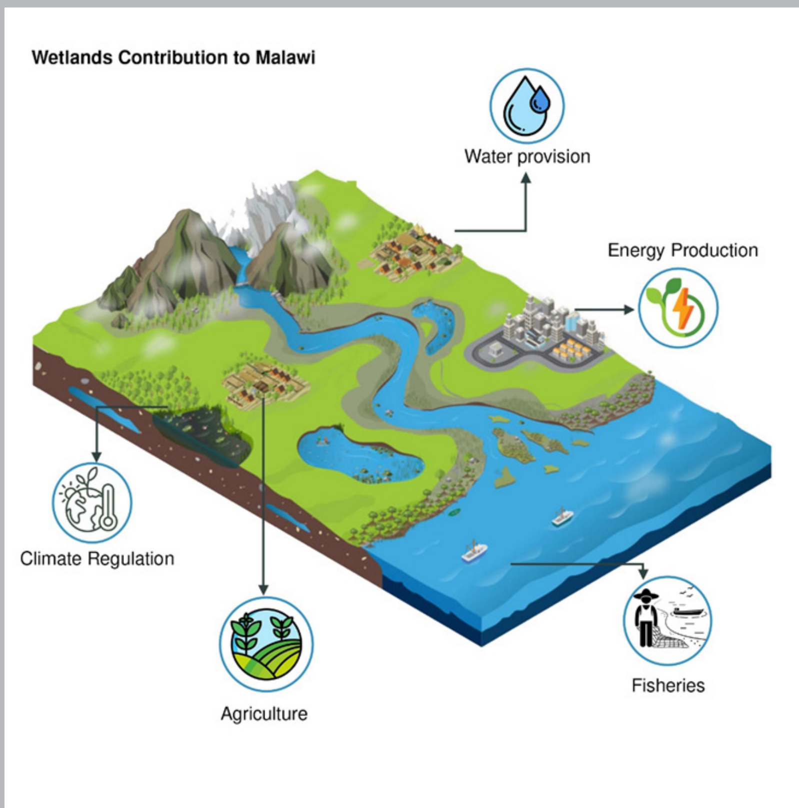

Figure 5-6: Wetlands Contributions in Malawi (Source: NEA)

In Malawi the Elephant marsh's regulatory services were valued in the range of at 3 to 255 million USD per year (World 2019). Farmers in Malawi also rely on wetlands for agriculture production; in 2012 Lake Chilwa wetland produced an estimated 50,000 metric tonnes of rice (Ngozo 2012). It is also estimated that 60% of Malawians get their animal protein from fish (Kosamu et al 2012). Elephant marsh has an estimated production of 85,000 tonnes of fish in 2012 (Kosamu et al 2012).

Wetlands in Malawi provide regulatory and support services which support both people and wild species (Kosamu 2014). The service of habitat provision supports a variety of birds in Malawi's wetlands (Chiotha et al 2017). Lake Chilwa in eastern Malawi, host over 160 bird's species some of which are migratory birds which use Asia East Africa flyway, whilst the Elephant Marsh in southern Malawi is known to host over 110 bird species (kafumbata et al. 2014: Chidyaonga 2023). While the birds provide food to the local communities, they are an important tourist attraction that has not yet been fully exploited in Malawi's wetlands (Pullanikkatil et al 2020). Birds provide many other services which are less known by the communities, such as assisting in plants dispersal, predators for insects and, as scavengers cleaning the ecosystems (Mariyappan et al 2023).

Wetlands play a unique function of ground water recharge which is a vital service in developing countries like Malawi which still have a section of its population depending on boreholes, (Chiotha 2014). In the year 2000 the country's ground water recharge was estimated at a value 50 to 80 mm annually whilst the lake Chilwa recharge value was estimated at 288.11 mm annually, this emphasizes the value of the wetland in recharging ground water (Chavula 2000).

Climate change has also resulted in frequent flooding in many areas across Malawi, since 2015 the country has experienced severe floods in each rainy season (McLaughlin 2023). Wetlands have provided the silent role of mitigating impacts of floods, in 2023 Malawi was hit by cyclone Freddy but it was reported that areas which are around the Elephants Marsh had mild impact, a factor which was attributed to the attenuation services by the marshes (Government of Malawi 2023).

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5.5.1 A case study on rapid assessment of wetlands

ecosystem services and multiple values in Mpatsa Njoka in Salima, Nkudzi Bay in Mangochi, Mpoto Lagoon in Phalombe, and Ndinde Marsh in Nsanje. A rapid assessment of wetland status was conducted using key informant surveys and focus group discussions across four additional wetland ecosystems: Mpatsa Njoka in Salima, Nkudzi Bay in Mangochi, Mpoto Lagoon in Phalombe, and Ndinde Marsh in Nsanje. These sites represent diverse wetland types, including inland floodplains, lakeshores, and marshes.

The assessment focused on the values community's place on wetlands, the pressures affecting these ecosystems, and local governance models. The rapid assessment presented the findings in detail and provides recommendations for policy as well as key issues for inclusion in the Wetlands chapter of the National Ecosystems Assessment Report.

5.5.1.1 Methodology

The assessment utilized key informant interviews at the four visited sites. Targeted key informants included Area Development Committee Chairpersons and extension workers such as Agriculture Extension Development Coordinators, Fisheries Officers, and Wildlife Officers. These interviews were complemented by focus group discussions with wetland users, including farmers, fishers, and other community members. A structured questionnaire was used to guide both the key informant interviews and focus group discussions. The findings highlighted the following:

5.5.1.2 Ndinde Marsh

Ndinde Marsh is located at the southern tip of Malawi. During the assessment visit, conducted at 14:00 hrs, a variety of birds were observed, an indication that the marsh provides important habitat for avifauna. Some of the bird species sighted included kakowa, Haliaeetus vocifer(chinswankhono), and mphopi. Communities further reported that the marsh supports several fish species frequently caught in the area, including Clarias gariepinus(Mlamba), Mphuta, Njole, Makakana, and Dowe. Hydrocynus vittatus (Tiger fish) are said to appear shortly after flooding events. The wetland also supports large populations of hippopotamus and crocodiles.
The team identified multiple uses of the wetland. Observed uses included water transport, irrigation, harvesting of thatch grass, and firewood collection. Communities reported cultivating beans, sweet potatoes, cowpeas, and sugarcane, with farming carried out either individually or through irrigation schemes. When asked to prioritize the most important uses of Ndinde Marsh, communities highlighted farming, fisheries, and grazing as their top three (see Figure: Key Wetland Uses for Ndinde Marsh in Nsanje).

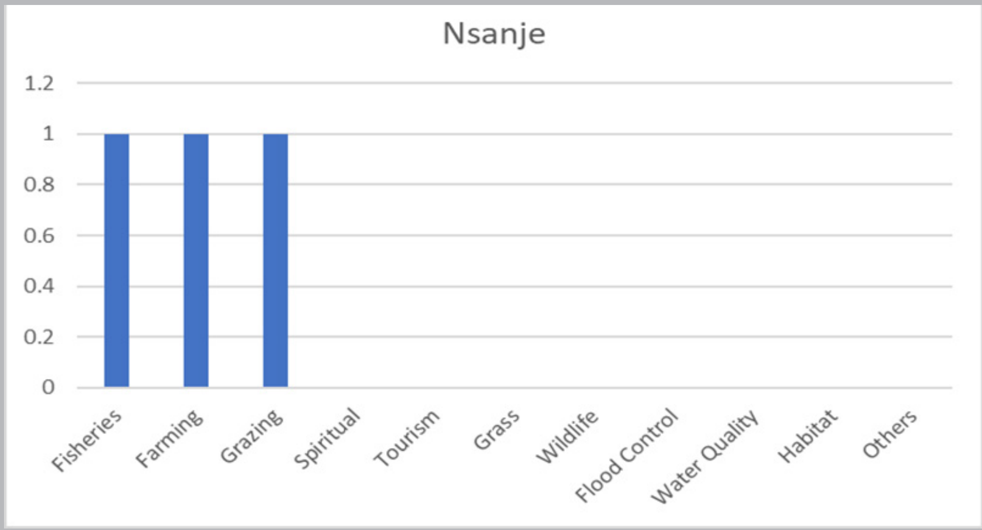


Figure 5-7: Key wetland Uses for Ndinde Marsh in Nsanje (Source: NEA)

The ecosystem services prioritized by the communities largely reflect provisioning services available to them. The presence of fish indicates that the wetland sustains fisheries; abundant water supports irrigation; and the flooding regime promotes growth of grasses used for livestock grazing. Water transport was also emphasized, particularly because the marsh's river channel connects Malawi to Mozambique. However, the community's focus was mainly on consumptive uses. There was limited awareness of the broader ecosystem services provided by the wetland, such as regulatory, supporting, and cultural services. For instance, while the wetland plays a vital role in flood attenuation in this flood-prone district, most community members did not recognize this function. Similarly, although crocodiles, hippopotamus, and diverse bird species inhabit the marsh, these were primarily perceived as protected wildlife under the Department of National Parks and Wildlife, with limited recognition of their ecological roles. Birds contribute to pollination and pest control, sustaining local agriculture, while crocodiles act as habitat engineers and contribute to nutrient recycling. These functions remain largely unknown to local communities. The presence of diverse wildlife also offers potential for nature-based tourism, which could provide alternative income streams.

Despite acknowledging key benefits, communities expressed concerns over declining wetland resources. Major pressures identified included overfishing, wetland conversion, and expansion of intensive agriculture. These pressures have been compounded by climate change. In the past four years, Malawi has experienced unusually high rainfall, causing the wetland to expand. Farmlands once used for cultivation are now submerged, negatively affecting food security. The team also identified three invasive species at Ndinde Marsh: Prosopis juliflora, Pontederia crassipes (water hyacinth), and Pistia stratiotes (water lettuce). Communities recognized water hyacinth as invasive but did not identify the other two species as threats, creating risks of further spread and compounded ecosystem impacts. Paradoxically, while the expansion of the wetland has reduced agricultural land, it has enhanced habitat quality for wildlife, particularly birds. Communities suggested that climate-smart agriculture and enforcement of fisheries regulations could help mitigate some of these pressures.

In terms of governance, communities indicated that wetlands are largely under the authority of traditional leaders, who allocate land within the wetland. In Nsanje, this responsibility falls under Traditional Authority Nyachikadza, with an estimated population of 6,000. Many households established settlements within the marsh when water levels receded but were later displaced by rising water, although they continue to claim ownership of this land. This arrangement is consistent with the Land Act, which classifies wetlands as community public land. However, the Act does not permit cultivation on ecologically sensitive zones such as wetland banks, which remain legally protected.

At Ndinde Marsh, fisheries and wildlife officers are present, but their mandates differ, and coordination is limited. The Water Resources Authority and the Malawi Environmental Protection Authority both have regulatory powers over wetlands and water resources, yet they have not effectively engaged district councils or local communities to develop unified wetland management strategies. This governance gap has resulted in fragmented management approaches, with no coherent institutional framework to balance the diverse ecological and socioeconomic functions of the wetland.

5.5.1.3 Mpoto Lagoon

Mpoto Lagoon is located in Phalombe District, in southern Malawi near the Mozambique border. It is connected to Lake Chilwa through the Sombani River, at an approximate distance of 15 km from the lake. The wetland supports a wide variety of birds; however, communities reported low occurrence of large wildlife species such as hippopotamus and crocodiles.

The lagoon provides multiple benefits, with communities ranking fishing, farming, and grazing as the most important uses. Farming is supported through the use of treadle pumps to draw water closer to gardens. According to the Agriculture Coordinator, five irrigation schemes currently depend on the lagoon for crop production. During the assessment visit, fishing activity was particularly visible, with the team observing seven fishing canoes within one hour. This indicates that Mpoto Lagoon sustains a viable fish population and that its soils are productive for agriculture. In addition, although communities were not able to identify regulatory or supporting ecosystem services similar to the case of Ndinde Marsh bird hunting was reported, though it remains unregulated.

Beyond subsistence uses, there have been attempts to market Mpoto Lagoon for tourism, notably by a former cabinet minister. The site has considerable tourism potential: the lagoon hosts diverse birdlife, its calm waters are suitable for canoeing and leisure fishing, and the nearby hill enhances the wetland's scenic value.

Despite these values, several pressures threaten the sustainability of the lagoon. Communities identified three major pressures (see **Figure 5-8** below)

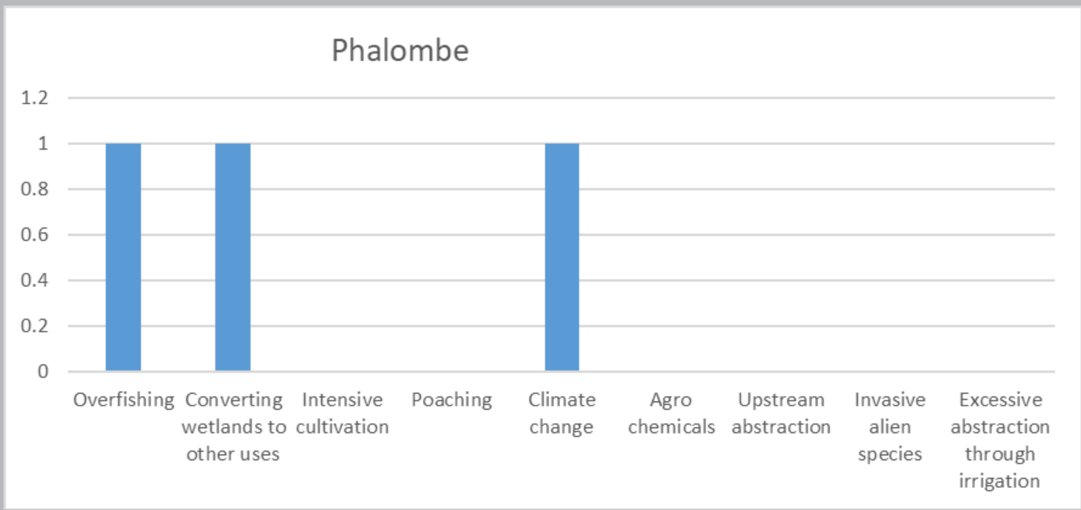


Figure 5-8: Key wetland Uses for Ndinde Marsh in Phalombe (Source: NEA)

climate change, conversion of wetland to other uses, and overfishing. Changes in the flood regime linked to climate change have disrupted farming cycles, mirroring challenges observed in Ndinde Marsh. Conversion of wetland areas for cultivation and intensive fishing practices have also had negative impacts. At the time of visit, cultivation was observed up to the fragile edge of the water channel (see Photo: Intensive Cultivation at Mpoto Lagoon).

Figure 5-9: Intensive Cultivation at Mpoto Lagoon (@Davies Chogawana)

This practice risks sedimentation and agrochemical pollution, with consequences for both human welfare and biodiversity. Communities proposed the promotion of climate-smart agriculture as a key strategy to mitigate these pressures and sustain wetland benefits.

In terms of governance, Mpoto Lagoon is overseen by local chiefs, as is common with other wetlands in Malawi. However, it also features a governance model that applies an ecosystem approach to wetland management. A local committee—comprising members of the Village Natural Resources Committee, Beach Village Committees, Village Agriculture Committee, and community leaders coordinates planning for multiple wetland uses. While this represents a more integrated model, an observation was made that strong involvement of agriculture and fisheries extension workers may skew management toward productive uses at the expense of conservation priorities. Nevertheless, effective implementation of this governance model offers potential to balance competing needs and ensure the sustainability of Mpoto Lagoon.

5.5.1.4 Nkudzi Bay

Nkudzi Bay is located at the southern tip of Lake Malawi, approximately 16 kilometers from the lakeshore. It is a lakeshore wetland that is extensively used for agriculture.

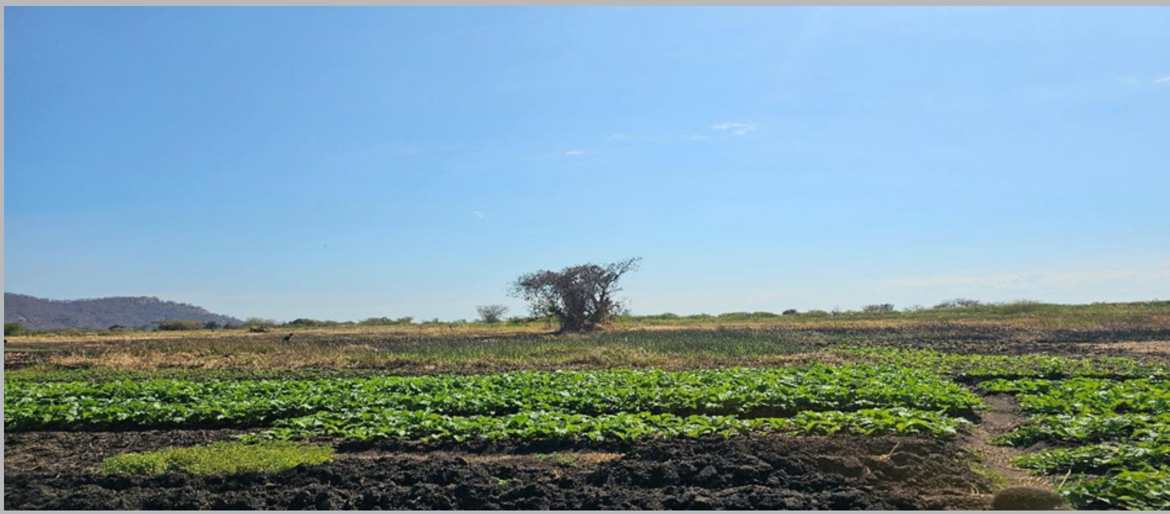


Figure 5-10: Extensive agriculture on Nkudzi Bay (@Chifundo Dalireni)

The wetland provides habitat for hippopotamus, crocodiles, and a variety of bird species. Communities in Nkudzi ranked farming, fisheries, and grazing as the most important uses of the wetland, consistent with findings from other wetlands. However, similar to other cases, they did not recognize the broader regulatory, supporting, and cultural ecosystem services. Communities also highlighted the challenge of human–wildlife conflict. Although the land is fertile, access is restricted due to fear of hippopotamus and crocodiles.

Wetland conversion and agrochemical use were identified as significant pressures. During the visit, widespread human settlement was observed, confirming that wetland conversion is a pressing issue. These settlements are likely contributing to human–wildlife conflict, as people are increasingly encroaching into the natural habitats of hippos and crocodiles. Communities suggested that developing income-generating activities around the wetland could help reduce pressure on wetland resources.

Figure 5-11: Human settlements at Nkudzi bay wetlands (@Davies Chogawana)

In terms of governance, the wetland falls under the authority of local chiefs. However, the Department of National Parks and Wildlife is also present in the area and leads conservation efforts focused on wetland species. The proximity of Nkudzi Bay to Lake Malawi National Park, which has wildlife rangers, strengthens protection of species by ensuring regular monitoring and enforcement.

5.5.1.5 Mpatsa Njoka

Figure 5-12: Mpatsanjoka wetland (@Davies Chogawana)

Mpatsa Njoka Wetland is located in Salima District, in the central region of Malawi. It is an inland floodplain situated approximately 5 km from Lake Malawi. The wetland supports a wide variety of fish species, including matemba, fwilili, and solomoni, as well as a viable bird population, observed even during the midday visit at 13:00 hrs. Crocodiles were also present, though communities reported that hippopotamus, once common in the area, have now become very few. The wetland is extensively used for livestock grazing, particularly for goats, cattle, and sheep.

Figure 5-13: Mpatsa Njoka wetland grazing area (@Chifundo Dalireni)

Farming is carried out using residual soil moisture, with no irrigation channels observed. Fishing is primarily done using traps, while navigation in the river channel is hindered by dense marsh grasses. Communities ranked livestock grazing, agriculture, and fisheries as the most important wetland uses, consistent with findings from other sites. Notably, Mpatsa Njoka features an integrated approach to farming, where crop production is supported by organic manure from livestock. This practice improves soil health while managing livestock waste sustainably.

The flat landscape, covered with extensive marsh grasses, enhances the scenic beauty of the wetland and makes bird viewing easy, giving the site potential for eco-tourism. The grasses also act as a natural barrier to riverbank cultivation, thereby protecting the river channel from agricultural encroachment. Fisheries are further supplemented by fish ponds, which help reduce fishing pressure on the wetland itself.

As in other wetlands, communities did not recognize broader ecosystem services beyond provisioning. Wetland conversion and overfishing were identified as the key pressures at Mpatsa Njoka. To mitigate these, communities suggested strengthening local by-laws to address the sale of wetland portions. Conversion pressure is particularly acute in this area due to high land demand in the lakeshore district. Communities reported that chiefs have sold much of the land along Lake Malawi, leaving little available for cultivation and thus increasing pressure on the wetland. This practice contravenes Malawi's Land Act, which prohibits the sale of wetlands and stipulates that they should remain under community use.

The case studies of Ndinde Marsh, Mpoto Lagoon, Nkudzi Bay, and Mpatsa Njoka Wetland demonstrate that wetlands across Malawi are highly biodiverse ecosystems supporting a range of species and providing critical services to local communities. These wetlands host fish species of subsistence importance such as Matemba, fwilili, solomoni, Mlamba, and Mphota, alongside megafauna including hippopotamus and crocodiles. They are also home to rich birdlife, which contributes ecological functions such as pollination, pest control, and nutrient cycling

The assessment of wetlands of the four wetlands demonstrated that communities place high value on wetlands, particularly for farming, fisheries and grazing. These consumptive uses reflect the communities' dependence on wetlands for food security, income, and daily livelihoods. However, there is limited recognition of the regulating, supporting, and cultural services such as flood control, water purification, nutrient cycling, and tourism potential. This gap in awareness reduces the incentive to safeguard wetlands beyond immediate resource needs.

Communities highlighted pressures such as overfishing, conversion of wetlands to agriculture and settlement, intensive farming, invasive species, and climate change impacts. These pressures are steadily degrading wetland ecosystems and threatening long-term sustainability. The situation is worsened by human–wildlife conflicts in areas where settlements overlap with habitats of hippos and crocodiles.

In terms of governance, wetlands are largely managed under traditional authority, with chiefs allocating land and guiding use. While this aligns with provisions of the Land Act recognizing wetlands as community public lands, it often results in conflicting claims and unsustainable allocations. Sectoral officers from fisheries, agriculture, and wildlife are present in most areas, but there is no harmonized management framework that integrates conservation priorities with community needs. Where community-based committees exist, such as at Mpoto Lagoon, there is potential to balance multiple uses, but strong support and coordination are required to ensure that management is not skewed toward short-term productivity

To safeguard wetland biodiversity and sustain livelihoods, several measures are necessary. These include: promoting climate-smart agriculture and integrated farming systems to reduce pressure on wetlands; strengthening by-laws and enforcement of fisheries regulations to manage resource use sustainably; enhancing awareness of the full suite of wetland ecosystem services among communities; and exploring alternative livelihoods such as eco-tourism and sustainable fish farming. At the governance level, greater institutional coordination is required between traditional authorities, district councils, and statutory bodies such as the Malawi Environmental Protection Authority and the Water Resources Authority to establish unified and adaptive wetland management frameworks.

Table 5-1: Summary of the benefits of wetlands to the society

Provisioning	
Food Production	Wetlands provide important food products like fish, fruits and rice (20% of the world's nutritional intake). Wetlands support 61.8 million people that earn their living directly from fishing and aquaculture.
Water Supply	Wetlands provide us with drinking water. Only 0,75% of the world's fresh water is accessible for direct human uses. The UN estimates that 2 billion people will not have access to safe drinking water by 2025.
Building materials	Papyrus and reeds grow thickly in some wetlands and are used locally to make mats, hats, chairs, thatch, granaries, baskets and fishing gear (Dr Sambo, 2014)
Regulatory Services	
Floods or Erosion control	Wetlands function as natural sponges that trap and slowly release surface water, rain, groundwater and flood waters. Trees, root mats and other wetland vegetation also slow the speed of flood waters and distribute them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion (EPA, 2023)
Water purification	80% of wastewater is discharged into the natural environment without any form of treatment. The abundant plant life in wetlands absorbs waste, which helps purify water.
Carbon sequestration	Wetlands are vital natural assets, capable of taking up atmospheric carbon and restricting subsequent carbon loss to facilitate long-term storage. They can be deliberately managed to provide a natural solution to mitigate climate change, as well as to help offset direct losses of wetlands from various land-use changes and natural drivers Wetland soils are wet, oxygen is not readily available to facilitate decomposition. Roots that die decompose slowly while new roots continue to be produced, which leads to accumulation of organic matter in the soil. Carbon makes up approximately 50 percent of this organic matter
Drought control	Wetlands are a natural buffer during extreme weather. They store heavy rainfall during storms, which reduces flooding and delays the onset of droughts.
Nutrient recycling	Wetlands are important for nutrient cycling as they act as natural filters, absorbing and transforming excess nutrients in the ecosystem. Wetlands play a crucial role in nutrient cycling, which is the process of how nutrients move from one organism or environment to another. They are often referred to as the 'kidneys' of the earth due to their ability to absorb, store and transform nutrients, particularly nitrogen and phosphorus, which are essential for plant growth but can be harmful in excess amounts.
Diseases regulation	Many wetland types, including constructed treatment wetlands, can regulate pollutants, pests and disease agents; biodiversity in itself can help to buffer against disease emergence. For specific threats such as vector-borne diseases, there are a range of targeted management actions that can be undertaken. More broadly, taking an ecosystem approach to health in wetlands reduces a wide range of risks and promotes health across the board.

Table 5-1 Conti.: Summary of the benefits of wetlands to the society

Supporting Services	
Habitat support	40% of the world's plant and animal species live or breed in wetlands Over 100,000 freshwater species have been identified in wetlands so far
Pollination	The primary abiotic factor is pollination by the wind (known as anemophily). This form of pollination is common in many wetland grass species, numerous coniferous, and many deciduous trees. Some wetland and aquatic plants release and disperse their pollen directly into water and this becomes the vector for pollination, known as hydrophilous pollination (Mcinnes, 2016
Cultural and recreation services	
Tourism	Wetlands offer significant tourism opportunities that can be an important source of income for communities and national economies. The Ramsar Convention supports Contracting Parties and other stakeholders in promoting and developing sustainable wetland tourism They also provide opportunities for tourism and recreational activities such as boating, swimming, fishing, bushwalking and bird watching, found to contribute billions of dollars to economies. Recreational hunting and fishing' is the most widespread tourism activity (43% of Ramsar Sites), while 'water-sport activities' are the least widespread (6% of Ramsar Sites).
Cultural	Cultural ecosystem services are one of the four key components identified in the Millennium Ecosystem Assessment and United Kingdom National Ecosystem Assessment, along with provisioning, regulating and supporting services. Cultural ecosystem services are identified as the benefits people gain from their interactions with different environmental spaces, such as woods or parks, and the activities, such as walking and cycling, they undertake in these spaces. These interactions give rise to a variety of wellbeing benefits that are wide ranging and can be valued in numerous ways, via monetary, qualitative, quantitative, and mixed methods.
Aesthetic and inspiration	Wetlands possess an inherent beauty that is both captivating and serene. They showcase a diverse palette of colors, from the vibrant greens of emergent vegetation to the reflections of the sky on calm water surfaces. The changing seasons bring forth a symphony of hues, as autumn transforms the wetland into a tapestry of warm tones, and spring adorns it with bursts of wildflowers. Wetlands have long been a source of inspiration for artists, writers, and musicians. The tranquility and natural rhythms found in wetland ecosystems have stirred the imagination and creativity of many. Artists are drawn to capture the spirit of wetlands, conveying their beauty, serenity, and environmental significance through their creations

Table 5-1 Conti.: Summary of the benefits of wetlands to the society

Education	Wetlands can provide tremendous opportunities for education and research. They are good systems to study for several reasons, one of which is that they are discrete ecosystems with easily defined boundaries. They also can exhibit a high diversity of habitats and species. By examining the types of pollen in layers of peat moss taken from bogs, we can learn about historical changes in climate and vegetation over thousands of years. Wetlands also have unique life forms, such as insectivorous plants, that are not found in the adjacent uplands. When wetlands are preserved as open areas, or are put into a land trust, they will remain valuable resources for education and research.
Spiritual	The spiritual significance of wetlands is closely related to the religious, cultural and historic importance wetlands play in human well-being. Spirituality contributes significantly to wetland services and values but often remains overlooked and undervalued. Indigenous peoples' spirituality is often directly related to wetlands being imbued by spirits while mainstream religions construct places of worship in wetlands. Pilgrimages the world over follow rivers and wetlands and in cases these can have a profound impact. Religious leaders can help protect wetlands and some incentives in international policy exist to assist policy makers and decision makers with this

5.6 Legal, policy and governance frameworks for wetland ecosystems

While wetlands are acknowledged as important ecosystems, there is absence of a dedicated wetland policy in Malawi. However, issues regarding wetlands conservation are partly discussed in other existing sectoral policies and legislation within the natural resources and agricultural subsectors. Though this is the case, these existing policies do not adequately address the issues of wetlands leading to wetlands not adequately managed and protected. Malawi is party to Ramsar Convention, which enhances the wise use of wetlands and development of national policies. The absence of a wetland-specific policy brings a gap in aligning with international commitments, and this compromises the country's position in achieving sustainable development goals (SDG) such as SDG 3 (good health and well-being), SDG 6 (clean water and sanitation), and SDG 15 (life on land). Below are some of the sectoral-specific policies that include some wetland aspects. **Table 6-2** highlights some of the policy and regulatory frameworks that tackle aspects of wetlands.

Table 5-2: An overview of key policy and regulatory frameworks addressing various aspects of wetland management

Environment Related Sectoral Policies	Wetlands Aspects Covered in the policy	Gaps	Remarks
National Environmental Policy 2004 (NEP)	As the overarching framework instrument in the environment sector, the NEP addresses wetlands issues through specific strategies that seek their conservation and sustainable utilization. Restoration, maintenance and enhancement of ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources, and conservation of biological diversity are explicitly stated. Under the employed strategies, the policy emphasizes the need to develop guidelines for proper use of wetlands and “dambos”, promotes rainwater harvesting, and advocates for integrated watershed management practices. In addition, it promotes community engagement and research and monitoring.	Lacks specific guidance on the unique ecological functions and management needs of wetlands. It also does not provide explicit guidance on transboundary issues associated with wetlands conservation and utilisation.	A revision could focus on detailing specific wetland ecosystem services and establish guidelines for their protection. Inclusion of transboundary issues is also important, building upon the international agreements to which Malawi is party.
Water purification	Recognizes wetlands as vital components of the country’s natural ecosystems important for biodiversity conservation, water purification, flood control, and providing habitats for various species. The policy promotes good catchment management to protect and sustain the ecosystem, biodiversity, and wetlands, promotes integrator water resources management, stakeholder engagement, and includes a guideline that establishes a buffer zone to protect water resources and infrastructure from flood risks and environmental impacts. International cooperation in the management of trans-boundary and cross-boundary waters is also promoted. The other water management strategies in the policy also indirectly support wetland health.	Lacks focus on distinct wetland ecosystems and sustainable community use.	There is need to enhance protection for wetland-specific ecosystems, particularly as water catchments, habitats, and buffers.
Fisheries and Aquaculture Policy 2016	The policy addresses climate-related issues that impact wetlands and fisheries, promoting adaptation measures to mitigate these effects. It also supports the Convention on Biodiversity and the RAMSAR Convention on Wetlands, committing to the preservation and wise use of wetland ecosystems	There is minimum emphasis on comprehensive wetland habitat management	Need to expand this policy to address wetland habitats which would promote biodiversity conservation beyond fish species.

Table 5-2 Conti.: An overview of key policy and regulatory frameworks addressing various

Environment Related Sectoral Policies	Wetlands Aspects Covered in the policy	Gaps	Remarks
Irrigation Policy 2016 and National Agriculture policy 2016	These policies intersect with wetland management, primarily through their focus on increasing irrigation to support agricultural productivity. However, the policies do not specifically address the unique needs of wetlands, creating a number of notable gaps.	It does not address unique wetland needs, prioritizing agriculture expansion that may degrade wetlands. It only prioritizes the expansion of irrigated agriculture, which targets wetlands areas due to their proximity to water sources and fertile soils leading to wetland degradation, altering water regimes and reducing biodiversity.	It must include wetland -specific guidelines for irrigation projects which could help mitigate water regime alterations and biodiversity loss.
Forestry Policy 2016	The policy focuses on ecosystem management, which includes wetlands and promotes conservation of biodiversity. Watershed management and community participation are also encouraged. However, it primarily addresses forested wetlands like swamp forest to some extent. It lacks comprehensive measures for managing non-forested wetlands and their associated biodiversity.	Lacks measures for the protection of open wetlands.	Need for a broader inclusion of non-forested wetlands which would enhance ecosystem resilience
Agriculture Extension Policy 2000	This policy enhances agriculture productivity by delivering services, knowledge, and resources to farmers. However, while it offers valuable support to farming communities, its approach to wetland management is very limited. For example, it promotes wetland-based agriculture without proper conservation guidelines leading to degradation of wetlands ecosystems.	Risk of wetlands degradation due to unsustainable practices	Introducing sustainable wetland agricultural practices could improve ecosystem protection
National Land Policy (2002)	This policy addresses land allocation, tenure, and sustainable land use, aiming to optimize land use across sectors. It acknowledges the sensitivity of wetlands, requiring protection from encroachment and degradation.	There is insufficient emphasis on sustainable wetland protection and land use.	Development of wetland specific land use policies could prevent encroachment and degradation.
	This is a long-term vision aimed at transforming the country into an inclusively wealthy and self-reliant nation by the year 2063. It is built around three key pillars of agriculture productivity and Commercialization, industrialization, and urbanization. Amongst the supporting enablers is environmental sustainability which focuses on sustainable environmental and natural resource management aligning with wetland conservation goals. Strategies for achieving sustainable environmental and natural resource management include proper waste management, management of air, land and water pollution, energy diversification, and climate resilience and adaptation.		The vision incorporates key issues for ensuring sustainable environmental and natural resource management to support sustainable development. These key issues need to be properly integrated in a wetlands policy and provide wetland specific measures and initiatives that ensure a balanced approach to development.

Table 5-2 Conti.: An overview of key policy and regulatory frameworks addressing various

Environment Related Sectoral Policies	Wetlands Aspects Covered in the policy	Gaps	Remarks
National Climate Change Policy 2016	The Policy emphasizes broad priority areas, including climate change adaptation and mitigation, capacity building, and sustainable resource management. These encompass the management and protection of wetlands. Wetlands are occasionally addressed within climate change adaptation strategies. .	Limited focus on wetlands as carbon sinks and climate buffers	There is need to integrate wetlands management into climate change initiatives alongside sustainable land use practices. Explicit climate adaptation roles for wetlands could enhance resilience strategies.
Environment Management Act 2017	This act provides a legislative framework for protecting the environment and promoting sustainable natural resource use. Its main objectives include environmental conservation, pollution control and sustainable development. Although the act addresses some aspects relevant to wetlands, it lacks comprehensive targeted provisions specifically for wetlands ecosystems.	Lacks targeted wetland provisions, however section 48 talks about some provisions for wetlands.	Adding specific wetland protections would support sustainable development goals.
Land Act	This act provides a legislative framework for land administration, ownership and management, including the acquisition, tenure and use of both public and private land. While the act aims to clarify land ownership and promote sustainable land management, it does not specifically address the unique needs of wetlands, resulting in several important gaps that impact wetland conservation and sustainable use	No wetland-specific land protection measures.	Including wetland land use guidelines would secure these areas from sustainable practices.
Irrigation Act	This act governs the use and management of water resources for irrigation purposes to enhance agricultural productivity. It establishes regulatory frameworks for irrigation projects, water allocation and irrigation scheme management. While the act aims to support agricultural development, it lacks specific provisions for wetlands ecosystems, which are often affected by irrigation practices. This omission results in gaps that can impact wetlands sustainability and ecosystem health.	The policy omits wetland ecosystem protections.	Integrating wetland preservation with irrigation could prevent habitat degradation
Water Resources Act	This act provides the legal framework for management, use, conservation and protection of water resources across the country. The act primarily aims to regulate water use, ensure equitable allocation and safeguard water quality, including provisions for pollution control and sustainable management. While this legislation supports some aspects of water conservation, it does not provide comprehensive protections specifically for wetlands ecosystems	There is no comprehensive wetland protections in the policy.	Adding providsions for wetland water regulation would enhance ecosystems health.

Table 5-2 Conti.: An overview of key policy and regulatory frameworks addressing various

Environment Related Sectoral Policies	Wetlands Aspects Covered in the policy	Gaps	Remarks
National Parks and Wildlife Act	The Act establishes the legal framework for managing, protecting and conserving wildlife and designated protected areas including national parks, wildlife reserves and game areas. Although wetlands within national parks or wildlife reserves benefit from the protections provided by the act, the legislation does not extend specific protections for wetlands outside these designated areas. This limitation creates gaps in the conservation of wetlands as unique ecosystems, especially those outside protected areas, leaving them vulnerable to degradation.	No protections for wetlands outside these areas.	Expanding coverage for non-protected wetlands could prevent ecosystem loss.
Forestry Act	It provides a framework for conservation, management and sustainable use of forest resources, focusing primarily on forest reserves plantations and natural forests. While it does not directly address wetlands, the act indirectly impacts wetland ecosystems by promoting sustainable land and resource management practices that can affect hydrological cycles, soil quality, and watershed health, all of which are essential to wetland ecosystems.	No direct wetland conservation focus.	Addressing forest-wetland interfaces could support ecosystem integrity.
The National Biodiversity Strategy and Action Plan (2015-2025)	The NBSAP serves as a guiding framework for conserving biodiversity and managing natural resources sustainably as required under the Convention on Biological Diversity (CBD). The NBSAP includes objectives and strategies to protect various ecosystems including forests, grasslands and aquatic habitats, though wetlands are not consistently addressed as stand-alone ecosystems. The plan is instrumental for coordinating conservation efforts. It promotes restoration efforts for degraded wetland ecosystems and encourages the designation of wetlands as protected areas.	Insufficient focus on wetland-specific strategies.	Wetland-specific goals could enhance biodiversity monitoring and protection.
National Adaptation Plan Framework (2020)	It aims to create a strategic long-term framework for addressing the impacts of climate change across critical sectors, including agriculture, water, forestry and biodiversity. While the NAP addressed various ecosystems in its approach to climate resilience, wetlands are not often highlighted as distinct ecosystems despite their significant role in climate adaptation. Given that wetlands contribute to flood regulation, water purification, carbon storage and biodiversity support, their integration to the NAP would enhance the effectiveness of Malawi's adaptation measures.	Limited recognition of wetlands' adaptation benefits.	Emphasizing wetlands' roles in climate resilience could strengthen adaptation outcomes.

5.6.1 Legal and Policy Framework

Malawi has various sectoral legislative and policy frameworks that address aspects of wetland issues indirectly at varying degrees. Key national frameworks include environmental, wildlife, water, fisheries, agriculture, land, irrigation, and biodiversity policies. The provisions contained in these instruments are sector-specific rather than ecosystem-based.
The NEP and several other sectoral policies acknowledge the importance of wetlands for biodiversity conservation and sustainable use, display a commitment to integrated management practices, promote stakeholder engagement, and to some extent address transboundary issues. The Environment Management Act (2017) provides a strong regulatory foundation by empowering the Malawi Environment Protection Authority (MEPA) to control harmful activities in wetlands, require Environmental and Social Impact Assessments (ESIAs), and declare protected wetlands. The National Biodiversity Strategy and Action Plan (NBSAP) explicitly commits Malawi to developing a National Wetlands Policy, reflecting alignment with international obligations. These existing frameworks establish the groundwork for better wetlands management. The general emphasis is on conservation, sustainable use, and restoration.

Although this relatively rich but fragmented policy basis exists, the absence of a dedicated National Wetlands Policy remains the most significant policy gap. The inexistence of a wetland-specific policy makes it difficult to pursue holistic, strategic and well-coordinated efforts in the conservation and sustainable use of wetlands (Makwinga et. al, 2025). The lack of a focused wetland policy makes wetlands to be treated as subsidiary resources, valued mainly for sectoral benefits (e.g., agriculture, fisheries, irrigation) rather than as an integrated ecosystem. Policy responses are often reactive and uncoordinated, leading to inconsistent decision-making and enforcement. In addition, conflicting mandates arise where sectoral priorities (e.g., wetland conversion for agriculture or irrigation) undermine conservation and ecosystem integrity. Without a unifying policy therefore, Malawi lacks a holistic framework to address wetland ecosystem functions such as flood regulation, groundwater recharge, climate adaptation, nutrient cycling, and habitat connectivity. At the national level, the lack of a wetland specific policy also weakens alignment with long-term development aspirations, including Malawi Vision 2063, where wetlands could play a strategic role in resilient livelihoods, water security, and nature-based solutions.

5.6.2 Wetland governance frameworks

Wetland governance in Malawi is institutionally complex and fragmented. The Department of National Parks and Wildlife serves as the National Ramsar Administrative Authority and is mandated to coordinate conservation and management of Ramsar Sites and wetland biodiversity. Its responsibilities include addressing poaching, habitat loss, encroachment, and human wildlife conflict. These responsibilities are largely confined to protected areas, with limited authority over wetlands outside gazetted reserves, where most wetlands occur. However, wetlands intersect with the mandates of numerous other institutions, including; Agriculture and irrigation authorities; fisheries departments; water and transport sectors; environmental affairs and land administration; Local government structures and traditional authorities. This has created a governance vacuum in which sectoral agencies (agriculture, fisheries, irrigation, water) operate independently, sometimes with conflicting objectives.

This multi-sectoral overlap has resulted in conflicting policy objectives, especially between conservation and production oriented sectors; weak enforcement on public and customary land, where DNPW has limited legal authority; limited coordination between national agencies and decentralized governance structures

The National Parks and Wildlife Act further vests authority over protected areas in the Chief Parks and Wildlife Officer but does not extend this authority clearly to wetlands located on customary or public land, where most wetlands occur. The absence of clear institutional coordination mechanisms has left wetlands vulnerable to open-access exploitation, particularly outside formally protected areas.

On customary or public lands wetlands are largely under local government jurisdiction, with traditional authorities playing a decisive role in access, use, and management. While this has enabled some successful community-based governance arrangements, it has also resulted in inconsistent management standards across districts, decisions driven by short term livelihood pressures rather than ecosystem sustainability and weak upward accountability to national conservation objective. District councils and traditional authorities play central roles in land allocation and wetland use, yet often lack clear policy guidance, technical capacity, and harmonized institutional frameworks for sustainable wetland management. As a result, wetlands frequently function under open access regimes, accelerating degradation through encroachment, overexploitation, and land-use conversion.

Against this backdrop, Elephant Marsh provides a practical and contextually appropriate example of an emerging, multi-level governance system that integrates national oversight, district administration, traditional leadership, and community participation

5.6.2.1 Case Study: Elephant Marsh Wetland Governance System, Malawi

Elephant Marsh is one of Malawi's largest and most important wetlands, designated as a Ramsar Site and supporting fisheries, agriculture, grazing, biodiversity conservation, and climate regulation. The wetland spans multiple districts and Traditional Authorities and lies largely on customary land. Increasing degradation driven by encroachment, overfishing, agricultural expansion, and competing sectoral interests necessitated a governance approach that integrates conservation with local livelihoods.

To address these challenges, Elephant Marsh adopted a Community Conservation Area (CCA) governance model, grounded in community-based natural resource management and supported by national policy and legislation. The model establishes a multi-level, participatory governance system that links community stewardship with district and national oversight.

At the community level, local user groups and Community-Based Organizations regulate access to wetland resources, develop and enforce by-laws, monitor compliance, and manage conflicts. These structures ensure that wetland users are both custodians and beneficiaries of conservation efforts.

Traditional Authorities play a central role by legitimizing governance arrangements, endorsing by-laws, and integrating customary norms into formal management systems. Their involvement strengthens social compliance and local ownership.

At the district level, District Councils provide coordination, technical support, and alignment with District Development Plans. Sectoral departments such as fisheries, agriculture, forestry, and environment contribute extension services and support integrated wetland management.

At the national level, the Department of National Parks and Wildlife, as the Ramsar Administrative Authority, provides policy guidance, coordination, and alignment with national and international conservation commitments. The governance model is consistent with the Environment Management Act and wildlife legislation, enabling conservation on customary land without the need for formal gazettement.

The Elephant Marsh governance system demonstrates clear roles and responsibilities across governance levels, strong community participation and ownership, integration of conservation objectives with livelihoods, especially fisheries and agriculture, conflict resolution mechanisms embedded within local institutions, adaptive management informed by local monitoring and stakeholder engagement.

5.6.3 Bridging the Policy Gap: Integrating ILK into the Management of Wetland Ecosystems

The sustainable management of wetlands in Malawi is inseparable from ILK, and from the local communities who on daily basis interact with, manage, and conserve wetland ecosystems. Understanding the complexities of Malawi's natural resources, including wetlands, demands a multifaceted approach. This National Ecosystem Assessment report goes beyond scientific literature and incorporates the invaluable insights of Indigenous Peoples and lLocal cCommunities (IPLCs) that have been primary custodians and direct beneficiaries of these ecosystems for generations. This chapter integrates various scientific disciplines (natural and social sciences) with Indigenous and Local Knowledge (ILK) systems gathered through participatory processes like walking workshops, key informants interviews (KII), and focus group discussions (FGDs). This inclusive approach reveals that Malawi's wetlands hold not only ecological and economic value but also profound cultural significance. By highlighting the critical role of ILK alongside scientific expertise, the assessment aims to illuminate a comprehensive strategy for effective wetland management and conservation (Makondo & Thomas, 2018). It explores their diverse contributions, sheds light on conservation challenges, and ultimately demonstrates the crucial role of both knowledge systems in safeguarding these vital ecosystems for current and future generations.

Across Malawi, wetlands underpin livelihoods linked to fisheries, agriculture, grazing, harvesting of reeds and medicinal plants, and cultural practices. These uses are governed by locally embedded knowledge systems, customary norms, seasonal calendars, and spiritual values that regulate access, harvesting periods and conservation. Despite its importance, ILK remains weakly integrated into Malawi's policy frameworks. Key sectoral policies affecting wetlands, including fisheries, water, irrigation, and land-use planning, are largely silent on ILK. As a result, wetland management remains dominated by top-down, sector driven approaches that inadequately reflect local realities, livelihood dependencies, and cultural values. The absence of a dedicated National Wetlands Policy further exacerbates this gap, as there is no unifying framework to systematically embed ILK across sectors and governance levels.

The Community Conservation Area (CCA) governance model exemplified in wetlands such as Elephant Marsh demonstrates that ILK is not only relevant but essential for effective wetland governance, particularly on customary land. Within the CCA governance model, this knowledge informs local by-laws, seasonal access restrictions, fishing gear controls, and land-use zoning, enabling adaptive management that responds to ecological change. Integrating ILK also enhances legitimacy, compliance, and social accountability in wetland management. Where governance systems align with customary norms and traditional authority structures, communities are more likely to respect rules and participate in monitoring and enforcement. This is particularly important in Malawi, where most wetlands occur on customary land and where state enforcement capacity is limited. The CCA model leverages ILK by embedding governance within existing social institutions, thereby reducing conflict and strengthening stewardship.

The CCA governance model provides a practical institutional mechanism for operationalising ILK within formal governance systems. By recognizing community institutions, traditional authorities, and local norms as legitimate governance actors, CCAs create space for ILK to inform resource-use decisions while remaining aligned with national conservation objectives. In Elephant Marsh, for example, ILK has been instrumental in regulating fisheries, managing seasonal access, and resolving conflicts between agriculture, fishing, and conservation interests. Importantly, CCAs demonstrate how ILK and scientific knowledge can be complementary rather than competing. Local observations of environmental change can inform scientific monitoring, while scientific data can support communities in adapting traditional practices to emerging pressures such as climate change, population growth, and market integration. Another challenge, observed particularly in the Vwaza Wildlife Reserve around Lake Kazuni and Zolokere, concerns ongoing and unresolved disputes over borders, land boundaries, and the burial sites of Traditional Authorities . Rapid population growth has further intensified pressure on land, increasing demand for space for settlement and agricultural use. These persistent and unresolved tensions between local communities and the government continue to undermine co management efforts, as communities have grown resentful toward the Department of Parks and Wildlife.

The development of a comprehensive National Wetlands Policy offers a critical opportunity to systematically integrate ILK into wetland governance in Malawi. Such a policy should explicitly recognize ILK as a core knowledge system, establish mechanisms for its inclusion in decision-making, support co-management through models such as CCAs, and ensure alignment between customary governance and statutory institutions. Integrating ILK in this manner will strengthen wetland governance, enhance resilience, and ensure that wetland conservation contributes meaningfully to sustainable development and local livelihoods.

The development of a comprehensive wetland policy is therefore crucial for ensuring the sustainable management of these vital ecosystems. Such a policy would provide a dedicated framework for managing these vital ecosystems while ensuring the integration of the invaluable knowledge held by local communities.

By addressing these policy shortcomings, Malawi can move towards a future where ILK and modern scientific knowledge work together to ensure the sustainable management and conservation of the country's irreplaceable wetlands.

5.7 Scenarios Mapping for Wetlands

5.7.1 The past, present and future outlook of wetlands under different scenarios

Scenario mapping for wetlands provides a structured approach to explore how different combinations of climate change, land-use change, and management decisions may affect wetland biodiversity, ecosystem functions, and ecosystem services over time. Consistent with the IPBES scenario framework, wetlands in Malawi can be assessed under past (baseline), present (current trends), and future (plausible pathways) to inform risk-aware and policy-relevant decision-making (IPBES, 2016; IPBES, 2019).
Wetlands in Malawi provide a wide range of ecosystem services, including flood regulation, food production, water purification, carbon storage, and biodiversity support, while also forming a critical component of national agricultural systems. It is estimated that wetlands including dambos, floodplains, and lake-associated systems support approximately 12% of land used for agriculture in Malawi, underscoring their socio-economic importance as well as their vulnerability to unsustainable land-use practices (Mzembe, n.d.; Chiotha, 2014).

A detailed scenario-based socio-economic assessment has been conducted for Elephant Marsh, providing a valuable methodological template for national level wetland scenario analysis (Birkhead et al., 2022). In this assessment, future scenarios were constructed by analysing changes in land cover, hydrological function, and ecosystem services under alternative development pathways, particularly agricultural expansion.

The landcover types to be impacted can be based on the same classification (1) open water surfaces, including areas with floating-leaved aquatic plants; (2) disturbed areas, including bare ground, barren lands, cultivated lands and burnt vegetation; (3) typically indigenous vegetation with a minor-to-moderate disturbance, including previously cultivated lands with regenerated vegetation; (4) indigenous vegetation, typically reeds/grasses but including previously disturbed vegetation; and (5) typically undisturbed papyrus, but including other vigorously growing indigenous plants 6) Open Water 7)mixed water/aquatic veg. These land-cover classes differ substantially in their capacity to support key ecosystem functions, including water storage, sediment retention, nutrient cycling, carbon sequestration, and habitat provision. Scenario analysis should therefore focus on changes in ecosystem function and service delivery, rather than simply on changes in human activities.

5.7.2 Human activities and Scenario drivers

Wetlands in Malawi are subject to multiple interacting pressures, including subsistence and commercial agriculture, rice cultivation, water abstraction for domestic and agricultural use, harvesting of reeds and grasses for construction and weaving, bird hunting, tourism, and infrastructure development. Under future scenarios, expansion of farming, both subsistence and commercial, represents one of the most significant drivers of wetland transformation, particularly in floodplain systems (Government of Malawi, 20

5.7.2.1 Flood regulation under alternative land-use scenarios: evidence from Elephant Marsh

Elephant Marsh, a Ramsar Site located in the Lower Shire Basin, plays a critical role in flood attenuation by slowing and storing floodwaters during extreme rainfall events. Recent hydrological modelling examined scenarios in which wetland and marsh vegetation were progressively replaced by cultivated and barren land to simulate agricultural expansion (Birkhead et al., 2022; Dube et al., 2023).

The results indicate that removal of marsh vegetation would lead to a 20% increase in average daily peak river discharge at Chiromo, resulting in an increase in downstream water levels of approximately 0.5 metres in the Shire River (excluding coincident flooding from the Ruo River). These findings demonstrate that wetland conversion significantly reduces flood attenuation capacity, increasing flood risk for downstream communities, infrastructure, and agricultural land.

5.7.3 Implications for future wetland scenarios

Future scenarios for Malawian wetlands suggest diverging outcomes depending on management pathways. Firstly, degradation scenarios, characterised by agricultural expansion, drainage, and vegetation removal, are likely to result in increased flood risk, reduced carbon storage, biodiversity loss, and declining ecosystem service provision.

Secondly, sustainability and restoration scenarios, involving wetland protection, regulated farming, catchment restoration, and ecosystem-based adaptation, maintain or enhance wetland functions while supporting livelihoods and climate resilience.

Detailed quantitative scenario outcomes for wetlands are further explored in the Scenarios Chapter of this assessment. However, existing evidence clearly demonstrates that wetlands function as critical natural infrastructure and that land-use decisions within wetlands will strongly shape Malawi's future exposure to climate risks.

5.8 Climate Change and Wetland Biodiversity and Ecosystem Services

Climate change is a major and accelerating driver of wetland degradation in Malawi, with particularly severe impacts observed in the Lake Chilwa Basin and other floodplain wetlands (IPCC, 2022; Government of Malawi, 2021). When natural ecosystems such as wetlands are degraded, drained, or cleared, significant amounts of stored carbon are released into the atmosphere, reinforcing global climate change (IPBES, 2019; Davidson et al., 2019). In turn, climate change alters hydrological regimes, temperature profiles, and disturbance patterns, leading to changes in biodiversity composition, ecosystem functioning, and the delivery of ecosystem services essential for human well-being (IPCC, 2014; IPCC, 2022).

5.8.1 Climate change as a driver of wetland ecosystem change in Malawi

Across Malawi, climate change is manifested through rising temperatures, increased rainfall variability, prolonged dry spells, and more frequent extreme events such as floods and droughts (IPCC, 2022; Government of Malawi, 2021). These changes are particularly pronounced in low-lying wetland systems and endorheic basins (Chiotha, 2014). The impacts are especially severe in the Lake Chilwa basin, covering the districts of Zomba, Phalombe, and Machinga, where livelihoods and food security are tightly coupled to wetland ecosystem services (LCBCCAP, 2012; Ramsar Convention Secretariat, 2018).

Lake Chilwa, designated as a Ramsar Site in 1997, is Malawi's second-largest lake and supports the livelihoods of approximately 1.5 million people through fisheries, flood-recession agriculture, grazing, harvesting of reeds and grasses, and non-timber forest products (Ramsar Convention Secretariat, 2018; Kosamu, 2014). These livelihood systems are highly sensitive to climate variability because they depend directly on ecosystem services such as nutrient cycling, water regulation, sediment deposition, and habitat provision (Pullanikkatil et al., 2020).
Observed climate change impacts in the Lake Chilwa basin over recent decades include:

- Erratic rainfall patterns, resulting in alternating floods and droughts (IPCC, 2022);
- Progressive decline in lake water levels, driven by reduced inflows, increased evaporation, and catchment degradation (Ngozo, 2012);
- Increased frequency of lake drying events, with Lake Chilwa having dried completely nine times over the past century, most recently in 2018 (LCBCCAP, 2012);
- Slower ecological recovery following drying events, indicating declining ecosystem resilience (Kosamu et al., 2012).

Although the lake can refill within one to three years under favourable rainfall conditions, successful recovery depends on intact forested catchments, functional wetlands, and the protection of perennial river pools that serve as refugia for aquatic biodiversity (MRAG, 2017; Ngozo, 2012).

5.8.2 Climate change impacts on wetland biodiversity and ecosystem services

5.8.2.1 Impacts on fisheries and aquatic biodiversity

Fluctuating and declining water levels disrupt fish breeding, feeding, and recruitment processes (Kosamu et al., 2012). Following lake drying events, fish stocks may take several years to recover, severely affecting fishing communities (Ngozo, 2012). Since the 1970s, annual fish catches in Lake Chilwa have declined from approximately 15,000 tonnes to about 5,000 tonnes in recent years, partly due to climate stress interacting with overfishing and habitat degradation (Kosamu & Donda, 2013).

Rising water temperatures further compound these pressures by altering dissolved oxygen levels, nutrient cycling, and primary productivity (IPCC, 2022). Climate model projections indicate that surface water temperatures in shallow tropical lakes such as Lake Chilwa may increase by 2.6–4.7°C by the latter half of the 21st century under medium to high emissions scenarios (IPCC, 2014). Such warming, combined with fluctuating water levels, increases the risk of ecosystem collapse, particularly for fisheries (IPBES, 2019).

5.8.2.2 Gendered and social dimensions of vulnerability

Climate-induced declines in fish stocks disproportionately affect women, who dominate fish processing and trading in the Lake Chilwa basin (Ngozo, 2012; Pullanikkatil et al., 2020). Reduced fish availability drives up prices, intensifies competition between fishers and consumers, and erodes women's income opportunities (Kosamu et al., 2012). In response, households diversify into alternative but often environmentally destructive livelihoods such as charcoal production, accelerating deforestation and further degrading wetland catchments (Government of Malawi, 2019).

5.8.2.3 Impacts on agriculture and food security

Wetlands in Malawi function as critical buffers against climate variability by supporting flood-recession and winter cropping (Chiotha, 2014). However, prolonged droughts and unpredictable flooding undermine these ecosystem-based adaptation strategies (IPCC, 2022). In the Lake Chilwa basin, reduced agricultural productivity has increased dependence on fisheries, intensifying pressure on already stressed fish stocks (LCBCCAP, 2012).

The basin is nationally significant, producing approximately 50% of Malawi's rice and contributing an estimated 14% of national fish catches (Government of Malawi, 2019; Kosamu, 2014). Consequently, climate-driven declines in wetland productivity have implications not only for local livelihoods but also for national food security (Government of Malawi, 2021).

5.8.3 Climate change, invasive alien species, and wetland degradation

Climate variability and ecosystem disturbance facilitate the spread of invasive alien species in Malawian wetlands, particularly in floodplain systems such as Elephant Marsh (MRAG, 2017; Wit, 2021). Invasive species such as Prosopis juliflora, Pontederia crassipes (water hyacinth), Pistia stratiotes (water lettuce), Azolla filiculoides, and Salvinia molesta degrade habitats, obstruct waterways, increase evapotranspiration losses, alter water chemistry, and reduce fish breeding grounds (MRAG, 2017).

These invasions undermine ecosystem services by reducing habitat quality for fish, birds, and invertebrates; increasing siltation and nutrient loading; disrupting fisheries, rice cultivation, and navigation; increasing water loss during drought periods (Wit, 2021). Climate change is expected to exacerbate these impacts by creating conditions favourable for invasive species proliferation, particularly during periods of low water levels and high nutrient availability (IPBES, 2019).

5.8.4 Wetlands as climate mitigation systems: carbon storage and sequestration

Wetlands are among the most carbon-dense ecosystems globally, storing carbon in above-ground biomass, below-ground biomass, sediments, and peat (Davidson et al., 2019)Wetlands play a critical role in Malawi's climate change mitigation strategy through their capacity to store and sequester carbon in biomass and waterlogged soils. Wetlands cover approximately 5.7% of Malawi's surface area, including major systems such as Lake Malawi, Lake Chilwa, Lake Malombe, dambos, floodplains, and lacustrine swamps (Government of Malawi, 2021). These ecosystems are among the most carbon-dense landscapes globally due to permanently or seasonally saturated soils that slow organic matter decomposition and promote long-term soil carbon accumulation (IPBES, 2019; Davidson et al., 2019).

In Malawi, papyrus-dominated wetlands play a particularly important role in carbon sequestration (MRAG, 2017). Elephant Marsh alone contains an estimated 32 km² of papyrus vegetation and stores approximately 0.6 million tonnes of carbon across its major vegetation types (MRAG, 2017). Key wetland areas with high carbon storage potential include Lake Chilwa marshes and swamps, Lake Malawi shoreline wetlands, Lake Malombe floodplains, Mpatsanjoka Dambo, and riverine dambos in the Shire and Linthipe basins (CEPA, 2022). Undisturbed wetlands function as net carbon sinks; however, drainage, agricultural conversion, burning, and overexploitation can rapidly reverse this function, releasing stored carbon dioxide and methane into the atmosphere (IPCC, 2022).

Recent national greenhouse gas inventory data indicate that emissions from wetlands in Malawi have increased, rising from 3,763.59 Gg CO -equivalent in 2018 to 3,814.20 Gg CO -equivalent in 2022, suggesting that many wetlands are transitioning from sinks to net emission sources due to degradation (CEPA, 2022; Government of Malawi, 2023). This trend highlights the urgent need for improved wetland protection, restoration, and sustainable management to safeguard carbon stocks.

Although the direct economic incentives for carbon conservation may appear modest at national scale, the social costs of wetland degradation through increased climate vulnerability, food insecurity, and loss of livelihoods are disproportionately high (IPBES, 2019). Protecting wetlands therefore represents a low-cost, high-benefit climate mitigation strategy with strong co-benefits for biodiversity and human well-being.

Wetlands also present emerging opportunities for carbon finance and carbon trading, particularly through nature-based solutions such as wetland restoration, rewetting of degraded dambos, and protection of papyrus swamps. While Malawi's participation in voluntary carbon markets remains limited, wetlands could contribute to future results-based climate finance mechanisms, provided that robust monitoring, reporting, and verification (MRV) systems are established (IPBES, 2019; IPCC, 2022). Compared to engineered mitigation options, wetland conservation represents a low-cost mitigation pathway with strong co-benefits for biodiversity conservation, water regulation, flood control, and livelihood resilience.

In the context of Malawi's Nationally Determined Contributions (NDCs), wetlands can directly support mitigation targets by reducing land-use emissions and enhancing carbon sinks, while simultaneously strengthening adaptation through ecosystem-based approaches. Integrating wetlands explicitly into NDC implementation through land-use planning, catchment restoration, and climate finance strategies would enhance Malawi's capacity to meet its climate commitments while advancing national development and biodiversity objectives (Government of Malawi, 2021).

5.8.5 Wetlands as natural infrastructure for climate adaptation and resilience

Wetlands provide regulating ecosystem services that are critical for climate adaptation, including flood attenuation, reducing peak flows during extreme rainfall events; sediment retention, maintaining river and lake depth and water quality; water storage, sustaining base flows during dry periods (IPBES, 2019; Chiotha, 2014).

In Elephant Marsh, flood regulation services are estimated to reduce annual flood damages by approximately US$3.3 million, while sediment retention services may be valued at over US$250 million per year (MRAG, 2017). Similar functions are performed by wetlands surrounding Lake Chilwa and Lake Chiuta, underscoring their importance as natural infrastructure (Government of Malawi, 2021).

4.8.6 Ecosystem-based adaptation and livelihood resilience

Wetland-based livelihood strategies such as winter cropping, flood-recession agriculture, and integrated agriculture and aquaculture systems constitute key forms of ecosystem-based adaptation in Malawi (Chiotha, 2014; IPBES, 2019). However, without sustainable management, these practices can degrade wetlands and undermine long-term resilience (Pullanikkatil et al., 2020).

When Lake Chilwa dries, fisheries and agriculture collapse, and communities often resort to coping strategies such as intensified bird hunting and charcoal production (Ngozo, 2012). Recovery of fisheries can take up to five years, during which pressure on biodiversity remains high (Kosamu et al., 2012). Strengthening wetland governance, protecting catchments, and supporting diversified, climate-resilient livelihoods are therefore essential for reducing vulnerability (Government of Malawi, 2021).

5.8.7 Policy response options

Climate change acts as a direct driver, while poverty, population pressure, and weak governance function as indirect drivers that amplify wetland degradation (IPBES, 2019). Effective responses will require Integration of wetlands into national climate adaptation and mitigation strategies; recognition of wetlands as nature-based solutions for disaster risk reduction; investment in catchment restoration and sustainable fisheries management; strengthening early warning systems and climate information services; aligning wetland conservation with food security, gender equity, and poverty reduction objectives.

Safeguarding Malawi's wetlands under climate change is therefore not only an environmental imperative but a cornerstone of national resilience, sustainable development, and long-term human well-being.

CHAPTER 6

THE INTERLINKAGES BETWEEN TERRESTRIAL, AQUATIC AND WETLAND ECOSYSTEMS IN MALAWI

CHAPTER 6 - THE INTERLINKAGES BETWEEN TERRESTRIAL, AQUATIC AND WETLAND ECOSYSTEMS IN MALAWI

6.1 Introduction

The ecosystems that have been assessed in this evaluation, specifically terrestrial, aquatic, and wetland, are intricately connected, forming a complex web of relationships that support biodiversity, ecosystem services, and sustain human wellbeing. The nexus of these ecosystems refers to the interactions between them, how they impact each other, and how changes in one can have ripple effects on the others. Understanding these connections is vial for biodiversity conservation, sustainable resource management, and climate change adaptation in Malawi. This chapter critically examines the evidence of interlinkages among terrestrial, aquatic and wetland ecosystems in Malawi focusing on key elements of the nexus such as biodiversity, water availability, food security and human health. The chapter also assesses the existing knowledge of cross cutting drivers of biodiversity loss such as climate change and invasive alien species in these three ecosystems including how challenges in one ecosystem type can affect elements in the other ecosystems is evaluated.

Another element that the chapter has considered though not included in Figure 6.1 is governance. Existing governance systems for the management of terrestrial, aquatic and wetland ecosystems at all levels have been evaluated. ILK practices have been integrated to complement the scientific knowledge of the nexus.

Key Concepts and Definitions

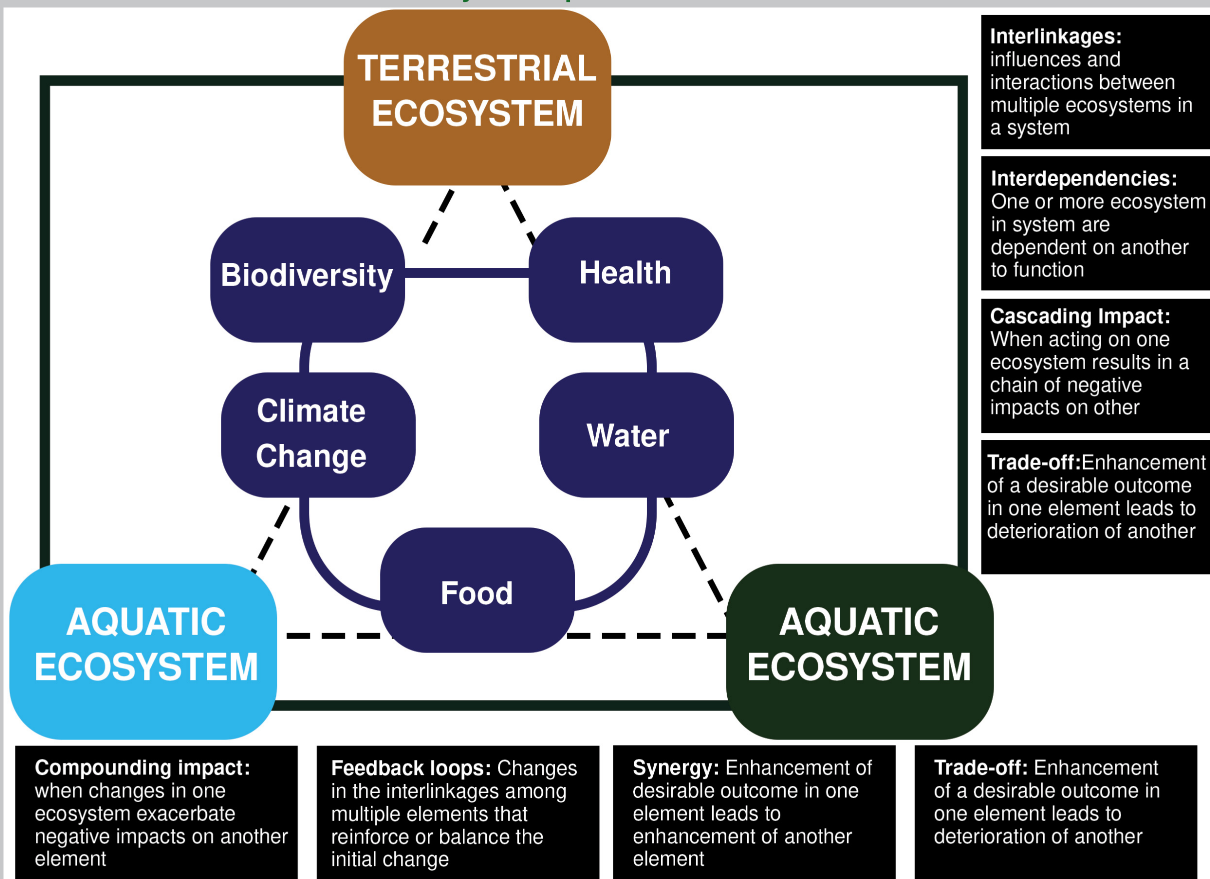


Figure 6-1: Holistic analysis of sectoral interlinkages to enhance integrated and adaptive decision-making

KEY

—— solid line represents interactions amongst ecosystems

----- dotted line represents elements affected with changes in ecosystems.

Nexus approach: Understanding the interlinkages and interdependencies between sectors and systems in a holistic manner to develop integrated and adaptive decisions that aim to maximize synergies and minimize trade-offs.

Siloed approaches: Addressing issues in isolation and without regard for interlinkages, resulting in potential misalignment, unintended consequences or trade-offs.

6.1.3 Human Rights-Based Approach in Biodiversity Conservation in Malawi: Compendium case study

Background and Objective

This case study assesses the application of a Human Rights-Based Approach (HRBA) in biodiversity conservation across six communities in Malawi: Khulubvi (Nsanje), Navingozi and Mbenje Island (Salima), Kazuni (Mzimba), Zolokele (Rumphi), and Kalambwe (Nkhatabay). The assessment aims to generate evidence that strengthens rights-based, participatory, and inclusive governance of natural resources at community and national levels, as part of the Malawi National Ecosystem Assessment (NEA).

Methodology

The study employed three complementary methods: (1) a desk review of 14 national policies, legislative frameworks, and district development plans; (2) qualitative community dialogues (focus group discussions) and key informant interviews with rights-holders and duty-bearers; and (3) a multi-stakeholder validation dialogue to review and refine preliminary findings.

Key Findings

Policy Framework: Desk review revealed that accountability, non-discrimination, and participation are widely mainstreamed in policy documents. However, Free, Prior and Informed Consent (FPIC) was referenced in only four of 14 documents, indicating a critical governance gap for community self-determination over lands and resources.

Community Realities: Communities possess strong practical understanding of environmental rights viewing them as rights to sustainable resource use and protection from environmental dangers, particularly human-wildlife conflict. However, application of HRBA principles remains inconsistent:

- Participation varies widely: some communities demonstrate strong self-governance through local by-laws (Salima, Nsanje), while others feel systematically excluded from decision-making (Zolokele).

- Equality and non-discrimination face significant hurdles. A critical gap is non-recognition of cultural rights, including denial of access to ancestral graveyards for cultural rites. Benefit-sharing often follows a contributory model that indirectly discriminates against those unable to participate in labor-intensive activities, including persons with disabilities, women with caregiving responsibilities, and the elderly.

- Transparency and accountability are weak at formal governance levels. Communities lack information on park revenues, project decisions, and policies. While local accountability structures (chiefs, VDCs) are trusted, formal grievance mechanisms are slow, unresponsive, or non-existent—particularly for human-wildlife conflict compensation.

Recommendations

To bridge the gap between policy and practice, the following actions are recommended:

1. Institutionalize meaningful participation by shifting from top-down to bottom-up governance, including community representatives in all planning forums.

2. Strengthen FPIC practice through national guidelines ensuring genuine community consultation and consent before project implementation.

3. Improve transparency using accessible platforms (community radio, SMS alerts) for sharing information in local languages.

4. Enhance accountability and access to justice through accessible grievance mechanisms and timely, fair compensation for human-wildlife conflict.

5. Promote equity and cultural rights by ensuring benefit-sharing accounts for differing capacities to participate, and mandating recognition of cultural rights including access to sacred sites.

6. Link conservation to livelihoods by integrating livelihood incentives (beekeeping, ecotourism) into conservation plans.

Conclusion

Communities across Malawi are motivated and active stewards of biodiversity, yet their potential is undermined by systemic governance challenges. HRBA is understood in principle but not yet fully operationalized in practice. The lack of FPIC, persistent top-down management, weak accountability, and disregard for cultural rights hinder equitable and sustainable conservation outcomes. Addressing these gaps is essential for building a conservation model that is both effective in protecting biodiversity and respectful of the rights and dignity of local communities.

6.2 Past and present nexus interactions

Table 6-1: Past and Present Nexus Interactions: Aquatic, Terrestrial, and Wetlands Ecosystem

Interaction Aspect	Past Nexus Interactions	Present Nexus Interactions
Hydrological Cycles	Natural river-wetland-terrestrial connectivity regulated water flow and reduced extreme floods or droughts	Damas, irrigation, and urbanization have altered water flows, leading to wetland drying and increased flooding. Also, the fragmentation of landscapes due to human activities alters hydrological cycles, affecting groundwater recharge and increasing the risk of floods and droughts.
Land use and Habitat	Traditional practices which included shifting cultivation, and seasonal wetland use) maintained the balance among terrestrial, aquatic, and wetlands ecosystems	Intensive agriculture, deforestation, and urbanization have disrupted ecosystem connectivity and habitat integrity. Also, infrastructure development on wetlands has further degraded these critical ecosystems, affecting their ecological functions and biodiversity.
Nutrient flow and Soil Health	Natural nutrient cycling from wetlands, aquatic to terrestrial systems enriched soils and supported biodiversity	Agricultural runoff and pollution lead to eutrophication in water bodies, degrading soil quality and aquatic health, while deforestation reduces soil stability, leading to increased sedimentation in rivers and wetlands. The loss of wetland buffers due to land conversion disrupts natural water filtration process, exacerbating water pollution and reducing habitat availability for aquatic species.
Biodiversity Exchange	Migratory species (birds, amphibians), historically moved freely across interconnected ecosystems, playing a crucial role in maintaining ecological balance and genetic diversity. For example, at the Lake Chilwa Ramsar site, seasonal migrations facilitated nutrient cycling, seed dispersal, and predator-prey dynamics across terrestrial, wetland, and aquatic habitats.	Habitat fragmentation, climate change, human induced disturbances such as pollution have increasingly disrupted these natural movements, threatening biodiversity and ecosystem resilience.
Human Impact and Management	ILK -based practices have long played a crucial role in ensuring the sustainable use of natural resources. Traditional land management techniques, such as shifting cultivation, agroforestry, and seasonal wetland use, helped maintain ecosystem balance while preserving soil fertility and water resources. Customary laws and community-led conservation practices regulated harvesting, protected sacred forests, and maintained fish breeding grounds, ensuring resource availability for future generations.	Initiatives of integrating Indigenous and local knowledge in modern conservation efforts are being done which encompass a range of strategies, including ecological restoration, reforestation, and wetland protection initiatives, aimed at reversing environmental degradation and enhancing ecosystem resilience.

6.3 Responce actions that adress the nexus interactions

Addressing the interconnections of terrestrial, Aquatic, and wetlands ecosystems needs a holistic integrated approach that will acknowledge the existing complex, interconnected nature. These ecosystems are not isolated, but they interact with each other in a variety of ways that influence biodiversity and ecosystem services. To manage these interactions effectively, and ensure the sustainability of these ecosystems, several response options can be considered

Table 6-2: Response Actions that Address the Nexus Interactions

NEXUS INTERACTION	RESPONSE OPTION
Hydrological Cycles	Restoration of connectivity through reestablishing the natural flow of rivers through measures like dam removal or the creation of wildlife corridors which can help reconnect aquatic, wetlands, and terrestrial ecosystems. This will improve groundwater recharge, mitigate flood risks, and support water availability for communities, agriculture, and biodiversity.
	Devise water management innovations by implementing integrated water management practices that account for ecosystem connectivity, such as floodplain restoration and sustainable irrigation, which can enhance resilience to extreme weather events and ensure equitable access to water for agriculture, drinking, and ecosystem services.
	Promoting policy integration to ensure that water management policies incorporate ecosystem-based approaches to protect wetlands and flood plains. This will help restore natural hydrological cycles and maintain water quality, benefiting both human health and biodiversity.
Land use and habitat	Promoting sustainable land-use practices like agroforestry, sustainable agriculture, and land-use zoning that protects critical ecosystems such as wetlands and riparian zones will help restore habitat connectivity, improve soil health, and enhance biodiversity. These practices also support food security by increasing crop resilience to climate change.
	Implementing sustainable land-use practices like agroforestry, sustainable agriculture, and land-use zoning that protects critical ecosystems such as wetlands and riparian zones will help restore habitat connectivity, improve soil health, and enhance biodiversity. These practices also support food security by increasing crop resilience to climate change.
	Mainstreaming ILK by leveraging traditional land management practices, which have historically maintained ecosystem balance, can be incorporated into modern conservation approaches. These methods are not only effective for maintaining biodiversity but also help enhance community resilience to climate change and improve food security.
Nutrient Flow and Soil Health	Agroecological and soil conservation will enhance sustainable farming practices that reduce nutrient runoff, such as no-till farming, cover cropping, and organic farming, which can mitigate nutrient pollution, restore soil health, and improve water quality, benefiting both ecosystems and human health.
	Wetland protection and restoration can protect and restore wetlands and can enhance their role in water filtration, reducing nutrient loading in aquatic systems, improving soil fertility, and preventing waterborne diseases. Wetlands also support biodiversity by providing habitats for a range of species.

Table 6-2 Conti.: Response Actions that Address the Nexus Interactions

NEXUS INTERACTION	RESPONSE OPTION
Nutrient Flow and Soil Health	Integrating nutrient management by developing integrated nutrient management plans that will link agricultural practices with watershed management can help minimize nutrient pollution, enhance ecosystem function, and improve food production while safeguarding water and soil health.
Biodiversity Exchange	Establishing wildlife corridors and protected areas that link terrestrial, aquatic, and wetlands habitats will help facilitate the movement of species and restore migratory routes. This will enhance biodiversity and ecosystem resilience, supporting both food security through healthy ecosystems and human health through ecosystem services like clean water and air.
	Empowering local communities to protect key biodiversity areas and species through community-led conservation programs can help maintain biodiversity exchange across ecosystems. These programs also promote health by safeguarding natural resources that communities rely on for food, water, and medicinal plants.
	Developing climate-smart conservation strategies that account for climate change impacts on species migration and ecosystem connectivity will help adapt to shifting biodiversity patterns. This approach also supports climate resilience, ensuring food security and public health by preventing the collapse of critical ecosystem services.
Climate Regulation	Promoting Ecosystem-based Climate Adaptation by restoring wetlands and forests for their role in carbon sequestration and climate regulation can help mitigate climate change impacts, such as temperature extremes, floods, and droughts. These efforts also reduce greenhouse gas emissions, contributing to better health outcomes by reducing climate-induced diseases and improving food security.
	Integrating Carbon Management by combining forest management, wetland restoration, and sustainable agriculture practices into carbon management strategies can enhance the capacity of ecosystems to act as carbon sinks. This approach also reduces environmental health risks, such as air pollution and water contamination, associated with deforestation and wetland degradation.
	Develop Climate resilience planning by incorporating climate adaptation into ecosystem management frameworks, such as floodplain restoration and watershed management, will reduce vulnerability to extreme weather events and support public health by preventing water and food shortages.
Human Impact Management	Implementing co-management approaches by promoting co-management frameworks that mainstream ILK with scientific expertise will strengthen conservation efforts, enhance biodiversity, and improve human well-being. This approach ensures sustainable resource use and better health outcomes through improved ecosystem services.
	Conduct capacity building by providing training and support for local communities and conservation practitioners to implement traditional and modern management practices will improve ecosystem resilience, restore biodiversity, and support sustainable food systems. It will also reduce health risks by promoting cleaner environments and better sanitation.
	Provide policy support for traditional practices by advocating for policies that recognize and protect Indigenous people and Local Communities rights can enhance the sustainability of conservation efforts. Policies that integrate these traditional practices into ecosystem management frameworks will foster more resilient ecosystems that provide food, water, and health benefits to communities.

Addressing the interconnections between Terrestrial, aquatic, and wetlands ecosystems needs a comprehensive approach that includes biodiversity conservation, water management, climate change mitigation, food security, and public health considerations. By restoring ecosystem connectivity, promoting sustainable land use practices, and integrating ILK , we can enhance ecosystem resilience, mitigate climate impacts, and secure critical resources for communities. These response options will protect the ecosystem, enhance food security, and support human health, and overall well-being.

6.4 Governance in the Nexus

Natural resources governance interlinkages in terrestrial, aquatic, and wetland ecosystems is critical for maintaining biodiversity, water quality, and overall ecosystem health. These ecosystems are interdependent, with changes in one often affecting the others. Effective governance must, therefore, recognize the complex connections between them and promote coordinated management. This section provides an outline of how governance interlinkages manifest across these ecosystems in Malawi through policies and laws governing these ecosystems. **Table 6.1** shows key legislation and policies for the three ecosystems in Malawi.

Table 6-3: Showing Legal Instruments for governing Natural Resources in Different Ecosystems

Ecosystem	Acts	Policies
Terrestrial	National Forestry Act of 2019 Local Government Act of 2017. National Parks and Wildlife Amendment Act of 2017 Environment Management Act (EMA) of 2017 Republic of Malawi (Constitution) of 1995, National Herbarium and Botanic Gardens Act of 2014 Water Resources Act of 2013	National Forestry Policy of 2016 Wildlife Policy of 2018 National Land Resources Management Policy and Strategy of 2002 Energy Policy of 2018 National Environmental Policy (NEP) of 2004
Aquatic	Fisheries Conservation and Management Act of 2014 Water Resources Act of 2013 Republic of Malawi (Constitution) of 1995,	National Fisheries and Aquaculture Policy of 2016 Irrigation Policy of 2016
Wetland	Water Resources Act of 2013 Fisheries Conservation and Management Act of 2014 National Parks and Wildlife Amendment Act of 2017 Republic of Malawi (Constitution) of 1995,	Irrigation Policy of 2016 National Fisheries and Aquaculture Policy of 2016

6.4.1 ENRM Policy Analysis

Pieces of legislation in the environment and natural resources (ENR) sectors have been reviewed to assess their connectivity in addressing common challenges of biodiversity loss, food insecurity, water availability and quality and sound human health in terrestrial, aquatic and wetland ecosystems. The Environment Management Act (EMA) of 2017 provides a broad framework for environmental governance and is considered as an overarching law such that any inconsistent provisions in other written laws are considered invalid to the extent of the inconsistency.

The EMA of 2017 has a broad spectrum, it has provisions that provide for conservation and sustainable use of biodiversity in terrestrial, aquatic and wetland ecosystems. It provides for regulations for use of wetlands and management of rivers and lakes under the aquatic ecosystem and management of invasive alien species cutting across all the ecosystems. Effective implementation of EMA 2017, enhances the nexus approach in addressing all the key elements of water availability and quality, biodiversity conservation, food security and improved human health. The EMA will therefore be used as a basis of comparison for the selected ENRM pieces of legislation and governance of the nexus ecosystems.

While both the EMA and National Parks and Wildlife Act (NPWA) contribute significantly to management and sustainable use of natural resources, the NPWA focuses on the sustainable management and conservation of wildlife and protected areas. Both acts emphasize the importance of sustainable resource use, requiring Environmental Impact Assessments (EIAs) for developments that might affect wildlife habitats, and aim to prevent illegal wildlife exploitation through stricter regulations on poaching and trade. They also promote coordinated governance, with the EMA and NPWA creating complementary institutional frameworks in the Environmental Affairs Department and Department of National Park and Wildlife. Furthermore, both acts acknowledge the impacts of climate change and stress the importance of public awareness and community participation in ensuring long-term environmental sustainability.

The Malawi Public Health Act focuses on infection prevention and management, its linkages with the Environment Management Act of 2017 is not clearly spelt out. The Health Act provide for the need for collaboration with Local Government in areas of sanitation to prevent nuisance including water-borne diseases. The Law also regulate building including sitting of pit latrine in relation to water supply for human consumption (sec 76 Health Public Act) which is closely related to the Water Management Act.

While the EMA focuses on overall environmental protection, the Fisheries Conservation and Management Act (FCMA) specifically targets the management and conservation of fisheries resources. However, the two acts are highly interconnected in terms of their shared objectives of sustainability, ecosystem management, and resource conservation. Both acts work in tandem to prevent pollution and maintain water quality, with the EMA addressing broader environmental concerns, while the FCMA targets pollution that directly affects aquatic life and fisheries sustainability. The EMA's EIA process directly influences the FCMA by ensuring that any development or activity that might negatively impact fisheries or aquatic ecosystems undergoes thorough environmental evaluation and mitigation measures to protect fish habitats. Both pieces of legislation promote an ecosystem-based approach, with the EMA ensuring that environmental management considers all ecosystems holistically, while the FCMA specifically addresses the health of aquatic ecosystems critical to fisheries.

The Environment Management Act (EMA) of 2017 and the Water Resources Act (WRA) of 2013 are both critical for sustainable resource management in Malawi. While the EMA provides a comprehensive framework for environmental governance, including pollution control, conservation, and sustainable development, the WRA focuses specifically on the management, use, and protection of water resources. Both acts aim to ensure the sustainable use of resources, with the EMA addressing broader environmental issues and the WRA focusing on water-related concerns.

They complement each other in regulating pollution control, water quality, and conducting Environmental Impact Assessments (EIAs) for projects affecting water. The EMA also supports climate change adaptation and resource governance, while the WRA governs water allocation and the protection of aquatic ecosystems. Both acts emphasize community involvement and coordination between institutional frameworks, ensuring effective governance and management of natural resources, including water. Together, they ensure that water resources are managed sustainably, equitably, and in line with environmental protection goals.

The EMA of 2017 and the National Land Resources Management Policy (NLRMP) of 2002 in Malawi work together to promote sustainable resource management, environmental protection, and climate change resilience. The EMA provides a broad framework for managing and conserving natural resources, including pollution control, while the NLRMP focuses on sustainable land use, soil conservation, and land tenure security. Both policies advocate for integrated planning, emphasizing the need for coordinated land and environmental governance. They recognize the importance of climate change adaptation, public participation, and institutional coordination. Additionally, both policies aim to prevent land degradation and promote conservation practices, such as agroforestry, to protect natural resources. By addressing land and water conservation, these policies create a cohesive approach to sustainable development and environmental resilience in Malawi.

The National Land Resources Management Policy (NLRMP) of 2002 and the Irrigation Policy of 2016 in Malawi are both focused on sustainable agricultural development, with interconnected goals. The NLRMP emphasizes the sustainable management of land resources, including soil conservation and land use planning, while the Irrigation Policy focuses specifically on the sustainable use of water resources for irrigation to enhance agricultural productivity. Both policies aim to improve food security, increase agricultural productivity, and build climate change resilience through integrated land and water management. They stress the importance of secure land tenure, capacity building, and infrastructure development, with the NLRMP promoting land conservation and the Irrigation Policy ensuring efficient water use to prevent environmental degradation. Together, they advocate for a holistic approach to resource management, ensuring both land and water are managed sustainably for long-term agricultural and environmental benefits.

6.4.2 Effectiveness of Current Governance Systems in the Nexus Ecosystems

The governance system for natural resource management in Malawi, which includes terrestrial, wetland, and aquatic ecosystems, faces several challenges, though it has some strengths. Institutions like the Forestry Department, the Department of Fisheries, and others guide resource management, but fragmented institutional structures and poor coordination often result in conflicting policies, especially between land-use and conservation goals. Enforcement remains weak due to inadequate resources, insufficient monitoring, and corruption, undermining the implementation of key policies. Despite efforts to involve communities through programs like Community-Based Natural Resource Management and Participatory Land Use Planning, stakeholder engagement is inconsistent, with local communities sometimes feeling disconnected from decision-making processes. The unsustainable exploitation of resources, such as deforestation and wetland drainage, continues to threaten ecosystem services, while climate change further complicates resource management through water scarcity and shifting agricultural patterns. The system has made strides in integrating climate change adaptation strategies, but the effectiveness of governance is limited by the lack of coordination between climate and natural resource management policies. Overall, the governance system is partially effective, but for greater positive impacts, integrated management, stronger enforcement, better inter-agency collaboration, and more active community participation are crucial for ensuring the sustainability of these ecosystems. The EMA 2017 which contain provisions that governs all the ecosystem types provides an opportunity for effective collaboration that can enhance inclusive and holistic approach to natural resource management with stronger positive impacts across all the nexus elements of biodiversity, food security, water health, and climate change.'

6.5 Future Nexus Interactions (Scenarios)

To enhance clarity, analytical rigor, and policy relevance, this section presents both a summarized scenarios and detailed scenario narratives. The scenario tables provides a concise synthesis of the key drivers, axes, and defining characteristics of each scenario, enabling comparison across alternative futures and supporting rapid understanding by policymakers and technical audiences. The accompanying narratives complement the table by elaborating plausible ecosystem trajectories, causal pathways, and implications for biodiversity, ecosystem services, livelihoods, and governance. This combined approach reflects best practice in national and global ecosystem assessments, including IPBES assessments, and supports a Multiple Evidence Base by weaving scientific analysis with ILK and stakeholder perspectives. Together, the table and narratives strengthen the interpretability, transparency, and usability of the scenarios for decision-making and long-term planning. The scenarios were developed through a participatory process using the DPSIR framework, engaging all authors from all technical working groups to identify key drivers, pressures, states, impacts, and response options relevant to Malawi's ecosystems. Drivers were ranked according to importance and uncertainty, and the two most influential drivers were combined to generate four plausible future scenarios. This process ensured that the scenarios reflect co-produced knowledge and diverse perspectives, including ILK.

6.5.1 Aquatic Ecosystem Scenarios

The aquatic ecosystem scenarios were developed through a participatory DPSIR-based process, identifying governance quality and socio-economic conditions as the two most influential and uncertain drivers shaping future aquatic ecosystem trajectories in Malawi. The resulting four scenarios reflect plausible futures for lakes, rivers, and fisheries systems.

6.5.1.1 Scenario 1: Mkaka ndi Uchi (Milk and Honey) – Abundance

(Good Governance and Good Socio-economic Conditions)

This scenario represents an optimistic future in which strong governance systems operate alongside improved socio-economic conditions. Robust regulatory frameworks, participatory decision-making processes, transparency, and accountability support effective aquatic resource management. Co-production of knowledge, environmental education, and the meaningful integration of ILK strengthen co-management arrangements and foster cultural revival related to aquatic ecosystems.

Under this scenario, aquatic biodiversity increases, fish biomass recovers, and ecosystem services such as clean water provision and sustainable fish supply are enhanced. Improved livelihoods, reduced poverty levels, and stronger social cohesion reduce pressure on aquatic resources. Communities are empowered to adopt sustainable practices, reinforcing a positive feedback loop between ecosystem health and human well-being.

6.5.1.2 Scenario 2: Chonchobe (Better, but Not Good Enough)

(Good Governance and Poor Socio-economic Conditions)

Chonchobe describes a future where governance structures are relatively strong, but socio-economic challenges persist. Regulatory systems and participatory governance mechanisms exist, yet poverty, limited alternative livelihoods, and low access to education constrain the ability of communities to fully engage in sustainable resource use.

Despite the presence of sound policies, pressures such as overexploitation of fish resources, pollution, and uneven access to benefits continue. Aquatic ecosystems may appear productive in the short term, but underlying social vulnerabilities create risks of gradual degradation. This scenario highlights that good governance alone is insufficient if not accompanied by broad-based socio-economic development.

6.5.1.3 Scenario 3: Chiyembekezo (Hope)

(Poor Governance and Good Socio-economic Conditions)

In this scenario, economic growth and improved living standards occur in the context of weak governance. Communities may enjoy better access to income, education, and healthcare, but weak law enforcement, corruption, and limited accountability undermine sustainable aquatic ecosystem management.

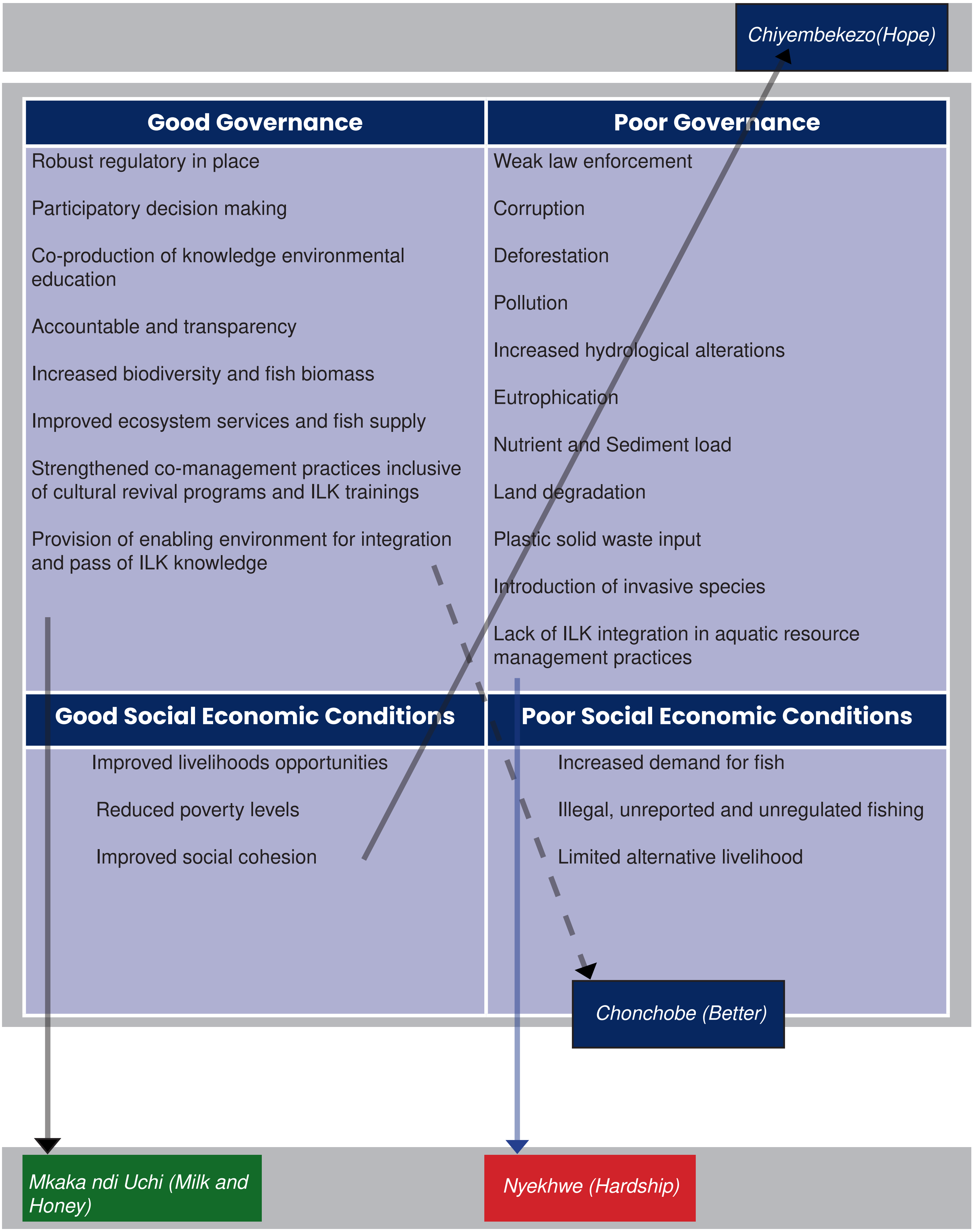
Industrial activities, urban expansion, deforestation, and pollution intensify pressures on aquatic systems, leading to eutrophication, increased sediment and nutrient loading, plastic waste accumulation, and habitat alteration. Although economic conditions provide short-term benefits, the absence of effective governance and limited inclusion of ILK increase the risk of long-term ecosystem decline. The “hope” embedded in this scenario lies in the potential for governance reforms to redirect development pathways toward sustainability.

6.5.1.4 Scenario 4: Nyekhwe (Hardship)

(Poor Governance and Poor Socio-economic Conditions)

Nyekhwe represents the most challenging future, characterized by weak governance and persistent socio-economic hardship. Poor law enforcement, corruption, and limited institutional capacity lead to unmanaged resource extraction, land degradation, invasive species introduction, and severe aquatic pollution.

Declining fish stocks, degraded water quality, and reduced ecosystem services exacerbate food insecurity, health risks, and poverty. Limited access to education and alternative livelihoods further entrenches unsustainable practices. This scenario illustrates a reinforcing cycle of environmental degradation and social vulnerability, emphasizing the urgent need for transformative governance and development interventions.


Chiyembekezo(Hope)
Good Governance
Robust regulatory in place
Participatory decision making
Co-production of knowledge environmental education
Accountable and transparency
Increased biodiversity and fish biomass
Improved ecosystem services and fish supply
Strengthened co-management practices inclusive of cultural revival programs and ILK trainings
Provision of enabling environment for integration and pass of ILK knowledge
Poor Governance
Weak law enforcement
Corruption
Deforestation
Pollution
Increased hydrological alterations
Eutrophication
Nutrient and Sediment load
Land degradation
Plastic solid waste input
Introduction of invasive species
Lack of ILK integration in aquatic resource management practices
Good Social Economic Conditions
Improved livelihoods opportunities
Reduced poverty levels
Improved social cohesion
Poor Social Economic Conditions
Increased demand for fish
Illegal, unreported and unregulated fishing
Limited alternative livelihood
Chonchobe (Better)
Mkaka ndi Uchi (Milk and Honey)
Nyekhwe (Hardship)

Scenario	Descriptor	Pictorial View	Explanation of the pictorial view
Good Governance and Good Social economic conditions	***Mkaka ndi Uchi (Milk and Honey)*.** The metaphor is associated with abundance). Good Governance with respect to robust regulations, participatory decision making, co-production of knowledge, environmental education and accountability and transparency with Good Social economic conditions will lead to vibrant ecosystems, support to biodiversity increase, provide clean water, and offer resources essential for livelihoods, while healthy economic conditions ensure access to education, healthcare, and sustainable practices.		The symbol showcases aquatic system characterized by aquatic flora and fauna, as well as prosperity and favorable economic status.
Good Governance and Poor Social economic conditions	***Chonchobe.*** Despite the strong governance systems leading to abundance of natural wealth, factors like resource exploitation, pollution, and lack of education hinder sustainable practices, leading to a cycle of degradation.		This symbol shows flourish aquatic ecosystem with disparity in living standards

Scenario	Descriptor	Pictorial View	Explanation of the pictorial view
Poor Governance and Good Social economic condition	***Chiyembekezo (Hope)***. Economic growth and development occur at the expense of environmental integrity. In such cases, industrial activities, urban expansion, and resource extraction may lead to habitat alterations and destruction, pollution, and biodiversity loss, if this is coupled by Poor Governance which is characterized by weak law enforcement and corruption; though communities may enjoy access to wealth, education, and healthcare.		This symbol showcases poor aquatic conditions campaigned by pollution, in a community thriving in social and economic wellbeing
Poor Governance and Poor Social economic conditions	***Nyekhwe (Hardship)***. A cycle of vulnerability that severely impacts both the environment and community well-being. In such scenarios, Poor Governance which is characterized by weak law enforcement and corruption may lead to degraded ecosystems and diminished natural resources, food insecurity, and health problems, while economic hardship limits access to education and sustainable practices.		This symbol depicts the worst case whereby there is poor aquatic health such as pollution as well as poor living conditions.

6.5.2 Terrestrial Ecosystem Scenarios

Terrestrial ecosystem scenarios explore the interaction between environmental health and governance effectiveness, reflecting land-use change, forest management, and resilience-building pathways.

6.5.2.1 Ngambwingambwi (Abundance) – Good Environmental Health and Good Governance

This scenario depicts a future where effective governance supports environmental restoration, sustainable land management, and resilience. Environmental education, forest and land restoration, and co-production of knowledge enhance ecosystem health. Wildlife populations recover, vegetation thrives, and ecosystem services are sustained, contributing to national development and community well-being.

6.5.2.2 Nkhasako (Average) – Poor Environmental Health and Good Governance

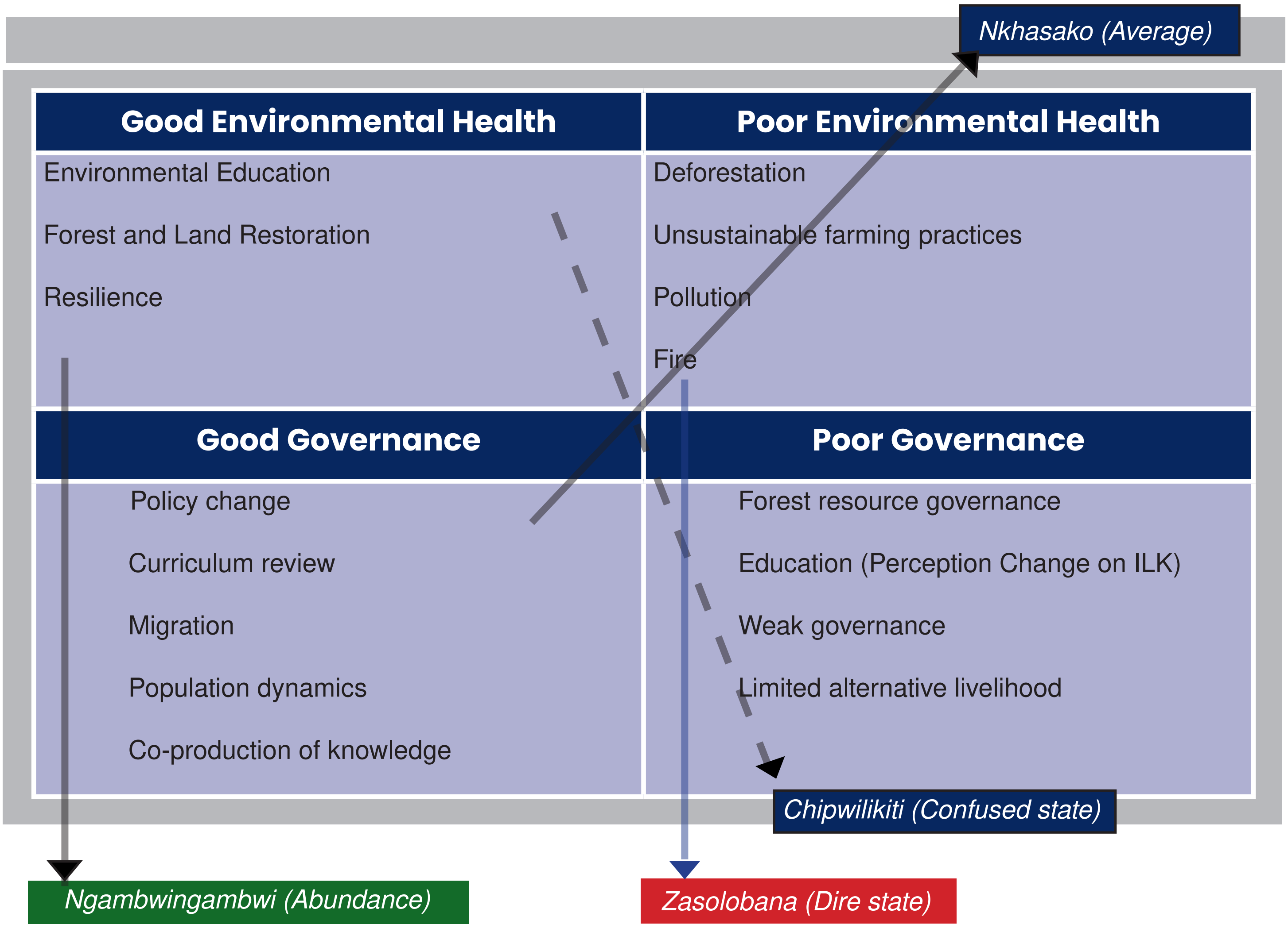
Nkhasako reflects a mixed outcome where strong governance exists, but environmental degradation persists due to historical land-use pressures, pollution, and climate stressors. While institutions attempt to address degradation through policy reforms and restoration initiatives, ecosystem recovery is slow, resulting in moderate ecological and socio-economic outcomes.

6.5.2.3 Chipwirikiti (Confused State) – Good Environmental Health and Poor Governance

In this scenario, ecosystems remain relatively healthy due to strong community stewardship, favorable natural conditions, or cultural conservation practices, despite weak governance. However, the absence of effective institutions creates uncertainty, leaving ecosystems vulnerable to future shocks and unregulated exploitation.

6.5.2.4 Zasolobana (Dire State) – Poor Environmental Health and Poor Governance

Zasolobana describes a reinforcing cycle of governance failure and environmental collapse. Unsustainable farming practices, deforestation, pollution, and fire degrade terrestrial ecosystems, while weak institutions are unable to reverse these trends. Livelihood insecurity and ecosystem loss intensify vulnerability at local and national levels.



Scenario	Descriptor	Pictorial View	Explanation of the pictorial view
Good Environmental state and Good Governance	***Ngambwingambwi (Abundance).*** This scenario illustrates the positive relationship between effective governance and environmental health.		This scene brings to life a thriving African terrestrial ecosystem: healthy wildlife, lush vegetation, and a confident park ranger standing on a winding path that leads to a well-maintained government building.
Poor Environmental state and Good Governance	***Nkhasako (Average).*** This scenario explores the relationship between environmental degradation and the effectiveness of governance.		This scene captures a powerful contrast: a dry, degraded savannah landscape with polluted water and barren trees, yet anchored by visible signs of strong governance.
Good Environmental state and Poor Governance	***Chipwilikiti (Confused state)*.** This scenario depicts regions enjoy a healthy environment despite ineffective governance. This can result from factors like strong community stewardship or favorable natural conditions		The symbol showcases nature flourishing in an African terrestrial ecosystem, while signs of poor governance linger in the background.
Poor Environmental state and poor Governance	***Zasolobana (Dire state)*.** This scenario examines the detrimental cycle where ineffective governance exacerbates environmental degradation		The symbol indicate terrestrial ecosystem suffering under the weight of environmental degradation and failed governance.

6.5.3 Wetland Ecosystem Scenarios

Wetland scenarios are shaped by governance and socio-economic conditions interacting with environmental and climate change dynamics.

6.5.3.1 Scenario 1: Diu Diu – Thriving Harmony
(Good Governance, Good Socio-economic Conditions, and Positive Environmental/Climate Conditions)

This scenario envisions well-managed wetlands where policy integration, research, gender inclusion, and community stewardship support conservation and sustainable livelihoods. Wetlands provide ecosystem services while supporting vibrant local economies.

6.5.3.2 Scenario 2: Mmwemo (Chaos) – Social Resilience, Ecological Strain
(Good Governance and Socio-economic Conditions, Poor Environmental/Climate Conditions)

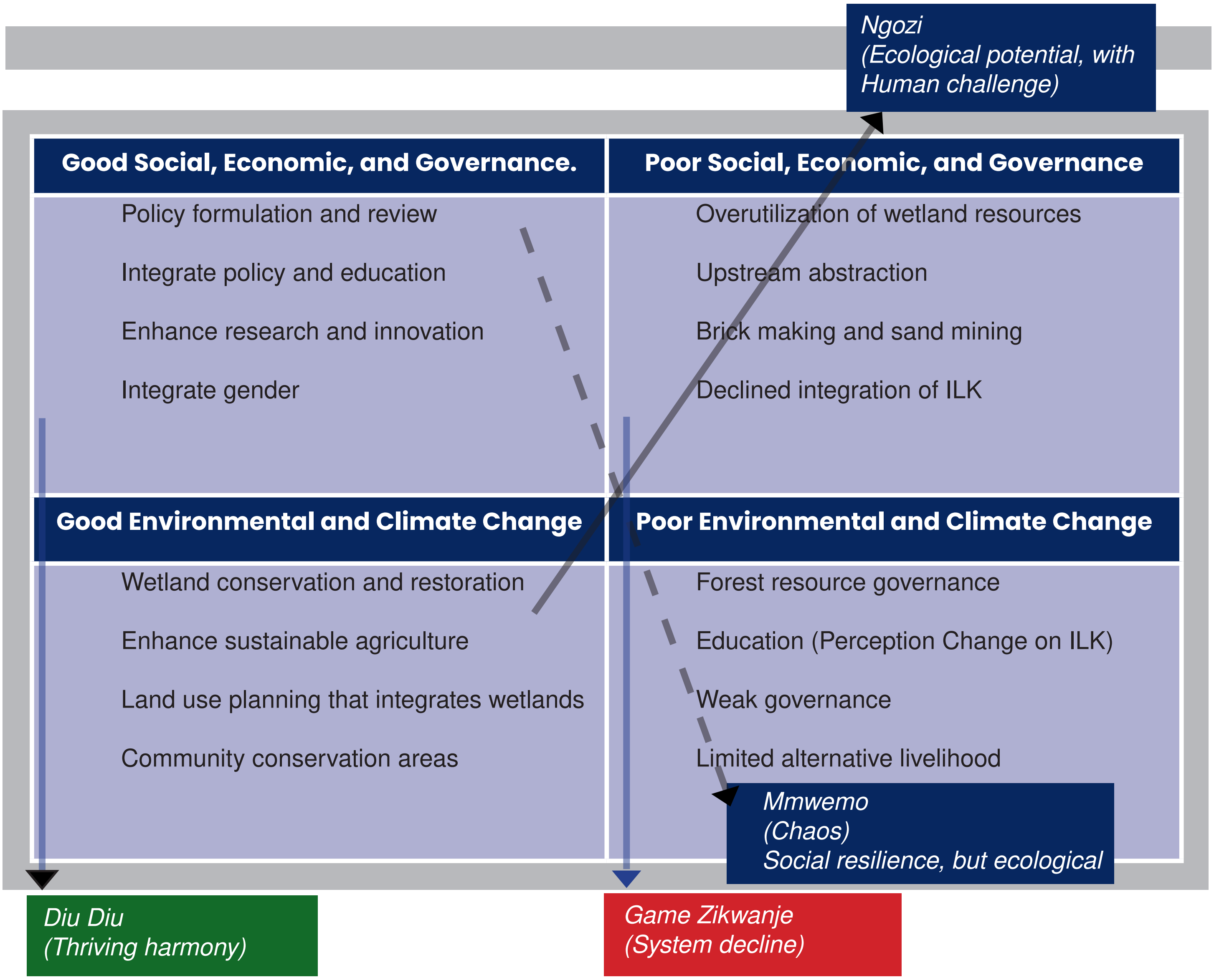
Despite strong institutions and social resilience, climate impacts, invasive species, and erosion strain wetland ecosystems. Human systems adapt, but ecological integrity declines, threatening long-term sustainability.

6.5.3.3 Scenario 3: Ngozi – Ecological Potential, Human Challenge
(Poor Governance and Socio-economic Conditions, Good Environmental/Climate Conditions)

Wetlands remain ecologically intact, but weak governance and poverty limit their sustainable use. The scenario highlights missed opportunities for development and conservation synergy.

6.5.3.4 Scenario 4: Game Zikwanje – System Decline
(Poor Governance, Poor Socio-economic Conditions, Poor Environmental/Climate Conditions)

This worst-case scenario depicts widespread wetland degradation driven by overexploitation, pollution, climate stress, and governance failure. Ecosystem collapse undermines livelihoods, food security, and resilience.



Scenario	Descriptor	Pictorial View	Explanation of the pictorial view
Good Social, Economic, and Governance. And Good Environmental and Climate Change	***Diu Diu.*** Thriving harmony		This symbol shows a thriving African wetlands community where vibrant market life, strong governance, and ecological stewardship coexist beautifully
Good Social, Economic, and Governance. And Poor Environmental and Climate Change	***Mmwemo.*** Social resilience, but ecological strain		This symbol shows channels the vibrancy and community spirit of your reference image, but places it in a wetlands setting where prosperity and governance thrive amid environmental decline
Good Environmental state and Poor Governance	***Ngozi.*** Ecological potential, but Human challenge		The symbol shows a lush, thriving wetland ecosystem with vibrant greenery and clean water, set against a backdrop of social and economic hardship
Poor Social, Economic, and poor Governance. And Poor Environmental and Climate Change	***Game zikwanje.*** System decline		The symbols shows dilapidated homes, polluted waterways, and weary expressions reflect the compounded impact of poor governance, economic hardship, and environmental degradation

6.5.4 ILK Scenarios

ILK scenarios examine the interaction between governance frameworks and social-cultural practices, highlighting pathways for knowledge preservation and loss.

6.5.4.1 Yakuyoyopela (Sweet) – Good Governance and Strong Social-Cultural Practices

This best-case scenario reflects full recognition and integration of ILK into conservation planning, education systems, early warning mechanisms, and policy frameworks. Cultural revival programmes, legal recognition of cultural rights, and strong co-management institutions support sustainable resource use and social cohesion.

6.5.4.2 Nyambwalinyambwali (Average) – Strong Social-Cultural Practices and Poor Governance

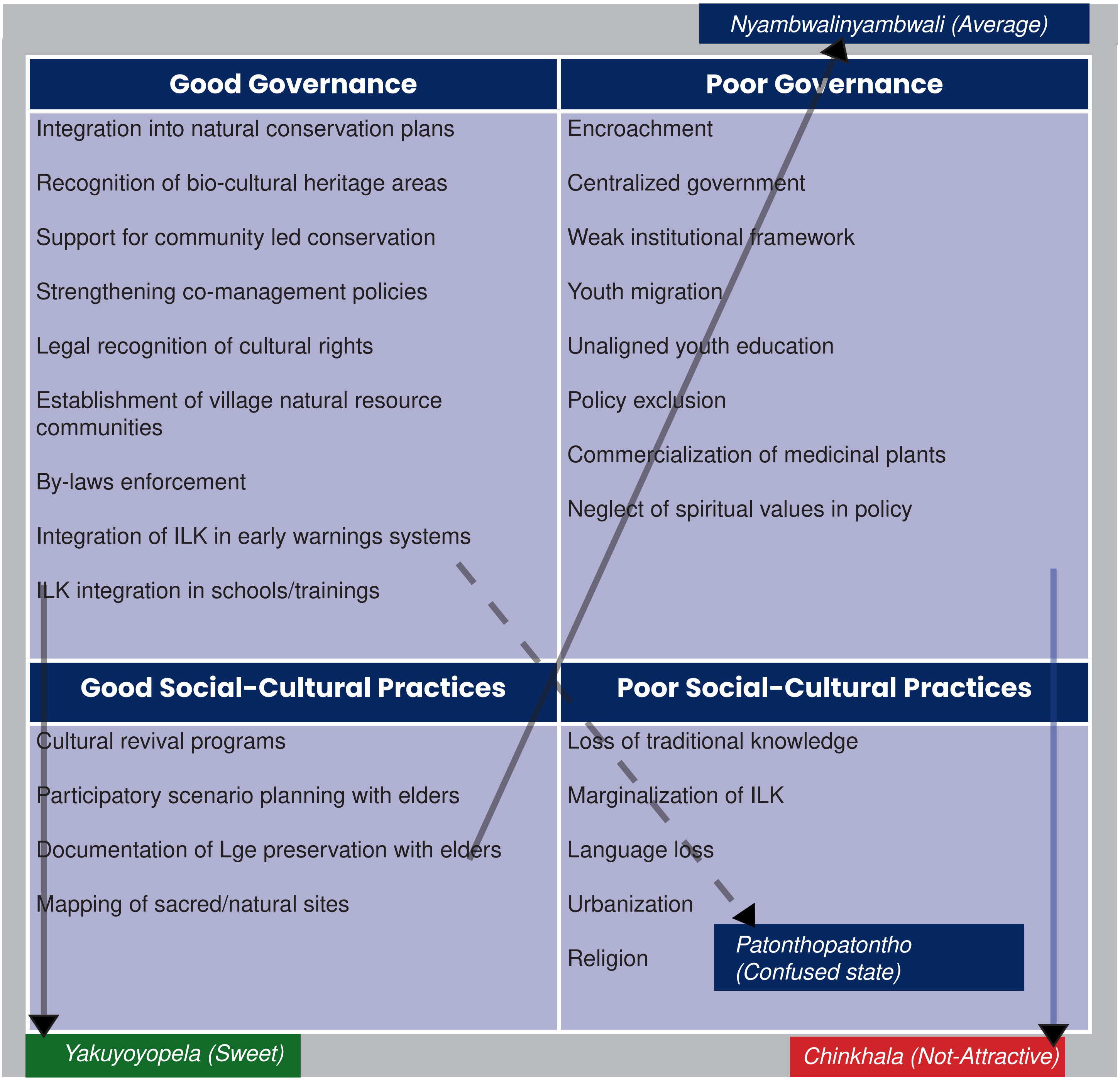
Here, cultural practices and ILK persist through community resilience and intergenerational transmission, despite weak institutional support. However, commercialization of resources and policy exclusion pose risks to long-term knowledge sustainability.

6.5.4.3 Patonthopatontho (Confused State) – Good Governance and Weak Social-Cultural Practices

This scenario reflects strong formal governance systems operating alongside declining cultural practices. Loss of language, marginalization of ILK, and youth disengagement weaken the social foundations needed for effective and inclusive resource management.

6.5.4.4 Chinkhala (Not Attractive) – Poor Governance and Weak Social-Cultural Practices

The worst-case ILK scenario is characterized by governance failure and erosion of cultural identity. Knowledge loss, urbanization, religious pressures, and exclusion from policy processes result in weakened social cohesion and reduced capacity for sustainable ecosystem stewardship.


Nyambwalinyambwali (Average)
Good Governance
Integration into natural conservation plans
Recognition of bio-cultural heritage areas
Support for community led conservation
Strengthening co-management policies
Legal recognition of cultural rights
Establishment of village natural resource communities
By-laws enforcement
Integration of ILK in early warnings systems
ILK integration in schools/trainings
Poor Governance
Encroachment
Centralized government
Weak institutional framework
Youth migration
Unaligned youth education
Policy exclusion
Commercialization of medicinal plants
Neglect of spiritual values in policy
Good Social-Cultural Practices
Cultural revival programs
Participatory scenario planning with elders
Documentation of Lge preservation with elders
Mapping of sacred/natural sites
Poor Social-Cultural Practices
Loss of traditional knowledge
Marginalization of ILK
Language loss
Urbanization
Religion
Patonthopatontho (Confused state)
Yakuyoyopela (Sweet)
Chinkhala (Not-Attractive)

Scenario	Descriptor	Pictorial View	Explanation of the pictorial view
Good social-cultural practices and Good Governance	***Yakuyoyopela (The metaphor means sweet).*** This is the best scenario which emphasizes the synergy between effective governance and positive social and cultural practices within a community		The symbol depicts thriving local social practices, and well-structured houses indicating stability in governance.
Good social-cultural practices and Poor Governance	***Nyambwalinyambwali (The metaphor means average).*** This scenario explores the situation where positive cultural and social traditions thrive despite ineffective governance.		The symbol shows local social interaction amongst the people, in unstable conditions shown by the poor houses and waste indicating poor governance.
Poor social-cultural practices and Good Governance	***Patonthopatontho (Confused state).*** This is scenario where effective governance exists alongside weak social and cultural practices.		In this symbol, there is poor social interaction between people being shown by the somber faces, although there is a presence of governing individuals.
Poor social-cultural practices and Poor Governance	***Chinkhala (the metaphor means not-attractive).*** This is the worst scenario examines the detrimental cycle where ineffective governance exacerbates environmental degradation		In this symbol, there is poor social interaction between people being shown by the somber faces, with poor governing systems poor structures and no governing individuals.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 7 - **Conclusions and Recommendations**

7.1 Conclusions

The Malawi National Ecosystem Assessment (NEA) has provided a comprehensive, evidence-based analysis of the status, trends, and drivers of change in the country's three priority ecosystems aquatic, terrestrial, and wetlands. The assessment affirms that Malawi's natural capital is foundational to national development, supporting key economic sectors, livelihoods, food security, and the well-being of the majority of its population, particularly women and rural communities.

KEY FINDINGS HIGHLIGHT:

- **Aquatic ecosystems** are under severe pressure from sedimentation, nutrient pollution, overfishing, invasive species, and climate variability. Iconic fisheries such as Chambo have declined dramatically, while shifts toward smaller, less valuable species signal ecological imbalance. ILK systems remain vital but underutilized in formal management frameworks.

- **Terrestrial ecosystems** have experienced rapid deforestation, habitat fragmentation, and biodiversity loss, driven by agricultural expansion, unsustainable resource extraction, and climate change. Protected areas and mountain ecosystems are increasingly encroached upon, threatening water catchment functions, genetic diversity, and community resilience.

- **Wetland ecosystems**, though covering nearly one-third of the country and providing critical services such as flood regulation, water purification, and livelihoods, suffer from weak governance, lack of dedicated policy, and accelerating degradation due to drainage, pollution, and unsustainable use.

The assessment underscores the strong interlinkages between terrestrial, aquatic, and wetland ecosystems. Degradation in one system triggers cascading impacts across others, affecting water security, agricultural productivity, biodiversity, and human well-being. Current governance remains fragmented, with limited policy coherence, weak enforcement, inadequate financing, and insufficient integration of ILK and gender-responsive approaches.

7.2 Recommendations

To reverse ecosystem degradation and secure sustainable development, the following recommendations are proposed:

7.2.1 Strengthen Integrated Ecosystem Governance

- Develop and implement a National Wetland Policy to provide clear legal and institutional frameworks for wetland conservation, sustainable use, and restoration.
- Enhance policy coherence under the umbrella of the Environmental Management Act (2017) to ensure cross-sectoral coordination among forestry, fisheries, water, agriculture, and energy sectors.
- Formalize and scale up community-based co-management models, such as Beach Village Committees and Ecosystem Approach to Fisheries Management, ensuring equitable participation of women, youth, and marginalized groups.

7.2.2 Mainstream ILK

- Systematically document and mainstream ILK into national biodiversity strategies, management plans, and climate adaptation frameworks.
- Support intergenerational knowledge transmission through community-led programs, cultural revitalization initiatives, and inclusive education curricula.
- Recognize and protect intellectual property rights of ILK holders, ensuring fair benefit-sharing and ethical collaboration in research and policy design.

7.2.3 Enhance Ecosystem-based Climate Adaptation and Mitigation

- Integrate nature-based solutions into National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs), emphasizing reforestation, wetland restoration, and sustainable land management.
- Strengthen early warning systems and community resilience-building in climate-vulnerable ecosystems, particularly floodplains, lakeshores, and mountain catchments.
- Promote sustainable energy and water management to reduce pressure on aquatic systems and ensure reliable hydropower generation.

7.2.4 Improve Monitoring, Research, and Data Accessibility

- Establish a national ecosystem monitoring framework with clear indicators, baselines, and regular reporting aligned with SDGs and multilateral environmental agreements.
- Invest in participatory research that weaves ILK with scientific knowledge to address data gaps, especially on wetland biodiversity, invasive species, and socio-ecological linkages.
- Enhance open-access platforms for data sharing among government, academia, communities, and development partners.

7.2.5 Secure Sustainable Financing and Institutional Capacity

- Mobilize domestic and international funding for ecosystem restoration, community-led conservation, and green enterprises.
- Build technical and institutional capacity within government agencies, local councils, and community organizations for effective planning, enforcement, and adaptive management.
- Promote innovative financing mechanisms, such as payments for ecosystem services, green bonds, and biodiversity offsets, to incentivize conservation.

7.2.6 Promote Inclusive and Gender-responsive Approaches

- Ensure meaningful participation of women in natural resource governance, recognizing their roles as primary users and knowledge holders.
- Integrate Gender Equality and Social Inclusion (GESI) criteria into all ecosystem management policies, programs, and monitoring systems.
- Address livelihood alternatives for communities dependent on degrading ecosystems, focusing on sustainable agriculture, agroforestry, ecotourism, and value-added fish processing.

The Malawi NEA provides a critical evidence base to guide the country toward a sustainable and resilient future. Its findings and recommendations call for urgent, coordinated action across sectors and scales grounded in science, enriched by ILK , and committed to equity and ecological integrity. By embracing integrated governance, inclusive stewardship, and forward-looking investments, Malawi can safeguard its natural heritage while advancing human well-being for generations to come.

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APPENDICES

9.0 APPENDICES

Appendix 1: Community Members

SALIMA KAFUMBU AND MAKANJIRA VILLAGE
Traditional Authority Makanjira Gogo Chalo, Tafele Milanzi, Elina Milanzi, Tobias Langiton, Thoko Isaac, Fonike Labison, Ajida Falison Leonard Nyambulo, Kingsley Nkalamba, Denison Kapindira, Rabson Chipangula, Yolamu Gayu, Mary yasini, Friday James, Mai Nyamasauka, Ligwa Kampambanya, Frank Lungu, Zampita Nyati, Village Headman Nkhangayawala, Wilson Ngalawe, James Ali, Frazer Lufani, Morin Gama, Majano Meraj, Patuma Bwanali, Grace Moses, Amina James , Atupele Lufani, Selina Milazi, Filisi Majawa, Esnart Memba, Ania Mdala, Agness Amesi, Biyana Jimmy, Rhahimu Chitenje, Amanu Mchingama, Yosuf Mwamadi, M'bwana Mdala, Maganga Ali, Hrisah Mustafa, Luka Ishamel, Nsumali Gizimoni, Chikopa Yunusu, Nkomanyama Chimbala, Zainabu Mayida, Tamamva Ediyasi, Utule Mzoma , Adidya Abasi, Anguwo Chitetenje.
LILONGWE NAZOMBE VILLAGE
Gilise Chilamba, Ketelesi Chigwenembe, Letiya Kasusu, Nasimbenji Dafuyele, Zainesi Banda, Esinta Malemiya, Likines Malindi, Mary Kuthedze, Maligelita White, Lonesi Lion, Meline Mamnyamata, Gilise Chilamba, Felechina Kapachika, Madalo Kapachika, Roda Lijanga, Anna Joseph, Chrissy Damiano, Ferezina Jedayi, Nasilira Kenedi, Felechina Kapachika, Lemita Kudakuyenera, Anesi Kalambule, Nasimati Mapulesi, Malita Masanda, Belita Chiyeletsa, Lemita Kudakuyenera, Anesi Kalambule, Nasimati Mapulesi, Village Head Mwandauka, Village head Lyson, Senior Group Village Headman Mazombe, Village Head Chikope, Group Village Head Mwerera, Group Village Head Masanda, Village Head Mwasanda, Mr Yendera, Mr Chikalira, Mr Tapenzi, Mr Bikson, Village Head Chivulamayani, Group Village Head Tsang'oma, Senior Group Village Head Malemia, Senior Group Village Head Chiyeletsa, Senior Group village Head Nathando, Senior Group Village Head Chisamba, Senior Group Village Head Chithonje, Group Village Head Tsang'oma.
LILONGWE NAZOMBE VILLAGE
Bisoni Kombe, Lamusi Jagwa, Group Village Head Mbukwa, Lipisoni Phiri (Group Village Head Chikumbi), Alfred Anock (Village Head Felo), Isaac Saul (Village Head Malekano), Messy Benjamin (Senior Group Village Head Chimphwembise), Lyson Sinosi (Village Head Khulubvi), Kisswel Matengambiri (Group Village Head Mpachika), Finesi Kombe (Group Village Head Kombe), Mande William (Msilikali Khulubvi), Khelesi Eliya, Grace Simon, Dama Sona, Teleza Maganizo, Mingress Joe, Samere Kambalame, Mingress Vintula, Estery Mazambani, Fanesi Folo, Magret Henry, Esther Kaferapangila (Village Head Nyandikhwe), Dofiya White, Edina Noah, Dofiya Fadileni, Alinesi Jeffrey, Dofiya Mestala, Stelia Window, Magret White, Dinales Zuze, Enert Chatayika, Denja Kamchira , Nema Kositantini, Mr Chilenje, Group Village Head Masimo, Mr Chimwaza, Foster Tchale, Group Village Head Mbangu, Mr Kamangira, Samuel Benjamin, Joseph Sign, Steven C. Mgabu, Kisswell Matengambiri, Henry Majegi, Fred Masterd, Tumbe Peka, Lyson Synos, Wisted Elias, Matias Beka, Wisterd Macheka, Henry Mageji, Smart Symone, GVH Chapirira, VH Chisoni, July Moses, Jimu Kheresi, GVH Chakuma, Elephant Gent, George Lunga, Jonas Demister, Wisterd Elias, Edina Nowa, Dophia Fardnocrk, Mingress Joel, Stamere Kambalame, Magret White, Esther Kaferapanjira, Dophia White, Aliness Sefule, Finales Zuze, Chrisy Jimu, Licia Brighton, Angelina Lyfod, Dorica Fosil, Dirca Mose, Etinala Mchimika, Annie Khezala, Stellia Window, Aluna Kasamu, Maness Dayi, Eliza Finias, Abesi Chilamwa, Ramsey Jangwa, July Mwanda, Isaac Rafiki, Sigere Yotamu, Standard Lambick, Monday Fraction, Matias Becka, VH Chisoni, GVH Chakuma, SGVH Chikhwembe, SGVH Ntemangawa, Chief Mpomba, Chief Mvula, Chief Mpachika, Gv W. Macheka-ngano, GV. Masterd, GV M'bona, Enet Chataika, Linly Nyamatcherenga, Phineous Kombe Piason Gentile, Lyson Sinosi, Nyson Thom, Lucy Donasi, Mercy Benjamin, Jonas Zongoloti, Fines David, Msilikali Chilamwa, GVH Bangula, Thomson Mkwezeka, Donish Vasco, Mingeless Joe.
MULANJE NAKHONYO AND MABUKA VILLAGE
Erias Jackson, Filesi Kabudula, Melita Mpawa, Mary Maphwanya, Mr Namate, Group Village Head Nakhonyo, Hamilton January, Traditional Authority Mabuka, Group Village Head Nande, Symon Mtema, Mercy Benjamin, Tony Ngondonga, Yonasi Tiousa, Thomas Mofolo, Kissewele Matengambiri, Penga Malekeza, Henry, Laysoni Sinosi, Piyason Gaiti, Wested Aliyasi, July Moses Mwanda, Phinias David , Etinala Chimika, Edna Nowa, Dinalesi Zuze, Eneti Chatayika, Samuel Mbenjeman, Ta Ngabu, Steven Chakuma Ngalu, Bernard Elias, Lydia Master, Eliyas Jackson, Liciano Aron, Finly Tchukambiri, Allan Maxwell, Rose Iron, Samuel Jumbe, Mery Damiano, Mercy Nthubula, Annie Nyozani, Ivory Kaliati, Sanderson Liwago, Luka Tikhiwa, Rabson Mponda, Richard Wale, Stenille Malishe, Golina Kajawo, Asigere Alisa, Fredson Bomani, Rosina Muoliwa, Mphatso Jimu, Magret James, Christina Jusino, Yona Chibalo, Paula Chiwaya, Jasadi Alisa, Sivero Benas, Alinafe Jewa, Mery Chiwaya, Annie Chingaje, Abigero Ulusoni, Letiya Macsesiyo, Lucy Gileva, Patrick Jewa, Egreta Chaika, Manyepo Mtonda, Chikondi Kasha, Frank Devison, Silasi Rashid, Linginati Foster, Lonia Lendewera, Eliza Saiwala, Gaveni Luka, Esnart Chitera, Arnold Zambika , Sesina Stipan, Chisomo Nelesi, Feliso Mako, Rozina Mako.

ZOMBA LAKE CHILWA
Mukuwa Kabandula,Winny Magwira, Mafukeni Ailo, Abubakar Matewere, Harrison Chapalapasa, Christopher Haji, Eliya Mose, Enelesi Izeki, Rhoda Chibade , Joster Buleya, Christina Feston, Loney Misokwe , Magret Msamila, James Unyenga , Hastings Malemba, Dean Mphalala, Apatsa Chikhasu, Great Munthali, Patrick B Makupete, Atupele Chatama, Loney Misokwe, Janet Nthanje, Fyness Masikini, Meliya Saidi, Chisomo Chiwaya.
MZIMBA MPHEREMBE AND KAZUNI VILLAGES
Goodnews Gumbo, Donald Gondwe, Esobel Gondwe Naice Kumwenda, Chikoma Nkandawire (Traditional Authority), Eneya Kumwenda (Group Village Head), Sandy Ngwira Inkosi Mpherembe, Joice Kalanga, Tionge Hara, Chimwemwe Hara, Veronica Nzima , Henry Jere, Alex Jere, Alefa Rozi, Gabriel Phiri, Tiwonge Chunda, Jeston Nkachane, Emily Mtonga, Phillimon Ndhlov, Laswell S Moyo, Jane Chirwa, William Msimuki, Sandy B Ngwara, Bernard Saka, Standaba Kumwenda, Rabson Msimuko, Mathews Saka, Magawa Zimmba, S.G.V.V.H Eneya Kumwenda, Kesitna Musimuko, Siteveliya Ngwira, Jenera Chirambo, Vick Chimaliro, Evelyn Chasula, Cecilia Zimba, Maina Mkandawire, Veronica Mhango, John Jiya, Kelvin Banda, Nathan Dzonzi, Henry Nkhambule.
NKHATABAY MKUMBIRA VILLAGE
Andrew Kamanga, Stella Nyanjiwe Phiri, Winston Shani, Isaac Phiri, Rosemary Mwase, Wisdom Kaonga, Never Mulungu, Maggie Mhone, Jonathaan Manda , Henry S Kanyanda, Elizaberth Kaunda, Fosita Phande , Elbon Phiri, Serra Manda, Bardely Phiri, Isaac M Nyirenda, Daina Nyirenda, Grace Kaunda, Mercy Banda, Chiels Mkumbika, Ruth Msimuka.
RUMPHI ZOLOKERE
Padington Harawa, Right Msiska, Kelness Harawa, William Msimuki, Sandy B Ngwara, Bernard Saka, Standaba Kumwenda, Rabson Msimuko, Mathews Saka, Magawa Zimmba, S.G.V.V.H Eneya Kumwenda, Kesitna Musimuko, Siteveliya Ngwira, Jenera Chirambo, Vick Chimaliro, Evelyn Chasula, Cecilia Zimba, Maina Mkandawire, Veronica Mhango, John Jiya, Kelvin Banda, Nathan Dzonzi , Henry Nkhambule.

Appendix 2: List of Species and Dominance in Key Protected Areas

CHIMALIRO FOREST RESERVE			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia amythethophylla	1	Dichrostachys cinerea	1
Acacia goetzei	2	Diplorhynchus condylocarpon	2
Acacia nigrescens	1	Erthrina abyssinica	7
Acacia polyacantha	1	Faurea racemosa	1
Aguaria salicifolia	4	Faurea rochetiana	11
Alangium chinense	1	Faurea saligna	9
Albizia antunesiana	1	Ficus chirindensis	8
Albizia gummifera	1	Ficus stuhlmannii	1
Albizia versicolor	1	Ficus sur	6
Allophylus africanus	8	Ficus sycomorus	1
Anisophyllea boehmii	6	Ficus valls-choudea	1
Annona senegalensis	3	Grewia micrantha	1
Bersama abyssinica	3	Julbernardia globiflora	1
Bobgunnia madagascariensis	10	Julbernardia paniculata	73
Brachystegia boehmii	58	Keetia gueinzii	1
Brachystegia floribunda	31	Lannea discolor	10
Brachystegia longifolia	7	Lecaniodiscus fraxinifolius	1
Brachystegia manga	74	Monotes africanus	12
Brachystegia spiciformis	84	Monotes magnifica	6
Brachystegia utilis	46	Myrica pilulifera	1
Burkea africana	1	Ochna schweinfurthiana	7
Combretum adenogonium	1	Parinari curatellifolia	32
Combretum apiculatum	1	Pericorpsis angolensis	10
Combretum molle	5	Protea angolensis	1
Combretum zeyheri	3	Protea goguedii	1
Cussonia arborea	1	Pseudolachnostylis maprouneifolia	10
Dalbergia nitidula	1	Rothmania engleriana	4
Rothmania manganjae	1	Syzigium owariense	3
Senna petersiana	1	Uapaca kirkiana	15
Sterculia rogersii	1	Zanha africana	4
Strychnos innocua	1		
Syzigium cordatum	4		
		TOTAL	605

KASUNGU NP			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia amythethophylla	6	Cassipourea congoensis	6
Acacia galpinii	10	Combretum adenogonium	2
Acacia polyacantha	9	Combretum apiculatum	10
Acacia seyal	4	Combretum collinum	11
Albizia gummifera	1	Combretum imberbe	1
Albizia versicolor	1	Combretum molle	2
Antidesma venosum	2	Combretum zeyheri	33
Balanites aegyptica	1	Crossopteryx febrifuga	7
Bauhinia petersiana	8	Dalbergia nitidula	9
Bobgunnia madagascariensis	1	Dichrostachys cinerea	3
Brachystegia allenii	1	Diospyros kirkii	33
Brachystegia boehmii	54	Diospyros mespiliformis	7
Brachystegia bussei	1	Diplorhynchus condylocarpon	59
Brachystegia longifolia	65	Dodonaea viscosa	1
Brachystegia manga	80	Dombeya burgesside	1
Brachystegia microphylla	1	Euclea racemosa	8
Brachystegia spiciformis	94	Faurea rochetiana	15
Brachystegia stipulata	60	Faurea saligna	6
Brachystegia utilis	27	Ficus stuhlmannii	1
Bridelia cathartica	3	Flacourtia indica	4
Burkea africana	15	Friesoldielsia obovata	1
Cassia abbreviata	2	Hexalobus monopetalus	5
Homalium dentatum	1	Phyllanthus africana	1
Hymenocordia acida	1	Piliostigma thonningii	3
Isoberlinia angolensis	21	Pleurostylia africana	3
Julbernardia globiflora	3	Podocarpus latifolius	1
Julbernardia paniculata	215	Prunus africana	1
Kigelia africana	4	Pseudolachnostylis maprouneifolia	45
Kirkia acuminata	2	Pterocarpus angolensis	5
Lannea discolor	17	Rothmania engleriana	9
Lannea stuhlmanii	7	Securidaca longepedunculata	2
Maprounea africana	12	Senna singueana	1
Markhamia obtusifolia	1	Stereospermum kunthianum	6
Maytenus heterophylla	8	Strychnos madagascariensis	3
Monotes africanus	26	Strychnos spinosa	10
Myrianthus holstii	1	Syzigium quineense	1
Ochna schweinfurthiana	8	Syzigium owariense	10

Oncoba spinosa	6	Terminalia sericea	13
Ormocarpum kirkii	1	Terminalia stenostachya	5
Ozoroa insigns	8	Trichilia emetica	2
Parinari curatellifolia	18	Uapaca kirkiana	17
Pericorpsis angolensis	36	Uapaca nitida	7
Phileniptera bussei	4	Ximenia caffra	1
Philenoptera violacea	12	Ziziphus mucronata	7
		TOTAL	**1,236**

MANGOCHI FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia nigrescens	7	Alfzelia quanzensis	1
Acacia nilotica	1	Albizia blaberrima	3
Acacia polyacantha	3	Albizia schimperana	1
Acacia sieberiana	1	Albizia versicolor	1
Annona senegalensis	10	Commiphora mollis	2
Anthocleista grandiflora	3	Commiphora mossambicensis	11
Antidesma venosum	4	Crossopteryx febrifuga	3
Bauhinia petersiana	19	Cussonia arborea	1
Bersama abyssinica	3	Dalbergia boehmii	2
Bobgunnia madagascariensis	1	Dalbergia nitidula	18
Boscia salicifolia	1	Dalbergiella nyasae	1
Brachystegia allenii	4	Dichrostachys cinerea	3
Brachystegia boehmii	62	Diospyros kirkii	1
Brachystegia bussei	53	Diospyros senensis	6
Brachystegia glaucenscens	7	Diplorhynchus condylocarpon	76
Brachystegia longifolia	69	Dombeya rotundifolius	2
Brachystegia manga	18	Erythroxylum emarginatum	2
Brachystegia microphylla	12	Faurea rochetiana	6
Brachystegia spiciformis	81	Faurea saligna	6
Brachystegia stipulata	2	Ficus bussei	1
Brachystegia utilis	54	Ficus capensis	1
Bridelia cathartica	9	Ficus sycomorus	1
Bridelia micrantha	6	Ficus valls-choudea	1
Bridelia mollis	2	Flacourtia indica	1
Burkea africana	10	Flueggea virosa	1
Catunaregam spinosa	2	Garcinia buchananii	1

MANGOCHI FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Combretum adenogonium	2	Holarrhena pubescens	1
Combretum apiculatum	3	Julbernardia globiflora	67
Combretum collinum	7	Julbernardia paniculata	3
Combretum psidiodes	8	Kigelia africana	1
Combretum zeyheri	10	Kiggelaria africana	1
Kirkia acuminata	2	Lannea stuhlmanii	1
Lannea discolor	18	Margaritaria discoidea	1
Markhamia obtusifolia	3	Securidaca longepedunculata	1
Markhamia zanzibarica	6	Steganotaenia araliacea	1
Monotes africana	14	Sterculia quinqueloba	3
Myrianthus holstii	1	Stereospermum kunthianum	10
Ochna schweinfurthiana	3	Strychnos madagascariensis	5
Olax obtusifolia	2	Syzigium quineense	10
Ozoroa insigns	2	Syzigium owariense	1
Parinari curatellifolia	11	Tarenna neurophylla	1
Parinari excelsa	1	Terminalia mollis	2
Pericorpsis angolensis	56	Terminalia stenostachya	9
Philenoptera violacea	10	Trichilia emetica	4
Pilistigma thonningii	13	Uapaca kirkiana	154
Pittosporum viridiflorum	4	Uapaca nitida	21
Pleurostylia africana	3	Uapaca sansibarica	10
Protea petiolaris	2	Vernonia amygdalina	1
Pseudolachnostylis maprouneifolia	24	Vitex doniana	4
Psorospermum febrifugum	1	Vitex mombassae	4
Pterocarpus angolensis	18	Vitex payos	2
Pterocarpus rotundifolius	3	Xeroderris stuhlmanii	2
Rothmania engleriana	1	Ximenia caffra	6
Rourea orientalis	4	Xymalos monospora	7
Scherera trichoclada	1	Zanha africana	2
Sclerocarya birrea	6	Zahna gorungensis	2
	TOTAL		**1,173**

BUNGANYA			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia amythethophylla	4	Drypetes gerrardii	3
Acacia nilotica	4	Faurea saligna	1
Albizia antunesiana	1	Julbernardia globiflora	61
Anisophyllea boehmii	6	Lannea discolor	12
Boscia salicifolia	2	Markhamia obtusifolia	2
Brachystegia allenii	9	Monotes africanus	8
Brachystegia boehmii	14	Pericorpsis angolensis	4
Brachystegia bussei	8	Philenoptera violacea	2
Brachystegia floribunda	12	Pseudolachnostylis maprouneifolia	10
Brachystegia longifolia	8	Pterocarpus angolensis	2
Brachystegia manga	4	Schrebera trichoclada	2
Brachystegia microphylla	1	Stereospermum kunthianum	1
Brachystegia spiciformis	23	Strychnos innocua	6
Brachystegia stipulata	1	Strychnos potatorum	4
Brachystegia utilis	36	UNIDENTIFIED SPECIES	4
Combretum molle	12	Vernonia exsertiflora	3
Combretum zeyheri	1	Zahna africana	2
Cussonia arborea	2	Zanthoxylum chalybeum	3
Diplorhynchus condylocarpon	15		
	TOTAL	293	

KANING'INA FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Aguaria salicifolia	17	Margaritaria discoidea	1
Anisophyllea boehmii	14	Mimusops zeyheri	4
Antidesma venosum	2	Mystroxylon aethiopicum	1
Bersama abyssinica	2	Ozoroa insigns	1
Brachystegia boehmii	3	Parinari curatellifolia	19
Brachystegia bussei	8	Pericorpsis angolensis	8
Brachystegia longifolia	15	Protea goguedii	2
Brachystegia spiciformis	76	Rhus longipes	3
Brachystegia stipulata	1	Rothmania engleriana	1
Brachystegia utilis	4	Schrebera alata	1
Bridelia micrantha	10	Securidaca longepedunculata	1

KANING'INA FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Cassipourea mollosana	1	Strychnos innocua	1
Combretum molle	13	Syzigium quineense	4
Dalbergia nitidula	1	Tricalysia acocanthiodes	1
Erythrina abyssinica	2	Uapaca kirkiana	1
Erythroxylum emarginatum	2	Uapaca nitida	19
Faurea rochetiana	2	Uapaca sansibarica	8
Faurea saligna	8	UNIDENTIFIED SPECIES	2
Julbernardia globiflora	17	Vernonia myriantha	3
Lecanodiscus fraxinifolius	8	Vitex doniana	1
Macaranga capensis	7		1
	TOTAL	**363**	

DEDZA-SALIMA ESCARPMENT			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia amythethophylla	10	Dalbergia nitidula	10
Acacia galpinii	18	Dalbergiella nyasae	10
Acacia goetzei	15	Diospyros kirkii	7
Acacia polyacantha	10	Diplorhynchus condylocarpon	73
Albizia adiantifolia	1	Erythrina abyssinica	3
Albizia glaberrima	1	Faurea rochetiana	1
Albizia harveyi	8	Ficus sycomorus	1
Albizia versicolor	1	Grewia bicolor	1
Annona senegalensis	5	Grewia micrantha	1
Bauhinia petersiana	30	Julbernardia globiflora	29
Bobgunnia madagascariensis	1	Kirkia acuminata	3
Boscia salicifolia	1	Lannea discolor	16
Brachystegia boehmii	30	Lannea stuhlmanii	6
Brachystegia bussei	113	Margaritaria discoidea	1
Brachystegia floribunda	6	Markhamia obtusifolia	2
Brachystegia longifolia	15	Monodora junodii	5
Brachystegia manga	68	Monotes africanus	1
Brachystegia spiciformis	8	Pericorpsis angolensis	16

DEDZA-SALIMA ESCARPMENT			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Brachystegia utilis	1	Philenoptera bussei	5
Bridelia cathartica	5	Philenoptera violacea	13
Bridelia micrantha	7	Piliostigma thonningii	10
Burkea africana	4	Pleurostylia africana	1
Cassia abbreviata	1	Protea angolensis	5
Combretum molle	13	Pseudolachnostylis maprouneifolia	39
Combretum adenogonium	7	Psorospermum febrifugum	1
Combretum apiculatum	15	Pterocarpus angolensis	7
Combretum zeyheri	11	Pterocarpus rotundifolius	12
Commiphora africana	8	Rourea orientalis	11
Commiphora mossambicensis	9	Securidaca longepedunculata	5
Crossopteryx febrifuga	2	Sterculia africana	1
Dalbergia boehmii	4	Sterculia quinqueloba	3
Stereospermum kunthianum	11	Vangueria infausta	2
Strychnos madagascariensis	1	Vitex payos	1
Terminalia sambesiaca	4	Xanthoceric zambesiaca	1
Terminalia sericea	8	Xeroderris stuhlmanii	4
Terminalia stenostachya	7	Ximenia caffra	3
Uapaca kirkiana	13	Zahna africana	1
Uapaca nitida	2	Ziziphus mucronata	3
UNIDENTIFIED	8		
	TOTAL	**796**	

DZALANYAMA			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia amythethophylla	1	Dichrostachys cinerea	11
Acacia goetzei	1	Diospyros lycioides	3
Acacia nilotica	1	Diospyros mespiliformis	3
Acacia polyacantha	8	Diplorhynchus condylocarpon	3
Albizia adiantifolia	1	Dombeya rotundifolius	1
Albizia amara	1	Erythrina abyssinica	22
Albizia antunesiana	1	Faurea rochetiana	14
Anisophyllea boehmii	4	Faurea saligna	14
Antidesma venosum	1	Ficus bubu	1
Apodytes dimidiata	2	Ficus sur	1
Bersama abyssinica	3	Ficus sycomorus	2

DZALANYAMA			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Bobgunnia madagascariensis	12	Flacourtia indica	4
Brachystegia boehmii	55	Garcinia kingaensis	1
Brachystegia bussei	29	Grewia micrantha	2
Brachystegia floribunda	24	Hippocratea parviflora	1
Brachystegia longifolia	29	Hymenocordia acida	9
Brachystegia manga	50	Julbernardia globiflora	46
Brachystegia spiciformis	15	Julbernardia paniculata	74
Brachystegia utilis	4	Lannea discolor	14
Breonadia salicina	1	Maprounea africanus	12
Bridelia micrantha	5	Maytenus heterophylla	1
Burkea africana	15	Monotes africanus	6
Catunaregam spinosa	3	multidentia crassa	2
Chrysophyllum gorungosanum	1	Ochna schweinfurthiana	18
Combretum molle	9	Olea africana	1
Combretum collinum	1	Oncoba spinosa	1
Combretum zeyheri	11	Ormocarpum trichocarpum	1
Cussonia arborea	32	Ozoroa insigns	2
Cussonia spicata	2	Pachystella brevipes	1
Dalbergia nitidula	2	Parinari curatellifolia	142
Dalbergiella nyasae	3	Pericorpsis angolensis	21
Phyllanthus africana	1	Strychnos spinosa	3
Pilistigma thonningii	12	Syzigium cordatum	18
Protea goguedii	6	Syzigium quineense	10
Protea welwitschii	6	Syzigium owariense	13
Pseudolachnostylis maprouneifolia	22	Tamarindus indica	3
Psychotria eminiana	1	Terminalia sambesiaca	1
Schrebera alata	1	Uapaca kirkiana	291
Securidaca longepedenculata	7	Uapaca nitida	2
Senna petersiana	3	Uapaca sansibarica	93
Senna singueana	8	UNIDENTIFIED SPECIES	4
Steganotania araliacea	3	Vangueria infausta	3
Steganotania araliacea	3	Vangueria infausta	3
Strychnos cocculoides	1	Vitex doniana	3
Strychnos madagascariensis	6	Vitex payos	2
Strychnos pungens	3		
TOTAL		**1,287**	

MUA-LIVULEZI			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia galpinii	1	Friesoldielsia obovata	5
Acacia goetzei	3	Kirkia acuminata	1
Acacia nigrescens	2	Lannea discolor	2
Acacia polyacantha	5	Markhamia obtusifolia	8
Acacia seyal	1	Monodora junodii	5
Acacia sieberiana	1	Monotes africanus	2
Albizia harveyi	6	Ochna schweinfurthiana	1
Albizia versicolor	8	Ormocarpum trichocarpum	2
Allophylus africanus	1	Pericorpsis angolensis	1
Annona senegalensis	2	Philenoptera violacea	9
Bauhinia petersiana	29	Piliostigma thonningii	1
Brachystegia boehmii	3	Pseudolachnostylis maprouneifolia	19
Brachystegia bussei	17	Pterocarpus angolensis	14
Brachystegia manga	14	Pterocarpus rotundifolius	7
Bridelia cathartica	2	Schrebera trichoclada	2
Cassia abbreviata	2	Sclerocarya birrea	2
Combretum molle	4	Soreindea madagariansis	2
Combretum apiculatum	5	Sterculia africana	1
Combretum zeyheri	5	Sterculia quinqueloba	3
Commiphora africana	1	Stereospermum kunthianum	6
Commiphora edulis	1	Strychnos madagascariensis	17
Commiphora mossambicensis	1	Terminalia sambesiaca	7
Cussonia arborea	2	Terminalia sericea	1
Dalbergia boehmii	4	Trichilia emetica	1
Diuospyros kirkii	1	Uapaca kirkiana	28
Diplorhynchus condylocarpon	13	Uapaca nitida	1
Elephantorrhiza goetzei	1	UNIDENTIFIED SPECIES	3
Erythrina abyssinica	1	Vitex payos	1
Faurea saligna	5	Xeroderris stuhlmanii	1
Ficus sycomorus	1	Ziziphus mucronata	1
TOTAL		**2,96**	

PEREKEZI			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Aguaria salicifolia	14	Kiggelaria africana	3
Albizia antunesiana	1	Lannea discolor	13
Bauhinia petersiana	2	Monotes africanus	29
Boscia salicifolia	5	Monotes magnifica	4
Brachystegia boehmii	44	multidentia crassa	2
Brachystegia floribunda	42	Ochna schweinfurthiana	10
Brachystegia glaucenscens	2	Oxyanthus speciosus	1
Brachystegia longifolia	27	Ozoroa insigns	3
Brachystegia manga	55	Parinari curatellifolia	28
Brachystegia microphylla	22	Pericorpsis angolensis	7

PEREKEZI			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Brachystegia spiciformis	87	Protea goguedii	3
Brachystegia stipulata	2	Pseudolachnostylis maprouneifolia	5
Brachystegia taxifolia	10	Rothmania engleriana	1
Brachystegia utilis	121	Schrebera alata	2
Bridelia micrantha	2	Schrebera trichoclada	2
Burkea africana	1	Strychnos spinosa	3
Cassia abbreviata	3	Strychnos potatorum	2
Combretum molle	23	Syzigium cordatum	10
Cimmiphora zanzibarica	1	Syzigium quineense	1
Cussonia arborea	6	Syzigium owariense	22
Dalbergia nitidula	1	Tricalysia acocanthiodes	8
Diplorhynchus condylocarpon	5	Uapaca kirkiana	79
Erythrina abyssinica	10	Uapaca sansibarica	27
Euphorbia ingens	2	UNIDENTIFIED SPECIES	6
Faurea rochetiana	4	Vangueria infausta	1
Faurea saligna	14	Vangueria parvifolia	6
Ficus ingens	1	Vitex doniana	4
Garcinia buchananii	3	Vitex payos	2
Isoberlinia angolensis	21	Zanthoxylum chalybeum	1
julbernardia paniculata	100	Ziziphus mucronata	2
TOTAL		**298**	

THUMA FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Acacia goetzei	6	Markhamia obtusifolia	12
Acacia polyacantha	5	Markhamia zanzibarica	1
Alfzelia quanzensis	1	Monotes africanus	8
Albizia versicolor	1	Ochna schweinfurthiana	2
Bauhinia petersiana	25	Olea africana	1
Brachystegia boehmii	20	Oncoba spinosa	3
Brachystegia bussei	50	Ozoroa reticulata	1
Brachystegia floribunda	1	Pericorpsis angolensis	1
Brachystegia longifolia	1	Philenoptera bussei	3
Brachystegia manga	23	Philenoptera violacea	24
Brachystegia utilis	4	Piliostigma thonningii	2
Bridelia cathartica	1	Pseudolachnostylis maprouneifolia	16
Cassia abbreviata	4	Pterocarpus angolensis	4
Combretum molle	6	Pterocarpus rotundifolius	4
Combretum adenogonium	5	Schrebera trichoclada	3
Combretum apiculatum	8	Senna singueana	2
Combretum collinum	26	Solanum nigram	1

THUMA FR			
SPECIES NAME	COUNT	SPECIES NAME	COUNT
Combretum zeyheri	30	Sterculia africana	1
Commiphora africana	4	Sterculia quinqueloba	1
Commiphora mossambicensis	1	Stereospermum kunthianum	9
Dalbergiella nyasae	4	Tarenna neurophylla	1
Diospyros kirkii	2	Terminalia sericea	4
Diplorhynchus condylocarpon	16	Tremma orientalis	4
Elephantorrhiza goetzei	2	Turrea nilotica	1
Faurea saligna	2	Uapaca kirkiana	1
Friesoldielsia obovata	8	UNIDENTIFIED SPECIES	3
Julbernardia globiflora	3	Xeroderris stuhlmanii	3
Kirkia acuminata	4	Ximenia caffra	1
Lannea discolor	6	Ziziphus mucronata	1
Lannea stuhlmanii	1		
	TOTAL	**388**	

Appendix 3: Species Distribution Across Key Protected Areas and their IUCN status

SPECIES NAME	FREQUENCY	IUCN STATUS	SPECIES NAME	FREQUENCY	IUCN STATUS
Uapaca kirkiana	617	LC	Philenoptera violacea	70	LC
Brachystegia microphylla	504	LC	Brachystegia stipulata	66	NE
julbernardia paniculata	465	LC	Faurea saligna	65	LC
Brachystegia manga	386	LC	Faurea rochetiana	53	LC
Brachystegia boehmii	343	LC	Pterocarpus angolensis	50	LC
Brachystegia utilis	297	LC	Syzigium owariense	49	NE
Brachystegia bussei	279	LC	Burkea africana	46	LC
Diplorhynchus condylocarpon	262	LC	Combretum collinum	45	LC
Parinari curatellifolia	250	LC	Erythrina abyssinica	45	LC
Brachystegia longifolia	236	LC	Cussonia arborea	44	LC
Julbernardia globiflora	227	LC	Diospyros kirkii	44	LC
Combretum zeyheri	205	LC	Stereospermum kunthianum	43	LC
Pseudolachnostylis maprouneifolia	190	LC	Isoberlinia angolensis	42	LC
Uapaca sansibarica	187	LC	Combretum apiculatum	42	LC
Pericorpsis angolensis	160	NE	Dalbergia nitidula	42	LC
Brachystegia floribunda	116	NE	Acacia polyacantha	41	LC
Bauhinia petersiana	113	LC	Piliostigma thonningii	41	LC
Lannea discolor	108	LC	Protea goguedii	12	NE
Monotes africanus	106	LC	Strychnos innocua	12	LC
Ochna schweinfurthiana	90	LC	Terminalia sambesiaca	12	LC
Combretum molle	87	LC	Vitex doniana	12	LC
Aguaria salicifolia	35	LC	Bersama abyssinica	11	LC
Uapaca nitida	35	LC	Senna singueana	11	LC
Strychnos madagascariensis	32	NE	Ximenia caffra	11	LC
Syzigium cordatum	32	NE	Acacia nigrescens	10	NE

Appendix 3 Conti.:Species Distribution Across Key Protected Areas and their IUCN status

SPECIES NAME	FREQUENCY	IUCN STATUS	SPECIES NAME	FREQUENCY	IUCN STATUS
Anisophyllea boehmii	30	NE	Brachystegia taxifolia	10	LC
Bridelia micrantha	30	LC	Dalbergia boehmii	10	LC
Acacia galpinii	29	LC	Diospyros mespiliformis	10	LC
Acacia goetzei	28	LC	Hymenocordia acida	10	NE
Markhamia obtusifolia	28	LC	Monodora junodii	10	LC
Pterocarpus rotundifolius	26	LC	Monotes magnifica	10	NE
Terminalia sericea	26	LC	Oncoba spinosa	10	LC
Bobgunnia madagascariensis	25	LC	Schrebera trichoclada	10	LC
Syzigium quineense	25	NE	Sterculia quinqueloba	10	NE
Maprounea africana	24	LC	Xeroderris stuhlmanii	10	NE
Acacia amythethophylla	22	LC	Allophylus africanus	9	LC
Commiphora mossambicensis	22	LC	Antidesma venosum	9	LC
Terminalia stenostachya	21	NE	Boscia salicifolia	9	NE
Annona senegalensis	20	LC	Brachystegia glaucenscens	9	NE
Bridelia cathartica	20	LC	Flacourtia indica	9	LC
Dalbergiella nyasae	18	LC	Lecaniodiscus fraxinifolius	9	NE
Dichrostachys cinerea	18	LC	Maytenus heterophylla	9	LC
Combretum adenogonium	17	LC	Tricalysia acocanthiodes	9	NE
Ozoroa insigns	16	NE	Zahna africana	9	NE
Rothmania engleriana	16	NE	Combretum psidiodes	8	NE
Securidaca longepedenculata	16	NE	Euclea racemosa	8	
Strychnos spinosa	16	LC	Ficus chirindensis	8	NE
Lannea stuhlmanii	15	NE	Sclerocarya birrea	8	LC
Rourea orientalis	15	LC	Vitex payos	8	LC
Albizia harveyi	14	LC	Ficus sur	7	LC
Albizia versicolor	14	LC	Macaranga capensis	7	LC
Brachystegia allenii	14	LC	Markhamia zanzibarica	7	LC
Commiphora africana	14	LC			
Friesoldielsia obovata	14	NE	Pleurostylia africana	7	NE
Ziziphus mucronata	14	LC	Trichilia emetica	7	LC
Cassia abbreviata	12	LC	Xymalos monospora	7	LC
Crossopteryx febrifuga	12	LC	Acacia nilotica	6	LC
Kirkia acuminata	12	LC	Cassipourea congoensis	6	NE
Philenoptera bussei	12	NE	Diospyros senensis	6	LC
Ficus sycomorus	6	LC	Apodytes dimidiata	2	LC
Protea angolensis	6	LC	Bridelia mollis	2	LC
Protea welwitschii	6	LC	Commiphora mollis	2	LC
Strychnos potatorum	6	NE	Cussonia spicata	2	LC
Vangueria infausta	6	LC	Euphorbia ingens	2	LC
Vangueria parvifolia	6	LC	Ficus stuhlmannii	2	LC
Acacia seyal	5	LC	Ficus valls-choudea	2	NE
Catunaregam spinosa	5	LC	Myrianthus holstii	2	LC
Hexalobus monopetalus	5	NE	Olax obtusifolia	2	LC

Appendix 3 Conti.:Species Distribution Across Key Protected Areas and their IUCN status

SPECIES NAME	FREQUENCY	IUCN STATUS	SPECIES NAME	FREQUENCY	IUCN STATUS
Kigelia africana	5	LC	Olea africana	2	NE
Albizia antunesiana	4	LC	Phyllanthus africana	2	NE
Albizia glaberrima	4	NE	Protea petiolaris	2	LC
Erythroxylum emarginatum	4	LC	Psorospermum febrifugum	2	LC
Garcinia buchananii	4	NE	Soreindea madagariansis	2	NE
Grewia micrantha	4	NE	Tarenna neurophylla	2	NE
Kiggelaria africana	4	LC	Terminalia mollis	2	LC
Mimusops zeyheri	4	LC	Vernonia myriantha	2	NE
multidentia crassa	4	LC	Zahna gorungensis	2	NE
Pittosporum viridiflorum	4	LC	Alangium chinense	1	NE
Schrebera alata	4	LC	Albizia amara	1	LC
Senna petersiana	4	LC	Albizia schimperana	1	NE
Steganotaenia araliacea	4	LC	Balanites aegyptica	1	LC
Tremma orientalis	4	NE	Breonadia salicina	1	LC
Vitex mombassae	4	LC	Cassipourea mollosana	1	NE
Zanthoxylum chalybeum	4	LC	Chrysophyllum gorungosanum	1	NE
Anthocleista grandiflora	3	NE	Cimmiphora zanzibarica	1	NE
Diospyros lycioides	3	LC	Combretum imberbe	1	LC
Dombeya rotundifolius	3	NE	Commiphora edulis	1	LC
Drypetes gerrardii	3	LC	Dodonaea viscosa	1	LC
Elephantorrhiza goetzei	3	LC	Dombeya burgesside	1	NE
Margaritaria discoidea	3	LC	Faurea racemosa	1	EN
Ormocarpum trichocarpum	3	LC	Ficus bubu	1	NE
Rhus longipes	3	LC	Ficus bussei	1	NE
Sterculia africana	3	LC	Ficus capensis	1	NE
Strychnos pungens	3	LC	Ficus ingens	1	LC
Tamarindus indica	3	LC	Flueggea virosa	1	LC
Vernonia exsertiflora	3	LC	Garcinia kingaensis	1	LC
Acacia sieberiana	2	LC	Grewia bicolor	1	NE
Albizia adiantifolia	2	NE	Hippocratea parviflora	1	NE
Albizia gummifera	2	LC	Holarrhena pubescens	1	LC
Alfzelia quanzensis	2	NE	Homalium dentatum	1	LC
Keetia gueinzii	1	LC	Turrea nilotica	1	NE
Myrica pilulifera	1	LC	Vernonia amygdalina	1	NE
Mystroxylon aethiopicum	1	LC	Xanthoceric zambesiaca	1	NE
Ormocarpum kirkii	1	LC			
Oxyanthus speciosus	1	LC			
Ozoroa reticulata	1	NE			
Pachystella brevipes	1	NE			
Parinari excelsa	1	LC			
Podocarpus latifolius	1	LC			
Prunus africana	1	VU			
Psychotria eminiana	1	LC			
Rothmania manganjae	1	NE			

Appendix 3 Conti.:Species Distribution Across Key Protected Areas and their IUCN status

SPECIES NAME	FREQUENCY	IUCN STATUS	SPECIES NAME	FREQUENCY	IUCN STATUS
Solanum nigram	1	NE			
Sterculia rogersii	1	LC			
Strychnos cocculoides	1	LC			

En= Endemic; NE= Not Evaluated; LC= Least Concern; VU= Vulnerable)

MW/MSBP SPECIMENS SENT TO MILLENIUM SEED BANK FOR STORAGE AT KEW

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 001	Cyperus hemisphaericus	Cyperaceae	26-06-03
MW/MSBP No. 002	Brachystegia boehmii	Caesalpinioideae	09/02/2003
MW/MSBP No. 003	Brachystegia utilis	Caesalpinioideae	09/05/2003
MW/MSBP No. 004	Diospyros kirkii	Ebenaceae	18-09-03
MW/MSBP No. 005	Brachystigia manga	Caesalpinioideae	19-09-03
MW/MSBP No. 006	Julbernardia globiflora	Caesalpinioideae	22-09-03
MW/MSBP No. 007	Sterculia quinqueloba	Sterculiaceae	20-09-03
MW/MSBP No. 008	Albizia versicolor	Mimosoideae	30-09-03
MW/MSBP No. 009	Brachystegia longifolia	Caesalpinioideae	09/08/2003
MW/MSBP No. 010	Widringtonia nodiflora	Cupressaceae	10/11/2003
MW/MSBP No. 011	Albizia adianthifolia	Mimosoideae	20-09-03
MW/MSBP No. 012	Brachystegia floribunda	Caesalpinioideae	23-09-03
MW/MSBP No. 013	Brachystegia speciformis	Caesalpinioideae	26-09-03
MW/MSBP No. 014	Uapaca kirkiana	Euphorbiaceae	28-10-03
MW/MSBP No. 015	Uapaca sansibarica	Euphorbiaceae	28-10-03
MW/MSBP No. 016	Strychnos cocculoides	Loganiaceae	28-10-03
MW/MSBP No. 017	Uapaca robynsii	Euphorbiaceae	29-10-03
MW/MSBP No. 018	Ximenia caffra	Olacaceae	14-11-03
MW/MSBP No. 019	Zahna gorungensis	Sapindaceae	13-11-03
MW/MSBP No. 020	Memexylon flavovirens	Melastomaceae	25-11-03
MW/MSBP No. 021	Syzygium guineense	Mytaceae	27-11-03
MW/MSBP No. 022	Elephantorhiza goetzei	Mimosoideae	12/10/2003
MW/MSBP No. 023	Ochna schweinfurthiana	Ochnaceae	13/12/03
MW/MSBP No. 024	Garcinia buchananii	Clusiaceae	13/12/03
MW/MSBP No. 025	Prunus capuri	Rosaceae	16-12-03
MW/MSBP No. 026	Garcinia huilensis	Guttiferae	13/11/03
MW/MSBP No. 027	Maerua angolensis	Capparaceae	20/12/03
MW/MSBP No. 028	Boscia salicifolia	Capparaceae	20/12/03
MW/MSBP No. 029	Trichilia emetica	Meliaceae	01/03/2004
MW/MSBP No. 030	Passiflora edulis	Passifloreae	01/09/2004
MW/MSBP No. 031	Parkia filicoidea	Mimosoideae	01/10/2004
MW/MSBP No. 032	Lecaniodiscus flaxinifolius	Sapindaceae	01/10/2004

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 033	Myrica humilis	Myriaceae	01/09/2004
MW/MSBP No. 034	Erythroxylum emarginatum	Erythroxylaceae	15-01-04
MW/MSBP No. 035	Capparis erythrocarpos	Capparaceae	17-01-04
MW/MSBP No. 036	Brackenridgea zanguebarica	Ochnaceae	17/01/04
MW/MSBP No. 037	Lannea stuhlmannii	Anacardiaceae	18/01/04
MW/MSBP No. 038	Zahna africana	Sapindaceae	17-01-04
MW/MSBP No. 039	Rourea orientalis	Connaraceae	17/01/04
MW/MSBP No. 040	Antidesma vernosum	Euphorbiaceae	23/01/04
MW/MSBP No. 041	Tricalysia welwitschii	Rubiaceae	25-01-04
MW/MSBP No. 042	Coffea logustroides	Rubiaceae	24/01/04
MW/MSBP No. 043	Ficus exasparata	Moraceae	23/01/04
MW/MSBP No. 044	Ficus cycomorus	Moraceae	23/01/04
MW/MSBP No. 045	Sporobolus pyramidalis	Poaceae	28/01/04
MW/MSBP No. 046	Desmodium tortuosum	Papilionoideae	01/06/2004
MW/MSBP No. 047	Ozoroa insigns	Anacardiaceae	01/10/2004
MW/MSBP No. 048	Panicum schinzii	Poaceae	02/11/2004
MW/MSBP No. 049	Psydrax livida	Rubiaceae	13/02/04
MW/MSBP No. 050	Capparis tomentosa	Capparaceae	13/02/04
MW/MSBP No. 051	Echinochloa pyramidalis	Poaceae	13/02/04
MW/MSBP No. 052	Premna senensis	Verbenaceae	15/02/04
MW/MSBP No. 053	Berchemia discolor	Rhamnaceae	15/02/04
MW/MSBP No. 054	Bidens pilosa	Compositae	19/02/04
MW/MSBP No. 055	Digitaria milanjiana	Poaceae	25/02/04
MW/MSBP No. 056	Panicum trichocladum	Poaceae	18/02/04
MW/MSBP No. 057	Ilex mitis	Aquifoliaceae	02/06/2004
MW/MSBP No. 058	Grewia bicolor	Tiliaceae	24/02/04
MW/MSBP No. 059	Setaria incrassata	Poaceae	25/02/04
MW/MSBP No. 060	Sporobolus iocrados	Poaceae	26/02/04
MW/MSBP No. 061	Sporobolus sanguineus	Poaceae	26/02/04
MW/MSBP No. 062	Diditaria ganzensis	Poaceae	25/02/04
MW/MSBP No. 063	Mariscus sieberianus	Cyperaceae	17/02/04
MW/MSBP No. 064	Tinospora caffra	Menispermaceae	26/02/04
MW/MSBP No. 065	Solanum anguivi	Solanaceae	26/02/04
MW/MSBP No. 066	Brachiaria jubata	Poaceae	03/01/2004
MW/MSBP No. 067	Vangueria infausta	Rubiaceae	03/04/2004
MW/MSBP No. 068	Monotes africana	Dipterocarpaceae	03/09/2004
MW/MSBP No. 069	Indigofera antunesiana	Papilionoideae	03/09/2004
MW/MSBP No. 070	Vitex payos	Verbenaceae	03/10/2004
MW/MSBP No. 071	Paspatum scrobiculatum	Poaceae	03/10/2004
MW/MSBP No. 072	Stephania abyssinica	Menispermaceae	03/11/2004
MW/MSBP No. 073	Grewia herbaceae	Tiliaceae	03/11/2004

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 074	Vitex mombassae	Verbenaceae	03/11/2004
MW/MSBP No. 075	Cymphostema gigantophyllum	Vitaceae	03/11/2004
MW/MSBP No. 076	Carisa edulis	Apocynaceae	14/03/04
MW/MSBP No. 077	Eragrostis exasperata	Poaceae	14/03/04
MW/MSBP No. 078	Ampelocissus obtusata	Vitaceae	14/03/04
MW/MSBP No. 079	Asparagus flagellaris	Liliaceae	14/03/04
MW/MSBP No. 080	Eragrostis aethiopica	Poaceae	15/03/04
MW/MSBP No. 081	Tacca leontopetaloides	Taccaceae	16/03/04
MW/MSBP No. 082	Burtt-davya nyasica	Rubiaceae	17/03/04
MW/MSBP No. 083	Psorospermum febrifugum	Guttiferae	03/12/2004
MW/MSBP No. 084	Embelia schimperi	Myrsinaceae	14/03/04
MW/MSBP No. 085	Karomia speciosa	Verbenaceae	16/03/04
MW/MSBP No. 086	Adenia rumiciflora	Passifloreae	17/03/04
MW/MSBP No. 087	Cissus faucicola	Vitaceae	18/03/04
MW/MSBP No. 088	Coccinia adoensis	Cucurbitaceae	18/03/04
MW/MSBP No. 089	Albidgaaria contexta	Cyperaceae	23/03/04
MW/MSBP No. 090	Rhoicissus revolii	Vitaceae	23/03/04
MW/MSBP No. 091	Diospyros zombensis	Ebenaceae	29/03/04
MW/MSBP No. 092	Vitex doniana	Verbenaceae	30/03/04
MW/MSBP No. 093	Brachiaria serrata	Poaceae	04/02/2004
MW/MSBP No. 094	Cymphostemma congestum	Vitaceae	31/04/04
MW/MSBP No. 095	Aeschynomene abyssinica	Papilionoideae	20/04/04
MW/MSBP No. 096	Bersema abyssinica	Melianthacaceae	20/04/04
MW/MSBP No. 097	Boerhavia diffusa	Nyctaginaceae	26/05/04
MW/MSBP No. 098	Tephrosia nyikensis	Papilionoideae	20/04/04
MW/MSBP No. 099	Andropogon schirensis	Poaceae	20/04/04
MW/MSBP No. 100	Senna septemtrionalis	Papilionoideae	21/04/04
MW/MSBP No. 101	Clematis scabiosfolia	Ranunculaceae	22/04/04
MW/MSBP No. 102	Chaemacrista mimosoides	Caesalpinioideae	22/04/04
MW/MSBP No. 103	Temnocalyx obovatus	Rubiaceae	22/04/04
MW/MSBP No. 104	Grewia stolzii	Tiliaceae	22/04/04
MW/MSBP No. 105	Crotalaria ochroleuca	Papilionoideae	22/04/04
MW/MSBP No. 106	Dalbergia boehmii	Papilionoideae	23/04/04
MW/MSBP No. 107	Diospyros pallens	Ebenaceae	23/04/04
MW/MSBP No. 108	Rottboellia exaltata	Poaceae	23/04/04
MW/MSBP No. 109	Sesbania tetraptera	Papilionoideae	23/04/04
MW/MSBP No. 110	Terminalia stenostachya	Combretaceae	23/04/04
MW/MSBP No. 111	Grewia inaequilatera	Tiliaceae	23/04/04
MW/MSBP No. 112	Holarrhena pubescens	Apocynaceae	24/04/04
MW/MSBP No. 113	Diospyros squarosa	Ebenaceae	24/04/04

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 114	Hippocratea indica	Celastraceae	25/04/04
MW/MSBP No. 115	Psychotria pumila	Rubiaceae	05/04/2004
MW/MSBP No. 116	Mimusops zeyheri	Sapotaceae	05/04/2004
MW/MSBP No. 117	Diospyros natalensis	Ebenaceae	05/05/2004
MW/MSBP No. 118	Feretia aeruginescens	Rubiaceae	05/04/2004
MW/MSBP No. 119	Psychotria mahonii	Rubiaceae	05/05/2004
MW/MSBP No. 120	Dalbegiella nyassae	Papilionoideae	05/10/2004
MW/MSBP No. 121	Crotalaria dedzana	Papilionoideae	05/11/2004
MW/MSBP No. 122	Markhamia obtusifolia	Bignoniaceae	05/11/2004
MW/MSBP No. 123	Commiphora edulis	Bursaraceae	05/12/2004
MW/MSBP No. 124	Diospyros senensis	Ebenaceae	05/12/2004
MW/MSBP No. 125	Gouania longispicata	Rhamnaceae	13/05/04
MW/MSBP No. 126	Hermannia glandulifera	Sterculiaceae	13/05/04
MW/MSBP No. 127	Xylotheca tettensis	Flacourtiaceae	14/05/04
MW/MSBP No. 128	Pterocarpus antunesii	Papilionoideae	14/05/04
MW/MSBP No. 129	Bidens pinnatipartita	Asteraceae	08/06/2004
MW/MSBP No. 130	Brumea crispata	Asteraceae	08/06/2004
MW/MSBP No. 131	Indifera atriceps	Papilionoideae	08/06/2004
MW/MSBP No. 132	Brumea brevipes	Asteraceae	08/06/2004
MW/MSBP No. 133	Lippia javanica	Verbanaceae	08/06/2004
MW/MSBP No. 134	Cassytha filiformis	Lauraceae	08/06/2004
MW/MSBP No. 135	Dicoma anomala	Asteraceae	08/06/2004
MW/MSBP No. 136	Spermacoce dibranchiata	Rubiaceae	08/06/2004
MW/MSBP No. 137	Helichrysum kirkii	Asteraceae	08/06/2004
MW/MSBP No. 138	Catunaregum spinosa	Rubiaceae	08/06/2004
MW/MSBP No. 139	Gardenia subacaulis	Rubiaceae	08/06/2004
MW/MSBP No. 140	Helichrysum chrysophorum	Asteraceae	08/07/2004
MW/MSBP No. 141	Chlorophytum decoratum	Liliaceae	08/07/2004
MW/MSBP No. 142	Tagetes minuta	Asteraceae	08/07/2004
MW/MSBP No. 143	Aeschynomene abyssinica	Papilionoideae	08/07/2004
MW/MSBP No. 144	Pannisetum microunum	Poaceae	08/07/2004
MW/MSBP No. 145	Sphaeranthus randii	Asteraceae	08/07/2004
MW/MSBP No. 146	Lipocarpa chinensis	Cyperaceae	08/07/2004
MW/MSBP No. 147	Elephantopus scaber	Compositae	08/07/2004
MW/MSBP No. 148	Protea gaguedi	Proteaceae	08/07/2004
MW/MSBP No. 149	Kotschya strobilantha	Leguminaceae	08/07/2004
MW/MSBP No. 150	Pericopsis angolensis	Papilionoideae	08/08/2004
MW/MSBP No. 151	Blepharis tenuinaunea	Acanthaceae	08/08/2004
MW/MSBP No. 152	Dicoma sessilifolia	Compositae	08/08/2004
MW/MSBP No. 153	Vernonia karanguensis	Asteraceae	08/08/2004
MW/MSBP No. 154	Faurea speciosa	Proteaceae	08/08/2004
MW/MSBP No. 155	Vernonia melleri	Asteraceae	08/08/2004

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 156	Schistostephium artemisiifolium	Asteraceae	08/08/2004
MW/MSBP No. 157	Cyathula uncinulata	Amaranthaceae	08/09/2004
MW/MSBP No. 158	Ageratum houstonianum	Asteraceae	08/09/2004
MW/MSBP No. 159	Galisoga perviflora	Asteraceae	08/09/2004
MW/MSBP No. 160	Pycnostachys stuhlmanii	Labiatae	08/09/2004
MW/MSBP No. 161	Rumex abyssinica	Polygonaceae	08/09/2004
MW/MSBP No. 162	Bothriocline longipes	Asteraceae	08/09/2004
MW/MSBP No. 163	Hyparrhenia cymbarica	Poaceae	08/09/2004
MW/MSBP No. 164	Rubus exsuccus	Rosaceae	08/09/2004
MW/MSBP No. 165	Brachystegia taxifolia	Caesalpinioideae	08/09/2004
MW/MSBP No. 166	Vernonia bellinghamii	Asteraceae	08/10/2004
MW/MSBP No. 167	Gnidia goetzeana	Thymalaceae	08/10/2004
MW/MSBP No. 168	Elephantopus scaber	Compositae	08/10/2004
MW/MSBP No. 169	Heteromorpha trifoliata	Umbelliferae	08/06/2004
MW/MSBP No. 170	Kirkii acuminata	Simaroubiaceae	24/04/04
MW/MSBP No. 171	Maesa lanceolata	Myrsinaceae	22/04/04
MW/MSBP No. 172	Pittosphorum viridiflorum	Pittospholaceae	20/04/04
MW/MSBP No. 173	Zizyphus mucronata	Rhamnaceae	24/04/04
MW/MSBP No. 174	Combretum zeyheri	Combretaceae	24/04/04
MW/MSBP No. 175	Acacia geradii	Mimosoideae	22/04/04
MW/MSBP No. 176	Xeroderis stuhlmanii	Papilionoideae	24/04/04
MW/MSBP No. 177	Nicandra physaloides	Solanaceae	24/04/04
MW/MSBP No. 178	Corchorus olitorius	Tiliaceae	23/04/04
MW/MSBP No. 179	Diospyros mesipiliformis	Ebenaceae	05/05/2004
MW/MSBP No. 180	Pteleopsis myrtifolia	Combretaceae	23/04/04
MW/MSBP No. 181	Grewia flavovirens	Tiliaceae	23/04/04
MW/MSBP No. 182	Rhynchosia hirta	Papilionoideae	20/04/04
MW/MSBP No. 183	Neotononia wightii	Papilionoideae	22/04/04
MW/MSBP No. 184	Pannisetum purpereum	Poaceae	21/04/04
MW/MSBP No. 185	Diospyros whyteana	Ebenaceae	01/09/2004
MW/MSBP No. 186	Euclea natalensis	Ebenaceae	16/03/04
MW/MSBP No. 187	Hibiscus cannabinus	Malvaceae	05/06/2004
MW/MSBP No. 188	Hymenocardia acida	Euphorbiaceae	26/04/04
MW/MSBP No. 189	Jasminum fluminance	Oleacaceae	05/04/2004
MW/MSBP No. 190	Harrisonia abyssinica	Simaroubiaceae	03/05/2004
MW/MSBP No. 191	Corchorus aestuans	Tiliaceae	05/12/2004
MW/MSBP No. 192	Spermacosa senensis	Rubiaceae	13/05/04
MW/MSBP No. 193	Khaya anthotheca	Meliaceae	25/10/04
MW/MSBP No. 194	Helichrysum nitens	Asteraceae	29/11/04
MW/MSBP No. 195	Anisopappus kirkii	Asteraceae	29/11/04
MW/MSBP No. 196	Tetraria mlanjensis	Cyperaceae	30/11/04

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 197	Dissotis johnstoniana	Melastomaceae	30/11/04
MW/MSBP No. 198	Plectranthus crassus	Labiatae	30/11/04
MW/MSBP No. 199	Diplolophium buchananii	Umbelliferae	30/11/04
MW/MSBP No. 200	Helichrysum densiflorum	Compositae	30/11/04
MW/MSBP No. 201	Lopholaena whyteana	Compositae	12/01/2004
MW/MSBP No. 202	Crassula argyrophylla	Crassulaceae	12/01/2004
MW/MSBP No. 203	Lobelia blantyrensis	Campanulaceae	12/03/2004
MW/MSBP No. 204	Xerophyta splendens	Velloziaceae	12/03/2004
MW/MSBP No. 205	Thesium whyteanum	Santallaceae	12/04/2004
MW/MSBP No. 206	Lotus milanjeanus	Papilionoideae	12/04/2004
MW/MSBP No. 207	Hypericum revolutum	Guttiferae	12/04/2004
MW/MSBP No. 208	Agauria salicifolia	Ericaceae	12/04/2004
MW/MSBP No. 209	Vernonia myrianthus	Asteraceae	12/05/2004
MW/MSBP No. 210	Rhynchosia pycrantha	Papilionoideae	12/05/2004
MW/MSBP No. 211	Hebenstretia angolensis	Selaginaceae	12/06/2004
MW/MSBP No. 212	Berkeya johnstoniana	Astraceae	12/06/2004
MW/MSBP No. 213	Vernonia milanjiana	Astraceae	12/06/2004
MW/MSBP No. 214	Faurea racemosa	Proteaceae	12/10/2004
MW/MSBP No. 215	Selago thomsonii var. whyteana	Scrophulariaceae	24/02/05
MW/MSBP No. 216	Plectranthus elegans	Labiatae	24/02/05
MW/MSBP No. 217	Disa fragrans subsp. fragrans	Orchidaceae	24/02/05
MW/MSBP No. 218	Pimpinella mulanjensis	Umbelliferae	25/02/05
MW/MSBP No. 219	Restio mlanjensis	Restionaceae	03/03/2005
MW/MSBP No. 220	Plectranthus dissectus	Labiatae	03/03/2005
MW/MSBP No. 221	Impatiens quisqualis	Balsaminaceae	03/04/2005
MW/MSBP No. 222	Crassocephalum crepidioides	Compositae	24/05/05
MW/MSBP No. 223	Helichrysum setosum	Compositae	24/05/05
MW/MSBP No. 224	Rumulea cameroonia	Iridaceae	24/05/05
MW/MSBP No. 225	Swertia curtioides	Gentianaceae	24/05/05
MW/MSBP No. 226	Kniphofia splendida	Liliaceae	24/05/05
MW/MSBP No. 227	Rhynchospora rugosa	Cyperaceae	24/05/05
MW/MSBP No. 228	Buchnera hispida	Scrophulariaceae	24/05/05
MW/MSBP No. 229	Rumex abyssinica	Polygonaceae	24/05/05
MW/MSBP No. 230	Pentas pubiflora	Rubiaceae	24/05/05
MW/MSBP No. 231	Protea welwitschii	Proteaceae	24/05/05
MW/MSBP No. 232	Polystachya johnstonii	Orchidaceae	25/05/05
MW/MSBP No. 233	Cyphia lasiandra	Campanulaceae	25/05/05
MW/MSBP No. 234	Xyris makuensis	Xyridaceae	25/05/05
MW/MSBP No. 235	Swertia abyssinica	Gentianaceae	25/05/05
MW/MSBP No. 236	Helichrysum buchananii	Compositae	25/05/05

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 237	Senecio milanjianus	Compositae	25/05/05
MW/MSBP No. 238	Crassula alba	Crassulaceae	25/05/05
MW/MSBP No. 239	Stereochlaena cameroonii	Gramineae	26/05/05
MW/MSBP No. 240	Indigofera lyalii	Leguminaceae	26/05/05
MW/MSBP No. 241	Helichrysum brassii	Compositae	26/05/05
MW/MSBP No. 242	Aristea angolensis	Iridaceae	26/05/05
MW/MSBP No. 243	Alepidea gracilis	Umbelliferae	26/05/05
MW/MSBP No. 244	Protea nyassae	Proteaceae	26/05/05
MW/MSBP No. 245	Crotalaria argyrolobioides	Papilionoideae	26/05/05
MW/MSBP No. 246	Thalictrum rhynchocarpum	Ranunculaceae	27/05/05
MW/MSBP No. 247	Chlorophytum sp.	Anthericeae	27/05/05
MW/MSBP No. 248	Helichrysum chrysophorum	Compositae	27/05/05
MW/MSBP No. 249	Myrsine africana	Myrsinaceae	27/05/05
MW/MSBP No. 250	Protea petiolaris	Proteaceae	28/05/05
MW/MSBP No. 251	Eragrostis slyviae	Gramineae	28/05/05
MW/MSBP No. 252	Widdringtonia whytei	Cuppressaceae	28/05/05
MW/MSBP No. 253	Costularia natalensis	Cyperaceae	28/05/005
MW/MSBP No. 254	Tephrosia whyteana	Papilionoideae	29/05/05
MW/MSBP No. 255	Triumfetta tomentosa	Tiliaceae	30/05/05
MW/MSBP No. 256	Vernonia colorata	Compositae	30/05/05
MW/MSBP No. 257	Clematis simensis	Ranunculaceae	08/03/2005
MW/MSBP No. 258	Plectranthus elegans	Labiatae	08/03/2005
MW/MSBP No. 259	Sparrmania ricinocarpa	Tiliaceae	08/03/2005
MW/MSBP No. 260	Leonotis mollissima	Labiatae	08/03/2005
MW/MSBP No. 261	Bidens pinnatipartita	Compositae	08/03/2005
MW/MSBP No. 262	Vernonia karaguensis	Compositae	08/03/2005
MW/MSBP No. 263	Eragrostis nindensis	Gramineae	08/04/2005
MW/MSBP No. 264	Sopubia simplex	Scrophulariaceae	08/04/2005
MW/MSBP No. 265	Sebaea longicaulis	Gentianaceae	08/04/2005
MW/MSBP No. 266	Helichrysum buchananii	Astraceae	08/04/2005
MW/MSBP No. 267	Gnidia chapmanii	Thymalaceae	08/05/2005
MW/MSBP No. 268	Kotschya thymodola	Papilionoideae	08/05/2005
MW/MSBP No. 269	Phyllathus confusus	Euphorbiaceae	08/05/2005
MW/MSBP No. 270	Stachys didymantha	Labiatae	08/05/2005
MW/MSBP No. 271	Heteromorpha arborescens	Umbelliferae	08/06/2005
MW/MSBP No. 272	Cyanotis barbata	Commelinaceae	08/06/2005
MW/MSBP No. 273	Anisoparpus lastii	Asteraceae	08/06/2005
MW/MSBP No. 274	Helichrysum kirkii	Asteraceae	08/06/2005
MW/MSBP No. 275	Helichrysum chrysophorum	Asteraceae	08/07/2005

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 276	Erica whyteana	Ericaceae	08/07/2005
MW/MSBP No. 277	Satureja punctata	Labiatae	08/07/2005
MW/MSBP No. 278	Gladiolus crassifolius	Iridaceae	08/08/2005
MW/MSBP No. 279	Plectranthus mandalensis	Labiatae	08/08/2005
MW/MSBP No. 280	Plectranthus crassus	Labiatae	08/08/2005
MW/MSBP No. 281	Erica benguelensis	Ericaceae	08/09/2005
MW/MSBP No. 282	Conyza pyrrhopappa	Asteraceae	08/09/2005
MW/MSBP No. 283	Anthrixia rosmarinifolia	Asteraceae	08/09/2005
MW/MSBP No. 284	Gutenbergia cordifolia	Asteraceae	08/09/2005
MW/MSBP No. 285	Corrigiola drymarioides	Illecebraceae	08/09/2005
MW/MSBP No. 286	Bothriocline longipes	Asteraceae	08/09/2005
MW/MSBP No. 287	Aeschynomene megalophylla	Papilionoideae	08/09/2005
MW/MSBP No. 288	Polygala virgata	Polygalaceae	08/10/2005
MW/MSBP No. 289	Helichrysum lastii	Asteraceae	08/10/2005
MW/MSBP No. 290	Cleome densifolia	Capparaceae	08/10/2005
MW/MSBP No. 291	Crotalaria goetzei	Papilionoideae	08/11/2005
MW/MSBP No. 292	Xymalos monospora	Monimiaceae	08/11/2005
MW/MSBP No. 293	Scheffrera umbellifera	Arariaceae	13/08/05
MW/MSBP No. 294	Impatiens shirensis	Balsaminaceae	13/08/05
MW/MSBP No. 295	Psychotria zombamontana	Rubiaceae	13/08/05
MW/MSBP No. 296	Nidolera auriculata	Asteraceae	13/08/05
MW/MSBP No. 297	Senecio latifolius	Asteraceae	13/08/05
MW/MSBP No. 298	Rutidea fuscescens	Rubiaceae	13/08/05
MW/MSBP No. 299	Senecio erubescens	Asteraceae	14/08/05
MW/MSBP No. 300	Rhynchosia buchananii	Papilionoideae	10/12/2005
MW/MSBP No. 301	Multidentian crassa	Rubiaceae	10/12/2005
MW/MSBP No. 302	Turraea nilotica	Meliaceae	10/12/2005
MW/MSBP No. 303	Isoberlinia angolensis	Caesalpinioideae	10/12/2005
MW/MSBP No. 304	Julbernardia paniculata	Caesalpinioideae	10/12/2005
MW/MSBP No. 305	Cryptolepis oblongifolia	Asclepiadaceae	10/12/2005
MW/MSBP No. 306	Droogmansia pteropus	Papilionoideae	10/12/2005
MW/MSBP No. 307	Flemingia grahamiana	Papilionoideae	10/12/2005
MW/MSBP No. 308	Maytenus heterophylla	Celastraceae	10/12/2005
MW/MSBP No. 309	Humularia descampsii		13/10/05
MW/MSBP No. 310	Imperata cylindrica	Gramineae	13/10/05
MW/MSBP No. 311	Wissadula rostrata	Malvaceae	13/10/05
MW/MSBP No. 312	Dombeya rotundifolia	Sterculiaceae	14/10/05
MW/MSBP No. 313	Securidaca longepedunculata	Polygalaceae	14/10/05
MW/MSBP No. 314	Brillantaisia pubescens	Acanthaceae	14/10/05
MW/MSBP No. 316	Ekebergia banguelensis	Meliaceae	14/10/05
MW/MSBP No. 317	Schistostephium artemisiifolium	Compositae	15/10/05
MW/MSBP No. 318	Antherotoma naudinii	Melastomaceae	15/10/05
MW/MSBP No. 319	Haumaniastrum callianthum	Labiatae	15/10/05
MW/MSBP No. 320	Lippia plicata	Verbenaceae	15/10/05

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 321	Leucas meuthifolia	Labiatae	15/10/05
MW/MSBP No. 322	Blepharis grandis	Labiatae	15/10/05
MW/MSBP No. 323	Rhus longipes	Anacardiaceae	15/10/05
MW/MSBP No. 324	Tecomaria capensis	Bignoniaceae	15/10/05
MW/MSBP No. 325	Pycnostachys dewildemaniana	Labiatae	15/10/05
MW/MSBP No. 326	Aeschynomene oligophylla	Papilionoideae	15/10/05
MW/MSBP No. 327	Stomatenthus africana	Compositae	15/10/05
MW/MSBP No. 328	Gnidia kraussiana	Thymalaceae	15/10/05
MW/MSBP No. 329	Hypoxis goetzei	Hypoxidaceae	15/10/05
MW/MSBP No. 330	Artemisia afra	Compositae	16/10/05
MW/MSBP No. 331	Acacia abyssinica	Papilionoideae	16/10/05
MW/MSBP No. 332	Cyperus nduru	Cyperaceae	16/10/05
MW/MSBP No. 333	Astragalus atropilosulus	Papilionoideae	16/10/05
MW/MSBP No. 334	Helichrysum patulifolium	Compositae	16/10/05
MW/MSBP No. 335	Helichrysum ceres	Compositae	16/10/05
MW/MSBP No. 336	Protea heckmaniana	Proteaceae	16/10/05
MW/MSBP No. 337	Dombeya torrida subsp. erythroleuca	Sterculiaceae	16/10/05
MW/MSBP No. 338	Lobelia gibberoa	Campanulaceae	17/10/05
MW/MSBP No. 339	Juniperus procera	Cuppressaceae	17/10/05
MW/MSBP No. 340	Olea europea subsp. africana	Oleacaceae	17/10/05
MW/MSBP No. 341	Combretum adenogonium	Combretaceae	18/10/05
MW/MSBP No. 342	Combretum mossambicensis	Combretaceae	18/10/05
MW/MSBP No. 343	Deinbollia nyikensis	Sapindaceae	20/10/05
MW/MSBP No. 344	Urena lobata	Malvaceae	20/10/05
MW/MSBP No. 345	Smilex asceps	Smilacaceae	20/10/05
MW/MSBP No. 346	Saba comorensis	Apocynaceae	20/10/05
MW/MSBP No. 347	Vernonia adoensis	Compositae	16/10/05
MW/MSBP No. 348	Dicliptera mossambicensis	Acanthaceae	16/11/05
MW/MSBP No. 349	Anisopappus lastii	Asteraceae	16/11/05
MW/MSBP No. 350	Dissotis phaeotricha	Melastomaceae	16/11/05
MW/MSBP No. 351	Chrysophyllum gorungosanum	Sapotaceae	17/11/05
MW/MSBP No. 352	Dombeya burgessiae	Sterculiaceae	17/11/05
MW/MSBP No. 353	Anisotes nyassae	Acanthaceae	17/11/05
MW/MSBP No. 354	Glyphaea tomentosa	Tiliaceae	17/11/05
MW/MSBP No. 355	Tricalysia coriaceae	Rubiaceae	17/11/05
MW/MSBP No. 356	Aphloia theiformis	Flacourtiaceae	20/11/05
MW/MSBP No. 357	Euphorbia depauperata	Euphorbiaceae	20/11/05
MW/MSBP No. 358	Crepis newii	Asteraceae	20/11/05
MW/MSBP No. 359	Hemizygia bracteosa	Labiatae	20/11/05
MW/MSBP No. 360	Silene burchelli var. burchelli	Caryophllaceae	20/11/05
MW/MSBP No. 361	Helichrysum odoratissimum	Asteraceae	20/11/05
MW/MSBP No. 362	Helichrysum nudifolium	Astraceae	21/11/05
MW/MSBP No. 363	Wahlenbergia virgata	Campanulaceae	21/11/05

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MW/MSBP No. 364	Euphorbia mlanjeana	Euphorbiaceae	22/11/05
MW/MSBP No. 365	Richardia braziliensis	Rubiaceae	23/11/05
MW/MSBP No. 366	Knowltonia transvaalensis	Ranunculaceae	23/11/05
MW/MSBP No. 367	Valeriana capensis	Valerianaceae	23/11/05
MW/MSBP No. 368	Cyrtanthus welwitschii	Amaryllidaceae	23/11/05
MW/MSBP No. 369	Treculia africana	Moraceae	17/11/05
MW/MSBP No. 370	Acalypha psilostachya	Euphorbiaceae	24/11/05
MW/MSBP No. 371	Gladiolus dallenii	Iridaceae	20/11/05
MW/MSBP No. 372	Merxmuellera davyi	Poaceae	20/11/05
MW/MSBP No. 373	Panicum ecklonii	Poaceae	20/11/05
MW/MSBP No. 374	Hypoxis filiformis	Hypoxidaceae	21/11/05
MW/MSBP No. 375	Chlorophytum nidulans	Liliaceae	21/11/05
MW/MSBP No. 376	Herschelianthe baurii	Orchidaceae	21/11/05
MW/MSBP No. 377	Scilla hycinthina	Anthericeae	21/11/05
MW/MSBP No. 378	Polygala nyikensis	Polygalaceae	12/05/2005
MW/MSBP No. 379	Cephalaria pungens	Dipsacaceae	12/05/2005
MW/MSBP No. 380	Setaria sphacelata	Poaceae	12/06/2005
MW/MSBP No. 381	Hypericum scioanum	Guttiferae	12/06/2005
MW/MSBP No. 382	Cyperus articulatum	Cyperaceae	12/06/2005
MW/MSBP No. 383	Euphorbia schimperiana	Euphorbiaceae	12/07/2005
MW/MSBP No. 384	Satureja punctata	Labiatae	12/07/2005
MW/MSBP No. 385	Microglossa longiradiata	Asteraceae	12/07/2005
MW/MSBP No. 386	Salvia nilotica	Lamiaceae	12/07/2005
MW/MSBP No. 387	Clusena anisata	Rutaceae	12/08/2005
MW/MSBP No. 388	Dichrocephala intergrifolia	Asteraceae	12/08/2005
MW/MSBP No. 389	Carex conferta var. lyculus	Cyperaceae	12/09/2005
MW/MSBP No. 390	Aspilia mossambicensis	Asteraceae	12/04/2005
MW/MSBP No. 391	Scutellaria schweinfarthii	Lamiaceae	12/04/2005
MW/MSBP No. 392	Eugenia malangensis	Myrtaceae	12/04/2005
MW/MSBP No. 393	Fadogia stenophylla	Rubiaceae	12/04/2005
MW/MSBP No. 394	Eriosema burkei	Fabaceae	12/04/2005
MW/MSBP No. 395	Hypoxis goetzei	Hypoxidaceae	12/05/2005
MW/MSBP No. 396	Bulbine abyssinica	Liliaceae	12/05/2005
MW/MSBP No. 397	Costus sp	Zingiberaceae	13/12/05
MW/MSBP No. 398	Tabernaemontanum sp		13/12/05
MW/MSBP No. 400	Culcasia scandens	Aracaceae	16/12/05
MW/MSBP No. 401	Garcinia kingaensis	Guttiferae	16/12/05
MW/MSBP No. 402	Rawsonia lucida	Flacourtiaceae	16/12/05
MW/MSBP No. 403	Solanum sp	Solanaceae	16/12/05
MW/MSBP No. 404	Commelina neurophylla	Commelinaceae	02/01/2006
MW/MSBP No. 405	Thunbergia lancifolia	Acanthaceae	02/01/2006
MW/MSBP No. 406	Plectranthus acaulis	Labiatae	02/02/2006
MW/MSBP No. 407	Senecio inornatus	Asteraceae	02/02/2006
MW/MSBP No. 408	Dolichos kilimandscharicus	Papilionoideae	02/02/2006

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 409	Panicum claytonii	Gramineae	02/02/2006
MW/MSBP No. 410	Conyza aegyptiaca	Asteraceae	02/02/2006
MW/MSBP No. 412	Clutia abyssinica	Euphorbiaceae	02/02/2006
MW/MSBP No. 413	Berkeya zeyheri	Asteraceae	02/02/2006
MW/MSBP No. 414	Vernonia calyculata	Asteraceae	02/03/2006
MW/MSBP No. 415	Gerbera viridiflora	Asteraceae	02/03/2006
MW/MSBP No. 416	Kniphofia grantii	Liliaceae	02/03/2006
MW/MSBP No. 417	Plectranthus salubenii	Labiatae	02/03/2006
MW/MSBP No. 418	Lobelia ovina	Campanulaceae	02/03/2006
MW/MSBP No. 419	Gnidia fastigiata	Thymelaeceae	02/03/2006
MW/MSBP No. 420	Stachys pseudonigricans	Labiatae	02/06/2006
MW/MSBP No. 421	Oxalis chapmaniae	Oxalidaceae	02/03/2006
MW/MSBP No. 422	Berberis holstii	Berberidaceae	02/03/2006
MW/MSBP No. 423	Indigofera hedyantha	Papilionoideae	02/04/2006
MW/MSBP No. 424	Geranium vagans ssp vagans	Geraniaceae	02/04/2006
MW/MSBP No. 425	Halleria lucida	Scrophulariaceae	02/04/2006
MW/MSBP No. 426	Alepidea propinqua	Umbelliferae	02/06/2006
MW/MSBP No. 427	Anisopappus africana	Asteraceae	02/07/2006
MW/MSBP No. 428	Begonia rumpiensis	Begoniaceae	02/08/2006
MW/MSBP No. 429	Solanum aculeatissimum	Solanaceae	02/06/2006
MW/MSBP No. 430	Buchnera cryptocephala	Scrophulariaceae	02/06/2006
MW/MSBP No. 431	Rhamnus prenoides	Ramnaceae	03/01/2006
MW/MSBP No. 432	Cissampelos torulosa	Menispermaceae	03/01/2006
MW/MSBP No. 433	Bulbostylis macra	Cyperaceae	28/02/06
MW/MSBP No. 434	Buchnera lastii ssp lastii	Papilionoideae	28/02/06
MW/MSBP No. 435	Eriosema verdickii	Papilionoideae	27/02/06
MW/MSBP No. 436	Panicum inaequilaterum	Gramineae	27/02/06
MW/MSBP No. 437	Senecio proprior	Asteraceae	18/02/06
MW/MSBP No. 438	Senecio ruwenzoriensis	Asteraceae	18/02/06
MW/MSBP No. 439	Peucedanum eylesii	Apiaceae	20/02/06
MW/MSBP No. 440	Vaccinium exul	Vacciniaceae	24/02/06
MW/MSBP No. 441	Lasianthus kilimandscharicus	Rubiaceae	24/02/06
MW/MSBP No. 442	Strombosia sp	Olacaceae	24/02/06
MW/MSBP No. 443	Vernonia bainesii	Asteraceae	21/04/06
MW/MSBP No. 445	Digitaria uniglumis	Gramineae	21/04/06
MW/MSBP No. 446	Guizotia scabra	Asteraceae	21/04/06
MW/MSBP No. 447	Vernonia griseopapposa	Asteraceae	21/04/06
MW/MSBP No. 448	Plectranthus schizophyllus	Labiatae	21/04/06
MW/MSBP No. 449	Brachythrix sonchoides	Asteraceae	21/04/06
MW/MSBP No. 450	Spermacoce natalensis	Rubiaceae	21/04/06
MW/MSBP No. 451	Loudetia simplex	Gramineae	22/04/06
MW/MSBP No. 452	Baumiella imbricata	Apiaceae	22/04/06
MW/MSBP No. 453	Carduus nyassanus	Asteraceae	22/04/06
MW/MSBP No. 454	Brachythrix pawekiae	Papilionoideae	02/02/2006

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 455	Dovyalis macrocalyx	Flacourtiaceae	22/04/06
MW/MSBP No. 456	Melinis nerviglumis	Gramineae	22/04/06
MW/MSBP No. 457	Lapeirousia setifolia	Iridaceae	23/04/06
MW/MSBP No. 458	Monocymbium ceresiiforme	Gramineae	23/04/06
MW/MSBP No. 459	Frommia ceratophylloides	Apiaceae	23/04/06
MW/MSBP No. 460	Aeschynomene nyikensis	Papilionoideae	23/04/06
MW/MSBP No. 461	Eragrostis mollior	Gramineae	24/04/06
MW/MSBP No. 462	Bothriocline trifoliata	Asteraceae	24/04/06
MW/MSBP No. 463	Galium bussei	Rubiaceae	24/04/06
MW/MSBP No. 464	Impatiens polyantha	Balsaminaceae	24/04/06
MW/MSBP No. 465	Trifolium semipilosum	Fabaceae	25/04/06
MW/MSBP No. 466	Carex echinochloe	Cyperaceae	25/04/06
MW/MSBP No. 467	Ageratinastrum polyphyllum	Asteraceae	26/04/06
MW/MSBP No. 468	Bulbostylis filamentosa	Cyperaceae	26/04/06
MW/MSBP No. 469	Eriosema lebrunii	Fabaceae	26/04/06
MW/MSBP No. 470	Setaria grandis	Gramineae	27/04/06
MW/MSBP No. 471	Rubus apetalus	Rosaceae	27/04/06
MW/MSBP No. 472	Peucedanum sp	Apiaceae	28/04/06
MW/MSBP No. 473	Delphinium leroyi	Ranunculaceae	28/04/06
MW/MSBP No. 474	Disa robusta	Orchidaceae	28/04/06
MW/MSBP No. 475	Lefebvrea stuhlmanii	Apiaceae	29/04/06
MW/MSBP No. 476	Hyparrhenia cymbarica	Poaceae	29/04/06
MW/MSBP No. 478	Festtuca abyssinica	Graminaea or Poaceae	23/03/06
MW/MSBP No. 479	Tephrosia elongata	Papilionoideae/Fabaceae	24/03/06
MW/MSBP No. 480	Disa erubescens	Orchidaceae	24/03/06
MW/MSBP No. 481	Eriocaulon teusczii	Eriocaulaceae	31/03/06
MW/MSBP No. 482	Unknown please name there		31/03/06
MW/MSBP No. 483	Dierama densiflorum	Iridaceae	31/03/06
MW/MSBP No. 484	Moraea schimperi	Iridaceae	04/01/2006
MW/MSBP No. 485	Rulbostylis capillaris	Cyperaceae	04/02/2006
MW/MSBP No. 486	Cyperus melas	Cyperaceae	04/02/2006
MW/MSBP No. 487	Cyphia brummittii	Campanulaceae	04/03/2006
MW/MSBP No. 488	Crotalaria goetzei	Fabaceae	19/04/06
MW/MSBP No. 489	Daylepis butt-davyi	Flacourtiaceae	19/04/06
MW/MSBP No. 490	Crotalaria lachnophora	Fabaceae	06/05/2006
MW/MSBP No. 491	Otiophora stolzii	Rubiaseae	06/06/2006
MW/MSBP No. 492	Helichrysum petersii	Astraceae	06/06/2006
MW/MSBP No. 493	Wahlenbergia capitata	Campanulaceae	06/06/2006
MW/MSBP No. 494	Hyperrhenia dregeana	Gramineae	06/06/2006
MW/MSBP No. 495	Eragrostis congesta	Gramineae	06/06/2006
MW/MSBP No. 496	Helichrysum squamosa	Astraceae	06/06/2006
MW/MSBP No. 497	Eragrostis volkensii	Gramineae	06/06/2006
MW/MSBP No. 498	Aeolanthus bucherianus	Labiatae	06/06/2006
MW/MSBP No. 499	Cynoglosum lanceolatum	Boraginaceae	06/06/2006

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 500	Lobelia adnexa	Loberiaceae	06/07/2006
MW/MSBP No. 501	Helichrysum sulphureo-fuscum	Astraceae	06/07/2006
MW/MSBP No. 502	Selago thyrsoides Bak. Var. nyikensis	Selaginaceae	06/07/2006
MW/MSBP No. 503	Katschya aeschynomenoides	Papilionoideae	06/07/2006
MW/MSBP No. 504	Buchnera quadrifaria	Scrophulariaceae	06/08/2006
MW/MSBP No. 505	Dicoma anomara	Astraceae	06/08/2006
MW/MSBP No. 506	Dephinium dasycaulon	Ranunculaceae	06/08/2006
MW/MSBP No. 507	Aloe nuttii	Asphudalaceae	06/09/2006
MW/MSBP No. 508	Bulbostylis capillatis	Cyperaceae	06/09/2006
MW/MSBP No. 509	Icomum lineare	Labiatae	06/09/2006
MW/MSBP No. 510	Crotalaria abbreviata	Papilionoideae	06/09/2006
MW/MSBP No. 511	Olinia rochetiana	Oliniaceae	06/10/2006
MW/MSBP No. 512	Peucedanum heracleioides	Apiaceae	06/05/2006
MW/MSBP No. 513	Vernonia turbinella	Astraceae	06/07/2006
MW/MSBP No. 514	Inula mannii	Compositae	09/02/2006
MW/MSBP No. 515	Blumea crispata	Compositae	09/02/2006
MW/MSBP No. 516	Brachystegia glaucescens	Ceasalpiniodeae	09/03/2006
MW/MSBP No. 517	Aloe mzimbana	Asphodelaceae	09/03/2006
MW/MSBP No. 518	Achyrospermum cryptanthum	Labiateae	09/03/2006
MW/MSBP No. 519	Argyrolobium tomentosum	Papilionoideae	09/04/2006
MW/MSBP No. 520	Phaulopsis imbricata	Acanthaceae	09/04/2006
MW/MSBP No. 521	Abutilon longicuspe	Malvaceae	09/04/2006
MW/MSBP No. 522	Macrotyloma axillare	Fabaceae	09/04/2006
MW/MSBP No. 523	Cyperus angolensis	Cyperaceae	09/05/2006
MW/MSBP No. 524	Buchnera speciosa	Scrophulariaceae	09/05/2006
MW/MSBP No. 525	Prunus africana	Rosaceae	09/06/2006
MW/MSBP No. 526	Microglossa pyrifolia	Astraceae	09/06/2006
MW/MSBP No. 527	Dyschoriste fischeri	Acanthaceae	09/06/2006
MW/MSBP No. 528	Pentas schimperana	Rubiaceae	09/06/2006
MW/MSBP No. 529	Thunbergia alata	Acanthaceae	08/09/206
MW/MSBP No. 530	Leonotis myricifolia	Labiateae	07/10/2006
MW/MSBP No. 531	Sopubia manii	Scrophulariaceae	07/10/2006
MW/MSBP No. 532	Clematis chrysocarpa	Ranunculaceae	13/07/2006
MW/MSBP No. 533	Syzygium guineense	Myrtaceae	14/07/2006
MW/MSBP No. 534	Berkheya bipinnalifida	Asteraceae	16/07/2006
MW/MSBP No. 535	Otholobium foliosum	Fabaceae	17/07/2006
MW/MSBP No. 536	Lepidagathis sparsiceps	Acanthaceae	22/07/2006
MW/MSBP No. 537	Crocosmia aurea	Iridaceae	22/07/2006
MW/MSBP No. 538	Amphiasma luzuloides	Rubiaceae	22/07/2006
MW/MSBP No. 539	Vernonia exsertiflora	Asteraceae	26/07/2006
MW/MSBP No. 540	Hibiscus debeerstii	Malvaceae	26/07/2006
MW/MSBP No. 541	Flacourtia indica	Flacourtiaceae	29/07/2006
MW/MSBP No. 542	Dombeya acutangula	Sterculiaceae	30/07/2006
MW/MSBP No. 543	Abrus pulchellus	Fabaceae	30/07/2006

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBP No. 544	Turbina stenosiphon	Convolvulaceae	30/07/2006
MW/MSBP No. 545	Keetia foetida	Rubiaceae	08/12/2006
MW/MSBP No. 546	Vernonia galamansis	Astraceae	24/8/2006
MW/MSBP No. 567	Achyrospermum laterale	Labiatae	10/04/2006
MW/MSBP No. 568	Paveta gardeniifolia	Rubiaceae	17/10/2006
MW/MSBP No. 569	Pachystela brevipes	Sapotaceae	17/10/2006
MW/MSBP No. 570	Homalium africanum	Flacourtiaceae	18/10/2006
MW/MSBP No. 571	Cola mossambiscensis	Sterculiaceae	18/10/2006
MW/MSBP No. 572	Tiliacora funifera	Menispermaceae	18/10/2006
MW/MSBP No. 573	Senna specie	Papilionoideae/fabaceae	18/10/2006
MW/MSBP No. 547	Catha edulis	Celastraceae	11/11/2006
MW/MSBP No. 548	Plectranthus sp.	Labiatae	11/11/2006
MW/MSBP No. 549	Pentanisia schweinefuethiana	Rubiaceae	11/11/2006
MW/MSBP No. 550	Indigofera hillaris	Papilionoideae	11/11/2006
MW/MSBP No. 551	Conyza welwitschii	Astraceae	11/12/2006
MW/MSBP No. 552	Eriocaulon schmperi	Eriocaulaceae	11/12/2006
MW/MSBP No. 553	Helichysum angustifrondosum	Astraceae	11/12/2006
MW/MSBP No. 554	Vernonia fractiflora	Astraceae	11/12/2006
MW/MSBP No. 555	Rothmannia fischeri	Rubiaceae	11/12/2006
MW/MSBP No. 556	Asclepias nyikana	Ascripidaeceae	15/11/2006
MW/MSBP No. 557	Eragostis racemosa	Poaceae	15/11/2006
MW/MSBP No. 558	Ostreospermum monocephalum	Astraceae	15/11/2006
MW/MSBP No. 559	Pelargonium luridum	Geramiaceae	15/11/2006
MW/MSBP No. 560	Epilobium capense	Onagraceae	15/11/2006
MW/MSBP No. 561	Aeschynomene nyassana	Papilionoideae	16/11/2006
MW/MSBP No. 562	Lablab purpureus	Papilionoideae	17/11/2006
MW/MSBP No. 563	Solanacio mannii	Astraceae	17/11/2006
MW/MSBP No. 564	Acacia xanthophyloea	Papilionoideae	19/11/2006
MW/MSBP No. 565	Albizia anthelmintica	Mimosoideae	19/11/2006
MW/MSBP No. 566	Pluchea dioscoridis	Astraceae	19/11/2006
MW/MSBP No. 567	Achyrospermum laterale	Labiatae	10/04/2006
MW/MSBP No. 568	Paveta gardeniifolia	Rubiaceae	17/10/2006
MW/MSBP No. 569	Pachystela brevipes	Fabaceae	19/04/06
MW/MSBP No. 570	Homalium africanum	Flacourtiaceae	18/10/2006
MW/MSBP No. 571	Cola mossambiscensis	Sterculiaceae	18/10/2006
MW/MSBP No. 572	Tiliacora funifera	Menispermaceae	18/10/2006
MW/MSBP No. 573	Senna sp.	Papilionoideae/Fabaceae	18/10/2006
MW/MSBPNo.574	Maranthus floribunda	Chrysobalanaceae	122/12/2006
MW/MSBPNo.575	Oldefieldia dactylophylla	Euphorbiaceae	12/12/2006
MW/MSBPNo.576	Maprounea africana	Euphorbiaceae	13/12/2006
MW/MSBPNo.577	Dissotis princeps	Melastomataceae	14/12/2006
MW/MSBPNo.578	Gnidia buchananii	THYMELAEACEAE	14/12/2006
MW/MSBPNo.579	Musaenda arcuata	Rubiaceae	12/12/2006

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.580	Magnistipula butayei bangweolensis	Chrysobalanaceae	15/12/2006
MW/MSBPNo.581	Trichodesma ambecensis	Boraginaceae	15/12/2006
MW/MSBPNo.582	Aeschynomene mimosifolia	Papilionoideae/fabaceae	15/12/2006
MW/MSBPNo.583	Ochna katangensis	Ochnaceae	16/12/2006
MW/MSBPNo.584	Cyperus sp:	Cyperaceae	18/12/2006
MW/MSBPNo.585	Ziziphus mucronata sub sp rhodesica	Rhamnaceae	18/12/2006
MW/MSBPNo.586	Neojeffreya decurrens	Astraceae	13/12/2006
MW/MSBPNo.587	Hypoxis sp.	Hypoxidaceae	16/12/2006
MW/MSBPNo.588	Gardenia imperialis	Rubiaceae	03/08/2007
MW/MSBPNo.589	Eriosema chrysadenium	Papilionoideae	03/08/2007
MW/MSBPNo.590	Moraea natalensis	Iridaceae	03/08/2007
MW/MSBPNo.591	Cyperus obtusifolius var. obtusifolius	Cyperaceae	03/08/2007
MW/MSBPNo.592	Crassocephalum rubens	Astraceae	03/09/2007
MW/MSBPNo.593	Phyllanthus paxii	Euphobiaceae	03/09/2007
MW/MSBPNo.594	Phyllanthus ovalifolius	Euphobiaceae	03/09/2007
MW/MSBPNo.595	Sporobolus panicoides	Poaceae	03/09/2007
MW/MSBPNo.596	Phyllanthus angolensis	Euphobiaceae	03/10/2007
MW/MSBPNo.597	Cyperus laxus subsp. buchnolzii	Cyperaceae	03/11/2007
MW/MSBPNo.598	Leptactina benguelensis sub.p. pubescens	Rubiaceae	03/11/2007
MW/MSBPNo.599	Emelia coccinea	Compositae	03/11/2007
MW/MSBPNo.600	Lindernia bifolia	Schrophulariaceae	03/11/2007
MW/MSBPNo.601	Tapiphyllum cinerascens var. laevius	Rubiaceae	03/12/2007
MW/MSBPNo.602	Phyllanthus muellerianus	Euphobiaceae	13/03/2007
MW/MSBPNo.603	Breonardia salicina	Rubiaceae	13/03/2007
MW/MSBPNo.604	Heteropholis sultaca	Poaceae	14/03/2007
MW/MSBPNo.605	Gnidia chrysantha var. ignea	Thymelaeaceae	14/03/2007
MW/MSBPNo.606	Gnidia chrysantha var. chrysantha	Thymelaeaceae	14/03/2007
MW/MSBPNo.607	Aneilema hirtum	Commelinaceae	29/04/2007
MW/MSBPNo.608	Spermacose sp.	Rubiaceae	29/04/2007
MW/MSBPNo.609	Zornia glochidiata	Fabaceae	29/04/2007
MW/MSBPNo.610	Commelina sp. c.f. vogelii	Commelinaceae	29/04/2007
MW/MSBPNo.611	Spilanthes sp.	Asteraceae	29/04/2007
MW/MSBPNo.612	Diclis sp.	Scrophulariaceae	29/04/2007
MW/MSBPNo.613	Fuirena leptostachya	Cyperaceae	29/04/2007
MW/MSBPNo.614	Scleralia melanomphala	Cyperaceae	29/04/2007
MW/MSBPNo.615	Psychotria eminiana var. eminiana	Rubiaceae	30/04/2007
MW/MSBPNo.616	Indigofera nyassica	Fabaceae	30/04/2007
MW/MSBPNo.617	Tephrosia decora	Fabaceae	30/04/2007

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.618	Rhynchospora candida	Cyperaceae	30/04/2007
MW/MSBPNo.619	Ascolepis anthemiflora	Cyperaceae	30/04/2007
MW/MSBPNo.620	Indigofera fusco-setosa	Fabaceae	30/04/2007
MW/MSBPNo.621	Lippia baunnii	Verbenaceae	05/01/2007
MW/MSBPNo.622	Vernonia kayuniana	Asteraceae	05/01/2007
MW/MSBPNo.623	Myrothamnus flabellifolius	Myrothamnaceae	05/01/2007
MW/MSBPNo.624	Hypericophyllum elatum	Asteraceae	05/02/2007
MW/MSBPNo.625	Adenodolichos punctatus var. decumbens	Fabaceae	05/02/2007
MW/MSBPNo.626	Achyropsis laniceps	Amaranthaceae	05/02/2007
MW/MSBPNo.627	Ascolepis elata	Cyperaceae	05/02/2007
MW/MSBPNo.628	Albuca nyikensis	Hyacinthaceae	05/02/2007
MW/MSBPNo.629	Barleria lactiflora	Acanthaceae	05/02/2007
MW/MSBPNo.630	Sphaelanthus randii	Asteraceae	05/02/2007
MW/MSBPNo.631	Lipocarpha nana	Cyperaceae	05/03/2007
MW/MSBPNo.632	Balanite aegyptica	Balanitaceae	05/04/2007
MW/MSBPNo.633	Zonotriche inamoena	Poaceae	05/04/2007
MW/MSBPNo.634	Schoenoplectus lateriflorus var. lateriflorus	Cyperaceae	05/04/2007
MW/MSBPNo.635	Antopetitia abyssinica	Fabaceae	05/04/2007
MW/MSBPNo.636	Chamecrista absus	Fabaceae	05/05/2007
MW/MSBPNo.637	Pseudathria hookeri	Fabaceae	05/05/2007
MW/MSBPNo.638	Kohoutia longifolia	Rubiaceae	05/05/2007
MW/MSBPNo.639	Orabache minor	Scrophulariaceae	05/05/2007
MW/MSBPNo.640	Acalpha fimbriata	Euphorbiaceae	23/01/2007
MW/MSBPNo.641	Geranium mlanjense	Geraniaceae	05/06/2007
MW/MSBPNo.642	Kiggelaria africana	Flacourtiaceae	18/03/2007
MW/MSBPNo.643	Eragrostis aspera	Poaceae	19/03/2007
MW/MSBPNo.644	Bromus leptoclados	Poaceae	04/11/2007
MW/MSBPNo.645	Digitaria sp	Poaceae	04/11/2007
MW/MSBPNo.646	Helichrysum dichroolepis	Asteraceae	05/04/2007
MW/MSBPNo.647	Ixora schefflera	Rubiaceae	04/09/2007
MW/MSBPNo.648	Sporobolus piliferus	Poaceae	05/04/2007
MW/MSBPNo.649	Agrocharis incognita	Apiaceae	05/05/2007
MW/MSBPNo.650	Andropogoon laxus	Poaceae	16/06/2007
MW/MSBPNo.651	Cliffortia nitidula	Rosaceae	16/06/2007
MW/MSBPNo.652	Helichrysum sordidum	Asteraceae	16/06/2007
MW/MSBPNo.653	Erica kiwuensis	Ericaceae	16/06/2007
MW/MSBPNo.654	Aeollanthus nyasae	Labiatae	16/06/2007
MW/MSBPNo.655	Anthospermum whyteanum	Rubiaceae	16/06/2007
MW/MSBPNo.656	Plectranthus alboviolaceus	Asteraceae	16/06/2007
MW/MSBPNo.657	Streptocarpus milanjianus	Generiaceae	18/06/2007
MW/MSBPNo.658	Pterocelastrus echinatus	Celasteraceae	19/06/2007
MW/MSBPNo.659	Streptocarpus sp.	Generiaceae	18/06/2007
MW/MSBPNo.660	Panicum monticola	Poaceae	18/06/2007

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.661	Rapanea melanophloeos	Myrsinaceae	18/06/2007
MW/MSBPNo.662	Festuca africana	Poaceae	18/06/2007
MW/MSBPNo.663	Melinis minutiflora	Poaceae	20/06/2007
MW/MSBPNo.664	Maytenus acuminata var. uva-usi	Celasteraceae	19/06/2007
MW/MSBPNo.665	Acalpha chirindica	Euphorbiaceae	20/06/2007
MW/MSBPNo.666	Maytenus acuminata var. acuminata	Celasteraceae	20/06/2007
MW/MSBPNo.667	Polyscias fulva	Arariaceae	20/06/2007
MW/MSBPNo.668	Isolepia fruitans	Cyperaceae	21/06/2007
MW/MSBPNo.669	Tarenna neurophylla	Rubiaceae	22/06/2007
MW/MSBPNo.670	Vernonia holstii	Asteraceae	22/06/2007
MW/MSBPNo.671	Cyanotis lanata	Comelinaceae	22/06/2007
MW/MSBPNo.672	Encephalatos sp.	Zamiaceae	23/06/2007
MW/MSBPNo.673	Blepharis sol	Acanthaceae	08/01/2007
MW/MSBPNo.674	Eragrotis chapelieri	Poaceae	08/01/2007
MW/MSBPNo.675	Oldenlandia rosulata	Rubiaceae	08/01/2007
MW/MSBPNo.676	Mariscus chysocephalus	Cyperaceae	08/01/2007
MW/MSBPNo.677	Crotalari variegata	Papilionoideae	08/01/2007
MW/MSBPNo.678	Buchnera buchneroides	Schrophulariaceae	08/01/2007
MW/MSBPNo.679	Ocimum gratissmum	Labiatae	08/02/2007
MW/MSBPNo.680	Asparagus buchanani	Asparagaceae	08/02/2007
MW/MSBPNo.681	Inula shirensis	Asteraceae	08/02/2007
MW/MSBPNo.682	Drocera affinis	Droceraceae	08/02/2007
MW/MSBPNo.683	Sacciolepsis chevalieri	Poaceae	08/02/2007
MW/MSBPNo.684	Crotalaria aculeata	Papilionoideae	08/02/2007
MW/MSBPNo.685	Crotalaria arggrolobloides	Papilionoideae	08/02/2007
MW/MSBPNo.686	Crotalaria rogersii	Papilionoideae	08/02/2007
MW/MSBPNo.687	Cyperus unioloides	Cyperaceae	08/03/2007
MW/MSBPNo.688	Kyrringer pumila	Cyperaceae	08/03/2007
MW/MSBPNo.689	Eragrostis paterns	Poaceae	08/03/2007
MW/MSBPNo.690	Eriocaulon sp	Cyperaceae	08/03/2007
MW/MSBPNo.691	Tephrosia paniculata	Papilionoideae	08/03/2007
MW/MSBPNo.692	Thesium subaphyllum	Santalaceae	08/03/2007
MW/MSBPNo.693	Thesium fimbriatum	Santalaceae	08/03/2007
MW/MSBPNo.694	Crotalaria cephalotes	Papilionoideae	08/03/2007
MW/MSBPNo.695	Vernonia chloropappa	Asteraceae	17/08/2007
MW/MSBPNo.696	Crotalaria nigricans	Papilionoideae	08/03/2007
MW/MSBPNo.697	Floscopa glomerata	Commelinaceae	08/04/2007
MW/MSBPNo.698	Anthospermum Herbacium	Labiatae	08/04/2007
MW/MSBPNo.699	Tephrosia nyikensis	Papilionoideae	08/04/2007
MW/MSBPNo.700	Indigofera trachyphlla	Papilionoideae	08/04/2007
MW/MSBPNo.701	Crotalara caudata	Papilionoideae	08/04/2007
MW/MSBPNo.702	Wahlenbergia napiformis	Campanulaceae	08/04/2007
MW/MSBPNo.703	Aeollanthus engleri	Labiatae	08/04/2007

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.704	Drocera burkeana	Droceraceae	08/04/2007
MW/MSBPNo.705	Stomatanthes zambeziensis	Asteraceae	08/05/2007
MW/MSBPNo.706	Cyphia mafingensis	Campanulaceae	08/05/2007
MW/MSBPNo.707	Helichrysom tillandisifolum	Asteraceae	08/05/2007
MW/MSBPNo.708	Osteospermum vaillantii	Asteraceae	08/05/2007
MW/MSBPNo.709	Ficus verruculosa	Moraceae	08/05/2007
MW/MSBPNo.710	Crotalaria sparsifolia	Papilionoideae	08/08/2007
MW/MSBPNo.711	Euclea racemosa	Ebenaceae	08/05/2007
MW/MSBPNo.712	Sopubia lanata	Schrophulariaceae	08/08/2007
MW/MSBPNo.713	Piper capense v ar. Brachyrachis	Asteraceae	22/06/2007
MW/MSBPNo.714	Hibiscus surattensis	Malvaceae	15/07/2007
MW/MSBPNo.715	Coffea mufindiensis	Rubiaceae	15/07/2007
MW/MSBPNo.716	Psychotria peducularis	Rubiaceae	13/07/2007
MW/MSBPNo.717	Memecylon sansibaricum	Melastomataceae	13/07/2007
MW/MSBPNo.718	Aidia micrantha	Rubiaceae	13/07/2007
MW/MSBPNo.719	Psychotria sp	Rubiaceae	07/01/2007
MW/MSBPNo.720	Carissa sp	Apocynaceae	17/07/2007
MW/MSBPNo.721	Dicoma plantaginifolia	Asteraceae	08/04/2007
MW/MSBPNo.722	Calanthe sylvatica	Orchidaceae	08/05/2007
MW/MSBPNo.723	Gnidia nutans	Thymelaeceae	08/06/2007
MW/MSBPNo.724	Agathisanthemum globosom	Rubiaceae	08/09/2007
MW/MSBPNo.725	Rubia cordifolia	Rubiaceae	13/08/2007
MW/MSBPNo.726	Helichrysum dilucidum	Asteraceae	11/09/207
MW/MSBPNo.727	Helichrysum polioides	Asteraceae	11/09/207
MW/MSBPNo.728	Helichrysum syncephalum	Asteraceae	11/09/207
MW/MSBPNo.729	Erica milanjiana	Ericaceae	27/09/207
MW/MSBPNo.730	Erica austronyassana	Ericaceae	28/10/2007
MW/MSBPNo.731	Erica microdonta	Ericaceae	28/10/2007
MW/MSBPNo.732	Maytenus acuminata	Celastraceae	28/09/2007
MW/MSBPNo.733	Erica whyteana	Ericaceae	28/09/2007
MW/MSBPNo.734	Aster milanjiensis	Asteraceae	29/09/007
MW/MSBPNo.735	Hibiscus burtt-davyi	Malvaceae	29/09/007
MW/MSBPNo.736	Erica nyassana	Ericaceae	09/02/2007
MW/MSBPNo.737	Helichrysum bullulatum	Asteraceae	11/01/2007
MW/MSBPNo.738	Rendlia altera	Poaceae	11/01/2007
MW/MSBPNo.739	Pennisetum sphacelatum	Poaceae	11/03/2007
MW/MSBPNo.740	Euphorbia whyteana	Euphorbiaceae	11/03/2007
MW/MSBPNo.741	Mikania cordata	Asteraceae	13/10/2007
MW/MSBPNo.742	Hypoestes triflora	Acanthaceae	13/10/2007
MW/MSBPNo.743	Dioscorea shimperiana	Dioscoreaceae	17/10/2007
MW/MSBPNo.744	Senecio auriculatissimum	Asteraceae	27/10/2007
MW/MSBPNo.745	Isoglossa grandiflora	Acanthaceae	17/10/2007
MW/MSBPNo.746	Lobelia gibberoa	Campanulaceae	17/10/2007
MW/MSBPNo.747	Polystachya johnstonii	Orchidaceae	27/10/2007

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.748	Sonchus bipontini	Asteraceae	15/10/2007
MW/MSBPNo.749	Eriosema affine	Papilionoideae	13/10/2007
MW/MSBPNo.750	Plectranthus esculentus	Lamiaceae	14/10/2007
MW/MSBPNo.751	Polygonum senegalense	Polygonaceae	15/10/2007
MW/MSBPNo.752	Vernonia nesta	Asteraceae	15/10/2007
MW/MSBPNo.753	Senecio seretii	Asteraceae	17/10/2007
MW/MSBPNo.754	Helichrysum whyteanum	Asteraceae	27/10/2007
MW/MSBPNo.755	Acrocephalus sericeus	Labiatae	15/10/2007
MW/MSBPNo.756	Adenostemma mauritianum	Asteraceae	17/10/2007
MW/MSBPNo.757	Sesbania micrantha	Fabaceae	13/10/2007
MW/MSBPNo.758	Dyschoriste albiflora	Acanthaceae	14/10/2007
MW/MSBPNo.759	Dissotis canescens	Melastomataceae	13/10/2007
MW/MSBPNo.760	Elephantopus scaber	Asteraceae	13/10/2007
MW/MSBPNo.761	Brachystephanus africanus	Acanthaceae	17/10/2007
MW/MSBPNo.762	Crassula globularioides	Crassulaceae	17/10/2007
MW/MSBPNo.763	Aneilema dispermum	Commelinaceae	18/10/2007
MW/MSBPNo.764	Nelsonia canescens	Acanthaceae	14/10/2007
MW/MSBPNo.765	Sericostachys scandens	Amaranthaceae	17/10/2007
MW/MSBPNo.766	Cyperus digitatus	Cyperaceae	13/10/2007
MW/MSBPNo.767	Ipomea acuminata	Convolvulaceae	13/10/2007
MW/MSBPNo.768	Culcasia scandens	Araceae	17/10/2007
MW/MSBPNo.769	Acanthopale conifertiflora	Acanthaceae	18/10/2007
MW/MSBPNo.770	Aristolochia albida	Aristolochiaceae	12/10/2007
MW/MSBPNo.771	Hermannia grandulifera	Sterculiaceae	12/10/2007
MW/MSBPNo.772	Becium angustifolium	Labiatae	12/12/2007
MW/MSBPNo.773	Convolvulus sagittatus	Convolvulaceae	13/12/2007
MW/MSBPNo.774	Panicum drageanum	Poaceae	13/12/2007
MW/MSBPNo.775	Triumfetta welwitschii	Tiliaceae	13/12/2007
MW/MSBPNo.776	Abutilon mauritianum	Malvaceae	13/12/2007
MW/MSBPNo.777	Tridax procumbens	Asteraceae	18/12/2007
MW/MSBPNo.778	Alyscapus rugosus	Papilionoideae	17/12/2007
MW/MSBPNo.779	Acalypha polymorpha	Euphorbiaceae	15/12/2007
MW/MSBPNo.780	Dracaena reflexa	Agavaceae	15/12/2007
MW/MSBPNo.781	Fuerena pubescens	Cyperaceae	15/12/2007
MW/MSBPNo.782	Brachiaria bovonei	Poaceae	15/12/2007
MW/MSBPNo.783	Murdannia simplex	Commelinaceae	15/12/2007
MW/MSBPNo.784	Fuerstia angustifolia	Labiatae	15/12/2007
MW/MSBPNo.785	Phyllanthus nummularifolius	Euphorbiaceae	16/12/2007
MW/MSBPNo.786	Cremaspora triflora	Rubiaceae	16/12/2007
MW/MSBPNo.787	Ludwigia abyssinica	Ornagraceae	16/12/2007
MW/MSBPNo.788	Glinus lotoides	Molluginaceae	18/12/2007
MW/MSBPNo.789	Clerodendrum glabrum	Vebenaceae	28/02/2008
MW/MSBPNo.790	Commiphora mollis	Burseraceae	28/02/2008
MW/MSBPNo.791	Microchloa caffra	Poaceae	03/03/2008

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.792	Brachythrix pawekiae	Asteraceae	03/03/2008
MW/MSBPNo.793	Commelina subcucullata	Commelinaceae	03/03/2008
MW/MSBPNo.794	Pimpinella stadensis	Umbelliferaceae	03/03/2008
MW/MSBPNo.795	Panicum drageanum	Poaceae	03/03/2008
MW/MSBPNo.796	Digitaria diagonalis	Poaceae	03/04/2008
MW/MSBPNo.797	Panicum lukwangulense	Poaceae	03/04/2008
MW/MSBPNo.798	Thalictrum zernyi	Ranunculaceae	03/05/2008
MW/MSBPNo.799	Carex Manni	Cyperaceae	03/05/2008
MW/MSBPNo.800	Brachiaria brizantha	Poaceae	03/05/2008
MW/MSBPNo.801	Brachythrix glomerata	Asteraceae	03/05/2008
MW/MSBPNo.802	Loudetia simplex	Poaceae	03/06/2008
MW/MSBPNo.803	Senecio proprior	Asteraceae	03/06/2008
MW/MSBPNo.804	Linum volkensii	Linaceae	03/07/2008
MW/MSBPNo.805	Indigofera mimosoides	Papilionoideae	03/07/2008
MW/MSBPNo.806	Cineraria deltoidea	Asteraceae	03/07/2008
MW/MSBPNo.807	Conyza limosa	Asteraceae	24/01/08
MW/MSBPNo.808	Helichrysum goetzeanum	Asteraceae	24/01/08
MW/MSBPNo.809	Panicum nymphoides	Poaceae	20/02/08
MW/MSBPNo.810	Alloeochaete geniculata	Poaceae	20/02/08
MW/MSBPNo.811	Crassula sarcocaulis	Crassulaceae	21/02/08
MW/MSBPNo.812	Panicum pusillum	Poaceae	22/02/08
MW/MSBPNo.813	Begonia nyassensis	Begoniaceae	27/02/08
MW/MSBPNo.814	Alloeochaete gracillima	Poaceae	27/02/08
MW/MSBPNo.815	Polygala adamsonii	Polygalaceae	15/03/08
MW/MSBPNo.816	Eucomis autumnalis	Hyacinthaceae	17/04/08
MW/MSBPNo.817	Mollugo nudicaulis	Molluginaceae	14/04/08
MW/MSBPNo.818	Portulaca oleracea	Portulacaceae	14/04/08
MW/MSBPNo.819	Indigofera hirsuta	Papilionoideae	14/04/08
MW/MSBPNo.820	Indigofera demisa	Papilionoideae	14/04/08
MW/MSBPNo.821	Rhynchosia minima	Papilionoideae	14/04/08
MW/MSBPNo.822	Oncoba spinosa	Flacourtiaceae	14/04/08
MW/MSBPNo.823	Ocimum urticifolium	Labiatae	14/04/08
MW/MSBPNo.824	Panisetum polystachyon	Poaceae	14/04/08
MW/MSBPNo.825	Aristida hordeacea	Poaceae	14/04/08
MW/MSBPNo.826	Gomphrena celosioides	Amaranthaceae	15/04/08
MW/MSBPNo.827	Ammania auriculata	Lythraceae	15/04/08
MW/MSBPNo.828	Eclipta alba	Asteraceae	15/04/08
MW/MSBPNo.829	Echinochloa colonum	Poaceae	15/04/08
MW/MSBPNo.830	Glinus lotoides	Molluginaceae	15/04/08
MW/MSBPNo.831	Platostema africanum	Labiatae	15/04/08
MW/MSBPNo.832	Aeschynomene indica	Papilionoideae	15/04/08
MW/MSBPNo.833	Centrostachys aquatica	Amaranthaceae	15/04/08
MW/MSBPNo.834	Waltheria indica	Sterculiaceae	15/04/08
MW/MSBPNo.835	Panicum sp.	Poaceae	03/03/2008

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.836	Fimbristylis dichotoma	Cyperaceae	15/04/08
MW/MSBPNo.837	Arectra sessiliflora	Schrophulariaceae	17/04/08
MW/MSBPNo.838	Microtyloma africanus	Papilionoideae	17/04/08
MW/MSBPNo.839	Rhamnus prinoides	Rhamnaceae	18/04/08
MW/MSBPNo.840	Impatiens gomphophylla	Poaceae	03/04/2008
MW/MSBPNo.842	Paspalidium germinatum	Poacaeae	07/10/2008
MW/MSBPNo.842	Paspalidium germinatum	Poacaeae	07/10/2008
MW/MSBPNo.843	Wahlenbergia hirsuta	Campanulaceae	07/10/2008
MW/MSBPNo.844	Harungana madagascariensis	Guttiferae	07/11/2008
MW/MSBPNo.845	Calopogonium mucunoides	Fabaceae	07/11/2008
MW/MSBPNo.846	Entada rheedei	Mimosoideae	07/11/2008
MW/MSBPNo.847	Chloris gayana	Poacaeae	13/07/08
MW/MSBPNo.848	Gladiolus gregarius	Iridaceae	13/07/08
MW/MSBPNo.849	Faroa acaulis	Gentianaceae	13/07/08
MW/MSBPNo.850	Polygala melilotoides	Polygalaceae	13/07/08
MW/MSBPNo.851	Desmodium adscendens	Fabaceae	13/07/08
MW/MSBPNo.852	Rhynchosia elegans	Fabaceae	13/07/08
MW/MSBPNo.853	Cryptolepis producta	Ascripidaceae	14/07/08
MW/MSBPNo.854	Hyptis pectinata	Labiatae	14/07/08
MW/MSBPNo.855	Polygala albida	Polygalaceae	15/07/08
MW/MSBPNo.856	Otiophora caerulea	Rubiaceae	15/07/08
MW/MSBPNo.857	Crotalaria recta	Fabaceae	15/07/08
MW/MSBPNo.858	Terminalia kaiserana	Combretaceae	15/07/08
MW/MSBPNo.859	Leucas martinicensis	Labiatae	16/07/08
MW/MSBPNo.860	Plectranthus pubescens	Labiatae	16/07/08
MW/MSBPNo.861	Tephrosia radicans	Fabaceae	16/07/08
MW/MSBPNo.862	Caylusea abyssinica	Resedaceae	16/07/08
MW/MSBPNo.863	Geniosporum rotundifolium	Labiatae	31/07/08
MW/MSBPNo.864	Buchnera nuttii	Scrophulariaceae	31/07/08
MW/MSBPNo.865	Brachypodium flexum	Poacaeae	08/03/2008
MW/MSBPNo.866	Panicum fluviicola	Poacaeae	08/03/2008
MW/MSBPNo.867	Austrosynotis rectirama	Asteraceae	04/08//08
MW/MSBPNo.868	Tristachya bequaertii	Poacaeae	08/05/2008
MW/MSBPNo.869	Satureja myriantha	Labiatae	08/10/2008
MW/MSBPNo.870	Cineraria grandiflora	Asteraceae	08/10/2008
MW/MSBPNo.871	Gladiolus bellus	Iridaceae	26/04/08
MW/MSBPNo.872	Alloeochaete oreogena	Poacaeae	27/04/08
MW/MSBPNo.873	Clutia brassii	Euphorbiaceae	30/04/08
MW/MSBPNo.874	Senecio peltophorus	Asteraceae	30/04/08
MW/MSBPNo.875	Phyllanthus welwitschianus	Euphorbiaceae	06/04/2008
MW/MSBPNo.876	Helichrysum petiolatum	Asteraceae	19/07/08
MW/MSBPNo.877	Helichrysum panduratum	Asteraceae	19/07/08
MW/MSBPNo.878	Clutia conferta	Euphorbiaceae	08/01/2008
MW/MSBPNo.879	Satureja verneyana	Labiatae	08/02/2008
MW/MSBPNo.880	Flamingia grahaminiana	Leguminosae	23/09/2008
MW/MSBPNo.881	Stylosanthes fruticosa	Papilionoideae	22/09/20008

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.882	Macroptilium atropurpureum	Papilionoideae	23/09/2008
MW/MSBPNo.883	Ludwigia erecta	Onagraceae	23/09/2008
MW/MSBPNo.884	Hygrophila pobeguinii	Acanthaceae	23/09/2008
MW/MSBPNo.885	Triumfetta rhomboidea	Tiliaceae	23/09/2008
MW/MSBPNo.886	Rhynchosia viscosa	Papilionoideae	23/09/2008
MW/MSBPNo.887	Sida urens	Malvaceae	23/09/2008
MW/MSBPNo.888	Desmodium salicifolium	Papilionoideae	23/09/2008
MW/MSBPNo.889	Desmodium salisfolium	Papilionoideae	23/09/08
MW/MSBPNo.890	Achyrospermum laterale	Labiatae	24/09/2008
MW/MSBPNo.891	Cissampelos mucronata	Menispermaceae	24/09/2008
MW/MSBPNo.892	Dioscorea dumentorum	Dioscoreaceae	24/09/2008
MW/MSBPNo.893	Rhynchosia luteoola	Papilionoideae	24/09/2008
MW/MSBPNo.894	Entada abyssinica	Mimosoideae	25/09/2008
MW/MSBPNo.895	Plectranthus sylvaticus	Labiatae	25/09/2008
MW/MSBPNo.896	Plectranthus sp.	Labiatae	25/09/2008
MW/MSBPNo.897	Lindernia oliverana	Schrophulariaceae	26/09/2008
MW/MSBPNo.898	Hibiscus surratensis	Malvaceae	26/09/2008
MW/MSBPNo.899	Adenodolichos punctatus	Papilionoideae	27/09/2008
MW/MSBPNo.900	Eriosema engleriana	Papilionoideae	27/09/2008
MW/MSBPNo.901	Vincentella passargei	Sapotaceae	24/09/2008
MW/MSBPNo.902	Chenopodium sp	Chenopodiaceae	28/12/2008
MW/MSBPNo.903	Panicim sp	Poaceae	31/12/2008
MW/MSBPNo.904	Craterispermum schweinfurthiana	Rubiaceae	31/12/2008
MW/MSBPNo.905	Anisophyllea boehmii	Rhizophoraceae	31/12/2008
MW/MSBPNo.906	Combretum pentagonum	Combretareae	31/12/2008
MW/MSBPNo.907	Landolphia buchananii	Apocynaceae	31/12/2008
MW/MSBPNo.908	Hypoxis virosa	Hypoxidaceae	31/12/2008
MW/MSBPNo.909	Dorstenia walleri	Moraceae	31/12/2008
MW/MSBPNo.910	Leptoderris goetzii	Papilionoideae	31/12/2008
MW/MSBPNo.911	Merrenia tridentata	Convolvulaceae	31/12/2008
MW/MSBPNo.912	Blighia unijugata	Sapindaceae	01/01/2009
MW/MSBPNo.913	Hoslundia opposita	Labiatae	01/01/2009
MW/MSBPNo.914	Coccinia adoensis	Cucurbitaceae	01/01/2009
MW/MSBPNo.915	Margaretta rosea	Asclepidaceae	01/02/2009
MW/MSBPNo.916	Ochna leptoclada	Ochnaceae	01/04/2009
MW/MSBPNo.917	Cynotis speciosa	Commelinaceae	25/2/09
MW/MSBPNo.918	Lecas milanjiana	Labiatae	25/2/09
MW/MSBPNo.919	Dactyloctenium giganteum	Poaceae	25/2/09
MW/MSBPNo.920	Ceratotheca sesamoides	Pedaliaceae	26/2/09
MW/MSBPNo.921	Striga gesneriodes	Schrophulariaceae	26/2/09
MW/MSBPNo.922	Cissus integrifolia	Vitaceae	26/2/09
MW/MSBPNo.923	Phyllanthus pentandrius	Euphorbiaceae	26/2/09
MW/MSBPNo.924	Ocimum americanum	Labiatae	28/2/09
MW/MSBPNo.925	Kohautia caespitosa	Rubiaceae	28/2/09
MW/MSBPNo.926	kohautia cosinia	Rubiaceae	28/2/10

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.927	Euphorbia hirta	Euphorbiaceae	28/2/09
MW/MSBPNo.928	Phyllanthus leucanthus	Euphorbiaceae	28/2/09
MW/MSBPNo.929	Amaranthus graecizans	Amaranthaceae	28/2/09
MW/MSBPNo.930	Cordia senensis	Boraginaceae	03/01/2009
MW/MSBPNo.931	Indigofera pratiola	Papilionoideae	03/02/2009
MW/MSBPNo.932	Cissus grisea	Vitaceae	03/02/2009
MW/MSBPNo.933	Commelina benghalensis	Commelinaceae	03/03/2009
MW/MSBPNo.934	Hibiscus vitifolius	Malvaceae	03/03/2009
MW/MSBPNo.935	Celosia anthelmintica	Amaranthaceae	03/03/2009
MW/MSBPNo.936	Crotalaria sperocarpa	Papilionoideae	03/02/2009
MW/MSBPNo.937	Crotalaria sp.	Papilionoideae	03/02/2009
MW/MSBPNo.938	Desmodium sp.	Papilionoideae	03/02/2009
MW/MSBPNo.939	Carvalhoa camanulata	Apocynaceae	09/10/2008
MW/MSBPNo.940	Hyptis sp.	Lamiaceae	10/10/2008
MW/MSBPNo.941	Kniphofia mulanjiana	Asphodelaceae	16/02/2009
MW/MSBPNo.942	Pyrostria sp.	Rubiaceae	04/03/2009
MW/MSBPNo.943	Persicaria nepalense	Polygonaceae	04/06/2009
MW/MSBPNo.944	Hippocratea africana	Hippocrateaceae	27/07/2009
MW/MSBPNo.945	Turbina stenosiphon	Convovulaceae	27/07/2009
MW/MSBPNo.946	Pentas decora	Rubiaceae	27/07/2009
MW/MSBPNo.947	Crotalaria pilosflora	Papilionoideae	27/07/2009
MW/MSBPNo.948	Chamecrista parva	Papilionoideae	28/07/2009
MW/MSBPNo.949	Pycbostachys urticifolia	Lamiaceae	28/07/2009
MW/MSBPNo.950	Stomatanthes africana	Asteraceae	29/07/2009
MW/MSBPNo.951	Leonotis myricifolia	Lamiaceae	28/07/2009
MW/MSBPNo.952	Moraea macrantha	Iridaceae	28/07/2009
MW/MSBPNo.953	Panicum phragmitoides	Poaceae	30/07/2009
MW/MSBPNo.954	Streblochaete longiarista	Poaceae	30/07/2009
MW/MSBPNo.955	Kosteletzkya adoensis	Malvaceae	30/07/2009
MW/MSBPNo.956	Rumex bequaertii	Polygonaceae	30/07/2009
MW/MSBPNo.957	Vernonia wollastonii S.Moore	Asteraceae	30/07/2009
MW/MSBPNo.958	Lantana rhodesciensis	Verbenaceae	30/07/2009
MW/MSBPNo.959	Tragia brevipes	Euphorbiaceae	31/07/2009
MW/MSBPNo.960	Ammania prieuriana	Lythraceae	01/08/2009
MW/MSBPNo.961	Agelanthus fuellebornii	Loranthaceae	01/08/2009
MW/MSBPNo.962	Peddiea africana	Thymeliaceae	08/01/2009
MW/MSBPNo.963	Arthraxon micans	Poaceae	08/01/2009
MW/MSBPNo.964	Trichopteryx fruticulosa	Poaceae	08/02/2009
MW/MSBPNo.965	Bidens acuticaulis	Asteraceae	08/02/2009
MW/MSBPNo.966	Indigofela microcalyx	Papilionoideae	08/03/2009
MW/MSBPNo.967	Aristida jumiciformis	Poaceae	08/03/2009
MW/MSBPNo.968	Knipholia grantii	Asphodelaceae	08/05/2009
MW/MSBPNo.969	Selago thomsonnii var. caerulea	Schrophulariaceae	08/07/2009
MW/MSBPNo.970	Sebaea leiostyla	Gentianaceae	08/07/2009
MW/MSBPNo.971	Crotolaria bequaertii	Papilionoideae	08/06/2009

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.972	Crabbea velutiana	Acanthaceae	24/9/2009
MW/MSBPNo.973	Combretum kirkii	Crombretaceae	24/9/2009
MW/MSBPNo.974	Trichilia capitata	Meliaceae	24/9/2009
MW/MSBPNo.975	Blumea viscosa	Asteraceae	24/9/2009
MW/MSBPNo.976	Phyllanthus reticulatus	Euphorbiaceae	24/9/2009
MW/MSBPNo.977	Monechma debile	Acanthaceae	24/9/2009
MW/MSBPNo.978	Vernonia petersii	Asteraceae	24/9/2009
MW/MSBPNo.979	Vernonia poskeana	Asteraceae	24/9/2009
MW/MSBPNo.980	Sericostachys sp	Amaranthaceae	24/9/2009
MW/MSBPNo.981	Grewia forbesii	Tiliaceae	24/9/2009
MW/MSBPNo.982	Combretum padoides	Crombretaceae	24/9/2009
MW/MSBPNo.983	Indigofela fulvopilosa	Papilionoideae	25-09-09
MW/MSBPNo.984	Deinbolia nyikensis	Sapindaceae	25-09-09
MW/MSBPNo.985	Decorsea spp	Papilionoideae	25-09-09
MW/MSBPNo.986	Eragrostis trenula	Poaceae	25-09-09
MW/MSBPNo.987	Hyptis spicigera	Lamiaceae	25-09-09
MW/MSBPNo.988	Blumela axillaris	Astraceae	25-09-09
MW/MSBPNo.989	Sida alba	Malvaceae	25-09-09
MW/MSBPNo.990	Ipomea cairica	Convolvulaceae	26-09-09
MW/MSBPNo.991	Erythrophleum sualveolens	Caesalpinioideae	26-09-10
MW/MSBPNo.992	Hibiscus diversifolius	Malvaceae	27-09-09
MW/MSBPNo.993	Adenocarpus mannii	Papilionoideae	28-09-09
MW/MSBPNo.994	Sonchus Schweinfurthii	Astraceae	28-09-09
MW/MSBPNo.995	Hisbiscus Sp.	Malvaceae	28-09-09
MW/MSBPNo.996	Isoglossa substrobilina	Acanthaceae	28-09-09
MW/MSBPNo.997	Unidentified	Unidentified	28-09-09
MW/MSBPNo.998	Eiphorbia aspilosa	Euphorbiacea	28-09-09
MW/MSBPNo.999	Prunus africana	Rosaceae	30-09-09
MW/MSBPNo.1000	Helichrysum milne-redheadii	Astraceae	30-09-10
MW/MSBPNo.1001	Helichrysum kirkii	Astraceae	30-09-11
MW/MSBPNo.1002	Cymbopogon densiflorus	Poaceae	10/01/2009
MW/MSBPNo.1003	Plectranthus daviesii	Lamiaceae	10/01/2009
MW/MSBPNo.1004	Polygala macrostigma	Polygalaceae	10/02/2009
MW/MSBPNo.1005	Lannea katangensis	Anacardiaceae	21/12/09
MW/MSBPNo.1006	Maerua juncea	Capparaceae	19/12/09
MW/MSBPNo.1007	Persicaria limbata	Polygonaceae	19/12/09
MW/MSBPNo.1008	Strychnos potatorum	Loganiaceae	20/12/09
MW/MSBPNo.1009	Heliotropium ovalifolium	Boraginaceae	20/12/09
MW/MSBPNo.1010	Albizia graberrima var. grabrescens	Mimosoideae	20/12/09
MW/MSBPNo.1011	Dalbergia arbutifolia	Papilionoideae	20/12/09
MW/MSBPNo.1012	Ximenia caffra var. natalensis	Olacaceae	20/12/09
MW/MSBPNo.1013	Boscia mossambicensis	Capparaceae	21/12/09
MW/MSBPNo.1014	Panicum wiehei	Poaceae	09/02/2009
MW/MSBPNo.1015	Mascarenhasia arborescens	Apocynaceae	15/09/09
MW/MSBPNo.1016	Rinorea holtzii	Violaceae	28/10/09

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.1017	Lobelis spp.	Campanulaceae	11/02/2009
MW/MSBPNo.1018	Vernonia glabra	Asteraceae	01/12/2010
MW/MSBPNo.1019	Landolphia parvifolia	Apocynaceae	02/12/2010
MW/MSBPNo.1020	Rothmania engleriana	Rubiaceae	03/12/2010
MW/MSBPNo.1021	Maerua angolensis	Capparaceae	04/12/2010
MW/MSBPNo.1022	Hypoxis goetzei	Hypoxidaceae	05/12/2010
MW/MSBPNo.1023	Poa schimperiana	Poaceae	06/12/2010
MW/MSBPNo.1024	Jasminium spp	Oleaceae	07/12/2010
MW/MSBPNo.1025	Erythrina abyssinica	Papilionaceae	08/12/2010
MW/MSBPNo.1026	Conyza limosa	Asteraceae	09/12/2010
MW/MSBPNo.1027	Justicia anagalloides	Acanthaceae	10/12/2010
MW/MSBPNo.1028	Cymphostemma junceum	Vitaceae	11/12/2010
MW/MSBPNo.1029	Adenia lanceolate	Passifloraceae	12/12/2010
MW/MSBPNo.1030	Kigelia africana	Bignoniaceae	13/12/2010
MW/MSBPNo.1031	Juncus oxycarpus	Juncaceae	14/12/2010
MW/MSBPNo.1032	Helichrysum odoratissimum	Asteraceae	15/12/2010
MW/MSBPNo.1033	Carex conferta	Cyperaceae	16/12/2010
MW/MSBPNo.1034	Vernonia incompta	Asteraceae	17/12/2010
MW/MSBPNo.1035	Cyperus micranthus	Cyperaceae	18/12/2010
MW/MSBPNo.1036	Asparagus virgatus	Asparagaceae	19/12/2010
MW/MSBPNo.1037	Crotalaria subcaespitosa	Malvaceae	27-09-09
Papilionaceae	20/12/2010	Papilionoideae	28-09-09
MW/MSBPNo.1038	Vernonia natalensis	Astraceae	28-09-09
Asteraceae	21/12/2010	Malvaceae	28-09-09
MW/MSBPNo.1039	Triumfeta welwitschii	Acanthaceae	28-09-09
Tiliaceae	22/12/2010	Unidentified	28-09-09
MW/MSBPNo.1040	Senecio spp	Euphorbiacea	28-09-09
Asteraceae	23/12/2010	Rosaceae	30-09-09
MW/MSBPNo.1041	Biophytum nyikense	Astraceae	30-09-10
Oxalidaceae	24/12/2010	Astraceae	30-09-11
MW/MSBPNo.1042	Aster tansaniensis	Poaceae	10/01/2009
Asteraceae	25/12/2010	Lamiaceae	10/01/2009
MW/MSBPNo.1043	Phacelurus huillensis	Polygalaceae	10/02/2009
Poaceae	26/12/2010	Anacardiaceae	21/12/09
MW/MSBPNo.1044	UNKNOWN	Rubiaceae	27/12/2010
MW/MSBPNo.1045	Eleocharis acutangula	Polygonaceae	19/12/09
Cyperaceae	28/12/2010	Loganiaceae	20/12/09
MW/MSBPNo.1046	Wahlenbergia subaphylla	Boraginaceae	20/12/09
Campanulaceae	29/12/2010	Mimosoideae	20/12/09
MW/MSBPNo.1047	Tephrosia aequilata Bak.	Papilionoideae	20/12/09
Papilinoideae	30/12/2010	Olacaceae	20/12/09
MW/MSBPNo.1048	Merxmueller burtt-davyii (C.E hubb) connert	Poaceae	31/12/2010
MW/MSBPNo.1049	Chlorophytum glabriflorum C.H. Wright.	Anthericaceae	01/01/2011
MW/MSBPNo.1050	Alloechaete oreogena Launert	Apocynaceae	15/09/09

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MW/MSBPNo.1051	Erica sp.	Ericaceae	03/01/2011
MW/MSBPNo.1052	Rhus monticola Meikle	Anacardiaceae	04/01/2011
MW/MSBPNo.1053	Senecio sp.	Astraceae	05/01/2011
MW/MSBPNo.1054	Ixora nacissodora Schum & K. Krausie	Rubiaceae	06/01/2011
MW/MSBPNo.1055	Polystachya albescens Ridley	Orchidaceae	07/01/2011
MW/MSBPNo.1056	Adenocarpus manii (Hook.F) Hook F.	Fabaceae	08/01/2011
MW/MSBPNo.1057	Coleochloa setifera (Ridley) Gilly.	Cyperaceae	09/01/2011
MW/MSBPNo.1058	Widdringtonia nodiflora	Cupressaceae	10/01/2011
MW/MSBPNo.1059	Mimulopsis solmsii Schweinf.	Acanthaceae	11/01/2011
MW/MSBPNo.1060	Oldenlandia rupicola (Sand) Kuntze var. rupicola	Rubiaceae	12/01/2011
MW/MSBPNo.1061	Crassula sarcocaulis	Crassulaceae	13/01/2011
MW/MSBPNo.1062	Gisekia pharnaceoides L. var. phanaceoides	Aizoaceae	14/01/2011
MW/MSBPNo.1063	Misopates erontium	Scrophulariaceae	15/01/2011
MW/MSBPNo.1064	Oxyanthus speciosus	Rubiaceae	16/01/2011
MW/MSBPNo.1065	Sporobolus olivaccus	Poaceae	17/01/2011
MSBP/MWNo.1066	Brachieria bovonei	Poaceae	18/01/2011
MSBP/MWNo.1067	Panicum graniflorum	Poaceae	19/01/2011
MSBP/MW No.1068	Panicum spp	Poaceae	20/01/2011
MSBP/MWNo.1069	Dactyloclenium aegyptium	Poaceae	21/01/2011
MSBP/MWNo.1070	Sporobolus kentrophyllus	Poaceae	22/01/2011
MSBP/MWNo.1071	Digitaria ganzensis	Poaceae	23/01/2011
MSBP/MWNo.1072	Perotis patens	Poaceae	24/01/2011
MSBP/MWNo.1073	Hyperrhenia nyassae	Poaceae	25/01/2011
MSBP/MWNo.1074	Sporobolus myrianthus	Poaceae	26/01/2011
MSBP/MWNo.1075	Panicum maximum	Poaceae	27/01/2011
MSBP/MWNo.1076	Melinis repens	Poaceae	28/01/2011
MSBP/MWNo.1077	Hyparrhenia cymbarica	Poaceae	29/01/2011
MSBP/MWNo.1078	Zehneria scabra	Curcubifaceae	30/01/2011
MSBP/MWNo.1079	Not identified		31/01/2011
MSBP/MWNo.1080	Digitaria maitlandii	Poaceae	01/02/2011
MSBP/MWNo.1081	Dicliptera mossambicensis	Acanthaceae	02/02/2011
MSBP/MWNo.1082	Rorippa micrantha	Cruciferae	03/02/2011
MSBP/MWNo.1083	Glinus lotoides	Aizoaceae	04/02/2011
MSBP/MWNo.1084	Mimosa pigra	Mimosoideae	05/02/2011
MSBP/MWNo.1085	Mullugo sp.	Molluginaceae	06/02/2011
MSBP/MWNo.1086	Cycnium brevipedicellata	Scrophulariaceae	07/02/2011
MSBP/MWNo.1087	Ludwigia abyssinica	Onagraceae	08/02/2011
MSBP/MWNo.1088	Zaleya pentandra	Azoaceae	09/02/2011
MSBP/MWNo.1089	Heliopium ovalifolium	Boraginaceae	10/02/2011
MSBP/MWNo.1090	Heliotropium indicum	Boraginaceae	11/02/2011
MSBP/MWNo.1091	Diospyros senensis	Ebenaceae	12/02/2011
MSBP/MWNo.1092	Bacilicum polystachyon	Labiatae	13/02/2011
MSBP/MWNo.1093	Trianthera portulacastrum	Aizoaceae	14/02/2011

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MSBP/MWNo.1095	Tragiella friesiana	Euphorbiaceae	15/02/2011
MSBP/MWNo.1096	Grangea maderaspatana	Euphorbiaceae	16/02/2011
MSBP/MWNo.1097	Wiltheria indica	Sterculiaceae	17/02/2011
MSBP/MWNo.1098	Widdringtonia whytei	Cupressaceae	18/02/2011
MSBP/MWNo.1099	Ficus ingens	Moraceae	19/02/2011
MSBP/MWNo.1100	Talinum portulacifolium	Portulacaceae	20/02/2011
MSBP/MWNo.1101	Panicum lukwangulense	Poaceac	21/02/2011
MSBP/MWNo.1102	Oryza barthii	Poaceac	22/02/2011
MSBP/MWNo.1103	Pardiaka carsonii	Amarantheceae	23/02/2011
MSBP/MWNo.1104	Cephalocroton mollis	Euphurbiaceae	24/02/2011
MSBP/MWNo.1105	Echinochloa pyramidalis	Poaceae	25/02/2011
MSBP/MWNo.1106	Leersia hexandra	Poaceae	26/02/2011
MSBP/MWNo.1107	Commelina nyasensis	Commelinaceae	27/02/2011
MSBP/MWNo.1108	Aristida textilis	Poaceae	28/02/2011
MSBP/MWNo.1109	Phyllanthus maderasptensis	Euphobiaceae	01/03/2011
MSBP/MWNo.1110	Schmittia pappophoroides	Poaceae	02/03/2011
MSBP/MWNo.1111	Paricum trichocladum	Poaceae	03/03/2011
MSBP/MWNo.1112	Crotalaria sp.	Fabaceae	04/03/2011
MSBP/MWNo.1113	Ormocarpum trichocarpum	Papilionoideae	05/03/2011
MSBP/MWNo.1114	Euphorbia transvaalensis	Euphobiaceae	06/03/2011
MSBP/MWNo.1115	Tragia okanyua	Euphobiaceae	07/03/2011
MSBP/MWNo.1116	Ficus abutifolia	Moraceae	08/03/2011
MSBP/MWNo.1117	Gomprena celosiodes	Amaranthaceae	09/03/2011
MSBP/MWNo.1118	Sphaeranthus angolensis	Astraceae	10/03/2011
MSBP/MWNo.1119	Pseudognaphalium luteo-album	Asteraceae	11/03/2011
MSBP/MWNo.1120	Erogrostis arenicola	Poaceae	12/03/2011
MSBP/MWNo.1121	Melanthera scandens	Astraceae	13/03/2011
MSBP/MWNo.1122	Spilanthes mauritiana	Astraceae	14/03/2011
MSBP/MWNo.1123	Solenostemon shirensis	Labiatae	15/03/2011
MSBP/MWNo.1124	Nuxia oppositiflora	Buddlejaceae	16/03/2011
MSBP/MWNo.1125	Olax disitiflora	Oleaceae	17/03/2011
MSBP/MWNo.1126	Opilia amentallea	Opiliaceae	18/03/2011
MSBP/MWNo.1127	Synaptolepis alternifolia	Asclepidaceae	19/03/2011
MSBP/MWNo.1128	Faurea saligna	Proteaceae	20/03/2011
MSBP/MWNo.1129	Tricalysia acocantheroides	Rubiaceae	21/03/2011
MSBP/MWNo.1130	Aporhiza paniculata	Sapindaceae	22/03/2011
MSBP/MWNo.1131	Drypetes natalensis	Euphorbiaceae	23/03/2011
MSBP/MWNo.1132	Trilepisium madagascariensis	Moraceae	24/03/2011
MSBP/MWNo.1133	Browallia americana	Solanaceae	25/03/2011
MSBP/MWNo.1134	Hyperrhenia nyassae	Poaceae	26/03/2011
MSBP/MWNo.1135	Rhynchosia minama	Papilionoideae	27/03/2011
MSBP/MWNo.1136	Momordica foetida	Cucurbitoceae	28/03/2011
MSBP/MWNo.1137	Caylusea adyssinica	Resedaceae	29/03/2011
MSBP/MWNo.1138	Rumex baquaertii	Polygobaceae	30/03/2011
MSBP/MWNo.1139	Schoenoplectus corymeosus	Cyperaceae	31/03/2011
MSBP/MWNo.1140	Indigofera homblei	Fabaceae	01/04/2011

IDENTITY No	BOTANICAL IDENTITY	FAMILY	COLLECTION DATE
MSBP/MWNo.1141	Solenostemon shirensis	Lamiaceae	02/04/2011
MSBP/MWNo.1142	Rhynchosia hirta	Fabaceae	03/04/2011
MSBP/MWNo.1143	Cyperus involucratus	Cyperaceae	04/04/2011
MSBP/MWNo.1144	Datura stramonim	Solanaceae	05/04/2011
MSBP/MWNo.1145	Euclea raremosa	Ebenaceae	06/04/2011
MSBP/MWNo.1146	Crotalaria bequuartii	Fabaceae	07/04/2011
MSBP/MWNo.1147	Helichrysum argyrosphaerum	Asteraceae	08/04/2011
MSBP/MWNo.1148	Indigofera tenuis	Fabaceae	09/04/2011
MSBP/MWNo.1149	Cardiospermum halicacabum	Sapindaceae	10/04/2011
MSBP/MWNo.1150	Ficus gnaphalocarpa	Moraceae	11/04/2011
MSBP/MWNo.1151	Toddalia asiatica	Rutacaea	12/04/2011
MSBP/MWNo.1152	Drymaria cordata	Caryophyllaceae	13/04/2011
MSBP/MWNo.1153	Droguetia iners.	Urticaceae	14/04/2011
MSBP/MWNo.1154	Solanecio mannii	Asteraceae	15/04/2011
MSBP/MWNo.1155	Dyschoriste albiflora	Acanthaceae	16/04/2011
MSBP/MWNo.1156	Mellera submuttica	Acanthaceae	17/04/2011
MSBP/MWNo.1157	Clinopodium sp.	Lamiaceae	18/04/2011
MSBP/MWNo.1158	Rubus rigidus	Rosaceae	19/04/2011
MSBP/MWNo.1159	Phyllanthus muellerianus	Euphorbiaceae	20/04/2011
MSBP/MWNo.1160	Crotolaria psidiodes	Fabaceae	21/04/2011
MSBP/MWNo.1161	Acanthospermum australe	Asteraceae	22/04/2011
MSBP/MWNo.1162	Clerodendrum myricoides	Verbanaceae	23/04/2011
MSBP/MWNo.1163	Welleria mackenzii	Tecophilaeaceae	24/04/2011
MSBP/MWNo.1164	Cyperus mundittii	Cyperaceae	25/04/2011
MSBP/MWNo.1165	Acalypha segatalis	Euphorbiaceae	26/04/2011
MSBP/MWNo.1166	Acalypha villicaulis	Euphorbiaceae	27/04/2011
MSBP/MWNo.1167	Ehretia obtusifolia	Boraginaceae	28/04/2011
MSBP/MWNo.1168	Justicia phyllostachys	Acanthaceae	29/04/2011
MSBP/MWNo.1169	Orthosiphon allenii	Lamiaceae	30/04/2011
MSBP/MWNo.1170	Senecio inornatus	Asteraceae	01/05/2011
MW/MSBP No. 1171	Ascolepis elata	Cyperaceae	02/05/2011
MW/MSBP No. 1172	Asparagus laricinus	Asparagaceae	03/05/2011
MW/MSBP No. 1173	Rotala wildii	Lythraceae	04/05/2011
MW/MSBP No. 1175	Boehrophylla macrophylla	Urticaceae	06/05/2011
MW/MSBP No. 1176	Asystasia malawiana	Acanthaceae	07/05/2011
MW/MSBP No. 1177	Cyperus pseudoleptocladus	Cyperaceae	08/05/2011
MW/MSBP No. 1178	Ehretia ovalifolius	Boraginaceae	09/05/2011
MW/MSBP No. 1179	Schkuria pinnata	Asteraceae	10/05/2011

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