THE JOINT SONGWE RIVER BASINCOMMISSION

SONGWECOM
Where it flows, communities grow

TRANSBOUNDARY DIAGNOSTIC ANALYSIS

Final Report

SEPTEMBER, 2023

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EXECUTIVE SUMMARY

Background

The Songwe River Basin (SRB) is part of the wider Zambezi River Basin with estimated area of 4,243 km$^{2)}$ drained by the Songwe River shared and marking a formal border between Tanzania and Malawi (55% and 45% respectively). Due to degradation of the riverbanks and the riparian catchments, the river changes its course occasionally in cases of flash floods shifting the formal border of the two countries. Studies have shown the major drivers of environmental degradation are growing population (25% in the past decade to current total of around 425,504 people[1] of which 62% are in Tanzania), unsustainable farming practices, deforestation, and land degradation. The degradations are posing danger to life, properties and infrastructure including human and ecosystem health, food and energy security, threatening political and social stability. Due to these challenges in the basin, riparian countries ratified a Convention that established a Joint Songwe River Basin Commission (SONGWECOM) in May 2017, resulting in SRBDP which is designed to deliver a Shared Vision 2050 i.e., Utilizing the basin's natural resources for sustainable and inclusive socio-economic development, and reducing the adverse impacts associated with floods in the lower basin".

Amongst the SRBDP projects, is the implementation of "Strengthening Transboundary Cooperation and Integrated Natural Resource Management in the Songwe River Basin (STCINRM-SRB)". The latter is to enhance cooperation for sustainable management of transboundary natural resources and strengthening institutional capacity which includes undertaking Transboundary Diagnostic Analysis (TDA) and Strategic Action Planning (SAP). This TDA report entails a collaboratively drawn information in 6 thematic areas (i.e., ecosystem and biodiversity, water resource, land resource, climate change, socioeconomics, and governance) to underscore stakeholders' views and empirical evidence to inform the politically negotiated SAP process.

The Approach and Methodology

The Global Environment Facility (GEF) methodology for TDA/SAP process was the overall approach used. The GEF's TDA/SAP framework is basically vested in three activities: 1) Identification and prioritisation the transboundary problems in the SRB; 2) Analysis of the impacts of the prioritized transboundary problems; and 3) Causal chain analysis to underpin immediate, underlying, and root cause of each priority problem. The transboundary problems were discussed, verified and added-on across different levels of stakeholders' consultations at different levels in district and regional technocrats and planners, local communities, local public dialogues and higher-level consultations. Key analyses were done for the water resources (meteorological and hydrological changes over time and projection of water demand by sectors), land resource (soil loss and erosion risk, and aridity analysis), climate change (projection of basin's temperature and rainfall circa 2025, 2035 and 2050 using Global Circulation Models – GCMs), Socio-economic (income poverty, estimation of

[1] SONGWECOM TDA 2023 estimates

returns from key growth sectors), Governance (existing policies, legislations, strategies, plans, conventions and agreements at all levels).

Major Findings and Implications for Management of Transboundary Natural Resources

The vegetation types in SRB are classified into Natural and Modified habitats based on the criteria within the IFC performance standard 6. The Lower Songwe River is an important breeding area for fish endemic to the area and Lake Malawi/Nyasa. The river and nearshore habitat degradation has led to declining of potamodromous fishes (mpasa and nchila). Although fisheries and gears involved are regulated, especially on Tanzanian side, most fishermen apply in random the gill nets, fish traps, hand lines, long lines and mosquito nets. Increased use of fertilisers in agriculture is exacerbating phytoplankton blooms, and hence a shift in species dominance whereas *Planktolyngbya tallingi*, has been replacing *Planktolyngbya nyassensis*. The major problem identified is ecosystem degradation, resulting to loss of ecosystem services, loss of income and reduced ability of the communities to mitigate the impacts. Lack of integrated ecosystem-based approach to natural resource management and limited knowledge on ecosystems were major root causes of ecosystem degradation. The chain of ecosystem degradation from forest to agro ecosystems have affected aquatic ecosystems leading to 20 species of fish endemic to lake Malawi/Nyasa to be critically endangered and one to be extinct (*Labeo worthingtoni*) according AUCN red list.

The land resource in SRB is characterized by pre-Cambrian gneiss rocks of various types and Karroo rocks in Malawi stretch from the confluence of Makeye and Songwe river for about two kilometres upstream. The upper catchment lays on a rocky basement with alluvial soils in its depression/valleys which are fertile and of good quality, coupled with poor land management and unreliable rainfall. Loss of forest area to cultivation, pressure for timber, and charcoal, shifting cultivation are features of the upper sub-basin. Legumes (beans, cowpeas and groundnuts) and cereals (Maize) are common throughout the basin. Main crop in lower sub-basin is rice. Analysis over the past three decades from 1990 to 2020 showed 62% decline of woodland while agriculture has increased 200% in the same period. This is attributed to increase in population, land for agriculture, bushfires, grazing and shifting cultivation. Ileje, Mbeya, Mbozi, Chitipa and Karonga districts have 50% 51%, 52%, 35%, 34% land areas with erosion rate greater than 10 tons/ha/year which is above tolerable losses. Kyela and Momba districts have lowest erosion risks at 84% and 87% of land areas under very slight to slight erosion (0 – 5 ton/ha/yr). Promoting sustainable agricultural intensification and access to sustainable and energy efficient cooking technologies as well other energy efficient technologies are recommended to mitigate the degradation of the land resource and ensure sustainable watershed management.

SRB experiences an average annual rainfall of approximately 1,482 mm, with an average runoff of 440 mm/year, the middle section of the basin, rainfall exhibits high variability, ranging from 1000 to 2500 mm/year with corresponding runoff levels varying from 100 to 250 mm/year. The basin has experienced warming trends in night temperatures (minimum temperatures) with annual increase of approximately 0.02 degree Celsius during the past 30 years while this may cause rapid plant growth and maturity it may indicate general temperature increase which in turn elevates the evaporative water demand. Downscaled future climate indicated an increasing future annual mean rainfall trend compared to the long-term average. Comparing the future (2021-2050) projection with historical (1991-2020) results shows increase in number of rainy days during NDJFMA season in the future period. Continued community engagement and capacity building on climate risks, adaptation and mitigation focusing on sustainable land and water management practices, promoting

efficient irrigation techniques, and reducing water pollution to enhance resilience of agricultural systems may reduce climate change related problems.

Findings reveal that the water resources in the SRB, as measured by the total annual runoff, amounted to approximately 994.2 million cubic meters (MCM) in 2022. Projections indicate an increase to 1060.8 MCM/year by 2025 and a further rise to 1190.9 MCM/year by 2035. However, there is an anticipated decline in annual runoff, reaching 934.7 MCM/year by 2050, representing a 6% reduction. This decrease is primarily attributed to the effects of climate change, including higher temperatures and reduced rainfall in the region.

The flow of the Songwe River closely mirrors rainfall patterns, resulting in higher flows during the wet season and decreased availability during the dry season, which impacts overall water availability. Irregular rainfall and human activities such as deforestation and cultivation on steep terrain exacerbate water scarcity issues. To address these challenges, sustainable land management, reforestation efforts, and water conservation measures are essential for ensuring a consistent water supply throughout the year.

The population growth in the basin has implications on the natural resources and other social systems. Around the beginning of the past century (2013-2015), the basin had a population of about 341,104 that was projected to increase to about 537,000 people by 2025. Malawi, youth unemployment is estimated around 23% with the target of reducing it to 18% and 6% by 2030 and 2063, respectively. In Tanzania, youth unemployment is estimated around 10%, but with apparent skews against female and rural youths – i.e., 7 vs. 13% and 8 vs. 12%, respectively. The two countries have youth-focused flagship development initiatives namely, Building a Better Tomorrow – Youth Initiative for Agribusiness (BBT-YIA) 2022-2030 in Tanzania and Shire Valley Transformation Program (SVTP) 2018-2030 in Malawi. Most of national perspectives (in development plans) are not generalizable at subnational scale. Sustainable improvement of productivity and production, value addition and optimization of circular opportunities would increase returns on investment in the agricultural sectors and attract unemployed youths.

Policy, legislative and institutional arrangements for both riparian countries was deemed important in terms of governance mechanisms to oversee how effective the structures to drivers and barriers to effective water and/or natural resources management of the Songwe River Basin. Regional and national poverty frameworks are key governance structures in the short term for SRB as they contain a perfect mix of development policies, strategies, plans, programmes and projects which are mainly preoccupied with reducing and eradicating poverty at all levels SRB included.

Conclusions

The Songwe River Basin (SRB), a basin rich in natural resources and biodiversity, faces complex environmental and socio-economic challenges that require immediate attention. Environmental issues include deforestation, land and water degradation, declining ecosystems, biodiversity loss, and increased siltation and soil erosion due to human activities. Socio-economic challenges in the SRB encompass widespread poverty, inadequate education systems, underdeveloped transportation networks, a growing youth population, and unsustainable energy practices. These problems have both cross-border and localized impacts with transboundary consequences.

Governance issues are at the heart of these challenges and span all thematic areas. Problems include incoherent national policies for river basin management, inadequate enforcement

of environmental, water, and land regulations, weak institutional capacity, political interference in regulation and enforcement, land tenure insecurity, lack of socio-economic data for policy support, insufficient financial resources for transboundary issues, and a lack of awareness about the cultural and economic value of SRB ecosystem goods and services.

Existing conventions and regional institutions play a role in promoting transboundary cooperation and integrated natural resource management but have deficiencies. These include weak enforcement mechanisms in conventions like UNFCCC and Kyoto Protocol, influence from major powers, the need for cross-sectoral approaches to biodiversity issues, a proliferation of conventions, and a shortage of trained professionals in relevant areas.

Recommendations

Addressing the challenges in the Songwe River Basin (SRB) is crucial for achieving sustainable socio-economic progress and realizing Vision 2050. Balancing natural resource preservation with improving residents' quality of life is essential, requiring action on deforestation, resource degradation, poverty, education, infrastructure, and sustainable energy. To address these challenges, ecologically sound and harmonized policies and laws must be enforced, supported by strong institutions at all levels. Key recommendations include:

1. **Government Commitment**: Both governments must commit to addressing transboundary governance issues, sustaining high-level political goodwill and resources for collaborative institutional frameworks.
2. **Integrated Management Plan**: Develop and implement an integrated Ecosystem-Based Management Plan, harmonize policies and laws, and expand international and regional cooperation.
3. **Sustainable Land Use**: Implement integrated watershed management, enhance land use planning, promote tree planting and protection, control livestock, and foster public-private partnerships.
4. **Community Participation**: Engage communities in sustainable environmental management through monitoring and control of human activities, awareness campaigns, harmonized principles in national legislation, and increased environmental education.
5. **Water Security**: Ensure clean and safe water access through standardized data collection, monitoring, and strengthening agreements related to the SRB.
6. **Biodiversity Conservation**: Develop and implement biodiversity strategies with integrated Ecosystem-Based Management, preventing harmful human activities in ecologically fragile areas.

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2.	SONGWECOM (2023a)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Ecosystem Services and Biodiversity Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
3.	SONGWECOM (2023b)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Land Degradation, Erosion and Management Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
4.	SONGWECOM (2023c)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Water Resources Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
5.	SONGWECOM (2023d)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Climate Change and Variability Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
6.	SONGWECOM (2023e)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Socio-Economic Analysis Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
7.	SONGWECOM (2023f)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Governance Analysis Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
8.	SONGWECOM (2023g)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Stakeholders Analysis and Engagement Thematic Report. SONGWECOM, Kyela. Tanzania. pp.
9.	SONGWECOM (2023h)	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB), Transboundary Diagnostic Analysis (TDA) Synthesis Report. Songwe River Basin Commission (SONGWECOM), Kyela, Tanzania. pp.

ACRONYMS AND ABBREVIATIONS

4Rs	Recycle, Reuse, Reduce and Remanufacture
ACF	Agriculture Credit Facility
AfCFTA	Africa Continental Free Trade Area
AFOLU	Agriculture, Forestry and Other Land Use
AI	Artificial Insemination
AMCOS	Agricultural Marketing Cooperative Society
AR	Afforestation and Reforestation
AR-CDM	Afforestation/Reforestation-CDM
ASF	African Swine Fever
AU	African Union
BBT-YIA	Building Better Tomorrow – Youth Initiative for Agribusiness
BMU	Beach Management Unit
BoT	Bank of Tanzania
BVC	Beach Management Committee
CAADP	Comprehensive Africa Agriculture Development Programme
CAG	Chief Auditor General
CBFM	Community Based Forest Management
CBO	Community Based Organization
CCAP	Church of Central Africa Presbyterian
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CMT	Council Management Team
CoMs	Council of Ministers
CSO	Civil Society Organization
DC	District Council
EAF	Ecosystem Approach to Fisheries
EBA	Ecosystem Based Approach
ESCOM	Electricity Supply Corporation of Malawi
ESIA	Environmental and Social Impact Assessment
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
FLEGT	SADC's Forest Law Enforcement, Governance and Trade
FMD	Foot and Mouth Disease
FMNR	Farmer Managed Natural Regeneration
FTA	Free Trade Area
GAPs	Good Agronomic Practices
GDP	Gross Domestic Product

GEF-IW	Global Environmental Facility – International Waters
GNI	Gross National Income
GoM	Government of Malawi
GoT	Government of Tanzania
GVA	Gross Value Added
H&S	Hides and Skins
ha	Hectare
ICS	Improved Cooking Stoves
ICT	Information and Communication Technology
ILUP	Integrated Land Use Plan
INRM	Integrated Natural Resources Management
IPM	Integrated Pest Management
IPP	Independent Power Producer
IWRM	Integrated Water Resource Management
JFM	Joint Forest Management
JSC	Joint Steering Committee
JPCC	Joint Permanent Commission on Cooperation
kg	Kilogram
kWh	kilowatts hour
LENRC	Local Environment and Natural Resources Committee
LGA	Local Government Authority
LPD	Local Public Dialogue
LPG	Liquified Petroleum Gas
LULC	Land Use Land Cover
M&E	Monitoring and Evaluation
MCS	Monitoring, Control and Surveillance
MERA	Malawi Energy Regulatory Authority
MK	Malawian Kwacha
MW2063	Malawi Vision 2063
NDCs	Nationally Determined Contributions
NEEF	National Economic Empowerment Fund
NEMC	National Environmental Management Council
NEPAD	New Partnerships for Africa's Development
O&M	Operating and Maintenance
PES	Payment for Ecosystem Services
PPCP	Public Private Community Partnership
PPP	Public Private Partnership
PRA	Participatory Rural Appraisal
PwD	People with Disability

R&D	Research and Development
RS	Regional Secretariat
RVC	Riverine Village Committee
SADC	Southern Africa Development Community
SAP	Strategic Action Planning
SBA	Strength Based Approach
SE4ALL	Sustainable Energy for All
SEA	Socio-Economic Analysis
SMEs	Small and Medium Enterprises
SONGWECOM	Songwe River Basin Commission
SRB	Songwe River Basin
SRBDP	Songwe River Basin Development Programme
SRH	Sexual and Reproductive Health
SSA	Sub-Saharan Africa
STCIRNM-SRB	Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin Project
STI	Science, Technology and Innovation
SUA	Sokoine University of Agriculture
SVTP	Shire Valley Transformation Programme
SWC	Soil Water Conservation
TADB	Tanzania Agriculture Development Bank
TANAPA	Tanzania National Parks
TANESCO	Tanzania Electric Supply Company Limited
TANROADS	Tanzania Roads Agency
TARURA	Tanzania Rural and Urban Roads Authority
TC	Town Council
TDA	Transboundary Diagnostic Analysis
TDV2025	Tanzania Development Vision 2025
TFS	Tanzania Forest Services Agency
ToC	Theory of Change
TPR	Teacher Pupil Ratio
TSR	Teacher Student Ratio
TVET	Technical Vocational Education Training
TZS	Tanzanian Shilling
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania
US$	United States Dollar
VEC	Village Environmental Committee

VET	Vocational Education Centre
VMS	Vehicle Monitoring System
ZRB	Zambezi River Basin

PART ONE

INTRODUCTION

1.0 BACKGROUND

1.1 Songwe River Basin in Perspective

The Songwe River Basin (SRB) which is part of the wider Zambezi River Basin is an important transboundary basin drained by the Songwe River shared by Tanzania and Malawi. The SRB covers an estimated area of 4,243 km^2 – of which 55 percent is in Tanzania (≈2,334 km^2) and the remaining 45 percent covers Malawi (≈1,909 km^2). The physiography of the SRB is characterized by highland, midland and lowland landscapes. The Songwe River marks the formal border between Malawi and mainland Tanzania. Due to degradation of the river banks and the riparian catchments, the river changes its course occasionally in cases of flash floods. Such shifts of the River course relocate the formal border of the two countries

Various empirical assessments show that, the major drivers of environmental degradation include growing population pressure, unstainable farming practices, deforestation and land degradation. The Basin has a population of 425,504 people[2,] of which 62% are Tanzanians (262,420) and the remaining 38% are Malawians (163,084). The basin's population has grown by 25% since 2013, hence increasing pressure on the natural resource base – with current population density in the range of 69 – 349 people per km^2. Over three quarters (80%) of the Basin's residents are rural income-poor or less privileged and vulnerable. The impacts of environmental degradation are posing a great danger to life and properties and infrastructure including but not limited to human and ecosystem health, food and energy security, deepened poverty while threatening political and social stability.

1.2 Songwe River Basin Programme (SRBP)

In response to the ecological, social, economic and political challenges of the shared Basin, the two Countries ratified a Convention that established a Joint Songwe River Basin Commission (SONGWECOM) in May 2017. The development goal of the cooperation Convention is vested in the SRBDP – designed to deliver the Shared Vision 2050. The development Goal of the SRBDP is to contribute to sustainable and inclusive economic growth, reduced poverty, improved health and living conditions of communities, while reducing the adverse impacts associated with floods and changing River course in lowland plains of the Basin.

The rollout of the SRBDP is through the implementation of different projects including a 4-year project "Strengthening Transboundary Cooperation and Integrated Natural Resource Management in the Songwe River Basin (STCINRM-SRB)". The four components of the project include: 1) Enhancing transboundary management and institutional capacity, 2) Improving early warning, disaster risk management, and monitoring measures, 3) Community-based demonstration in Integrated Natural Resources Management and Cooperation, and 4) Project management and coordination.

The Transboundary Diagnostic Analysis (TDA) was undertaken through a collaborative and participatory process to generate empirical evidence and stakeholder views in the identification of critical transboundary environmental and socio-economic problems, their

[2] SONGWECOM TDA 2023 estimates

impacts, underlying and root causes, and strategic actions informing the joint Strategic Action Programme (SAP).

The TDA was conducted according to the GEF-IW but with some methodical adaptations. Based on critical transboundary environmental and socio-economic issues, the TDA was addressed through six thematic analytical areas: 1) ecosystem and biodiversity, 2) water resources, 3) land degradation, erosion and management, 4) climate change and variability, 5) socio-economics, and 6) governance. Moreover, the stakeholder analysis and engagement planning were done to establish the stakeholders' engagement and public involvement plans throughout the TDA process. In this regard, the TDA was completed through a collaborative and participatory process with the Client, Joint Steering Committee (JSC), stakeholders and the public.

1.3 Organization of the Report

The report is divided into eleven parts, each focusing on different aspects of the Songwe River Basin Development Program (SRBDP) and the Transboundary Diagnostic Analysis (TDA).

Part one introduces the SRBDP and TDA. Part two discusses the approaches and methodology used. Part three provides an overview of the SRB, including its geography, climate, hydrology, and the population and livelihoods of its communities.

Part four describes the methodologies used in the TDA process. Part five explores the importance of water resources in the SRB and their role in community well-being and ecosystem health. Part six discusses land management, soil erosion, and resource degradation.

Part seven examines climate variations and their impact on the region, as well as their linkages to other TDA themes. Part eight covers sustainable food systems, economic development, population growth, and various sectors in the SRB.

Part nine delves into governance issues at global, regional, and national levels, addressing policy frameworks, natural resource management, poverty reduction, and more.

Part ten explores the interconnections between the different TDA themes and outlines strategic actions for the future.

Finally, part eleven summarizes the discussions, highlights implications for the SRB, and offers recommendations for sustainable management and development.

In essence, the report provides a comprehensive analysis of the SRBDP and TDA, offering insights into various aspects of the Songwe River Basin and proposing pathways for its sustainable development.

PART TWO

BASIN OVERVIEW AND DESCRIPTION

2.0 An Overview

Part Two covers the perspective of the SRB including the geography, climate and hydrology, population and livelihoods. The aim is to provide a comprehensive overview of the basin's location, climate patterns, hydrological characteristics, and the communities it supports for a better understanding.

2.1 Geography, Climate and Hydrology

Geographically, the SRB spans an area of 4,243 km^2 covering part of Southwest Tanzania and Northern Malawi. The basin area spans five (5) districts of Tanzania and two (2) districts of Malawi (Figure 2.1). Chitipa and Ileje cover the largest part of the basin, at 38% and 35% respectively. The average annual rainfall ranges from 800 mm on the lower Songwe to about 1,000 in the mountainous areas of the basin. The basin experience temperature ranging between 16.3°C and 32.2°C.

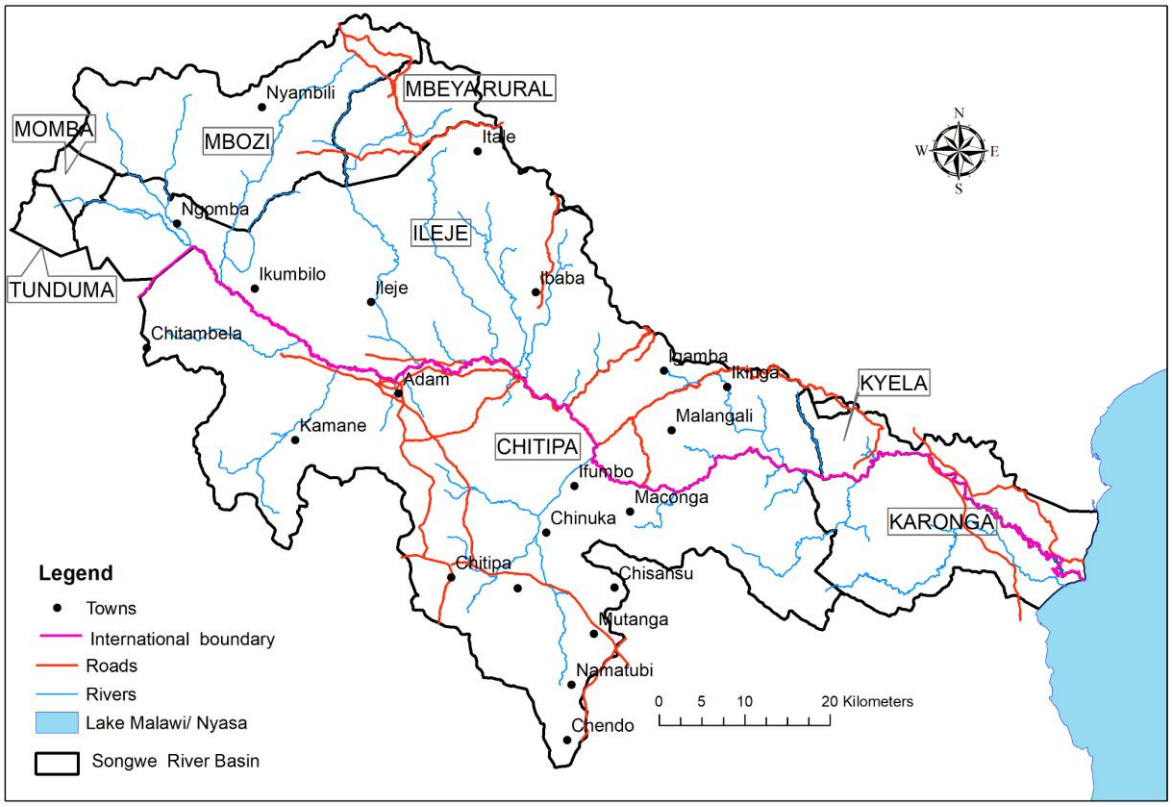

Figure 2.1: Location of the Songwe River Basin (SRB)
Source: SONGWECOM TDA 2023

The Songwe river change its course time to time prompting sovereignty disputes. It is estimated that about 15,000 hectares of land and more than 50,000 people in the lower part of the basin are affected by flash floods. The Songwe river drains its water into Lake Nyasa/Malawi. Further downstream, its waters flow into Shire and Zambezi rivers. Kosamu

et al. (2022)[3] reported that during drought period Lake Nyasa/Malawi waters becomes too low to fill the Shire River. The Shire River hosts an important Hydropower potential for Malawi generating about 398.2 MW out 565.5 MW electricity (70.4%) in 2023. The current flagship development programme – the Shire River Transformation Programme in Malawi – depends on the integrity of the ecosystem of the Shire valley including the riparian Songwe River basin sub-catchment.

2.1.1 Population

Based on the methodology applied in the SEA, the population in the basin as project for 2022 is estimated at 425,504 people. Presumably, the basin's population documented by the SONGWECOM since 2013 was computed from the districts' populations from 2008 census projected into 2012 for Malawi and 2012 (GoM 2008[4]) census for Tanzania. Assuming that the settlement pattern has not changed significantly since 2013, the proportions of the districts' populations living in the basin as of 2022 is approximately the same. Such proportions were applied to the 2021 projections for Malawi (GoM 2022[5]) and 2022 census for Tanzania to estimate the basin's populations by 2022 (Table 2.1).

Thus, since 2013, nearly a decade, the basin's population has increased by 25% - equivalent to an addition of 84,400 people. The highest percentage increase of 125% is noted in Tunduma TC due to higher rate of urbanization. The basin's population density has increased from 80 to 100 people per km^2 between 2013 and 2022. Ileje and Mbozi districts located in the upper-basin seem to have registered relatively smaller population growth rates.

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4 GoM 2008. Population Projections in Malawi. http://www.nsomalawi.mw/images/stories/data_on_line/demography/census_2008/Main%20Report/ThematicReports/Population%20Projections%20Malawi.pdf

5 GoM 2022. Statistical Year Book 2022. National Statistical Office. Lilongwe.

Table 2.1: Districts, population and areas in river basin

Country/District	Area and %		Basin's Population (2013) †		District Population (2012)	District Population (2021/2022)	Basin's Proportions of Districts Populations	Estimated Basin's Population (2022) ¥		
	km²	%	Total	People/km²)				Total	People/km²)	% increase
Malawi					*Projected 2012*	*Projected 2021*				
Chitipa	1,590	38	99,698	63	200,061	247,514	0.50	123,346	78	24
Karonga	335	7.8	31,401	94	307,216	388,780	0.10	39,738	119	27
Sub-total	**1,925**	**46**	**131,099**	**68.1**	**507,277**	**636,294**	**0.26**	**163,084**	**84.7**	**24**
Tanzania					*2012 Census*	*2022 Census*				
Kyela	118	2.9	32,993	280	221,490	266,426	0.15	39,687	339	20
Mbozi	484	11	46,156	95	446,339	510,599	0.10	52,801	109	14
Tunduma TC	80	1.9	12,405	155	97,562	219,309	0.13	27,885	349	125
Mbeya Rural	136	3.2	15,852	116	305,319	371,259	0.05	19,276	142	22
Ileje	1,500	35	102,599	68	124,451	125,869	0.82	103,768	69	1.1
Sub-total	**2,318**	**54**	**210,005**	**90.6**	**1,195,161**	**1,493,462**	**0.18**	**262,420**	**113**	**25**
Basin	**4,243**		**341,104**	**80.4**				**425,504**	**100.3**	**25**

†***Source:*** Final Project Report SRBDP (2015); ¥ Authors' computation

2.1.2 Livelihoods

Over three quarters (80%) of the population in the SRB consists of the rural income poor. Agriculture in downstream areas is threatened by flooding which destroy harvests and livelihoods. Flood events have been observed in multiple parts of the Lower Songwe basin. As a consequence of the increasing pressure on the environment, degradation of agricultural areas, forests and natural areas is observed.

The basin plays an essential role in supporting the livelihoods for the majority of the rural poor that depend on the ecosystem-based productive and extractive livelihood activities. The basin consists of diverse and richer ecosystem and biodiversity habitats including forests, arable land, waters, swamps, and grasslands that support a diversity of terrestrial and aquatic flora and fauna. This makes the basin the hotspot for ecosystem and biodiversity conservation to ensure continued flows of ecosystem services. The basin's ecosystem supports the local population engaged in various growth livelihood sectors including agriculture, livestock, forestry and fishery.

However, the current livelihood activities are pursued unsustainably leading to degradation of the vital ecosystems and biodiversity. Such environmental degradation apart from threatening the ecosystem health, it undermines socio-economic development in basin. Thus, it is pertinent to reposition the local livelihoods on sustainable socio-economic development path. The transboundary nature of the shared water and related resources in the basin calls for jointly coordinated efforts between the two countries.

PART THREE

APPROACHES AND METHODOLOGY

3.0 The Analytical Approaches

3.1 The GEF-IW TDA/SAP Framework

The TDA-SAP process adopted the comprehensive approach outlined in the GEF-IW TDA/SAP framework (GEF 2020)[6], as illustrated in Figure 3.1. This process commenced with an inception phase involving the SRB secretariat, members of the Joint Steering Committee (JSC), primarily comprising key Ministries, Departments, and Agencies (MDAs) from both countries, along with a select group of stakeholders. During this inception phase, various environmental, social, and economic transboundary issues were identified, analysed, and prioritized by these stakeholders. The outcomes of this inception phase served as the initial list of transboundary problems, which were subsequently refined and expanded upon through extensive stakeholder consultations conducted throughout the theme-based TDA and eventual SAP stages. These consultations involved multi-level engagement with various stakeholders.

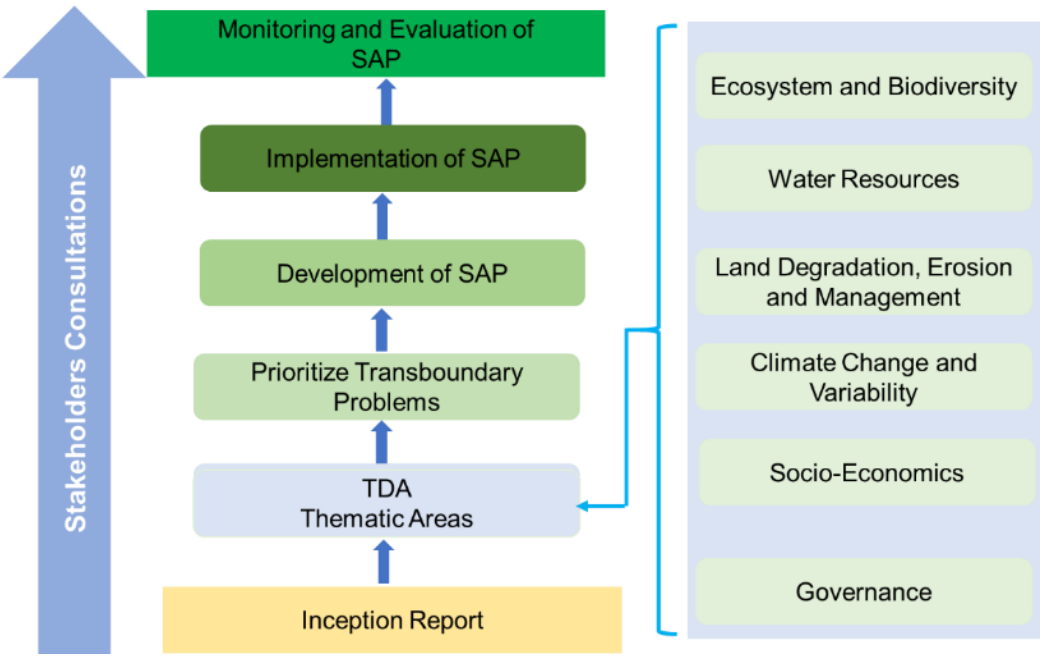

Figure 3.1: TDA/SAP Process Framework

3.1.1 Transboundary Diagnostic Analysis Approach

The TDA employed a thematic approach, depicted in Figure 3.1, to guide its comprehensive analysis. The analysis encompassed five interconnected phases involving data collection, analysis, and stakeholder verification.

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[6] GEF-IW TDA/SAP Methodology, 2020

Practically, the TDA process addresses three basic systemic activities in the context of GEF-IW framework presented in the embedded text box (Box 1.1). In the first place, the TDA process was intended to ultimately underpin transboundary problems that are locally relevant but still contextualized within the higher-level development visions of the two countries. In this regard, five interrelated phased steps (Figure 3.2) were followed in the TDA process addressed issues across the thematic areas: 1) Inception; 2) subnational consultations with Regional Secretariats (RS) and Technocrats in the District Councils; 3) Participatory Rural Appraisals (PRAs) with local community and Village Governments; 4) Local Public Dialogues (LPDs) that involved participants from the communities, Community Based Organizations (CBOs), Civil Society Organizations (CSOs) and the Private Sector; and 5) Higher-Level Consultations that covering Ministries, Departments and Agencies (MDAs), Civil Society Organizations (CSOs), Development Partners and the Private Sector. The data collection and analyses were focused on the identification, prioritization and verification of transboundary problems, interrelations, impacts, drivers, and potential solutions at different stages stakeholder consultations.

Box 1.1: GEF:IW Framework Activities

- Identification and prioritisation the transboundary problems in the SRB;
- Analysis of the impacts of the prioritized transboundary problems; and
- Causal chain analysis to underpin immediate, underlying, and root cause of each priority problem.

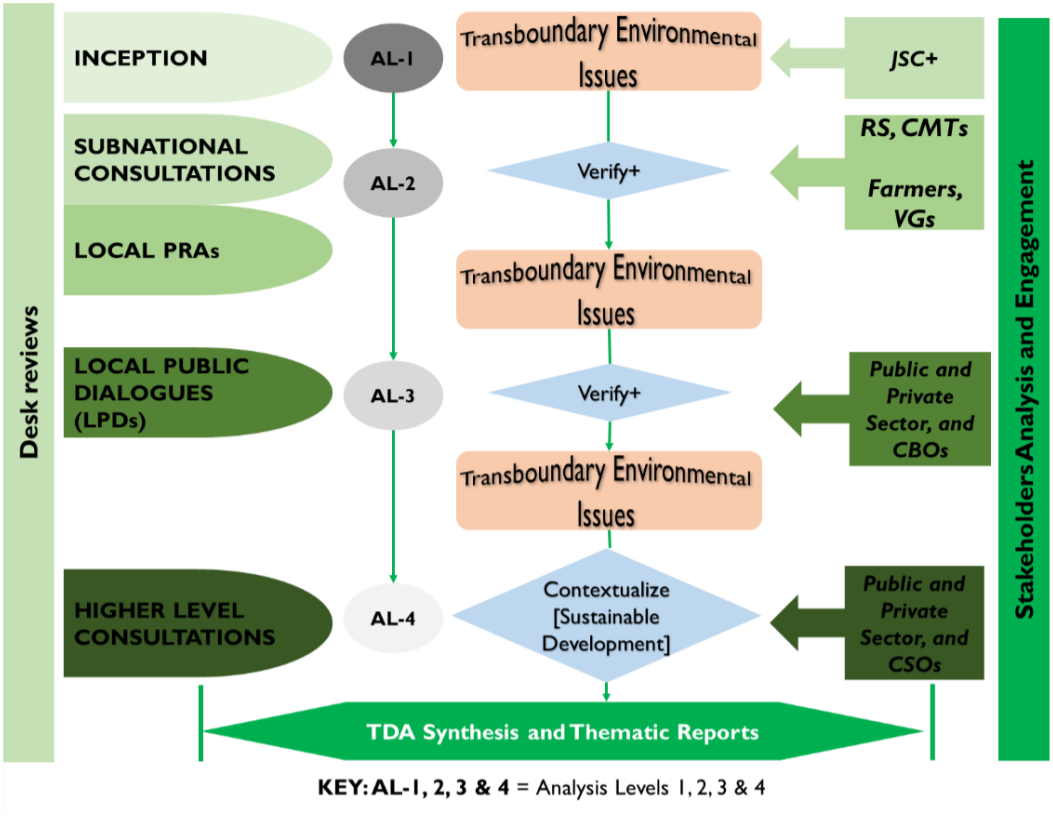


Figure 3.2: Transboundary Diagnostic Analysis Framework

3.2 Methodology

3.2.1 Desk Review

The desk review of existing secondary information and literature through the entire process. In order to comprehend the TDA/SAP process, the primary document that was reviewed

was the GEF-IW SAP/TDA manual (GEF 2013). The published and unpublished literature are cited in the respective texts each one refers to. Different programme documents were reviewed particularly previous feasibility studies of the SRBDP conducted in between 2013-2015. In the very first place, the TDA was expected to update and build on the existing information to underscore the trends, current state and futures of the basin.

3.2.2 Inception

An inception meeting convened with a total of 24 participants, comprising members of the SONGWECOM Secretariat SRB and members of the Joint Steering Committee (JSC) representing both countries. Within the organizational framework of the joint commission, the JSC serves as the crucial technical bridge connecting the managing Secretariat and the higher-level political body, the Council of Ministers (CoMs). Beyond initiating a collaborative roadmap for the Transboundary Diagnostic Analysis and Strategic Action Plan (TDA/SAP), the inception meeting served as a capacity-building platform. It provided attending members of the Secretariat and the JSC with a comprehensive understanding of the TDA/SAP process, following the GEF-IW methodology.

Leveraging the insights gained from the Secretariat's extensive experience in the basin, the inception meeting identified and assessed a range of transboundary environmental and socio-economic challenges. These issues were evaluated in terms of their impacts and underlying causes. The meeting marked the initial step in this collaborative effort.

3.2.3 Subnational Consultations

Figure 3.3: PRA in Isinde, Tunduma TC

The subnational consultations included roundtable discussions with technocrats at regional and district councils in both countries. The discussions involved technocrat staff from key growth and service sectors, and development planning departments. The discussions were focused on environmental, social and economic problems, their localized and transboundary implications, actions and plans to address them and avenues for joint cooperation between the two countries for advancing sustainable socio-economic development in the basin. At the end of discussion in the districts, the participating staff helped with identification of village communities to be visited for conducting the Participatory Rural Appraisals (PRAs). The village community to be visited needed to represent the typical reality of the environmental problems discussed.

3.2.4 Community PRA Exercises

The PRA exercises with 7 village communities were conducted with each of the 7 districts represented by one village community. The PRA exercises conducted include Focus Group Discussions (FGDs), participatory resource mapping, and transect walks in the agro-landscapes (Figure 3.3). Two interrelated PRA exercises – the resource mapping and FGD on problems facing the growth and service sectors in the locales. A range of other pertinent issues were discussed during the FGDs including the local context of issues raised from the preceding inception and subnational consultations. The transect walks involved field observations regarding the state of the ecosystems, biodiversity, land degradation, water resources, agricultural activities, and visible socio-economic situations such as settlements, social and economic services.

A range of other issues were also discussed with FGD participants including general livelihoods, local ecological and socio-economic problems and cross-border relations among neighbouring communities in the two countries. The PRAs were guided by a checklist as indicated in Annex 8. A total of 75 community participants were involved in the PRA exercises (Annexes 2a to 2g). The transect walks involved field observations of the ecosystems, biodiversity and visible socio-economic situations such as settlements, social and economic services.

3.2.5 Local Public Dialogues (LPDs)

The consultations were broadened to capture a wider spectrum of views from stakeholders through the LPDs. The participants of the LPDs were drawn from grassroots communities, CBOs, CSOs and the private sector. Four LPDs were conducted in the basin between 2nd to 6th March 2022, two in each of the two countries covering stakeholders in the lower and upper basin locations. In Malawi, the two LPDs were conducted in Karonga and Chitipa districts both involving a total of 31 participants (Annexes 4b to 4c). In Tanzania, the two LPDs were conducted in Kyela and Ileje districts with a total of 34 participants (Annexes 4a & 4d). The LPDs in the two countries involved a total of 65 participants. A checklist was used to guide the dialogues (Annex 9). The local dialogues provided a wealth of local broad-based information about key transboundary problems, related impacts, underlying drivers and potential solutions. Development opportunities across the growth and service sectors were discussed during the dialogues.

3.2.6 Higher Level Consultations

The higher-level consultations were necessary in order to contextualize the transboundary problems that evolved from local and subnational processes in the broader national development visions of the two countries. The higher-level consultations involved key MDAs, CSOs and the private sector. The consultations were guided by a checklist with questions customized to the roles and mandates of specific stakeholder organizations (Annex 10). In Malawi, a total of 39 higher level Consultations were conducted – of which 36 involved physical discussions and 3 were conducted through mail surveys that involved filling the checklist (Annex 5a). In Tanzania, a total of 22 higher level consultations were conducted (Annex 5b). The discussion with each of the consulted higher-level stakeholder culminated with elicitation of critical issues and strategic actions.

3.2.7 In-depth Expert Analyses

The study employed comprehensive methodologies to analyse meteorological and hydrological data changes over time. The Mann-Kendall test was used for trend analysis across monthly, seasonal, and annual cycles, allowing for non-parametric assessment with low sensitivity to abrupt breaks. Additionally, Sen's slope estimator, Kendall, Spearman Rank, and linear regression tests were used to establish temporal correlations. Change point detection was performed using Sequential Mann-Kendall, while drought analysis employed the standardized Precipitation Index (SPI) to interpret positive and negative values indicating precipitation variations. Projections of climate change impacts from GCM ensembles (CanESM2-RCA4, NorESM1-RCA4, CSIRO-CMS, and HadGEM2-ES) were analyzed for 2021-2050. Modeling through the restructured Soil and Water Assessment Tool (SWAT+) provided insights into spatial and temporal effects for potential interventions. The model, calibrated with Mwandenga gauging station data and sediment information, yielded outputs on river discharge and sediment yield. Environmental flow was assessed using the Indicators for Hydrological Alterations (IHA) model and the renewable freshwater availability per capita was estimated using the Falkenmark Stress Indicator.

Future water demands for various sectors were calculated considering population growth and estimated needs for domestic use, irrigation, industry, hydropower, and environmental concerns.

To understand status and changes of land over time, the study used a combination of Geographic Information System (GIS), Remote Sensing technologies and modelling techniques to detect land use/cover changes and quantify magnitude. This was critical for understanding spatial distribution and arrangement of various degradation processes hotspots, trends and some proposed management strategies. Land Cover and Land Use Change (LULC) maps initially produced by processing of satellite images of 1990s, 2000s, 2010s and 2020s. Soil erosion risk was established using Revised Universal Soil Loss Equation (RUSLE) model in GIS environment Proposed land management interventions for soil erosion were spatially mapped and for vegetation decline processes areas requiring reforestation, afforestation and natural regeneration can be located on the vegetation decline change detection maps.

Apart from narratives, in-depth socio-economic analysis involved qualitative and quantitative analyses including estimation of gross revenues from key growth sectors, income poverty and socio-economic trends. Governance analysis involved thematic content analysis and reviews of policies, strategies, legislations, conventions and agreements across planning scales – national, regional and global.

PART FOUR

ECOSYSTEM SERVICES AND BIODIVERSITY

4.0 An Overview

The Songwe River Basin is part of the larger Zambezi River basin and covers approximately 4,200 km^2. Floristically, the area falls under the Zanzibar – Inhambane Regional Centre of Endemism phytochorion (White, 1983). To the north, this phytochorion is bordered by the Somali - Maasai Regional Mosaic and to the West by the Zambezian phytochorion. To the east of the Zanzibar – Inhambane Regional Centre of Endemism is the Indian Ocean (White, 1983). Therefore Tanzania-Malawi transboundary Songwe River Basin (SRB) consists of an admixture of the Zanzibar – Inhambane, Somali - Maasai and the Zambezian regional centers of endemism species elements.

4.1 Critical Habitats of the Songwe River Basin

Proximity of the Songwe River Basin to wildlife protected areas such as Kitulo National Park in the North and Nyika National Park as well as Vwaza Marsh Wildlife Reserve to the south, most likely account for the promising wildlife richness of the area through serving as sources of wildlife despite the rampant illegal environmental activities and habitat destruction through agriculture.

Based on the criteria within the IFC performance standard 6, the vegetation types can simply be classified into Natural and Modified habitats. The natural habitats are composed of plant species of largely native origin and human activities had not essentially modified the primary ecological functions and species composition. Conversely, the modified habitats contained a large proportion of plant species of non-native origin and human activities had substantially modified the primary ecological functions and species composition.

With it great diversity both biotic (flora and fauna) within Miombo woodland the area may provide ecosystem services such as (i) provisioning services (e.g. food, water, timber, and fibres); (ii) regulating services (e.g. carbon sequestration, pollination, biological pest control, floods, disease and water quality); (iii) cultural services (e.g. recreational, aesthetic, and spiritual benefits) and (iv) supporting services (e.g. soil formation, and nutrient cycling).

4.2 Fauna and Flora of the Songwe River Basin

The aquatic ecosystem is characterized by the highly commercially fish species such as the African Catfish (*Clarias gariepinus*), Zambesian Parrotfish (*Hippopotamyrus discorhynchus*) and *Oreochromis* sp., the cyprinids *Opsaridium microcephalus* (Sanjika/Mbelele) and *Opsaridium microlepis* (Mpasa/Mbasa). *Clarias gariepinus*, *Opsaridium microcephalus* and *Opsaridium microlepis*.

The basin is also home to a variety wildlife species such as the Hippos, crocodiles, monkeys, snakes, amphibians, black-and-white colobus monkey (*Colobus angolensis*), Red and white colobus monkeys, Blue monkeys (*Cercopithecus mitis*), vervet monkeys (*Chlorocebus pygerythrus*), and Greater kudu (*Tragelaphus strepsiceros*). Other animals include wild pigs, hares, and snakes such as pythons and cobras. Birds found in the lower basin include ground hornbill, pigeons, francolins, helmeted guinea fowl, spur-winged goose, and white-backed duck.

4.3 An empirical outlook: gap analysis and thematic scoping

Like in most African inland freshwater bodies, the fishery in SRB is multi-gear and multi-species in nature. Although fisheries and gears involved are regulated, especially on Tanzanian side, most fishermen apply in random the following gears; gill nets, fish traps, hand lines, long lines and mosquito nets (Njaya, 2006). Majority of these gears are mostly non-selective with the end results in overfishing (NORPLAN, 2002 and Njaya 2006). In addition, there are frequent blockage of some river sections with application of poisonous herbs which not only fish but also other animals.

4.4 Ecosystem and Biodiversity Resources

4.4.1 Fisheries

Fishery catches in the SRB have remained relatively stable, but catches of a number of larger, more economically valuable species have declined dramatically, particularly in the middle and lower river basin. These include Catfish (*Bagrus meridionalis*), mpasa (*Opsaridium microlepis*), nchila (*Labeo mesops* and *L. cylindricus*), and chambo are among them (*Oreochromis species*) (Table 4.1). Overfishing is to blame for the decline of catfish and chambo, while a combination of overfishing and river and nearshore habitat degradation is to blame for the decline of potamodromous fishes (mpasa and nchila). In Tanzania, endemic and highly endangered *Opsaridium microlepis* is reported to be steadily decreasing (Tweddle, 2001).

Table 4.1: Fish species reported, collected and identified during survey fishers in the Songwe River

No.	Fish species	Local name	Status	
			Reported by fishers	Specimen collected
1	*Opsaridium microlepis*	Mpasa, Mbasa	√	√
2	*Opsaridium microcephalus*	Sanjika, Mbelele	√	√
3	*Synodontis njassae*	Nkholokolo, Ngolokolo	√	√
4	*Bagrus meridionalis*	Kampango, Mbushi	√	√
5	*Tilapia* species	Chambo, Magheghe	√	√
6	*Labeo cylindricus*	Ningwi, Nungu	√	√
7	*Clarias gariepinus*	Mlamba, Nkhumba	√	√
8	*Barbus johnstonii*	Ngumbo	√	
9	*Barbus litamba*	Thamba, Songola	√	√
10	*Mormyrus longirostris*	Samwamowa, Mwekera	√	
11	*Matercembalus* spp	Mkunga, Ngunga	√	
12	*Hippopotamyrus discorhynchus*	Mphuta/Mbuwe	√	√
13	*Barbus* species	Matemba/Mapwa	√	√
14	*Rhamphochromis* spp	Mcheni	√	

Source: SONGWECOM TDA 2023

4.4.2 Migration patterns and breeding areas

The potamodromous fish that migrates into the Songwe River provides the basis for subsistence and small-scale commercial fishery all along the lower Songwe River. The Lower Songwe River is an important breeding area for fish and that the potamodromous species predominantly spawn/breed in the deep pools below Matuli Falls and in the Makeye River.

4.4.3 Unsustainable Fishing

Overfishing and the use of destructive methods alter biological community's structure and food chain and may have negative socio-economic consequences of community living adjacent to Songwe River Basin. As a result of overfishing and environmental degradation, the cyprinids *O. microlepsis*, *O. microcephalus* and *labeo mesops* are listed as endangered species by the IUCN red list. Fish that migrate from lakes to rivers to reproduce including *Opsaridium microlepsis* (Mpasa, or the Lake Salmon) and *Labeo mesops* (Ntchila), are declining due to a combination of overfishing and habitat degradation.

4.4.4 Phytoplankton

Advance agricultural practices with increasing use of fertiliser is exacerbating frequent phytoplankton blooms. A comparison of phytoplankton species composition in sediment cores, and among various studies conducted over the past several decades, suggests there has been a shift in species dominance. *Planktolyngbya nyassensis* has been replaced by *Planktolyngbya tallingi*, a species more commonly seen under conditions of higher nutrient concentrations and lower light availability.

4.4.5 Zooplankton

The Copepoda was the most dominant group (82%) in the Songwe River Basin. *Thermocyclops neglectus* and *Thermocyclops emini* are the most common species in the basin. The gut contents of juvenile planktivorous fish species such as *Labeo*, *Oreochromis Barbus* and *Tilapia* of Songwe River Basin were mainly characterized with *Asplanchna* spp., *Caridina nilotica*, Cyclopoid copepodite, Cyclopoid, Calanoid, *Ceriodaphnia cornuta*, Chaobrid larvae, Chironomid larvae, *Filinia opoliensis*, Insects, *Lecane* spp., *Macrothrix* spp., *Moina micrura*, *Nauplii, Ostracods* and Phytoplankton.

4.4.6 Zoobenthos

The zoobenthos was characterised by (*Hemiptera, Diptera, Odonata, Ephemeroptera, Coleoptera, Lepidoptera, Crustacea, Gastropoda, Annelida and Platyhelminthes* (Table 4.2).

Table 4.2: Zoobenthos taxa collected from the Songwe River Basin

Sn.	Taxonomical group	Collected Taxa (Family/Genus/Species)	Abundance	Dominance group
1	Annelida	*Limnodrilus hoffmeisteri* Claparede, 1862	26	Dominant
		Limnatis nilotica (Savigny, 1822)	2	Resident
2	Coleoptera	*Cybister fimbriolatus* (Say, 1823)	2	Resident
		Cybister fimbriolatus (Say, 1823) larva	13	Subdominant
		Hydaticus sp. Leach, 1817	3	Subdominant
		Hyphydrus sp. (Illiger, 1802) larva	17	Dominant
3	Crustacea	*Chirocephalus diaphanus* Prévost, 1820 "fairy shrimp"	8	Subdominant
		Triops longicaudatus (LeConte, 1846) "tadpole shrimp"	4	Subdominant
		Stenocypris Sars, 1889	9	Subdominant
4	Diptera	*Chironomus Meigen*, 1803 larva	82	Eudominant
		Chironomus Meigen, 1803 pupa	24	Dominant
		Mosquito larva	15	Dominant
		Mosquito pupa	3	Subdominant
		Dichaeta caudata (Fallén, 1813) larva	9	Subdominant
		Dichaeta caudata (Fallen, 1813) pupa	6	Subdominant
		Limnophora riparia (Fallén, 1824) larva	2	Recedent
		Limnophora riparia (Fallén, 1824) pupa	6	Subdominant
5	Ephemeroptera	Mayfly	13	Subdominant
6	Gastropoda	*Melanoides tuberculata* (Müller, 1774)	18	Dominant
		Pseudosuccinea columella (Say, 1817)	19	Dominant
		Physa acuta (Draparnaud, 1805)	26	Dominant
		Biomphalaria arabica (Melvill & Ponsonby, 1896)	20	Dominant
7	Hemiptera	*Corixa punctata* (Illiger, 1807)	19	Dominant
		Ambrysus sp. (Stal, 1862)	18	Dominant
8	Lepidoptera	Psychodidae larva	5	Recedent
		Psychodidae pupa	3	Recedent
9	Odonata	Cordulegastridae (Tillyard, 1917) "Spiketails dragonflies nymph"	17	Dominant
		Corduliidae Kirby, 1890 "Emeralds dragonflies nymph"	22	Dominant
		Libellula Linnaeus, 1758 "Pond skimmers dragonflies nymph"	4	Recedent
		Libellula forensis Hagen, 1861 "Eight-spotted Skimmer dragonflies nymph"	1	Recedent
		Protoneuridae Tillyard, 1917 "Threadtails damselflies nymph"	24	Dominant
10	Platyhelminthes	*Planaria sp.* Müller, 1776	9	Subdominant

Source: SONGWECOM TDA 2023

4.4.7 Invasive species

Invasive alien species are a threat to ecosystem integrity and native species of the basin. In fact, the presence of *Eichhornia crassipes* (common water hyacinth) is a major threat to the ecosystem and biodiversity, affecting fish and aquatic faunas, plant community structure and diversity, water supplies and human health. It has also major impacts on multiple economic activities and community livelihoods.

4.5 Ecosystem and Biodiversity Transboundary Problems: Impacts, Drivers and Potential Solutions

Degradation of the ecosystem and loss of biodiversity were the broad transboundary problems reported in the basin. Inversive species were not identified at the level of threatening biodiversity loss through competition. The impacts, drivers (immediate, underlying and root) and potential solutions were identified and discussed through stakeholder consultations in both countries. The stakeholders' assessments were the foundation of deeper expert analysis and reflections.

The causal chain analysis is the central process of unravelling the effects and causality of the transboundary problems. This is necessary step towards devising strategic actions to address the problems. As shown in Figure 4.1, a causal chain is an ordered sequence of events linking the causes of a problem with its effects or impacts (GEF IW: LEARN 2017[7]). However, the relationships among components of the causal chain are non-linear and actions are constantly shaped by policy responses. The dynamics of ecological, social, economic and governance systems and their feedbacks are inextricably shaping the causes and effects. In order to allow systemic comprehension, we still present causal chains simply in tabular forms.

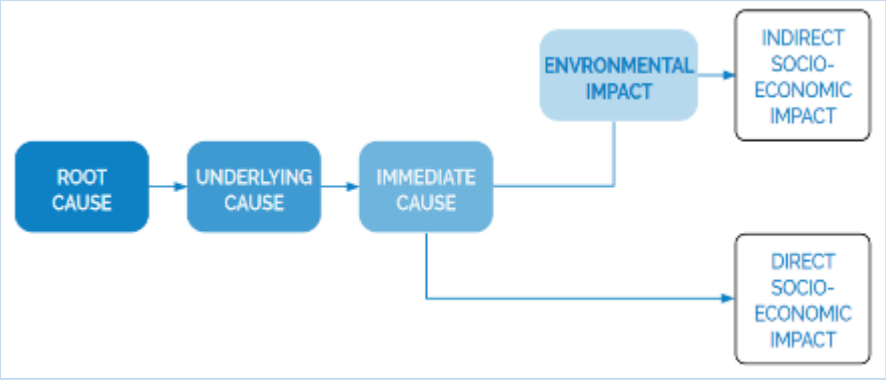


Figure 4.1: Major Components of a Causal Chain

Source: GEF IW: LEARN 2017

4.5.1 Ecosystem Degradation: Impacts, Drivers and Solutions

4.5.1.1 Pathways to Environmental and Socio-Economic Impacts

At presence, the basin is experiencing rapid degradation of forest ecosystems, woodlands, grasslands ecosystem, wetlands, and riparian ecosystems of the basin. This degradation resulted to the decrease viability of biological resources, loss and modification of ecosystems. The main factors leading to the degradation include deforestation, agriculture,

[7] GEF IW: LEARN 2017. GEF Transboundary Diagnostic Analysis/Strategic Action. Programme Manual. GEF.

overgrazing, pollution from various sources such as uncontrolled use of agricultural inputs and encroachment of riverbanks.

Ecosystems especially wetlands, woodlands and forests are reduced, hence decimated in terms of the services such vital natural resources can offer. Moreover, as degradation of vegetation cover reduces the availability of medicinal plants is reduced, and health of soils and habitats conditions. Furthermore, nature-dependent economic sectors such as beekeeping and eco-tourism are adversely affected. Ultimately, such socioeconomic consequences have negative impacts on integrity of the ecological systems and sustainable socio-economic development in the basin.

4.5.1.2 Causal Chain Analysis of Ecosystem Degradation

The causal chain analysis of ecosystem degradation elicits environmental and socio-economic impacts and their immediate, underlying and root causes (Table 4.3). Notably, the presentation does not follow a horizontal logic along the rows, but rather a cluster of issues identified under respective columns. Lack of integrated ecosystem-based approach to natural resource management and limited information and knowledge on ecosystems to the local communities and technocrats were the major root causes of ecosystem degradation.

Table 4.3: Causal Chain Analysis of Ecosystem Degradation

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Loss of ecosystem services	Loss of income	Degrading water quality and flows	Climate change	Lack of Integrated Ecosystem-based Approach to NRM
	Loss of capability to mitigate	Unsustainable NRM	Limited economic benefits from the ecosystem	Limited information and knowledge on ecosystems
		Unsustainable grazing		

Source: Stakeholders' Consultations, 2023

4.5.2 Biodiversity Loss: Impacts, Drivers and Solutions

4.5.2.1 Pathways to Environmental and Socio-Economic Impacts

Overexploitation of species, habitat degradation, and conversion of natural landscapes to other land use categories have variably affected a range of aquatic and terrestrial species in the basin. Some of such species such as fisheries are of socio-economic significance in the basin. Catches of the most valuable fishes such as *Chambo* (*Oreochromis spp.*) have declined averaging 4,000 tonnes per annum in 2015 compared to period between 1981 and 1990 during which over 10,000 tonnes of *Chambo* could be landed per annum (GoM 2016[8]).

The Fisheries Department of Malawi provided a list of fish species at varying levels of AUCN's Red List Assessment (Annex 1). These fish species are endemic in Lake Malawi/Nyasa fish catchment including the lake itself and joining rivers such as Songwe. Only

[8] GoM 2016. Harnessing the Demographic Dividend to Accelerate Socio-economic Transformation and Economic Development in MalawiGoM 2016. Harnessing the Demographic Dividend to Accelerate Socio-economic Transformation and Economic Development in Malawi.

one specie was reported to be Extinct (EX), none was reported to be Extinct in the Wild (EW), 20 were Critically Endangered (CR), 7 were Endangered (EN), and 11 were rated Vulnerable (VU). Others that are not presented but reported by the Department include 37 species Near Threatened (NT), 342 Least Concern (LC) and 41 were Data Deficient (DD). The threat to aquatic biodiversity was also reported for a range of invertebrate molluscs' species.

Degradation of forestry and agro-ecosystems affect aquatic ecosystems such as water resources in terms of quality, and quantity and patterns of flows. Intensive agriculture involving use of fertilizers in the riparian agro-landscape of the basin is contributing to the eutrophication of Lake Malawi/Nyasa. Ecosystem degradation in combination with climatic and environmental changes would intricately affect stability of biodiversity causing proliferation of invasive plant species. Invasive plant species can displace native plants with resulting overgrowth and blockage of waterways. Biodiversity loss have a direct impact on availability of ecosystem services and goods in the basin.

4.5.2.2 Causal Chain Analysis of Biodiversity Loss

The root causes of biodiversity loss were identified to be poverty and population growth (Table 4.4). The nexus between poverty and biodiversity vested in the environment is intricately cyclic. The poor and the most vulnerable depend on the environment for survival and out of desperation the poor will embark on unsustainable extraction activities such as exploiting natural forests, sand mining and quarrying, slash-and-burn agriculture, and cultivating on fragile lands and closer to water sources. Such unsustainable survival strategies diminish the ecosystem services and cause loss of biodiversity, hence perpetuating poverty and vulnerability in a long run. Furthermore, the underlying causes of biodiversity loss reported included climate change and overexploitation of plant and animal species. The immediate causes of biodiversity loss are ecosystem degradation and deforestation.

Table 4.4: Causal Chain Analysis of Biodiversity Loss

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Decrease of habitats and their values	Loss of income	Ecosystem degradation	Climate change	Poverty
Endangerment and extinction of species	Food insecurity	Deforestation	Over exploitation of flora and fauna	Population growth

Source: Stakeholders' Consultations, 2023

4.5.2.3 Game-Changing Actions for Addressing Ecosystem Degradation and Biodiversity Loss

Many actions to manage the ecosystem degradation and biodiversity loss have been suggested before. The scope of payoffs is rather limited by repeating the same actions in the same way under the same context to address the very same issues that have persisted. In the SEA, an attempt is made not to reinvent the wheel but rather underpin actions that are game-changing in the facets of novelty in the practice, process and/or context. Table 4.5 presents potential game-changing actions for sustainable management of ecosystems and biodiversity with key stakeholders for effective implementation.

Table 4.5: Game-Changing Actions for Ecosystem and Biodiversity Conservation

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote and scale-up integrated ecosystem-based approach in natural resources management	Community (Beekeepers, Environmental Clubs, Charcoal producers), NGOs (WCS, ChooseWater, CRC, TFC), CSO (CISONECC), MDA (Dept of Forestry, Dept of Fisheries – Northern Region)
2	Inculcate the ecological civilization culture in the basins' citizens and countries at large	NGOs (CRC, AEJ) CSOs (CISONECC) Community (Environmental Clubs, Fishermen) MDA (Dept of Forestry, Dept of Fisheries)
3	Promote community-based regeneration of the degraded ecosystems through restoration of forests, fragile hills, riverbanks and fish breeding sites	MDAs (TFS, Dept of Forestry, Dept of Fisheries – Northern Region, LGAs, NEMC), Community (BMUs, BFVs, Environmental clubs, Fishermen Association), NGOs (WCS, CODE P)
4	Re-engage with key stakeholders that most programs have tended to ignore (e.g., media, faith-based organizations, feminist and social justice advocates) in the past in the planning, implementation, and monitoring and evaluation of environmental management programs	MDAs (LGAs, NEMC, Dept of Forestry, Dept of Fisheries, MNRT), NGOs (TFC, CODE P, AEJ, Agri-Connect), Community (Farmers Associations, Eco-tourism, Fishermen Associations, Beekeepers Associations)
5	Re-envision coordinated transboundary planning, actions and investment in management of shared ecosystems	MDAs (LGAs, NEMC, Dept of Forestry, Dept of Fisheries, MNRT), NGOs (TFC, CODE P, AEJ, Agri-Connect), Community (Farmers Associations, Eco-tourism, Fishermen Association, Tree-crop farmers, BFVs, BMUs)

Source: Stakeholders' Consultations, 2023

PART FIVE

WATER RESOURCES

5.0 An Overview

This part of the TDA report explores the intricate realm of Water Resources within the SRB. This section shines a spotlight on the pivotal role that these resources play in fostering the advancement, expansion, and enduring well-being of both local communities and interconnected ecosystems. By investigating the multifaceted issues intertwined with water management and allocation, this segment elucidates the fundamental connection between the vitality of the SRB's water sector and the overall prosperity of the region it serves. Using multi-pronged approaches and participatory process, the Water Resources Analysis explores the situational analysis of water resources in the basin, utilizing historical information, modelling approaches as well as multisector experts and local communities in exploring the linkages between environmental problems, livelihoods and survival of people and sustainability of the resources. The WRA deals with the identification of the transboundary problems affecting sustainability of water resources, analysing impacts associated with the transboundary problems, their immediate, underlying and root causes of the problems as well as strategic actions to address them for achieving sustainable development and sustainability of the environment and ecosystems.

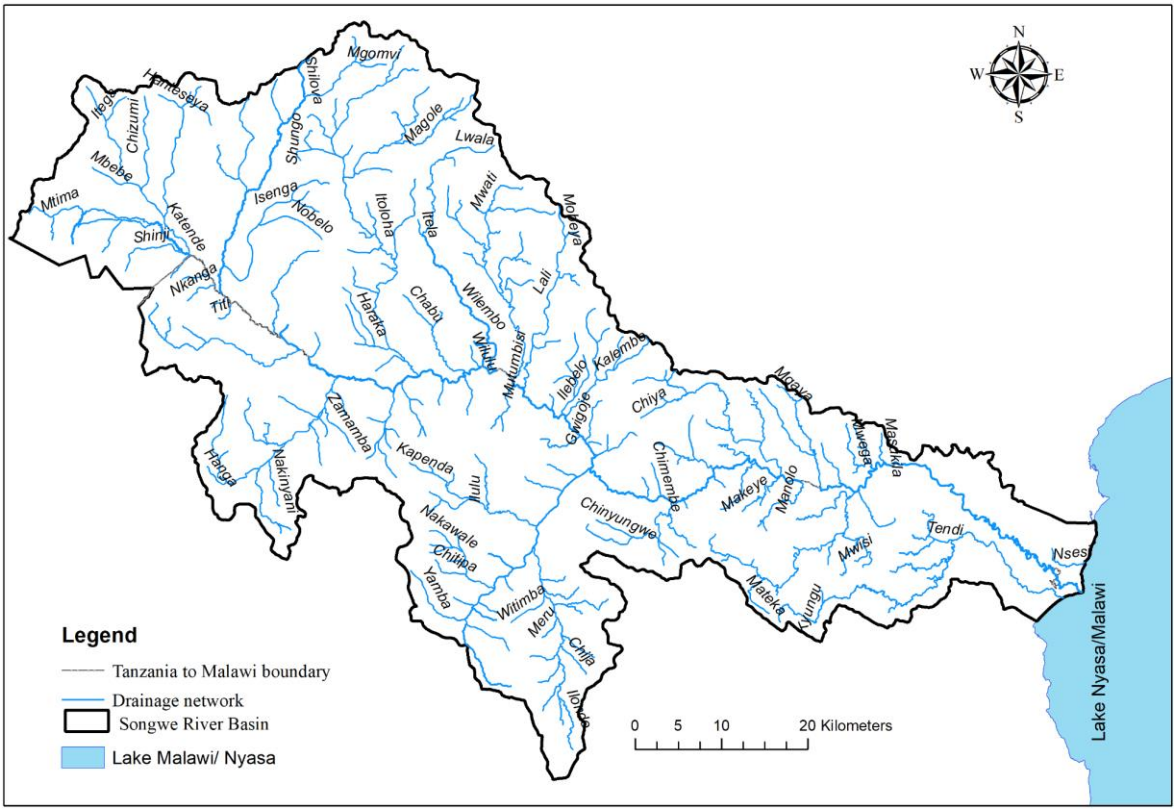


Figure 5.1: Drainage patterns in the SRB
Source: SONGWECOM TDA, 2023

5.1 Water Resources and Hydrology of the SRB

5.1.1 Drainage and morphology

The Songwe River stretches for approximately 200 km, encompassing a catchment area of about 4,243 square kilometers. It receives significant contributions from major tributaries such as Mutumbisi, Kaseye, Kyungu and Makeye rivers. The physical characteristics of the region, including the distribution of rainfall, create favorable conditions for frequent flooding events.

The Songwe River exhibits notable morphological activity and displays significant meandering along the stretch between the foothills and Lake Nyasa/Malawi. The lower basin, in particular, features a highly tortuous reach, with meandering extending over at least 40 km, although the direct distance is only 25 km. The river displays both primary and secondary meanders, with smaller meanders occurring within larger ones, and there are frequent 180° bends in its course.

The Songwe River Basin can be divided into six sub-basins (Figure 5.2), which can be further aggregated into three sub-units representing the lower, middle, and upper basins[9] . The division of sub-basins is based on various criteria, primarily hydrology and geomorphology. The following are the identified sub-basins:

a) Kameme Hills and Plateau: This sub-basin is primarily drained by streams that serve as tributaries to the Songwe River.
b) Itumba/Mwati basin: This sub-basin consists mainly of two tributary sub-catchments, namely Itumba and Mwati.
c) Bulambia (Kaseye) Plain and adjacent Plateau: The drainage of this sub-basin is primarily facilitated by the Kaseye River.
d) Misuku Hills: The Misuku Hills sub-basin is drained by the tributaries of Sofwe, as well as the upper reaches of Makeye and Kyungu, along with other small streams with steep gradients that directly flow into the Songwe River.
e) Scarp Zone: This sub-basin includes a significant portion of the Kyungu catchment and is drained by the Kyungu and Makeye Rivers in Malawi, as well as the Chija River in Tanzania.
f) Songwe Floodplain: This area is characterized by flat to very gentle slopes, predominantly covered in alluvium, and is prone to periodic flooding in various locations.

These sub-basins and sub-units provide a framework for understanding the drainage patterns and morphological characteristics of the Songwe River Basin.

[9] NORPLAN, 2003: *Final Feasibility Study Report; Preliminary Environmental Impact Assessment Main Report; Norplan A.S. in Association with COWI, DHI Water and Environment, W&PES: Oslo, Norway, 2003; Volume 4A.*

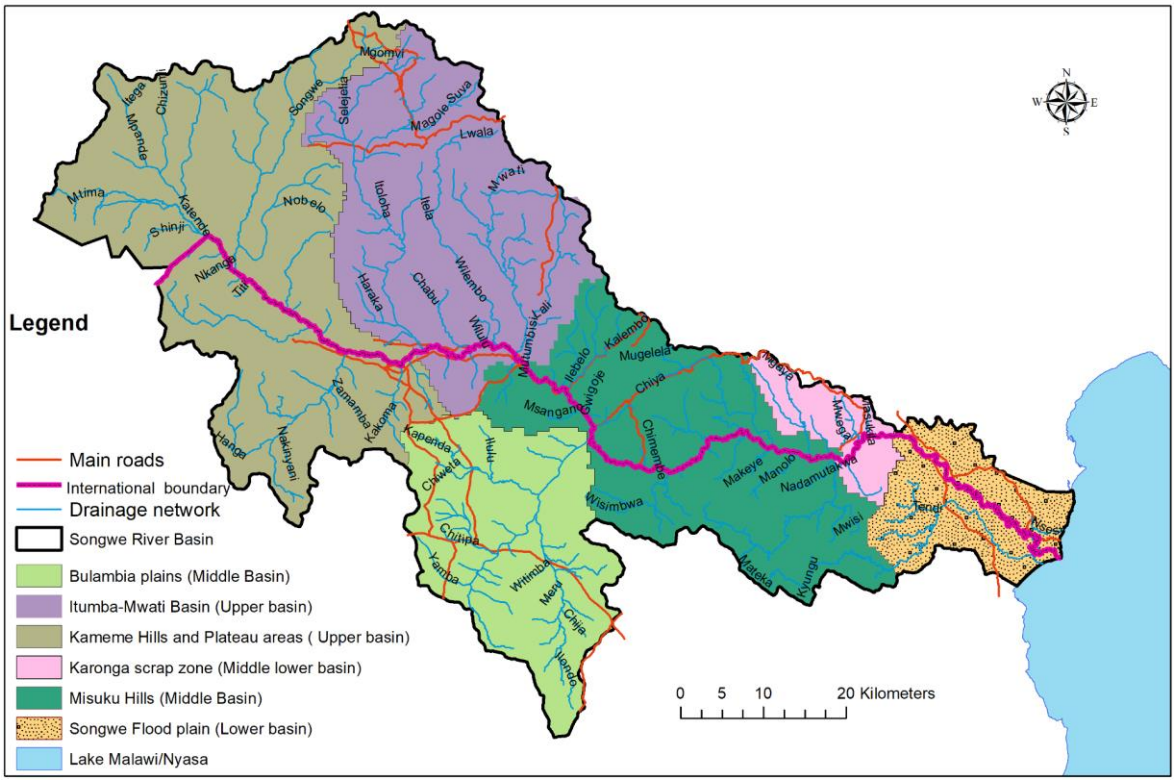


Figure 5.2: Sub-basins of the SRB

(Source: SONGWECOM TDA,2023)

The flow of water in the river follows a similar pattern to the distribution of rainfall. In plateau areas, streams often dry up during the dry season, while in the floodplain, the main concern is the occurrence of flooding. Additionally, many water sources in the catchments of the Songwe River Basin have been encroached upon and converted for cultivation purposes. This encroachment, coupled with extensive deforestation, has had a detrimental impact on numerous water sources and catchment areas within the basin.

5.1.2 Climate and rainfall in the SRB

The climate of the Songwe River Basin is classified under the Köppen Climate Classification System as a tropical wet and dry climate, often denoted as Aw. This classification reflects the distinct wet and dry seasons and the region's location within the tropical belt. The Songwe River Basin's climate supports diverse ecosystems, including savannahs, forests, and wetlands, which are adapted to the seasonal rainfall patterns and temperature variations. The SRB experiences a tropical climate characterized by high temperatures and distinct wet and dry seasons. The climate of the Songwe River Basin is influenced not only by the movement of the Intertropical Convergence Zone (ITCZ) but also by the interaction between winds and the region's topography. These factors play a significant role in shaping the climate patterns and characteristics of the basin.

Rainfall varies considerably across the basin, with an average annual rainfall ranging from about 800 mm in the upper parts of the basin up to more than 2750 mm in the lower parts of the basin. Wet and dry seasons are distinct, occurring from November to May, resulting in high flows during the wet season and lower flows in the dry season. The mean annual temperatures for the SRB are highest in the lower part of the basin, that is the Kyela and

Karonga districts and decrease with increasing altitude with the lowest mean annual temperatures found in Ileje, Mbeya and Mbozi districts.

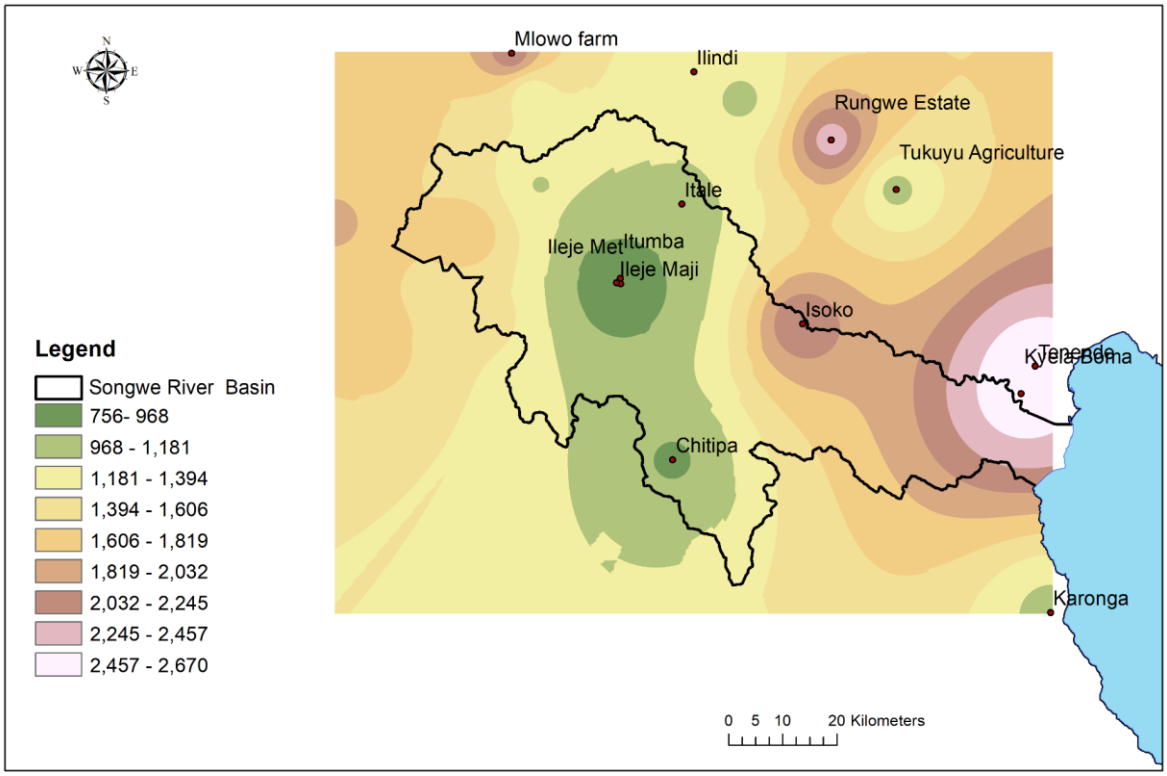


Figure 5.3: Map of Mean Annual Rainfall in the SRB
(SONGWECOM TDA,2023)

The average minimum temperature ranges between 14.1 and 17.8 °C and the average maximum temperature ranges between 25.8 and 28.7 °C. While both maximum and minimum temperature trends displayed an upward trajectory across the entire basin, the Malawian side consistently encountered higher temperatures in comparison to the Tanzanian side.

The topography of the Songwe River Basin also influences its climate. The basin is characterized by diverse landforms, including mountains, valleys, and plateaus. These variations in elevation and slope create microclimates within the region. The higher elevations experience cooler temperatures compared to the lower-lying areas. As moist air masses encounter the elevated terrain, they are forced to rise, leading to the formation of clouds and increased rainfall on windward slopes. Conversely, the leeward sides of mountains often experience drier conditions due to the rain shadow effect, where the descending air from the mountains results in reduced precipitation.

The Songwe River Basin (SRB) is a steep, mountainous catchment. The upper part of the basin has elevations 2000 – 2400 m asl, with peaks over 3,000 m asl, and dropping down to Lake Nyasa / Malawi at about 474 m asl. The Tanzania side is somewhat higher than the Malawi side, with the Chitipa highlands averaging 1300 m asl. The topography of the basin can be broadly classified into several categories from top to the floodplain:

- ✓ **Mountain zone:** This zone includes the mountain range stretching northwest to southeast along the northern boundary of the basin, the hills along the south western boundary of the basin (Kameme hills), and the Misuku hills which are located east of

Chitipa plain. The area lies in the Malawian District of Chitipa and the Tanzanian Districts of Ileje, Momba, Mbozi and Mbeya Rural.

- ✓ **Plateau zone** with elevations between about 1,200 masl and 1,500 masl, which includes the lands on both sides of the Songwe River and on the Chitipa plains, through which the Kaseye river flows. The middle part of the SRB lies within the two districts of Ileje in Tanzania and Chitipa in Malawi. The area is generally flat to gently undulating.
- ✓ **Escarpment zone** starting at the western edge of the floodplain, where the terrain rises steeply from 700 masl to about 1,200 masl over a relatively short distance (horizontal width of the zone about 20 to 30 km)[10]. The middle part lies within the two districts of Chitipa in Malawi and Ileje in Tanzania.
- ✓ **Flood plain** (upper and lower) with elevations below 700 masl and begins on the foothills down to Lake Malawi/Nyasa at 476 m above mean sea level. It is this part that dominates the Songwe river floodplain at elevations of mostly less than 1,000 m above sea level[11].

The topography of the Songwe River Basin also influences its climate. The basin is characterized by diverse landforms, including mountains, valleys, and plateaus. These variations in elevation and slope create microclimates within the region. The higher elevations experience cooler temperatures compared to the lower-lying areas. As moist air masses encounter the elevated terrain, they are forced to rise, leading to the formation of clouds and increased rainfall on windward slopes. Conversely, the leeward sides of mountains often experience drier conditions due to the rain shadow effect, where the descending air from the mountains results in reduced precipitation.

[10] Munthali et al., 2011: Munthali, K. G., Irvine, B. J., & Murayama, Y. (2011). Reservoir sedimentation and flood control: using a geographical information system to estimate sediment yield of the Songwe river watershed in Malawi. *Sustainability*, *3*(1), 254-269

[11] NORPLAN, 2003: *Final Feasibility Study Report; Preliminary Environmental Impact Assessment Main Report; Norplan A.S. in Association with COWI, DHI Water and Environment, W&PES: Oslo, Norway, 2003; Volume 4A.*

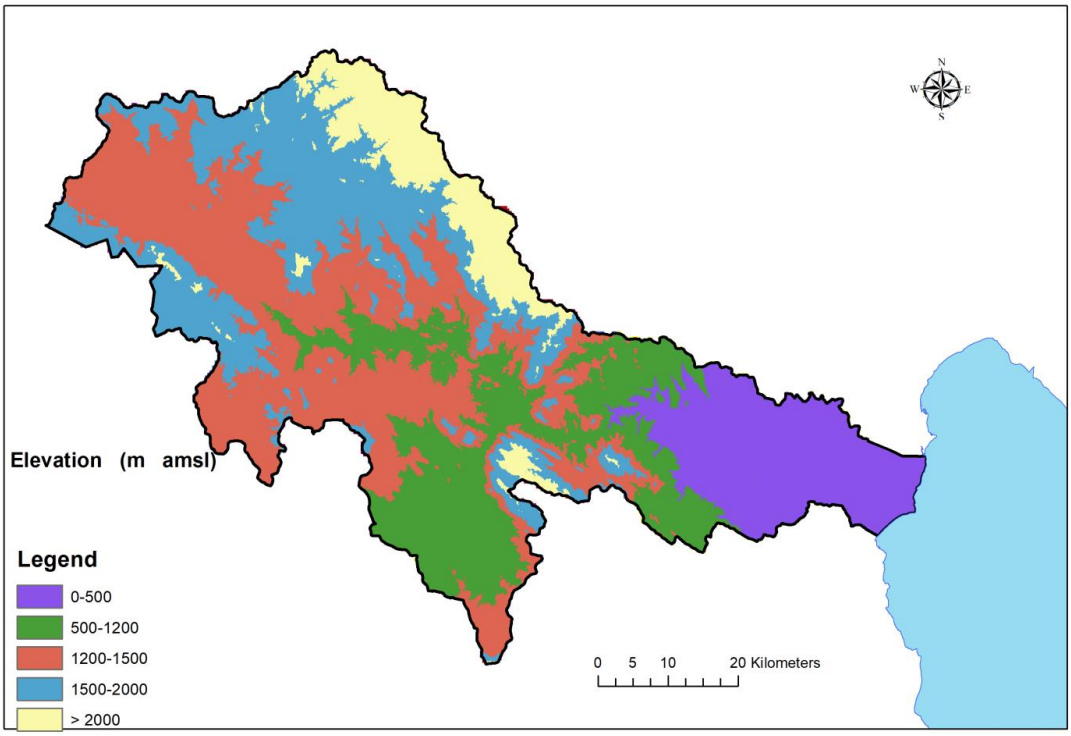


Figure 5.4: Map of Songwe River Basin showing topography
(***Source:*** SONGWECOM TDA, 2023)

5.1.3 Rainfall monitoring and rainfall data

Rainfall and meteorological parameters monitoring in the SRB and adjacent areas are carried out by the Department of Climate Change and Meteorological Services and District water Offices in Malawi and the Lake Nyasa Basin Water Board under the Ministry of Water in Tanzania. There are several monitoring stations within the Songwe River Basin that track rainfall and meteorological parameters. Among the 14 stations, nine are rain gauges, and five are automatic weather stations that track rainfall and other pertinent parameters (Figure 5.5). Yet, a significant number of these stations, suffer from non-functionality or partial operation due to instrument malfunctions, and inadequate station management and maintenance.

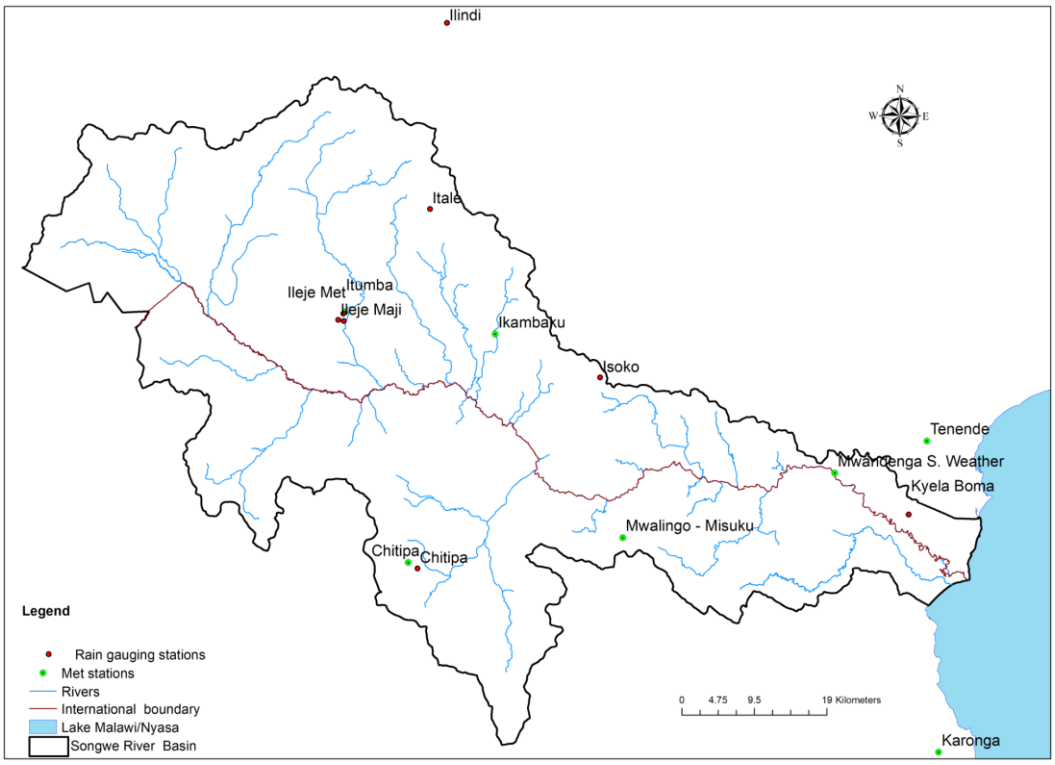


Figure 5.5: Rainfall gauging stations in the SRB

Groundwater monitoring are non-existent in the SRB and therefore no time series of groundwater level and the extent of water quality is available in the basin. However, the SRB has embarked on establishing new groundwater monitoring network and four stations located in the floodplain zone have been proposed (Table 5.1). The drilling and installation of equipment has been commissioned as part of the series of improvements earmarked in the SRB.

Table 5. 1: Proposed Groundwater Monitoring Stations in the SRB

S/No.	Country	Monitoring Stations	Latitude	Longitude	Altitude
1	Tanzania	Katumba P/School, Kyela (GW1)	-9.69370	33.91798	487
2	Tanzania	Ndwanga Dspensary, Kyela (GW2)	-9.64009	33.85561	490
3	Malawi	Shelasongwe P/School, Karonga (GW3)	-9.72087	33.89957	484
4	Malawi	Iponga- Chief, Karonga (GW4)	-9.64131	33.881591	513

Source: SONGWECOM FEWS, 2023

Analysis of rainfall data from eight rain gauge stations with considerable long time series of data was carried out to determine the general pattern of the rainfall in the basin over years and to discern whether trends existed or not. Among the eight stations analyzed, it was observed that three stations—Tenende, Chitipa, and Karonga—exhibited a noteworthy and statistically significant decline in trend, ranging from -3.9 mm/year at Chitipa to 23.9 mm/year at Tenende. Meanwhile, two stations situated in the upstream section of the catchment area, namely Isoko and Ileje Maji, displayed an upward trend, although it was not found to be statistically significant. The majority of the stations indicated a decreasing trend, although it was not statistically significant. The majority of short-duration series stations in the SRB exhibit no significant monotonic trends, indicating minimal changes in the basin's rainfall pattern in both directions (increase and decrease). Thus, despite the declining trend,

recent years (2000-2022) have not seen substantial rainfall alteration in the basin. Among stations with longer time series (over 30 years), a consistent decreasing monotonic trend is evident. This suggests higher historical basin rainfall compared to recent decades, potentially contributing to the observed variability and decline in annual rainfall due to climate change.

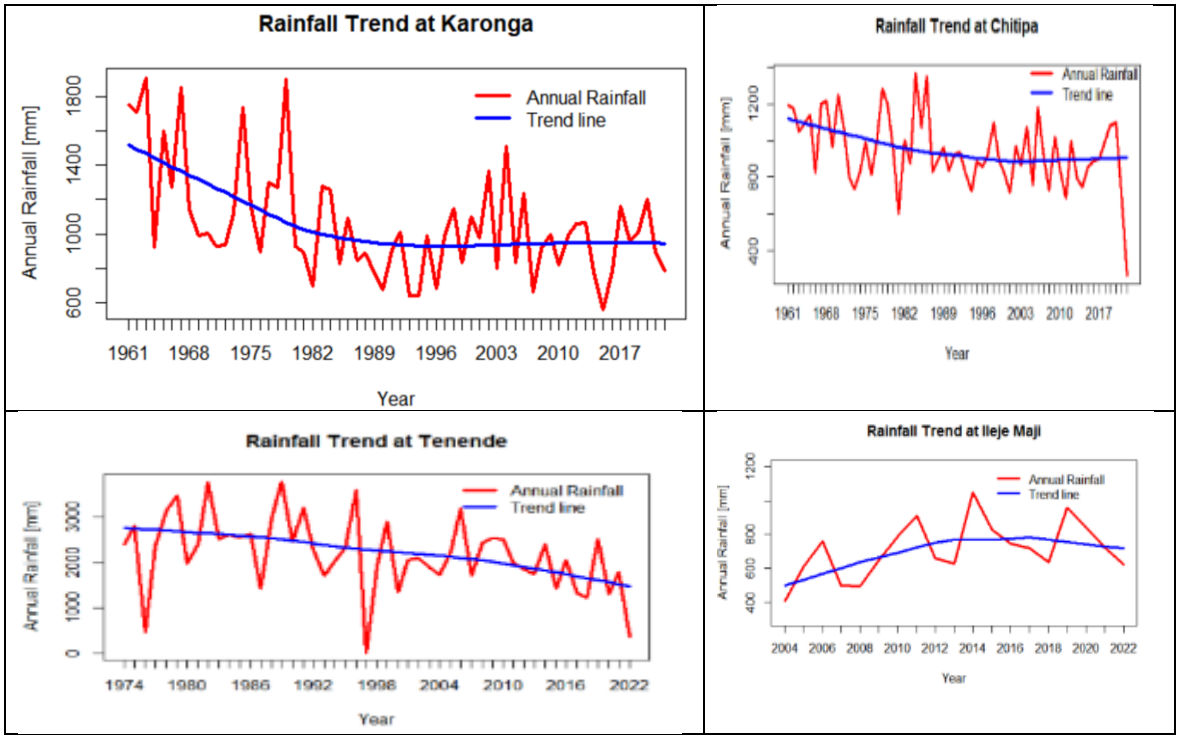


Figure 5.6: Rainfall Trends for selected stations in the SRB

Furthermore, investigations were carried out to determine whether there were any abrupt changes or jumps in the rainfall time series and the years of the change as well as possible implications. Results show that abrupt changes were experienced in the basin with stations such as Tenende exhibiting a change point in recent years around 2014, Chitipa around the mid-1990s (1997/1998), Karonga in the 1975s, and Ileje Maji around 2009. These shifts in rainfall time series within the basin can result from factors like climate variability (e.g., El Niño or La Niña events), climate change, atmospheric phenomena, topography, and land use changes. Consultations with experts and communities indicate that these shifts often coincide with flooding events. Notably, the historically wet year of 1965/1966 is evident for Karonga and Chitipa and shifts are also evident in 2009 and 2014, corresponding to Tenende and Ileje Maji stations. These changes have far-reaching implications: ecologically, they disrupt habitats and species distributions; agriculturally, they impact crop yields and food security; water resource management faces challenges; infrastructure vulnerabilities pose flooding and erosion risks; public health can be compromised; and these shifts can lead to economic instability, resource conflicts, necessitating adaptive policy and planning to ensure long-term resilience and sustainability across the watershed.

5.1.4 Discharge analysis

An analysis of discharge data was conducted using the time series data collected at the Mwandenga gauging station, spanning from 1986 to 2022, although there were occasional gaps in the data. The dataset underwent rigorous quality control and consistency checks, and any periods with missing data were interpolated using simulated data generated by the Soil Water Assessment Tool (SWAT). The selection of the Mwandenga station over Kasumulu was primarily influenced by the former's availability of a longer, more consistent time series dataset, despite their close proximity to each other.Another critical factor to consider is that this gauging station is the furthest downstream, making it essential for evaluating the flow in the Songwe River. It has recorded several instances of high peak flows. The long term daily average flow (1986-2022) is estimated to be 47.2 m^3/s. This is slightly higher (0.4%) from what was estimated in 2015 at the same site which is 47 m^3/s. One possible explanation for this phenomenon could be the increased availability of data during calculations. Additionally, it may be influenced by climate change and alterations in the physical characteristics of the catchment area over time. Notably, peak floods have been observed, with the highest recorded at 1,470 m^3/s on April 16, 2015. These peak discharges typically occur in April, towards the conclusion of the rainy season.

An analysis was conducted to assess the correlation between rainfall data from stations within the Songwe Basin and the discharge levels at the Mwandenga gauging station. The objective of this analysis was to identify any potential linkages between rainfall patterns and the resulting flow measurements at the Mwandenga location.

Figure 5.7 illustrates the relationship between rainfall and discharge data and reveals a noteworthy finding: rainfall data observed at the Tenende station exhibit a strong correlation with the discharge levels recorded at Mwandenga. Tenende, situated in close proximity to the Songwe River floodplain, serves as a representative location for the lower basin, even though it is slightly outside its formal borders. This station experiences weather patterns similar to those within the basin and is strategically positioned closer to the Mwandenga stations.

Comparatively, the correlations between rainfall and discharge data appear to be less pronounced for stations like Itale and Ileje Maji, located in the upstream portion of the basin, and Karonga, situated on the Malawian side. This observation highlights the significance of Tenende as a valuable reference point for understanding the hydrological dynamics of the Songwe River Basin, particularly in relation to the Mwandenga gauging station.

Mwandenga is located immediately downstream from the confluence of the Kaseye River with the Songwe River. Therefore, it is anticipated that the contributions from all the tributaries will be measured and recorded at the Mwandenga gauging station. The station has a discharge peak value of 1470 cumecs on 16.04.2015 corresponding to rainfall of about 147.2 mm. Highest rainfall was observed at Tenende on 27/04/2010 which was about 357.6 mm corresponding to a discharge of about 1330 cumecs.

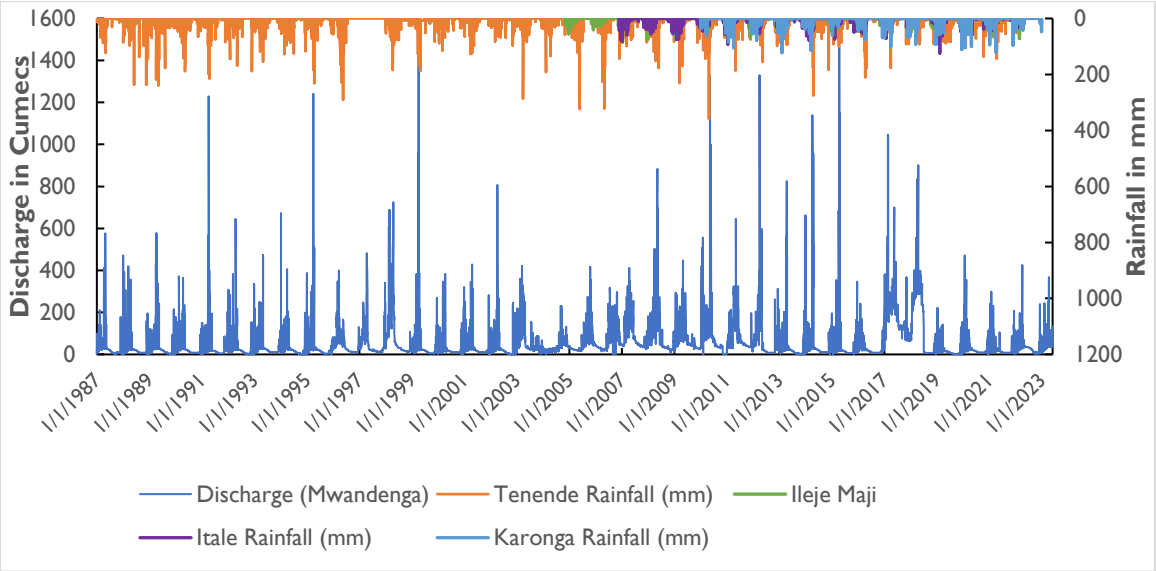


Figure 5.7: Relationship between Rainfall and Discharge at Mwandenga in the SRB

5.1.5 Trends in discharge series

The trend test and change-point analysis were carried out on mean annual discharge series of three hydrometric stations (Mwandenga, Ipenza and Itumbi) for the period between 1986 and 2022. For Mwandenga the trend analysis was further carried out on the annual maximum, annual minimum discharge series for the period ranging from 1986-2022. The results of both the Mann-Kendall and the sen's slope tests show that, at the 5% significance level, the annual mean discharge series did not have any statistically significant trend for Mwandenga and Ipenza stations. However, a significant increasing trend was observed for Itumba gauging station, located in the upstream part of the catchment, signifying an increasing trend towards high flows (0.0175 (m^3/s/year) (Table 5.1). The results further show that the annual minimum discharge values at Mwandenga station showed a decreasing trend of about -0.008 m^3/s/year. The increasing trend in the maximum discharge values can be observed at Mwandenga station (of up to 6.5 m^3/s/year), albeit not significant.

Table 5.1: Trends in Annual Discharge Values for selected stations in the SRB

Station	Data Range	P Value	S Value	Sen's slope	Tau Value	Remarks
Mwandenga(mean)	1986-2022	0.9399	-7	-0.0486	-0.00996	Decreasing
Mwandenga (max)	1986 to 2022	0.059	146	6.4927	0.219219	Increasing
Mwandenga(min)	1986 to 2022	0.89	-11	-0.0080	-0.016579	Decreasing
Ipenza (mean)	1986-2021	0.3473	-70	-0.0714	-0.111	Decreasing
Itumba (mean)	2006-2022	0.00018*	92	0.0175	0.676471	Increasing

**Significant different at 5% level of significance*

5.1.6 Flow Duration Curve

The flow duration curve, presented, depicted in Figure 5.8 illustrates the relationship between the frequency and magnitude of daily streamflow in the Songwe River Basin. It represents the percentage of time that a specific discharge was equaled or exceeded from 1986 to 2022. This curve provides a visual representation of the historical variations in streamflow within the basin. Each discharge value corresponds to an exceedance probability, allowing for the analysis of quartiles or percentiles of daily streamflow. For example, a peak discharge of 100 m^3/s occurs less than 10% of the time, while the mean discharge of 47 m^3/s

is reached approximately 35% of the time or less. The discharge value with a 90% exceedance represents approximately 8.5 m³/s.

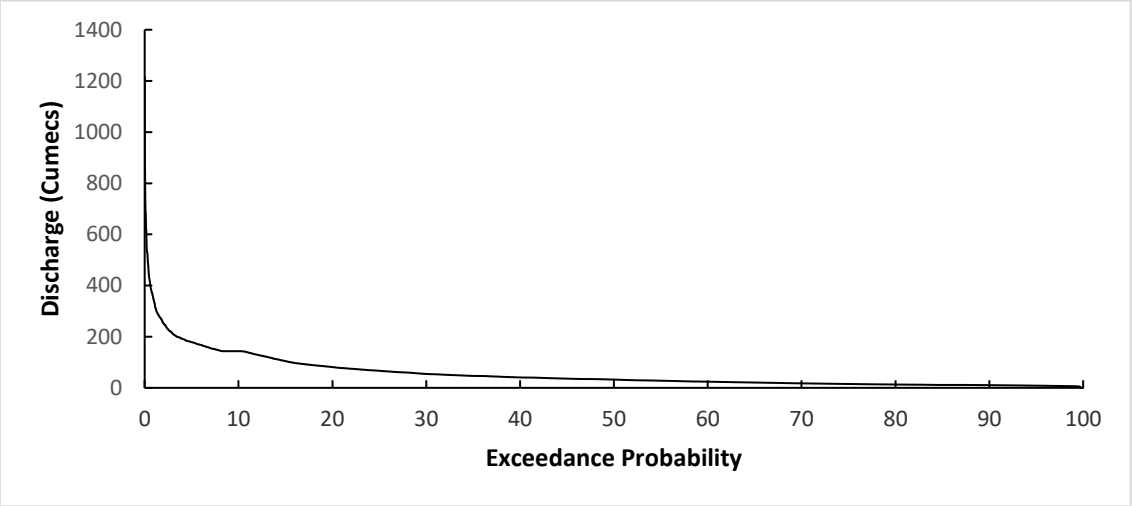


Figure 5.8: Flow duration Curve for Mwandenga Station (1986-2022)

5.1.7 Drought analysis

Meteorological analysis employs the Standardized Precipitation Index (SPI) methodology to assess intricate drought conditions and their patterns in the Songwe River Basin (SRB), focusing on the Chitipa and Karonga stations. The SPI technique delves into precipitation fluctuations, yielding insights into drought dynamics. Figure 5.9 presents SPI values for 1- and 3-month durations, depicting a range from -2 to 2. This index offers a lens to decode rainfall trends across the basin. The graph's trajectories correspond with periods of increased or decreased precipitation. The analysis unveils a pattern: recent years exhibit drought phases alternating with moisture-rich intervals, sometimes leading to extreme dry spells. This narrative indicates that the basin experiences normal, moderately arid, or saturated conditions. Noteworthy meteorological extremes emerge during specific time frames. The 1960s stand out as wet years, with 1965 and 1966 notably extreme wet years. A meteorologically excessive trend is seen in 1966 for Karonga. The 1970s shift between wet and normal years until a dry spell in 1976, followed by cycles of normal and dry years. The mid-1980s witness dryness in 1986 and 1987, transitioning to wet years until 1990, which are normal with some dry periods. This interplay persists up to 2006/2007, consistently marked as dry across the basin.

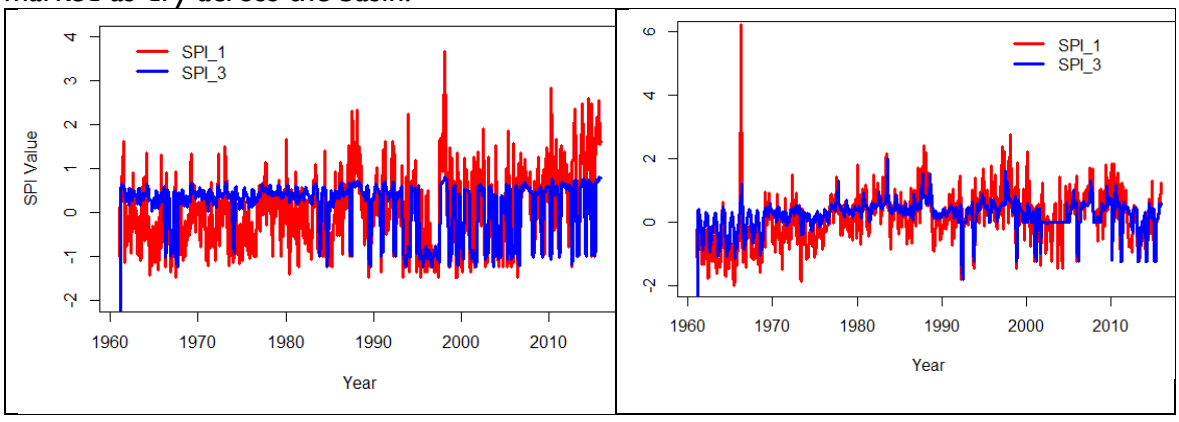


Figure 5.9: SPI values for Chitipa Station (Left) and Karonga (Right)

In the Songwe River Basin, periods of mild to moderate aridity are common, with extreme events occurring roughly every 3 to 10 years. This pattern applies to both meteorological and agricultural droughts, which peak in severity within this timeframe. Interestingly, the basin exhibits a prevailing trend toward wetter conditions, evident from the shift towards positive SPI values. However, there is a recent tendency towards aridity, notably in Karonga and the lower parts of the basin.

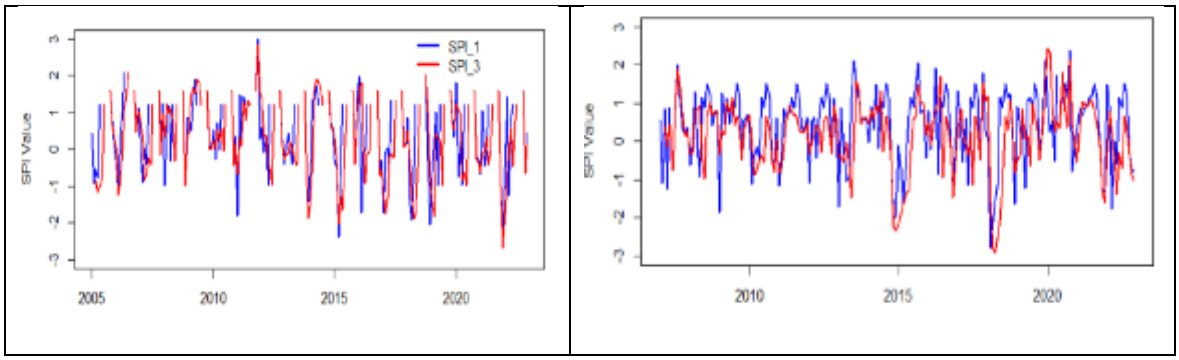


Figure 5.10: SPI values for Ileje Maji Station (Left) and Isoko Station (Right)

5.1.8 Sediment rate and sediment loading

The Songwe River Basin (SRB) faces significant land degradation challenges. Analysis of land use and cover change reveals a 62% decline in woodland and a 200% increase in cultivated land. The study also indicates that about 31% of the basin experiences high to severe soil erosion risks, with 11% facing very severe to catastrophic erosion risks, exceeding 10 tons per hectare per year. A study by Vargas and Omuto (2016)[12] estimated mean soil loss rates of 15.22 and 15.81 tons/ha/year in Chitipa and Karonga, respectively. Recent data for Karonga suggests soil loss ranging from 4 to 30 tons/ha/year. Another study (Munthali et al.,2016)[13] demonstrated upper catchment areas with a potential for over 25 tons per hectare per year. With the basin's steep slopes and variable rainfall, infrequent heavy rains predominantly transport sediment. The SWAT+ model simulation shows substantial sediment yield from landscapes, transported in river reaches and deposited in Lake Malawi/Nyasa, contributing about 10% of the lake's inflow. Figure 5.11 illustrates an average sediment yield of 21.5 tons per hectare per year from the landscapes, attributed to steep slopes and agricultural activities in the basin. Considering climate change, the sediment yield was simulated for the period between 2022-2050 and results show an increase in sediment generated from the landscapes, mainly due to the influence of climate variability, unsustainable agricultural practices and lack of conservation practices.

[12] Vargas and Omuto (2016): Soil loss Assessment in Malawi; Food and Agriculture Organization of the United Nations and the UNDP-UNEP Poverty-Environment Initiative and the Ministry of Agriculture, Irrigation and Water Development, Malawi.

[13] Munthali, K. G., Irvine, B. J., & Murayama, Y. (2011). Reservoir sedimentation and flood control: using a geographical information system to estimate sediment yield of the Songwe river watershed in Malawi. *Sustainability*, *3*(1), 254-269.

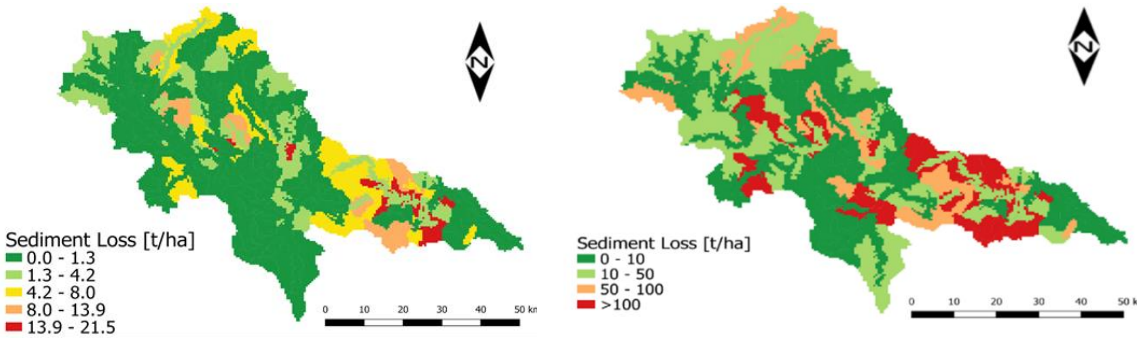


Figure 5.11: Sediment yield in tonnes per hectare per year in the SRB -current and 2050

5.1.9 Surface Water Resources

The Songwe River serves as a vital water source for domestic, agricultural, and other socio-economic needs within the basin. It is complemented by various tributaries such as Mwega River, Luswisi, Itumba, Kija, Lubangalala, Hanga, Kasaya, Kakoma, Kyungu, and Makeye in, which contribute to overall water availability. These rivers' water flow corresponds to rainfall patterns, resulting in higher flows during the wet season and decreased availability in the dry season, which worsens during droughts and affects water availability. Factors like irregular rainfall and human actions such as deforestation and cultivation on steep terrain further exacerbate water scarcity. To tackle these challenges, sustainable land management, reforestation, and water conservation are crucial for ensuring a steady water supply throughout the year. Furthermore, efficient hydrological monitoring is critical, but the basin is not adequately gauged for monitoring flows (Figure 5.12).

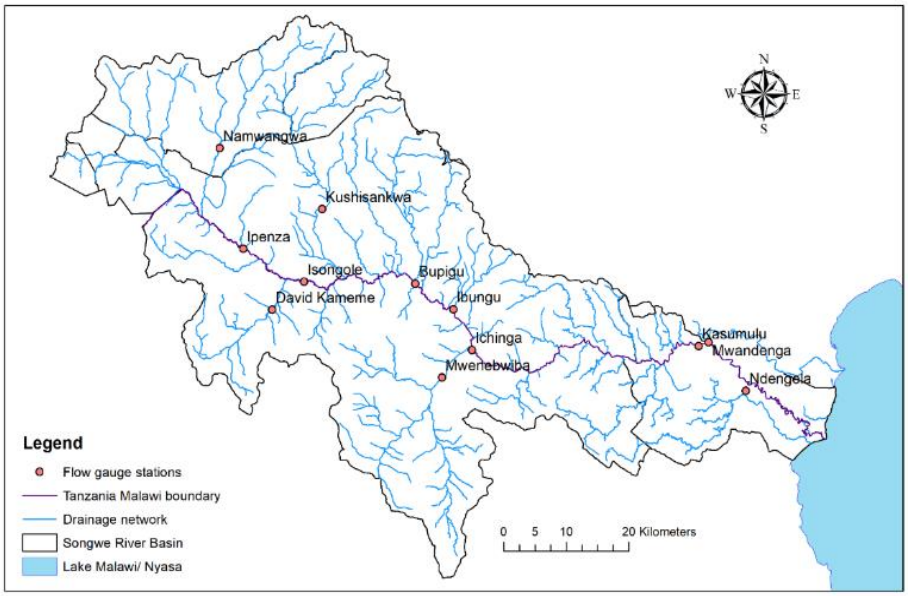


Figure 5.12: Hydrometeorological stations in the Songwe River Basin

Source: SONGWECOM TDA, 2023

Analysis carried out reveal that, the Songwe River Basin's total annual runoff was around 994.2 million cubic meters (MCM) in 2022 (Table 5.2). Projections taking into account climate change indicate an increase to 1060.8 MCM/year by 2025 and further to 1190.9 MCM/year by 2035. However, a decline in annual runoff is anticipated, reaching 934.7

MCM/year by 2050, signifying about a 6% reduction. This decrease is mainly linked to climate change effects, including higher temperatures and decreased rainfall in the area.

Table 5.2: Estimated surface runoff for SRB with climate change effects

Month	Monthly Runoff (m^3/s)			
	2022	2025	2035	2050
January	31.3	53.0	60.7	44.5
February	41.1	55.1	68.8	53.0
March	56.6	64.3	76.5	53.3
April	61.5	47.4	54.8	53.9
May	35.8	40.4	38.7	31.2
June	34.5	35.5	47.3	34.6
July	30.8	25.9	25.1	23.5
August	22.9	14.6	13.7	11.6
September	8.61	7.9	6.3	4.7
October	5.87	11.8	6.6	8.2
November	8.19	7.8	8.4	11.7
December	40.1	38.9	45.1	24.6
Annual Total (MCM/Year)	**994.2**	**1060.8**	**1190.9**	**934.7**

Source: SONGWECO TDA, 2023

5.1.10 Groundwater Resources

Groundwater resources significantly contribute to water availability in the basin, offering additional water sources for both human consumption and agricultural activities. Nonetheless, the sustainability of these groundwater resources requires careful management to prevent overexploitation and depletion.

The available groundwater is quantified as the sustainable Annual Safe Yield (ASY), representing the amount of water that can be extracted without causing substantial harm to groundwater resources. This approach aims to prevent groundwater depletion, ensuring sufficient environmental and base flow in rivers. Based on model outcomes and anticipated climate impacts, the ASY in the SRB is projected to decrease from 9.63 million cubic meters (MCM) per year in 2022 to 9.55 MCM/year in 2025. An increase is foreseen in 2035, reaching up to 9.81 MCM/year, followed by a decrease to 9.01 MCM/year by 2050, as indicated in Table 13. This demonstrates a decline of nearly 6.5% from 2022 to 2050.

5.1.11 Climate Change and Water Resources in the SRB

The SRB is currently experiencing the rapid impacts of climate change, which are affecting both water availability and users. It is crucial for the SRB to develop and implement effective adaptation measures to mitigate these impacts. One notable direct effect of climate change on hydrological conditions is the rising temperature, which is expected to lead to a decrease in surface runoff by around 6%. However, the assessment highlights the current limited capacity within the basin to carry out interventions in climate-sensitive areas.

To effectively tackle the challenges posed by climate change, it is imperative for the SRB to prioritize capacity-building for adaptation and establish robust coordination and collaboration with other stakeholders. This will facilitate the implementation of initiatives aimed at adapting to the impacts of climate change on water resources. By bolstering its capacity and fostering partnerships, the SRB can adeptly respond to the challenges of climate change and ensure the sustainable management of water resources throughout the basin.

5.2 An Empirical Outlook on Water Resource Degradation: Trends, State and Futures

Malawi and Tanzania are water abundant countries with average renewable freshwater availability per capita of 1,412m^3 and 2,250 m^3 per year, respectively (URT undated[14], GoM 2023[15]). However, spatial and temporal supply problems is mainly due to limited investments in portable water storage and supply systems. Deforestation, agricultural expansion, land degradation in the highlands and water catchment areas are the main cause deteriorating water quality and water flows in rivers.

The Songwe river stretches for approximately 200 km, encompassing a catchment area of about 4,240 square kilometers. It receives significant contributions from major tributaries such as Mutumbisi, Kaseye, and Makeye rivers. The basin's physical attributes, including rainfall distribution, make it prone to frequent flooding. The river showcases remarkable morphological dynamics, prominently meandering between the foothills and Lake Nyasa/Malawi. Notably, the lower basin exhibits intricate meandering, extending over 40 km despite a direct distance of 25 km, with both primary and secondary meanders and frequent 180° bends.

The water flow in the Songwe river and its tributaries mirrors the rainfall seasons and follows the same pattern to the distribution of rainfall. In plateau areas, streams often dry up during the dry season, while in the floodplain, the main concern is the occurrence of flooding. Additionally, many water sources in the catchments of the Songwe River Basin have been encroached upon and converted for cultivation purposes. This encroachment, coupled with extensive deforestation, has had a detrimental impact on numerous water sources and catchment areas within the basin.

The SRB faces multiple threats to its sustainable water supply and water quality in both countries. The river plays a vital role by providing ecosystem services (ES) and benefits to communities and connected townships, such as water resources, pollination, flood and landslide control, and climate regulation. Despite these benefits, ongoing environmental problems pose a risk to the long-term sustainability of these services. It is crucial to address these threats urgently and prioritize conservation to prevent further depletion and degradation. The main threats in the Songwe River Basin include inadequate management of catchment areas, environmentally harmful agricultural practices, rapid population growth, improper discharge of municipal and industrial waste, and weak institutional structures for enforcing Water Resources Acts and implementing Integrated Water Resources Management (IWRM).

The Songwe River serves as a vital water source for domestic, agricultural, and socio-economic needs within the basin. It is complemented by various tributaries such as Mwega River, Luswisi, Itumba, Kija, and Lubangalala in Tanzania, and Hanga, Kasaya, Kakoma, Kyungu, and Makeye in Malawi, which contribute to overall water availability. These rivers' water flow corresponds to rainfall patterns, resulting in higher flows during the wet season and decreased availability in the dry season, which worsens during droughts and affects groundwater levels. Factors like irregular rainfall and human actions such as deforestation and cultivation on steep terrain further exacerbate water scarcity. To tackle these challenges, sustainable land management, reforestation, and water conservation are crucial for ensuring a steady water supply throughout the year.

[14] URT undated. Water Resources Fact Sheet. Ministry of Water. Dodoma

[15] GoM 2023. Water Resources Management and Development Plan (Draft). Department of Water Resources. Lilongwe.

5.3 Water supply and access

Access to safe water remains a significant challenge for many people in the Songwe River Basin (SRB). Both Tanzania's National Water Policy (2023) and Malawi's 2018 policy highlight the importance of households being within 400-meter and 500-meter distances from a safe water source, respectively. Aligned with the National Water Policies, the Water Resources Act of 2013 for Malawi, the Water Resources Management Act of 2009 (with a 2022 amendment), and Sustainable Development Goal 6, there is a shared commitment to ensuring fair access to water for all communities throughout the Songwe River Basin.

Major sources of water for communities within the Songwe River Basin include boreholes, shallow wells, springs and gravity schemes. The water supply composition on the Malawian side includes 43.9% from piped water, 44.3% from public taps, and 7.9% from boreholes and protected dug wells. On the Tanzanian side, townships and peri-urban areas are served by Water Supply and Sanitation Authorities (WSSAs) managed by their respective Boards of Directors. Examples include Itumba-Isongole and Tunduma under the RUWASA Board of Directors, and Kyela-Kasumulu under the Mbeya Water Supply and Sanitation Authority. Communities that are not directly served with water utilities in the basin highly depend on groundwater sources, particularly in the rural areas.

In Tanzania, approximately 65% of rural and 91% of urban residents have access to drinking water within a distance of less than 0.5 km (URT 2022). As of 2020, 70% of the rural population in Tanzania had access to piped or protected water as their primary source, with a target of increasing this to 85% by 2025 (URT 2021). In Malawi, roughly 85% of rural and 98% of urban areas have access to drinking water (GoM 2021). In 2020, approximately 88.3% of Malawians were connected to domestic drinking water supply, and the aim is to ensure universal access to water for all Malawians by 2030.

Level of access to potable water in the Songwe River Basin (SRB) is summarized in Table 5.3. The general trend is that urban areas typically have higher coverage of piped water supply compared to rural areas. However, there is an increasing coverage of piped water in rural areas on the Tanzanian side. Stakeholders during the discussions associated this trend with the growing role and investment made by RUWASA in extending their reach. This is evident in places such as Kyela district, where piped water supply covers 70% of rural households, while only 54% of urban households have access to the piped water network. The same trend can be observed in Mbozi and Mbeya rural areas.

Table 5.3: Access to potable water by District in the SRB

District	Access to Piped Water (%)[16] Urban	Access to Piped Water (%)[17] Rural
Chitipa	75	15
Karonga	70.3	17
Kyela	54	70.24
Ileje	88	69
Mbeya Rural	41.0	65
Mbozi	22	59.8
Momba	37.6	15

Source: Field Data

[16] District Council Socio-Economic Profiles and Field data
[17] District Council Socio-Economic Profiles and Field data

Figure 5.13: Shallow borehole with hand pump in Isinde Street, Tunduma TC
(***Source:*** TDA Field Data – Jumanne Placid)

5.4 Water demands

Water is an important component in human life to facilitate domestic needs and social-economic activities. Water demand and uses were determined in several sectors; including domestic demands, irrigation demand and demands for other socio-economic activities including hydropower.

Previous studies carried out in the basin (DDIP-SBRDP (2015))[18] and (SMEC (2014)) [19] indicated that the daily domestic demand per person in the SRB was about 67 l/c/d. This estimation was used to calculate the domestic demand based on population living within the Songwe River Basin. Estimations indicate that the domestic water demand in the SRB was around 11.64 MCM in 2022, 12.78 MCM in 2025, 17.16 MCM in 2035 and will reach 64293 m^3/day in 2050. Irrigation water demand was estimated at 51.5 MCM in 2022, 58.1 MCM in 2025, 78.4 MCM in 2035 and reaching 111.0 MCM in 2050. Demands of water for livestock is estimated at 1.45 MCM in 2022, rising to 1.55 MCM in 2035 and 2.08 MCM in 2050. Although the SRB is not currently heavily industrialized, this is expected to change in the near future and water demands are expected to rise to 2.12 MCM in 2050. Hydropower demand for the anticipated three dams are expected to take effect by the year 2035 going into the 2050s. Demands for water for sustaining the environment are currently estimated to contribute to 337 MCM (2022), 347.1 MCM (2025), 263 MCM (2035) and 201.57 MCM (2050).

[18] DDIP-SBRDP, (2015):Detailed Design and Investment Preparation Project for the Songwe River Basin Development Programme: Environmental and Social Impact Assessment-ESIA.

19 SMEC. (2014). Integrated Water Resources Management and Development (IWRMD) Plan for the Songwe Catchment.

Table 5.4: Water Demand and Water Balance in the SRB

	Values in Respective years (MCM/year)				
Demand/Supply Type		**2022**	**2025**	**2035**	**2050**
Water Demand	Domestic	11.64	12.78	17.16	26.71
	Livestock	1.45	1.45	1.55	2.08
	Industrial and Mining	1.69	1.7	1.88	2.12
	Irrigation	51.5	58.1	78.4	111.00
	Hydropower Demand	-	-	1664	1664
	Env. Flows-	337	347.1	263.5	201.57
	Total Demand	400.28	421.13	2026.49	2007.48
Water Available	Surface Runoff	994.2	1060.8	1190.9	934.7
	Groundwater ASY	9.6	9.55	9.05	8.483
Total Water Available- (Run-off + ASY)		1003.8	1070.4	1200	943.183
Balance		603.52	649.27	-826.49	-1064.30
Demand as % of available		39.90%	39.30%	168.80%	212.84%

Source: SONGWECOM TDA, 2023

The analysis indicates that the annual water requirement constitutes a significant portion of the total available water, with averages of 39.9%, 39.8%, 168.8%, and 212.84% for the years 2022, 2025, 2035, and 2050, respectively. This underscores a substantial demand for water, surpassing the available resources within the Songwe River Basin. The situation becomes highly critical when the three dams are operational, where water scarcity could potentially impede power generation. Addressing these looming challenges requires careful consideration of projected climate change impacts and proactive measures to restore and conserve landscapes.

5.5 Water quality

There are no continuous monitoring programs for water quality in the SRB. Data within the Songwe River Basin stems primarily from occasional sampling efforts from studies[20,21,22,23] and other reports from RUWASA and the District Water Authorities. Noteworthy data collection spots encompass regions near Kasumulu and the upper and lower stretches of the Songwe. This study additionally conducted sampling at the Kasumulu station in October 2022 (dry season) and May 2023 as well as from boreholes for analysis.

Analysis of data from the different studies show favourable physico-chemical conditions in the Songwe River. (Table 5.5). However, turbidity levels display significant variation across distinct basin sites, influenced by discharge and sampling timing. Data indicates a consistent rise in turbidity over time, alongside an increase in Total Suspended Solids in water sources during most years. These escalating trends might point to heightened sediment loads due to compromised land-use practices. While conducting fieldwork, the team of consultants identified a range of water quality concerns in the Songwe River. The water exhibited a

[20] Bootsma, H., & Hecky, R. (1999). Nutrient cycling in Lake Malawi/Nyasa. *Water Quality Report: Lake Malawi/Nyasa Biodiversity Conservation Project. Southern African Development Community/Global Environmental Facility (SADC/GEF)*, 215-241.

[21] DDIP-SBRDP, (2015): Detailed Design and Investment Preparation Project for the Songwe River Basin Development Programme: Environmental and Social Impact Assessment-ESIA.

[22] Munthali et al., 2011: Munthali, K. G., Irvine, B. J., & Murayama, Y. (2011). Reservoir sedimentation and flood control: using a geographical information system to estimate sediment yield of the Songwe river watershed in Malawi. *Sustainability*, *3*(1), 254-269

[23] SMEC. (2014). Integrated Water Resources Management and Development (IWRMD) Plan for the Songwe Catchment.

distinct brown hue, indicative of elevated turbidity levels. Notably, agricultural activities along the riverbanks pose significant risks, contributing to pollution from nutrient loads. Additionally, the presence of pesticides and herbicides further poses a threat to the downstream water quality. These observations underscore the need to address agricultural practices and potential pollutants to safeguard the water quality of the Songwe River.

Figure 5.14: Brown Colour implying turbidity in the Songwe River

Source: SONGWECOM TDA, 2023

Table 5.5: Water Quality of Surface Water from Selected locations in the Songwe River

Parameters	Sample location	Lower reach[1]	Lower Reach[24]	Kasumulu	Upper reach[25]	Lower Reach[26]	Kasumulu	Kasumulu (TDA)	Songwe Kasumulu (TDA)
	Date	1993	1997/98	Mar-07	2013	2013	2014(Jan)	Oct-22	May-23
pH				7.4	7.5	8	7.8	7.6	7.5
EC	uS/cm			187	69	115	78	176	245
TDS	mg/l			103	37	58	51	87	121
TSS	mg/l			540	2	1.6	1971.2	845	985
Turbidity	NTU		934	630			1050	943	1240
Total Hardness	mg/l $CaCO_3$			77			42.5	53	82
SO_4	mg/l	0.67	0.57	6.2	n.d.	0.04	0.75	1.2	4.5
Cl-	mg/l	0.35		4.18			9.1	7.8	5.6
NO_3	mg/l			0.04			1	1.2	0.89
NH_4	mg/l						0.48		
TP	mg/l		0.25		0.66		0.72		

Source: Field Data and various sources

[24] Bootsma, H., & Hecky, R. (1999). Nutrient cycling in Lake Malawi/Nyasa. Water Quality Report: Lake Malawi/Nyasa Biodiversity Conservation Project. Southern African Development Community/Global Environmental Facility (SADC/GEF), 215-241.
[25] SMEC. (2014). Integrated Water Resources Management and Development (IWRMD) Plan for the Songwe Catchment.
[26] SMEC. (2014). Integrated Water Resources Management and Development (IWRMD) Plan for the Songwe Catchment.

Water quality from selected boreholes showed good quality except in some areas such as around Kyela, it was observed that there is a high concentration of fluoride, iron, manganese and electric conductivity beyond the allowable limits. Stakeholders consulted highlighted a big concern on poor water quality and this was associated with incidences of water-borne diseases. The agricultural practices along the river banks poses high risks with pollution from nutrients loads, pesticides and herbicides are also threat to the water quality downstream.

In the larger context, the Songwe River significantly contributes to the annual river input into Lake Nyasa/Malawi, thus wielding a substantial influence over the lake's water quality. Atmospheric contributions account for 33% of new phosphorus and 72% of new nitrogen inputs to the lake[27]. Given its expansive surface area and sluggish water-flushing rates, Lake Nyasa/Malawi is particularly susceptible to nutrient enrichment and pollution. As the degradation of the Songwe River Basin persists, the potential impact on the lake's water quality is concerning, which in turn could affect aquatic life and the lake's overall aesthetic appeal.

Both Malawi and Tanzania are actively working to manage and regulate groundwater resources within the basin. This includes the monitoring of groundwater levels, the implementation of water conservation practices, and the promotion of sustainable water use. Given the transboundary nature of the groundwater resources, collaborative efforts between the two countries are imperative to ensure effective management of these resources within the Songwe River Basin.

5.6 Water Scarcity Indicators

The Falkenmark water scarcity indicator was used to assesses per capita share of total annual runoff against predefined thresholds of water stress status, centering on essential human water requirements, surface water runoff sources, and their correlation with population size. Analysis indicates that, the renewable fresh water available per capita per year within the basin is approximately 2330 m^3/ca/year for the current period (2022). This is generally above the national average of 1,412m^3 and 2,250 m^3 per year, for Malawi and Tanzania, respectively (URT, 2015[28], GoM 2023[29]).

However, considering the impacts of climate variability, climate change, and population growth, these projections anticipate a decline to 2279.40 by 2025, 1921.22 by 2035, and a substantial reduction to 983.44 m^3 per capita per year by 2050.

This pronounced decrease in 2050 is primarily attributed to the interplay of projected population expansion and the implications of climate change, including elevated temperatures and diminished precipitation, consequently affecting annual runoff. The threshold for water shortage is defined at water availability exceeding 1,700 m^3/capita/year, beyond which water scarcity emerges sporadically or locally. Below this level, water scarcity manifests with varying degrees of severity, while water stress becomes a regular occurrence when water availability falls below 1,000 m^3/capita/year, presenting constraints to both economic advancement and human health and well-being.

27 Bootsman & Hecky (1999)

28 URT 2015. Water Sector Status Report, Ministry of Water. Dodoma

29 GoM 2023. Water Resources Management and Development Plan (Draft). Department of Water Resources. Lilongwe.

Table 5.6: Falkenmark Water Scarcity Indicator for different Time Horizons

	2022	2025	2035	2050
Runoff (MCM)	994.2	1060.8	1190.9	934.7
ASY (MCM)	9.63	9.55	9.81	9.01
Total AW(MCM)	1003.83	1070.35	1200.71	943.71
Basin Population	430,982	469,575	624,970	959,599
Falkenmark Indicator (m^3/ca/year)	2329.17	2279.40	1921.22	983.44
Remark	No stress	No stress	No stress	Scarcity

Source: SONGWECOM TDA, 2023

5.7 Water Resources Degradation: Impacts, Drivers and Solutions

5.7.1 Pathways to Environmental and Socio-Economic Impacts

In the intricate fabric of Earth's interconnected systems, the health of water resources is a crucial linchpin, reflecting the well-being of ecosystems and societies alike. However, this vital asset faces mounting environmental challenges that threaten its purity, abundance, and accessibility. From pollution's pervasive grip to the intricate dance of climate change, these issues intertwine, endangering aquatic habitats and the sustainable provision of clean water. A comprehensive exploration of these environmental problems is essential for charting a path toward their enduring preservation. Identified through consultations with stakeholders ranging from grassroots to national levels, these problems encompass flooding, water pollution, inefficient agricultural practices, watershed degradation, reduced environmental flow, escalating water demand, untapped hydropower potential, and inadequate stakeholder engagement in water resource management. These issues not only impact water availability but also its quality with implication on ecological and social systems.

5.7.2 Causal Chain Analysis of Water Resources Degradation

The causal chain analysis underpins cause-effect relationships among the key drivers and resulting impacts are summarized in Table 5.7. Three main root causes identified include: increased demand for irrigation, unsustainable agricultural practices in the watershed and lack of investment in hydropower generation that would have ensured water conservation actions in the basin.

Flooding issues have far-reaching consequences, affecting crops, infrastructure, and public health. Immediate triggers encompass intense rainfall, topography, drainage issues, blocked waterways, and sediment build-up. Underlying factors involve deforestation, land use shifts, poor floodplain management, lack of flood protection, and inadequate watershed strategies. Root causes encompass climate change, unsustainable land practices, and insufficient infrastructure and planning.

The consequences of water pollution, including sedimentation and siltation, have brought about diminished water quality, reduced water storage in bodies, decreased fish catches, leading to income and nutritional losses. This issue's direct origins are tied to deforestation, unsustainable agricultural practices, and livestock grazing near water sources and on hillsides. At a deeper level, the lack of sewerage and water treatment facilities, coupled with the degradation of watersheds and riverbanks, serves as underlying factors. The fundamental drivers contributing to this predicament involve encroachment on catchment areas, inadequate agricultural methods, unregulated release of untreated sewage and wastewater, as well as the discharge of pollutants from mining and agriculture.

Inadequate agricultural practices have significant repercussions on soil fertility, productivity, water resource depletion, and environmental degradation. The immediate

triggers encompass limited knowledge, awareness, access, and financial constraints. Deeper factors involve adherence to traditional farming methods, inadequate extension services, and institutional hindrances. Ultimately, the overarching reasons entail the absence of proper irrigation infrastructure, insufficient capacity for irrigation management, and a lack of effective irrigation practices.

The consequences of watershed and water resources degradation encompass erosion, sedimentation, diminished water availability and quality, along with biodiversity loss. These impacts have roots in unsustainable land use practices like deforestation and livestock grazing, as well as unregulated urbanization, industrial and agricultural activities. Immediate triggers are linked to inadequate awareness and education, insufficient policy and governance measures, and unsustainable land practices. Ultimately, fundamental factors involve population pressure, inadequate resource management policies, lack of institutional coordination, climate change impacts, variability, and shortcomings in land use planning strategies.

The decrease in environmental flow has profound effects on ecological degradation, declining water quality, and socio-economic repercussions. These issues are rooted in underlying factors such as alterations in land use, water abstraction, diversion, and the expansion of hydropower development. Immediate influences include climate change impacts and variability, alongside population growth and urbanization. Ultimately, the core reasons encompass climate change's role in inducing droughts and shifting rainfall patterns, unsustainable water utilization practices, and the absence of integrated water management strategies.

The rise in water demand amid diminishing availability has far-reaching consequences, straining agriculture and contributing to poverty, water scarcity, and ecosystem degradation. Immediate triggers encompass population growth, urbanization, and intensified agricultural practices. These issues stem from underlying factors like evolving population dynamics, expanding agriculture, ineffective water usage habits, insufficient investment in new water sources, and limited awareness and education.

The untapped hydropower potential carries significant implications, including the loss of opportunities for renewable energy generation, hampered economic growth, energy security worries, and restricted climate change mitigation efforts. These outcomes stem from immediate factors like inadequate investment, infrastructure shortcomings, and regulatory and policy obstacles. Underlying factors involve limited progress in infrastructure development, intricate political and economic considerations, as well as challenges tied to transboundary relations and stakeholder dynamics. Ultimately, the root causes lie in the scarcity of investment and financing, compounded by technical and infrastructural hurdles that hinder the harnessing of hydropower resources.

The lack of active involvement of stakeholders in water resource management yields notable consequences, such as inadequate decision-making and resource management, conflicts, disputes, and a lack of ownership. These outcomes are directly linked to immediate causes such as restricted access to information, a deficiency in participation platforms, and challenges related to resource economics. Deeper issues encompass inadequate awareness and capacity-building efforts, frail institutional capabilities, and social and cultural barriers. Ultimately, the root causes are attributed to limited awareness and educational initiatives, alongside policy and regulatory gaps that hinder meaningful stakeholder engagement in effective water resource management.

Table 5.7: Causal Chain Analysis of Water Resource Degradation

Environmental Problems	Impacts	Immediate Causes	Underlying Causes	Root Cause
Flooding	1. Crop damage and loss 2. Infrastructure damage 3. Health risks	1. Intense rainfall events 2. Topography and drainage characteristics 3. Blocked water ways and sedimentation	1. Deforestation and land use changes 2. Lack of floodplain management and flood protection measures 3. Inadequate watershed management	1. Climate change and variability 2. Unsustainable land management 3. Inadequate infrastructure and planning
Water pollution and reduced water quality including sedimentation/siltation	1. Reduced water quality 2. Reduced storage in water bodies 3. Reduced fish catch hence loss of income and nutrition	1. Deforestation 2. Unsustainable agricultural practices 3. Livestock grazing on hills and close to water sources	1. Lack of sewerage and water treatment facilities 2. Watershed and river banks degradation 3. Unprotected water sources	1. Encroachment of catchments 2. Poor agricultural practices 3. Discharge of untreated sewers and wastewater 4. Effluent from mining and agriculture
Inefficient agricultural practices	1. Reduced soil fertility and productivity 2. Water resources and depletion 3. Environmental degradation	1. Lack of knowledge and awareness 2. Limited access and resources 3. Financial constraints	1. Traditional farming norms 2. Limited extension services 3. Institutional barriers	1. Lack of irrigation infrastructure 2. Lack of capacity for irrigation management 3. Lack of irrigation management
Watershed and water resources degradation	1. Erosion and sedimentation 2. Reduced water availability and quality 3. Loss of biodiversity	1. Unsustainable Land Use Practices (deforestation, livestock grazing et) 2. Unregulated development and urbanization 3. Uncontrolled industrial and agricultural activities	1. Lack of awareness and education 2. Inadequate policy and governance 3. Unsustainable land use practices	1. Population pressure 2. Inadequate Resource Management Policies 3. Lack of institutional coordination 4. Climate change and variability
Deforestation	1. Erosion and sedimentation 2. Reduced water availability and quality 4. Loss of biodiversity	1. Unsustainable Land Use Practices (deforestation, livestock grazing et) 2. Unregulated development and urbanization 4. Uncontrolled industrial and agricultural activities	1. Lack of awareness and education 2. Inadequate policy and governance 3. Unsustainable land use practices	1. Population pressure 2. Inadequate Resource Management Policies 3. Lack of institutional coordination 5. Climate change and variability

Environmental Problems	Impacts	Immediate Causes	Underlying Causes	Root Cause
Reduced Environmental flow	1. Ecological degradation 2. Water quality decline 3. Socio-economic consequences	1. Land use changes 2. Water abstraction and diversion 3. Hydropower development	1. Climate change and variability 2. Population growth and urbanization 3. Poor water governance and management	1. Climate change that induced drought and changing rainfall patterns 2. Unsustainable Water Use Practices 3. Lack of Integrated Water Management
Increased water demand with decreasing water availability	1. Agricultural strain and hence poverty 2. Water scarcity 3. Ecosystems degradation	1. Population growth 2. Urbanization 3. Agricultural intensification	1. Population dynamics 2. Agricultural expansion 3. Inefficient water use practices 4. Lack of investment on new water sources 5. Limited awareness and education	1. Population growth 2. Climate Change causing drying of water sources 3. Lack of investments to develop new water sources 4. Unsustainable water management
Untapped hydropower potential	4 Missed Renewable Energy Generation 5 Economic Stagnation 6 Energy Security Concerns 7 Limited Climate Change Mitigation	1. Lack of investment 2. Infrastructure **deficiencies** 3. Regulatory and policy barriers	1. Limited infrastructure development 2. Political Economy 3. Transboundary and stakeholder dynamics	1. Limited investment and financing 2. Technical and infrastructural challenges
Insufficient engagement of stakeholders in the management of water resources	1. Inadequate decision making/Resources mismanagement 2. Conflicts and disputes 3. Lack of ownership	1. Limited access to information 2. Lack of participation platforms 3. Resource constraints	1. Lack of awareness and capacity building 2. Weak institutional capacity 3. Social and cultural barriers	1. Limited awareness and education 2. Policy and regulatory gaps

Source: SONGWECOM TDA, 2023

5.7.3 Game-Changing Actions for Sustainable Water Resources Management

The water resource itself is transboundary and is actually the hallmark of the cooperation between the two countries. In this regard, every issue that affects the water resource is also transboundary even if it is localized in practice, but by the very effects it becomes a shared problem in the basin. It is imperative now to promote EBA approach in the management of watershed and catchments (Table 5.8). The EBA will also address the issue of aquatic ecosystem health related with eutrophication. Increasing water use efficiency and productivity is critical to have more socio-economic benefit per drop. This endeavour is critical across the water demand sectors such as domestic use, irrigated agriculture, livestock watering, and industry. As more water is saved, the environmental flows are also served sustainably. It is pertinent to address the climate change through mitigation and adaptation measures, and to build the resilience of the environmental and socio-economic systems. The stakeholders urged that, it is high time now for the countries to turn the vision into actual actions and investments, and enforce that vision in effective management and governance of the shared water resources.

Table 5.8: Game-Changing Actions and Stakeholders for Addressing Water Resources Degradation

SN	Game-Changing Action	Key Stakeholder Categories
I	Promote integrated Ecosystem-Based management of watersheds and catchments	MDA, (Lake Nyasa Water Basin Board, MoW, NIRC, DIS), Development Partners (GEF, AfDB)
, 2	Promote water use efficiency and productivity across major water demand sectors	MDA (RUWASA, NRWB, EWURA)
3	Promote mutual enforcement of agreed vision for transboundary management of the water and related resources	Water Basin Authorities (ZamCom, SongweCom), MDA (MoW, NRWA)

Source: SONGWECOM TDA 2023

5.8 Conclusion and Recommendations

5.8.1 Conclusion

The Songwe River Basin (SRB) is a valuable resource for both the environment and the economy, supporting the livelihoods of its people. However, the basin is faced with complex environmental and socio-economic challenges. Addressing these transboundary issues is crucial for achieving sustainable socio-economic development and realizing the shared Vision 2050 outlined in the SRB Development Plan (SRBDP). Understanding the current status of water resources is essential for the protection and conservation of this precious asset. The SRB's water resources are under threat from human activities and the impacts of climate variability and change. Identifying and prioritizing these issues is a necessary step in finding effective solutions.

5.8.2 Recommendations

i. Improve data collection infrastructure: Investments should be made to establish and strengthen monitoring networks for hydrometeorological parameters and water quality. Access to quality and critical data is crucial for making informed decisions and implementing successful interventions.

ii. Reduce flood risks through strategic investments: Develop strategies that engage communities in flood risk management, considering the increasing population and climate change impacts. Promote rainwater harvesting at the household level to reduce the demand on water supplies.
iii. Implement the Ecosystem-Based Approach: Institutionalize and scale up the use of the Ecosystem-Based Approach for restoring, regenerating, and sustainably managing the ecosystems, biodiversity, and land and water resources in the basin.
iv. Address catchment degradation and unsustainable land use practices: Raise awareness about sustainable farming practices, improved irrigation methods, and Integrated Water Resources Management (IWRM). Encourage communities to engage in tree planting and grassland restoration to reduce erosion. Promote alternative income-generating activities to discourage destructive practices.
v. Strengthen stakeholder engagement: Enhance participation of local communities in the planning, implementation, and monitoring and evaluation of sustainable natural resource management initiatives in the basin.
vi. Foster cooperation and harmonization: Strengthen collaboration and coordination between the two countries to ensure the adoption of sustainable management strategies and actions in the basin.
vii. Engage youth in sustainability initiatives: Involve youth in programs and projects that promote sustainable environmental management, fostering their interest and active participation.
viii. Consider root causes for sustainability: Policy and decision makers should consider the underlying drivers of environmental changes to ensure long-term sustainability in the management of the basin's resources.

PART SIX

LAND MANAGEMENT

6.0 An Overview

Part six presents land management and soil erosion, and other forms of degradations that affect economic production and productivity of the resource. Land degradation refers to the persistent reduction in the biological and economic productivity of terrestrial ecosystems, including soils, vegetation, other biota, and the ecological, biogeochemical and hydrological processes that operate therein. Land resource is the natural base on which other terrestrial natural resources are seated. Thus, a healthy and productive land resource means health of the terrestrial ecosystem. Degradation of the land resource cascades into the degradation of the aquatic ecosystems – rivers, wetland and lakes.

6.1 Land Resource Management in the SRB

6.1.1 Physiography and soils

The Songwe River Basin (SRB) is a steep, mountainous catchment. The upper part of the basin has elevations 2000 – 2400 masl, with peaks over 3,000 masl, and dropping down to Lake Nyasa/Malawi at about 474 masl. The Tanzania side is somewhat higher than the Malawi side, with the Chitipa highlands averaging 1300 masl. The upper catchment area lies in the Malawian District of Chitipa and the Tanzanian Districts of Ileje, Momba, Mbozi and Mbeya Rural. The middle part of the SRB lies within the two districts of Ileje in Tanzania and Chitipa in Malawi. The area is generally flat to gently undulating with elevations between 1,100 and 1,300 masl.

The geological condition of Songwe River Basin is characterized by pre-Cambrian gneiss rocks of various types (NORPLAN, 2003)[30], which cover almost 75% of Tanzania. These types include gneisses of Ubendian System, Karroo beds, Dinosaur beds, volcanic and the superficial. According to Norplan (2003), lithologically the area is comprised of metamorphosed greywacke, new micaceous gneisses that predominate in the upper parts of the Songwe River while volcanic, karroo, fluvial and lake deposits dominate in the lower parts near Lake Nyasa. Karroo beds in the project area are found in the southern extension of the Songwe-Kiwira basin of Tanzania. They occur in the Ngana Basin in both Malawi and Tanzania. They are unconformable on the underlying gneisses in down-faulted zones a few kilometres upstream from the lakeshore plain. The Karroo rocks in Malawi stretch from the confluence of Makeye and Songwe Rivers for about two kilometres upstream. These rocks outcrop on both riverbanks all the way to the rapids above Ngana. They are divided into coal measures, sandstones and shales, basal beds (basal conglomerates, arkoses and flaggy shale) and Mwesia beds (green to grey green mudstones, arenaceous and argillaceous limestones). The volcanic cobbles and boulders consisting of basalts and basaltic tuffs overlaying the Karroo rocks. The volcanic rocks rest directly upon the Dinosaur beds in Malawi and overlie gneisses on the hills upstream the Ngana Basin. They are said to be deposited on an eroded surface under lacustrine conditions and are comprised of basaltic pebbles and cobbles. They are considered to be the southernmost extension of the Rungwe

[30] NORPLAN (2003). Feasibility Study Report For the stabilisation of the course of the Songwe River (Volume 2). Norplan A.S.

Volcanics of southwestern Tanzania. Alluvium and beach sands occur downstream approaching the lakeshore. The effect of the retreat of the lake has caused the river to meander in the plain thus depositing a lot of sand along the bank. Beach sand and marshes are present on the lakeshore.

The upper catchment of the SRB lays on a rocky basement with alluvial soils in its depression/valleys. This catchment is made up of arable and fertile alluvial soils. The hilly highlands which are located above the plains are generally covered with residual soil formed from weathering and disintegration of the gneissic bedrock. These soils are red to brownish soils, normally with grain size of clays, silts and sands (Norplan, 2003). Generally, soil type is moderately shallow, overlying iron stone or deep sands with some better deep red soils. Gravel soils are also common in southwestern plateau. In some areas, soil is loam and deep red with low natural fertility which is suitable for agriculture. The overburden thickness varies highly and depends on the degree to which the disintegrated materials have been exposed to erosion (Norplan et al, 2003). The border between the residual soil and the bedrock is difficult to assess. A gradual transition from soil to solid rock is common. The refraction seismic survey carried out during the feasibility study at the proposed dam sites gave an indication of the variation in weathering depths. The dominant soil types (world reference base –wrb classification system) on the Tanzania side of the basin are Eutric-Greyic Fluvisols, Eutric Leptisols, Haplic Ferrasols, Haplic Lixisols, Mollic Andosols, Rhodic-acric Ferralssols and Vitric Andosols whereas on the Malawi side the soil types (wrb classification system) are chromic Ferralic Cambisols, Chromic Lixisols, Chromic Luvisols, Chromic Paraleptic Lixisols, Dystric Leptisols, Eutric Chromic Cambisols, Eutric Leptisols, Eutric Paraleptic Regosol, Ferraric Paraleptic Cambisols, Ferric Luvisols, Greyic Luvisols, Rhodic Lixols and Xanthetic Ferrasols (Figure 6.1).

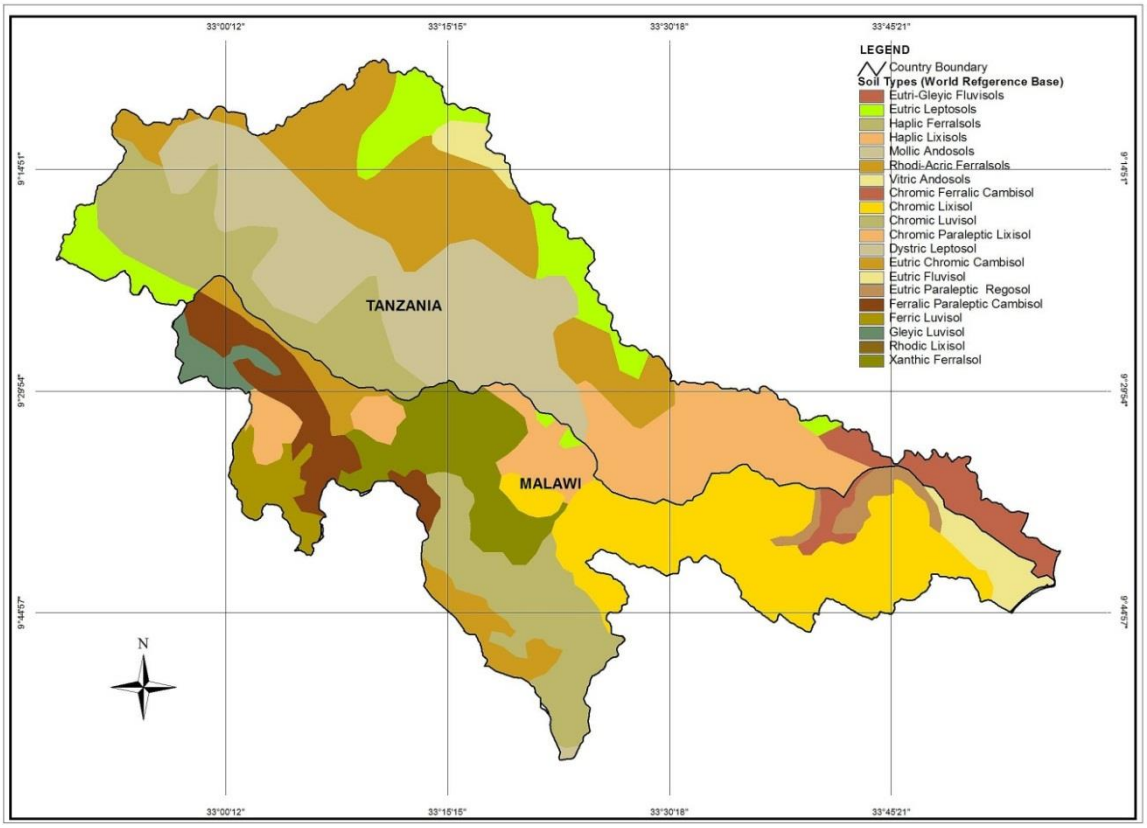


Figure 6.1: Dominant soil types in the basin
Source: ISRIC World Soil Information

6.1.2 Land Use in the SRB

The economy of the SRB is primarily based on agriculture, making land and water the most important resources. Farming is almost entirely rainfed, even in the upper parts of the basin where rainfall is low. In the upper basin land is considered to be of reasonably good quality, but poverty is common because of poor land management coupled with low, and often unreliable rainfall. Population pressure has resulted in a loss of forest area as cultivation increases. Forests are also lost to the increasing pressure for timber, poles and charcoal. Intensive shifting cultivation is a feature of the upper sub-basin, with legumes such as beans, cowpeas and groundnuts, intercropped with cereals like maize as common crops.

Some improved traditional irrigation is practiced along Mtumbisi River in Bupighu on the Tanzania side with maize as the main irrigated crop with vegetables and beans as secondaries. There are a few other smallholder irrigation schemes in the area of Sasenga, along the Katendo River and in Ikumbilo – Chitete, along the Songwe River on the Tanzania side, with rice as their main crop. In Malawi some motorized and treadle pumps are used for irrigation. Cultivation is done on riverbanks due to their natural fertility and access to water. The irrigation is wet season only to supplement rainfall.

In the middle sub-basin people also depend on rainfed mixed farming for their livelihood, with crops including beans, groundnuts, coffee, maize, finger millet, bananas and sweet potatoes. Most farming is done along the riverbanks and in mountain slopes. There is generally non-sustainable land use practices in the catchment with extensive shifting cultivation. Farm inputs are unaffordable for the majority of the people.

In the lower sub-basin the main crop is rice, grown along with other crops including maize, beans, groundnuts, cassava, sweet potatoes, soybean and sunflower in both countries. Rice is the major cash and food crop and is grown in the wet season only. In the dry season maize, cassava and groundnuts are grown with an increasing interest in watermelon due to its high value. Other crops are bananas, oil palm and cocoa, which are grown around the homesteads as important food security and cash crops. Other land uses within the basin include settlement and livestock grazing, fishing, macrophyte harvesting for handcraft activities and water for domestic activities.

6.2 An Empirical Outlook on Land Management: Trends, State and Futures

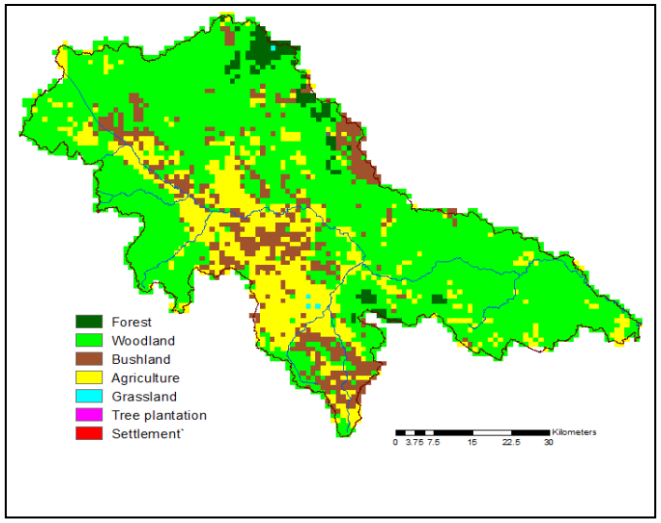
6.2.1 Land Use and Land Cover Status and Vegetation Decline Trend

Vegetation cover has a wide variety of applications in the assessment of land degradation and desertification processes in forest and non-forest areas. Land use/land cover dynamics is an important landscape process capable of altering the fluxes of water, sediment, contaminants, and energy. Degraded watersheds tend to accelerate overland flow reducing soil moisture and base-flow recharge and increase the sediment detachment and transport. Vegetation cover above the ground protects soil against rain splash and ground surface vegetation cover protects the soil against rain splash and runoff scouring and it encourages deposition of eroded soil. The vegetation also protects the soil against crusting which would otherwise reduce its infiltration capacity. Therefore, decline of vegetation cover has huge consequence in the ecosystem health in the SRB.

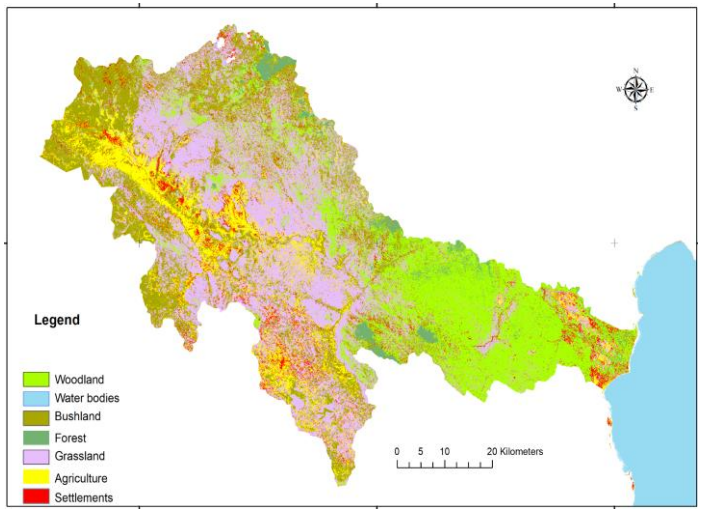
Land Use and Land Cover (LULC) analysis was conducted using Landsat (4-8) satellite imagery for four distinct time periods: the 1990s, 2000s, 2010s, and 2020s. These images were specifically chosen for acquisition during the dry seasons, which typically occur between July and November, with a strict cloud cover criterion of ≤ 10%. The classification process was performed using the Random Forest (RF) algorithm, and the quality of the training data was rigorously evaluated using variables generated by RF.

To further ensure the accuracy of the LULC classification, high-resolution Google Earth images were employed for visual validation. Post-classification accuracy assessment was carried out to evaluate the quality of the image classification. For the LULC maps of the 1990s, 2000s, and 2010s, classification quality was assessed by overlaying the classification results onto the corresponding color composites, followed by a meticulous visual inspection for accuracy.

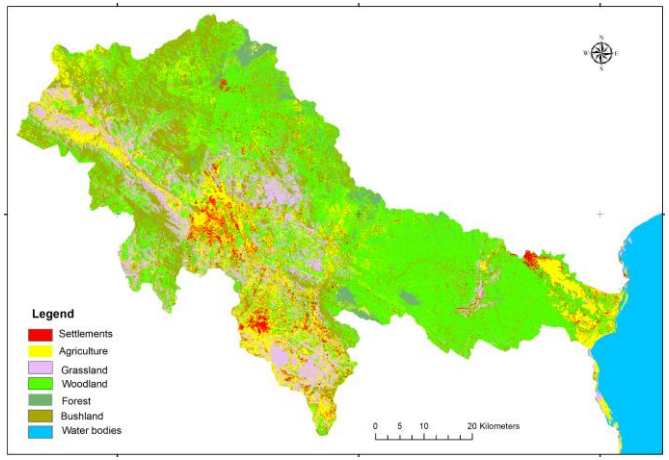
In the case of the 2020 LULC map, an overall accuracy assessment was conducted using an error matrix. The results of this assessment demonstrated an impressive overall accuracy of 86%, reaffirming the high quality and reliability of the LULC classification for that year.



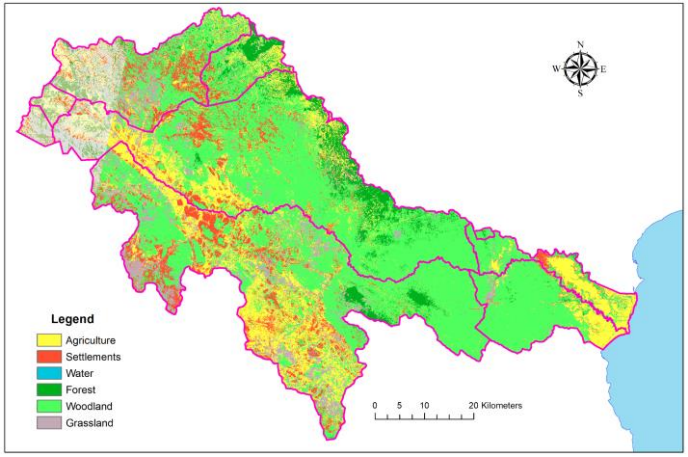
a) 1990



b) 2000

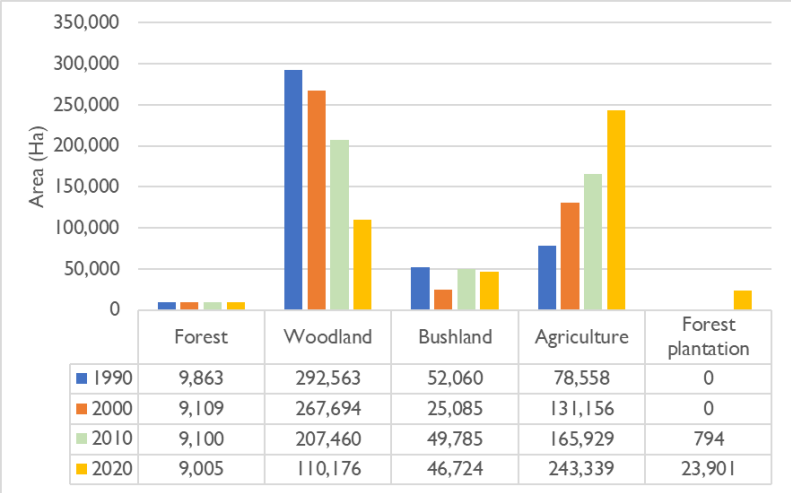


c) 2010



d) 2020

Figure 6.2: Land Use/Cover Trend between 1990 – 2020

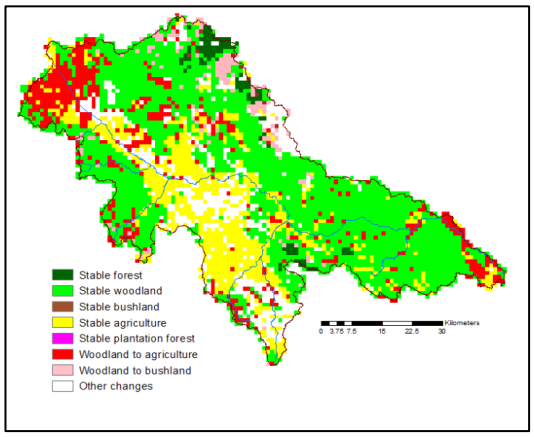


	Forest	Woodland	Bushland	Agriculture	Forest plantation
1990	9,863	292,563	52,060	78,558	0
2000	9,109	267,694	25,085	131,156	0
2010	9,100	207,460	49,785	165,929	794
2020	9,005	110,176	46,724	243,339	23,901

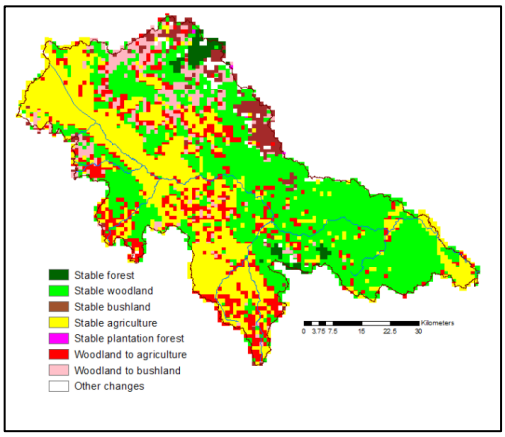
Figure 6.3: Land Use/Cover Changes (Ha) 1990 – 2020
Source: SONGWECOM TDA 2023

6.2.2 Land Use/Land Cover Change Detection (Vegetation Decline)

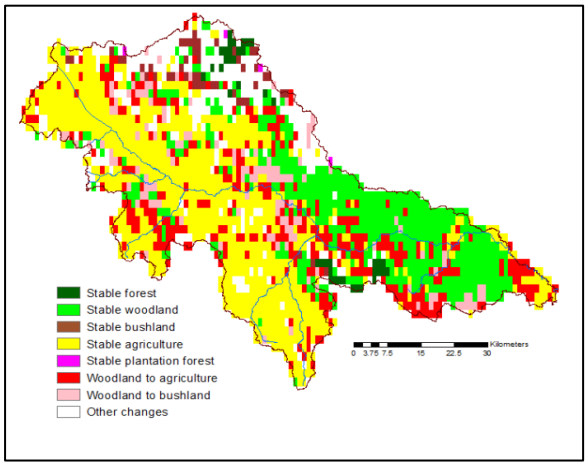
Change detection was then done using post classification comparison analysis in Erdas Imagine software by comparing the produced LULC maps. This resulted in the three change detection maps, i.e., 1990 to 2000, 2000 to 2010, and 2010 to 2020 in Figures 6.4 (a, b & c), respectively.



a) 1990 – 2000



b) 2000 - 2010



c) 2010 - 2020

Figure 6.4: Land Use/Cover Changes Detection 1990 – 2020
Source: SONGWECOM TDA 2023

Furthermore, Figure 6.5 shows the deforestation rate between 1990 to 2020 and trend on the transitions from woodland to agriculture, woodland to bushland and total (deforestation) respectively. Furthermore, Figure 6.5 indicates the trend of annual rate of deforestation from 1990 to 2020. Agriculture is the main driver of deforestation in the basin. Conservation efforts should focus on reducing lateral expansion of agricultural land by, for example, emphasizing on intensive agricultural practices.

Deforestation annual rate has been increasing from 6,830 ha/year (1990-2000) to 9,638 ha/year (2010-2020). This is an alarming trend which needs to be checked to avoid depletion of essential land cover for the basin environment and climate change mitigation at large. The vegetation decline from woodland to agriculture and bushland is attributed to a number of factors including human population increase, opening agriculture fields on steep slopes due to inadequate land, uncontrolled bush fires, cultivation along riverbanks, shifting cultivation, and overgrazing in protected areas and careless cutting of trees for production of charcoal.

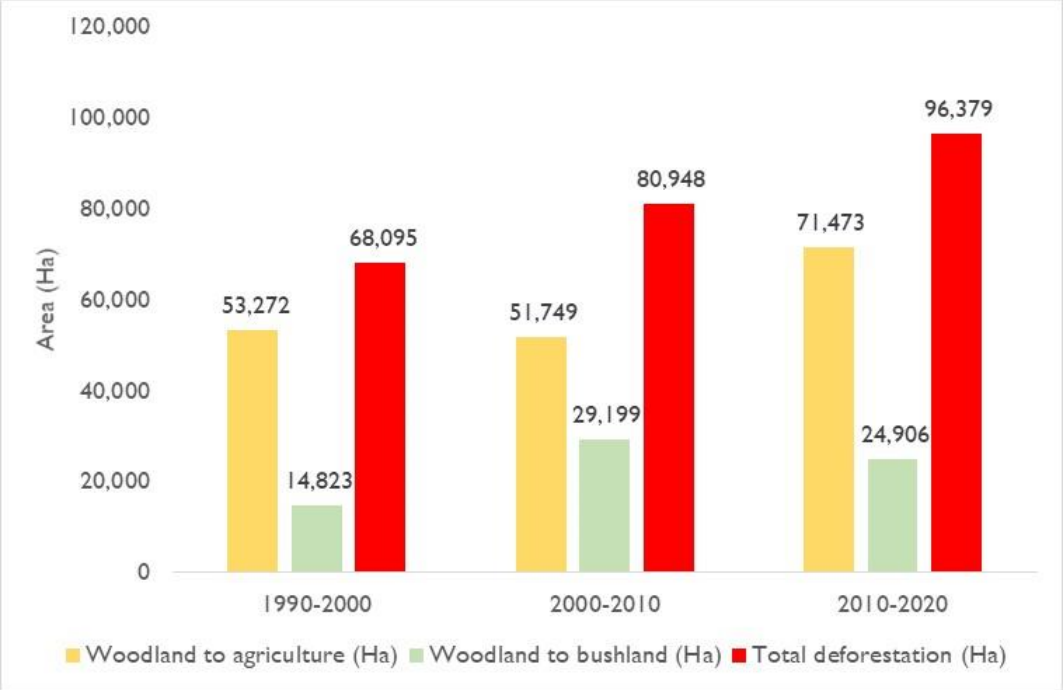


Figure 6.5: Deforestation Trends, woodland to agriculture and woodland to bushland
Source: SONGWECOM TDA 2023

6.2.3 Land Resource Management in the SRB

The predominant land use, agriculture is not sustainable. The overall LULC changes have contributed to different forms of land degradation mainly erosion.

6.2.3.1 Soil Erosion Risk: The Extent

Soil erosion by water seems to be the greatest factor limiting soil productivity and impeding agricultural enterprise in many regions of Africa, mainly in the humid and sub-humid zones of Sub-Saharan Africa including the SRB. The results of the current study identify the spatial pattern of the potential soil erosion risks in the SRB. Figure 6.6 show magnitude and severity

levels of soil erosion risk per district within the basin – according to classification by Morgan et al. (200431).

The findings in Annex 7a show that Ileje, Mbeya and Mbozi districts have highest risk of soil erosion compared to other districts in the basin, with about 50.7%, 51.3% and 49% of the district's land areas respectively having erosion rate greater than 10 Tons/Ha/Year. This is also far above tolerable soil losses. This is followed by Chitipa and Karonga districts having 34.4% and 34% of the district land areas respectively with erosion rate greater than 10 Tons/Ha/Year. On the other hand, Kyela and Momba districts have lowest erosion risks with 85.3% and 87.3% of the district land areas respectively falling under Very slight to Slight erosion which has erosion magnitude of 0–5 Ton/Ha/Year which is also within the magnitude of tolerable (acceptable) soil loss. It is evident that the situation for the Ileje, Mbeya, Mbozi, Chitipa and Karonga districts have big land areas exposed to unacceptable soil losses which is detrimental to land productivity in both arable and no-arable land and this is likely to generate huge amount of sediments which results into several problems downstream including siltation of water bodies if no conservations (support practices) put in place especially in arable land. This situation calls for integrated natural resources management strategy in the basin.

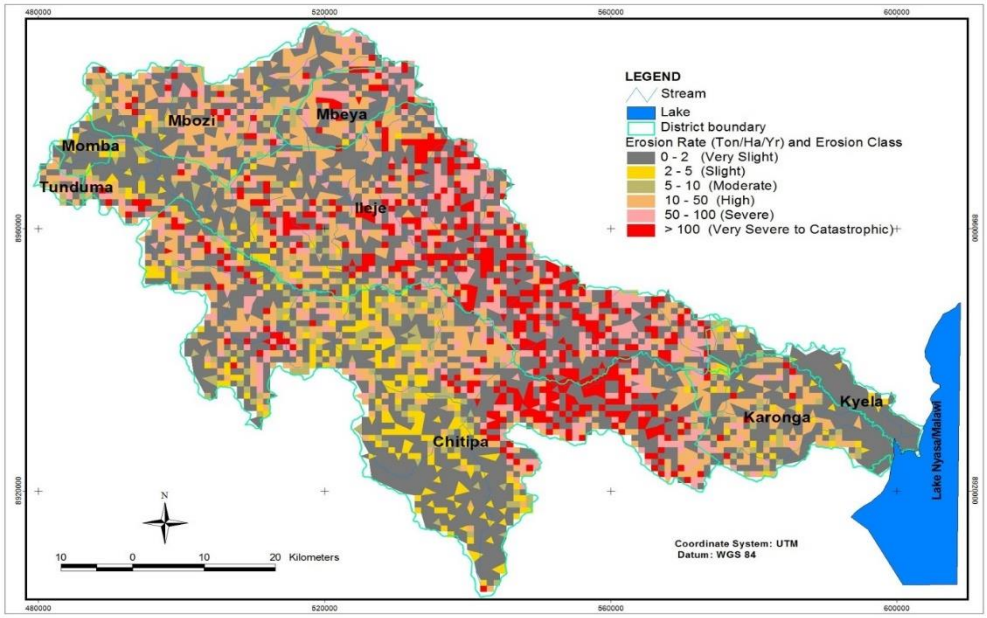


Figure 6.6: Spatial Pattern of the Potential Soil Erosion Risks in the SRB
Source: SONGWECOM TDA 2023

6.2.3.2 Soil Erosion Risk: The Tolerance

Soil erosion affects many soil characteristics which are related to crop growth and yield. Continuous soil erosion results in reduced crop rooting depth and soil water storage capacity, crusting, soil compaction, change in cation exchange capacity (CEC), aluminium and manganese toxicity, soil alkalinity and deterioration of soil biological properties. The end result of all these effects of soil erosion on soil properties is reduced soil productivity.

[31] Morgan, R.P.C., Hann, M.J., Shilston, D., Lee, E.M. et al. (2004). Use of terrain analysis as a basis for erosion risk assessment: a case study from pipeline rights-of-way in Georgia. Paper presented to International Conference on Terrain and geohazard challenges facing onshore oil and gas pipelines. BP/ICE, London.

Since soil loss cannot be avoided at all it is important to establish a practical tolerable soil loss which denotes the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically through fertility maintenance for a period not less than 20 – 25 years (Morgan, 2005). For the case of Tropical and mountainous soils including the soils of SRB area, the recommended acceptable soil loss is 0 – 5 ton/Ha/Year (Hudson 1986[32], Lal 1980[33] and Lal 1983[34]).

Figure 6.7 shows the proportion of land areas with acceptable and unacceptable soil losses per district. Similar tabular results shown in Figure 6.7 are presented in Annex 7b. The results show that Tunduma district has the highest proportion (56.8%) of land potentially susceptible to risks of unacceptable soil losses. Other districts with higher proportions of land potentially at risk of experiencing unacceptable soil loss if no support/conservation practices applied when undertaking a number of land uses including agriculture are Ileje (53.4% of land area), Mbeya (52.9% of land area), and Mbozi (53.5% of land area). Furthermore, Chitipa and Karonga have about 41.9% and 41.1% of the lands areas respectively which has potential risk of experiencing unacceptable soil loss if no support/conservation practices applied when undertaking a number of land uses including agriculture. On the other hand, Kyela and Momba have the lowest soil erosion risks with only 14.7% and 12.7% of unacceptable soil losses respectively. This may be attributed to topography of those districts which are dominated by flat to very gently sloping (0 – 2-degree slope) (FAO, 2006).

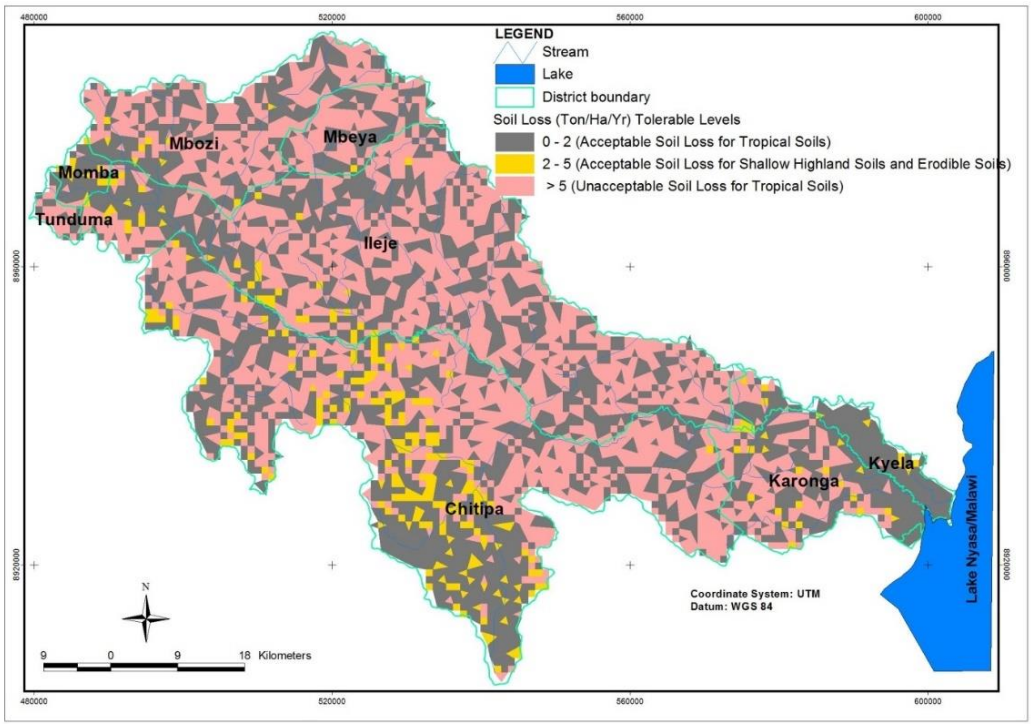


Figure 6.7: Spatial Pattern of Soil Loss Tolerable Levels in the SRB
Source: SONGWECOM TDA 2023

[32] Hudson, N.W. (1986). Soil conservation. Batsford Limited, London, UK: 324 pp.
[33] Lal., R. (1980). Soil Conservation: Preventive and control measures. In: Morgan RPC (ed.): Soil conservation, problems and prospects. Proc. International conference. Soil Conservation, Silsoe, UK. John Wiley& Sons, New York: 175-181.
[34] Lal, R. (1983). Soil erosion and its relation to productivity in tropical soils. In: El-Swaify, SA., Moldenhauer, W.C. and Andrew, L.O. (eds.): Proceedings of the International Conference of Soil Erosion and Conservation, Hawaii: 237-247

6.3 Land Degradation: Impacts, Drivers and Solutions

6.3.1 Pathways to Environmental and Socio-Economic Impacts

Land management is the process of managing the use and development (in both urban and rural settings) of land resources. It is therefore important to have a more effective, culturally-appropriate and sustainable systems of land management for food production and provision of ecological goods and services. On the other hand, Land degradation, which is manifested as erosion, vegetation decline, soil compaction, nutrient depletion, and salinisation, often results in loss of soil biota, plant and animal species, with concomitant risks to sustainable production of food and ecological goods and services that support livelihoods and the economy.

6.3.2 Causal Analysis of Land Degradation

The three root causes of land degradation identified during the LPDs include: population growth, poverty, and inadequate governance in the context of political ecology for sustainable development (Table 6.1). The underlying causes of land degradation impacts included the hilly nature of the upper-basin terrain with steep slopes that are prone to runoff erosion and sometimes landslides, climate change and overdependence on biomass energy for cooking. An array of immediate causes envisaged grazing on steep hills, mining and quarrying, poor use and handling of agro-chemicals and expansion of agriculture in the basin. The rationale of causal chain analysis is to inform the scoping and design of strategic actions addressing the root causes while envisioning underlying and immediate causes for ultimately reducing undesired impacts of the problem.

Table 6.1: Causal Chain Analysis of Land Degradation

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Declining water quality	Poverty/Low income Increased cost of water supply	Soil erosion leading to sedimentation of water bodies	Grazing, mining and cultivation on hills and mountains Poor governance, Inadequate policy and poverty	Population growth
Flooding	Food insecurity and Poverty	Mining and quarrying	Climate change Lack of appropriate technology and capital	Poverty Inadequate policy and financing of small-scale mining activities
Soil losses	Poverty and food insecurity	Vegetation decline Steep slopes Unsustainable agricultural practices like shifting cultivation, lack of appropriate soil and water conservation measures	Overdependence on biomass energy Agricultural expansion	Inadequate political will and participation
Ecosystem and landscape degradation	Food insecurity Poverty Decline of land productivity	Agricultural expansion	Lack of land use plans Inadequate enforcement of appropriate land use and management plans	Population growth Inadequate political will and participation

Source: Stakeholders' Consultations, 2023

6.3.3 Game-Changing Actions for Sustainable Land Management

Potential game-changing solutions for sustainable land management in the basin are proposed as indicated in Table 6.2. Lack of land use and management planning for most of the villages has remained a stumbling block to sustainable land management. A few villages have land use plans and even very few have extended their land use plans into management plans. Therefore, undertaking land use and management plans in the basin should prelude any management interventions. As a harbinger for poverty reduction and sustaining local actions in land management, economic payoffs to investments mainly labour, must be guaranteed. This will require promotion of agribusiness and market access of land-based enterprises and value chains.

Table 6.2: Game-Changing Actions for Sustainable Land Management

SN	Game-Changing Action	Key Stakeholder Categories
1	Implement land use and management planning in the basin	MDA (NLUPC, DLRC, Surveyor General)
2	Promote agribusiness and market access for farmers to realize the benefits of land management	Local communities (Tree Crop farmers, local traders, charcoal producers/traders), AMCOS, Vi Agroforestry
3	Setting up a robust land management M&E system with targets and performance indicators	NLUPC, Surveyor General
4	Commit government investment in structural land conservation in degradation hotpots within the catchment which are beyond the ability and scope of local conservation	MoL, MLHHSD
5	Develop innovative incentive schemes for promoting sustainable land management practices such as robust terracing	LGAs
6	Strengthen cooperation between two countries on harmonized sustainable land management	MoL, MLHHSD
7	Integrate land use planning and management in all rural development programs	MoL, MLHHSD, NLUPC, DLRC, Livestock Dept

Source: Stakeholders' Consultations, 2023

PART SEVEN

CLIMATE VARIATIONS AND CHANGES

7.0 An overview

Climate variation and change is a phenomenon whose effects are wide, ranging from rising sea levels, alterations in rainfall patterns to droughts and soil erosion. As a result, efforts to bring sustainable development to the people have in part, been derailed by the ever-changing climate. The SONGWECOM is interested in understanding how climate change can potentially underpin or undermine the implementation of SRBDP that is jointly being implemented by the governments of the Republic of Malawi and the United Republic of Tanzania. SRBDP is a multipurpose transboundary programme under which the challenges and opportunities emanating from the natural behaviour of Songwe river are planned to be worked upon through various projects. These projects include construction of dams for flood control and hydropower generation, irrigated agriculture, domestic and industrial water supply, fisheries, and tourism.

This part is comprised of four sub-sections, whereby section one focuses on climate and weather, empirical outlook on climate change and variability is presented in sub section two and section three is focused on climate change-related transboundary problems. Subsection four highlights on linkages of climate change and variations with other thematic areas of the TDA. analysis.

7.1 Climate and Weather in the SRB

The climatology of the SRB is shaped by the climate, weather, drainage and physiographic morphology. According to previous studies conducted by NORPLAN in 2003[35], the SRB can be divided into six sub-basins, which can be further aggregated into three sub-units representing the lower, middle, and upper basins. The division of sub-basins is based on hydrological and geomorphological criteria. The following are the identified sub-basins:

a) Kameme Hills and Plateau: This sub-basin is primarily drained by streams that serve as tributaries to the Songwe River.
b) Itumba/Mwati basin: This sub-basin consists mainly of two tributary sub-catchments, namely Itumba and Mwati.
c) Bulambia (Kaseye) Plain and adjacent Plateau: The drainage of this sub-basin is primarily facilitated by the Kaseye River.
d) Misuku Hills: The Misuku Hills sub-basin is drained by the tributaries of Sofwe, as well as the upper reaches of Makeye and Kyungu, along with other small streams with steep gradients that directly flow into the Songwe River.
e) Scarp Zone: This sub-basin includes a significant portion of the Kyungu catchment and is drained by the Kyungu and Makeye Rivers in Malawi, as well as the Chija River in Tanzania.

[35] NORPLAN (2003). Feasibility Study Report For the stabilisation of the course of the Songwe River (Volume 2). Norplan A.S.

f) Songwe Floodplain: This area is characterized by flat to very gentle slopes, predominantly covered in alluvium, and is prone to periodic flooding in various locations.

The Songwe River Basin experiences an average annual rainfall of approximately 1,482 mm, with an average runoff of 440 mm/year. In the upper part of the basin, rainfall is generally low, ranging from less than 900 mm/year to a maximum of 1400 mm/year. The majority of the annual precipitation, ranging from half to three-quarters, occurs during the rainy season between December and March. Runoff levels range from 100 mm/year in the southwest to 250 mm/year in the northeast.

In the middle section of the basin, rainfall exhibits high variability, ranging from 1000 to 2500 mm/year. Correspondingly, runoff levels vary from 100 mm/year on the Kaseye/Bulambia Plain to approximately 700-800 mm/year in the lowest parts of the sub-catchment in Tanzania. This region experiences a longer rainy season, spanning from November to April.

The lowland areas, including the flood plains below 700 meters above mean sea level (masl), receive an average annual rainfall of around 1000 mm. The middle part of the basin, with elevations between 1200 to 1500 masl, records lower annual rainfall values ranging from 800 to 1000 mm. Conversely, the highland areas register higher annual rainfall ranging from approximately 1000 to 1200 mm. The rainfall pattern in the basin is characterized by a single rainy season occurring between December and April, while the period from June to September is relatively dry.

According to WorldClim version 2.1 climate data for 1970-2000, the mean annual temperatures for the SRB are highest in the lower part of the basin, i.e., Kyela and Karonga districts and decrease with increasing altitude with the lowest mean annual temperatures found in Ileje, Mbeya and Mbozi districts. The spatial variability of mean annual temperature in the basin is presented in Figure 7.1.

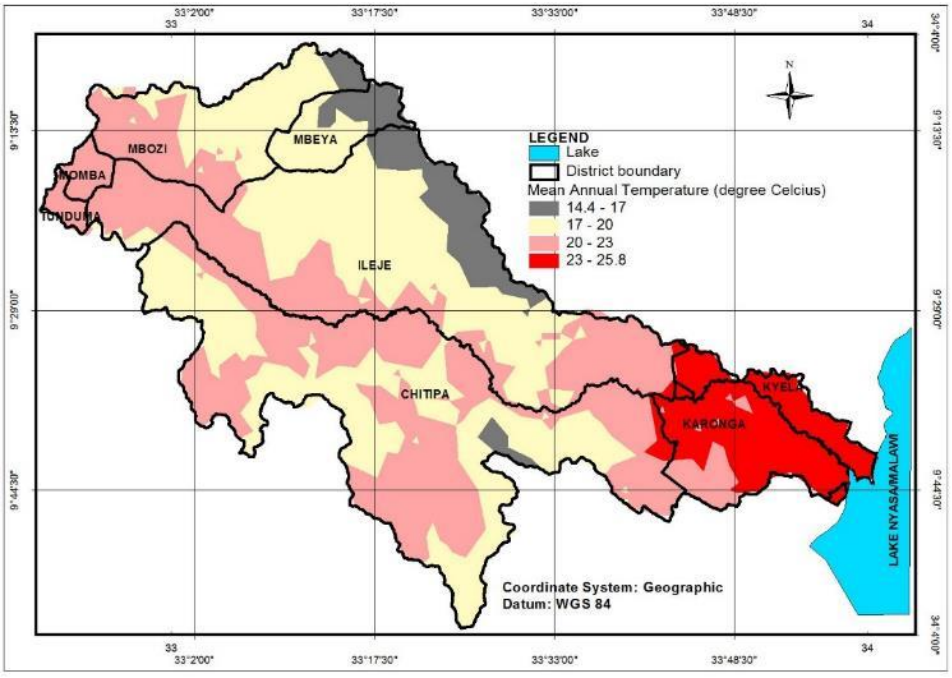


Figure 7.1: Mean Annual Temperature in SRB

Source of data plotted: WorldClim Version 2.1 Climate Data

Elevated temperatures in combination with other climatic conditions such as wind accelerate evapotranspiration (ET). ET_0 analysis from historical climate data indicates that it is highest during the months of September, October and November and drops in December, during when seasonal rains commence (Figure 7.2).

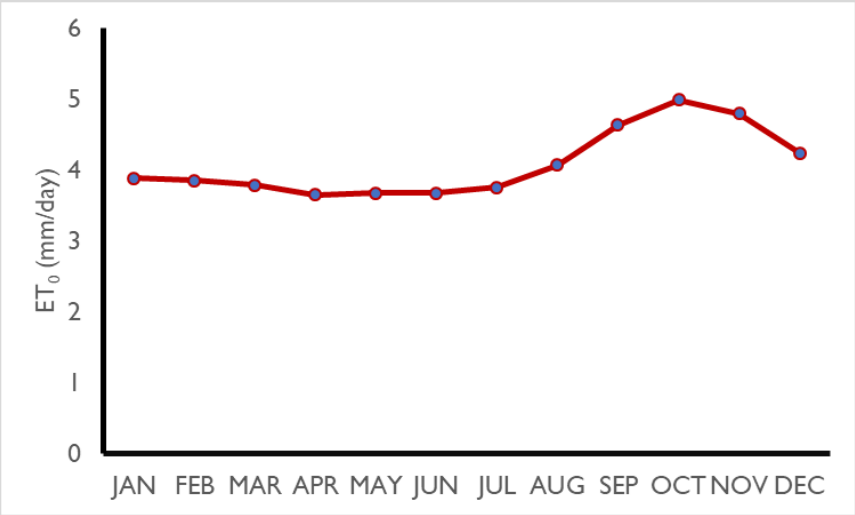


Figure 7.2: Mean Annual Temperature in SRB
Source of data plotted: WorldClim Version 2.1 Climate Data

The increase in ET_0 corresponds to the average air temperature pattern during the same months.

Furthermore, the combination of rainfall, temperature and potential evapotranspiration measure aridity. Aridity Index is expressed as the ratio of precipitation and Potential Evapotranspiration (PET). Aridity measures soil moisture stress specific crops grown in an area would face. The TDA results on aridity analysis (Figure 7.3) indicate that the SRB falls within dry-sub-humid (0.5 – 0.65 Aridity Index value) to humid (> 0.65 Aridity Index value) climate class and therefore not susceptible to desertification, but still prone to varying moisture stress over time and space. This calls for efficient agricultural water management that would include SWC. With likely excessive moisture and risk of flooding, farming in the lower basin needs to have mechanisms of drainage systems.

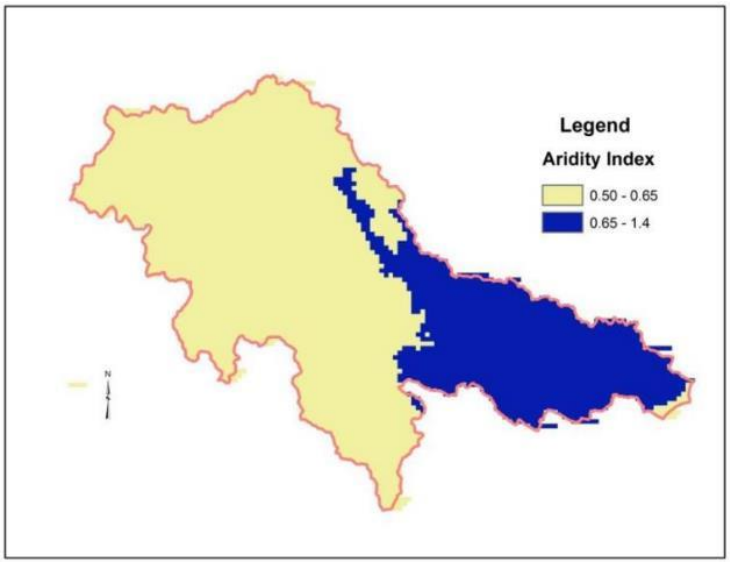


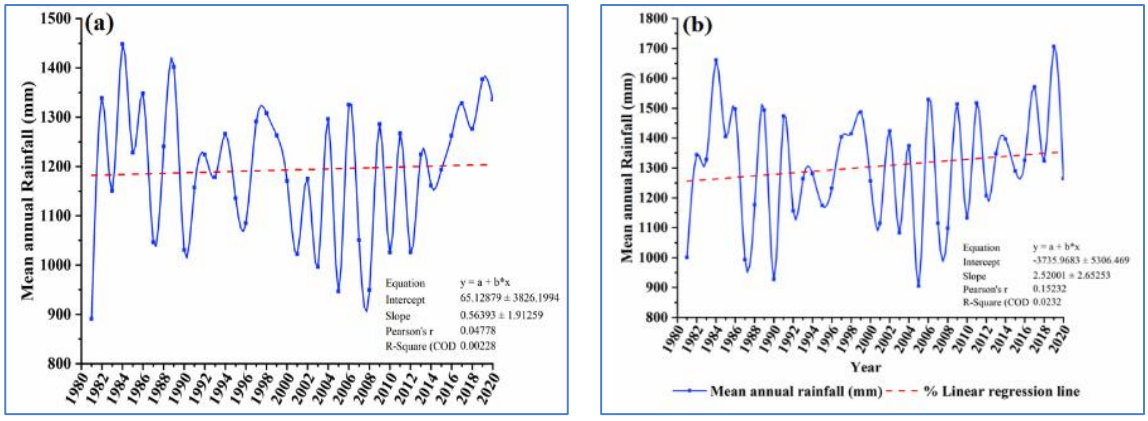
Figure 7.3: Spatial Pattern of Aridity in the SRB
Source: SONGWECOM TDA, 2023

Aridity measures soil moisture stress specific crops grown in an area would face. The TDA results on aridity analysis (Figure 6.3) indicate that the SRB falls within dry-sub-humid (0.5 – 0.65 Aridity Index value) to humid (> 0.65 Aridity Index value) climate class and therefore not susceptible to desertification, but still prone to varying moisture stress over time and space. This calls for efficient agricultural water management that would include SWC. With likely excessive moisture and risk of flooding, farming in the lower-basin needs to have mechanisms of drainage systems.

7.2 An Empirical Outlook on Climate Change and Variability: Trends, State and Futures in the SRB

7.2.1 Rainfall and Temperature

The observed long-term country-area average annual rainfall, during 1981–2020 is higher in Tanzania (1305.31 mm) than in Malawi (1193.28 mm) side of the basin. With regards to the trends analysis increasing trends were observed on both sides of the basin, however the trends were not significant with correlation coefficient (r) of less than 0.4% as shown in Figure 7.4(a, b).



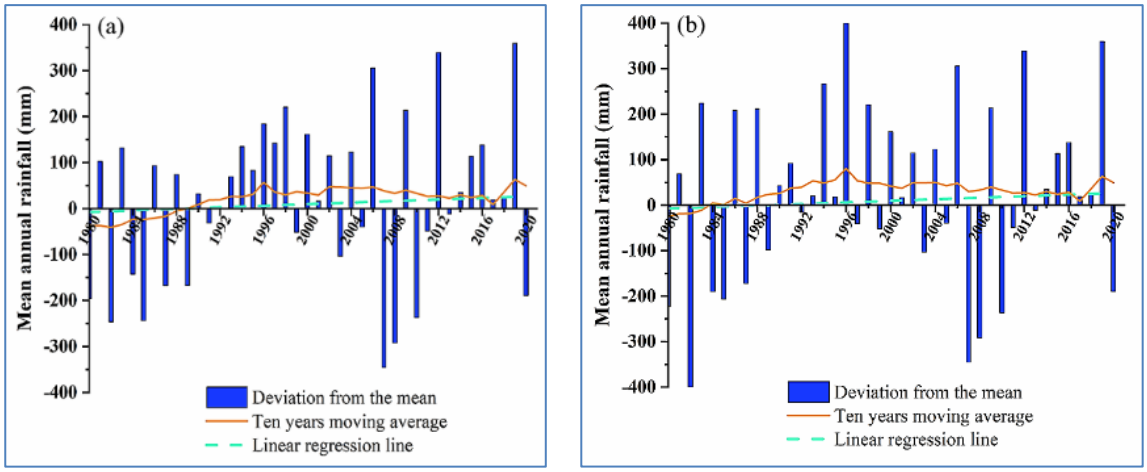
a) Tanzanian side of the basin *b) Malawian side of the basin*

Figure 7.4(a,b): Annual Rainfall Trends in the SRB

Source: SONGWECOM TDA, 2023

The mean annual rainfall of the basin on Tanzania's side is 1193.3 mm (range: 891.2 to 1448.8 mm) with a standard deviation (SD) of 138 mm. However, for the Malawian side of the basin, the mean annual rainfall is 1305.3 mm (ranging from 905 to 1707 mm) with a standard deviation (SD) of 193.4 mm. This analysis indicates that the basin receives high rainfall on the Malawian side compared to the Tanzanian side. Out of 30 years, 15 and 16 years, respectively, received less rainfall than normal on the Tanzanian and Malawian sides of the basin, as depicted in Figure 6.4 (a, b). The highest deficit was about 350 mm on the Tanzanian side in 2007, while on the Malawian side a maximum deficit of 400 mm of rainfall was observed in 1982.

A high frequency of drought conditions was experienced between 1981 and 1993 over both sides of the basin, while from 1993 to 2006 the basin was dominated by a wet condition over both sides. Dry conditions re-occurred between 2007 and 2009, followed by the dominance of wet conditions from 2012 to 2019. The wettest year for the whole period of 1981-2020 was 2019, with an increase of about 350 mm of rain for Tanzania's side, while for Malawi's side of the basin, the wettest year was 1996 with an excess of about 400 mm.

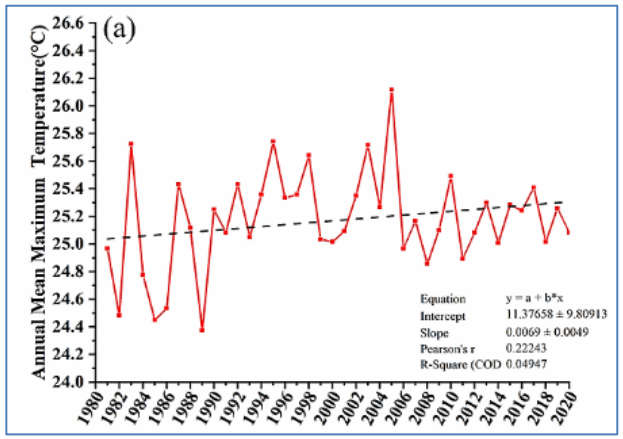


a) Tanzanian side of the basin b) Malawian side of the basin

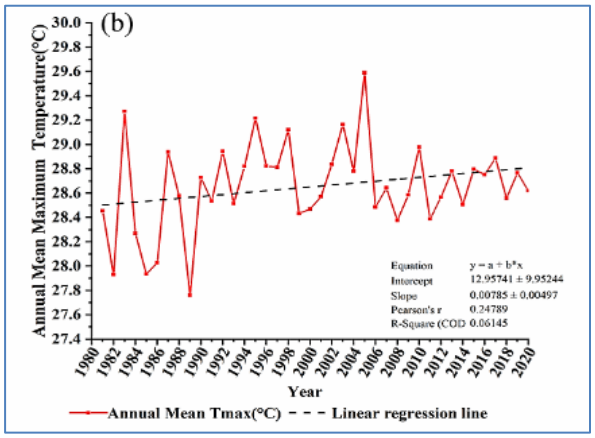
Figure 7.5(a,b): Mean Annual Anomalies and Moving Averages in the SRB

Source: SONGWECOM TDA, 2023

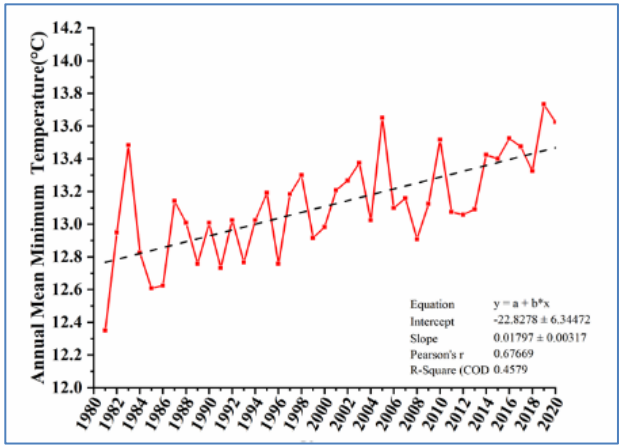
Figures 7.6 (a-d) provide a comprehensive overview of the results pertaining to both T-max (maximum temperature) and T-min (minimum temperature) across the entire basin. These figures collectively illustrate a consistent trend of increasing temperatures each year, indicating a warming trend within the region. The results for the T-max over the Tanzanian (Figure 7.6a) and Malawian (Figure 7.6b) sides of the basin both indicated an increase in Tmax; however, the increase is not significant (Pearson, $r < 0.4$). The average annual maximum temperature is 25.8°C and 28.7°C, over Tanzanian and Malawian sides of the basin, respectively. For the minimum temperatures, the results over both the Tanzanian (Figure 7.6c) and Malawian (Figure 7.6d) sides of the basin show a significant rise in T-min (Pearson, $r > 0.4$). The average annual minimum temperature is 14.1°C and 17.9 °C over the Tanzanian and Malawian sides of the basin, respectively. Although the whole basin indicated an increase in T-max and T-min trends, the Malawian side of the basin experienced warmer temperatures than the Tanzanian side of the basin.



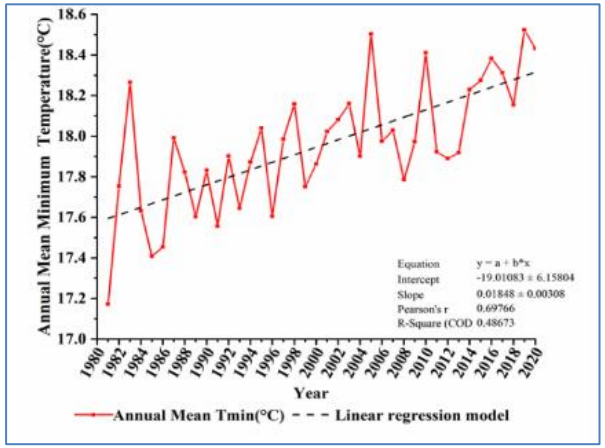
a) Tanzanian side of the basin



b) Malawian side of the basin



c) Tanzanian side of the basin



d) Malawian side of the basin

Figure 7.6: Mean Annual Tmax (a &b) and Tmin (c&d) in the SRB

Source: SONGWECOM TDA, 2023

7.2.2 Drought Analysis

The standardized precipitation index (SPI) and the standardized Precipitation and Evapotranspiration Index (SPEI) are the frequently employed statistics for describing drought conditions over a variety of periods. On short timeframes, the SPI and SPEI are highly correlated with soil moisture, however on longer durations, it can be correlated with groundwater and reservoir storage. These indices can be compared across regions where climates are notably distinct. It quantifies recorded precipitation as a standard deviation from a chosen probability distribution function. This study applied both SPI and SPEI to determine the occurrence of drought conditions over the SRB. These simple indices with perform comparatively well compared to more complicated indices in depicting periods and density of droughts. The SPI and SPEI are the dimensionless indices, where negative values indicate drought and the positive values indicate wet conditions.

Using annual rainfall data, the SPI was calculated. The results are shown in Figure 7.7 (a and b) for the SPI and Figure 7.7 (c and d) for the SPEI on the Tanzanian and Malawian sides of the basin, respectively. From the results, it is clear that the annual rainfall on both the Tanzanian and Malawian sides of the Songwe basin varies with time, whereas the upward and downward movements of the graph correspond, respectively, with those of above and below average rainfall. The results indicate that out of 40 years, about 15 years experienced drought conditions while the remaining years were dominated by wet conditions, with some extreme dry years. However, generally, the results indicated increasing trends of wet conditions over the entire basin during the past 40 (1981-2020) years.

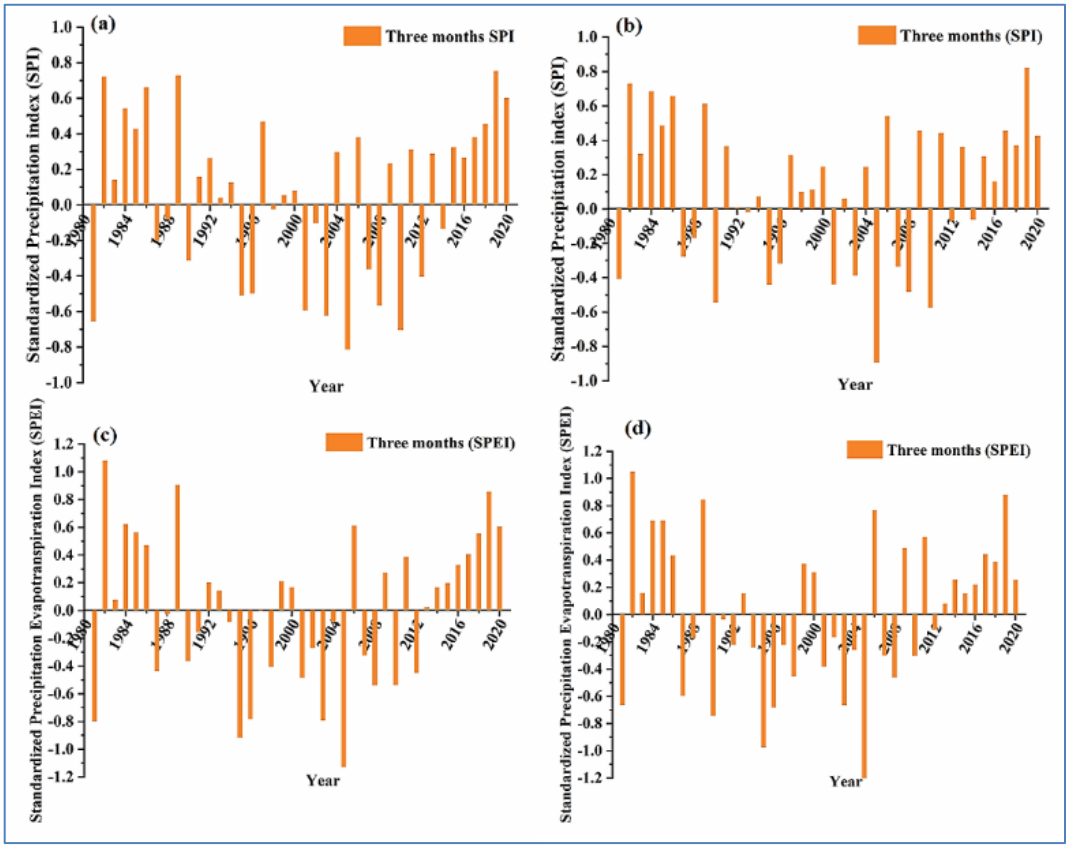


Figure 7.7: The standardised Precipitation index (SPI) for Tanzanian's (a) and Malawian's (b) and Standardized Precipitation and Evapotranspiration Index (SPEI) over the Tanzanian (c) and Malawian (d) sides of the basin.

Source: SONGWECOM TDA, 2023

7.2.3 Downscaled Future Climate

7.2.3.1 Rainfall Analysis

Figures 7.8, and 7.9, show the annual, seasonal, and monthly change in rainfall from 2021 to 2050 compared to the baseline (1991–2020) climate. The results for the future annual mean rainfall (Figures 7.8a and b) indicated an increasing trend in rainfall compared to the long-term average. Out of 30 years from 2021–2050, 19 years would experience the increasing annual rainfall trends over Tanzania, while over Malawi, 20 years would experience the increase in rainfall. The higher decrease in rainfall of 15% was observed on the Tanzanian side during 2021, and a similar condition of decreasing rainfall of the same amount would be experienced in 2026 on the Malawian side of the basin. Other years with an expected decrease in rainfall will receive a deficit of about 105% from the long-term mean on both sides of the basin. Like for the years with increased rainfall, a 10% increase would occur on both sides of the basin except for the years 2024 and 2036, where an increase of more than 10% would be experienced on the Malawian side of the basin, as shown on Figure 7.8b.

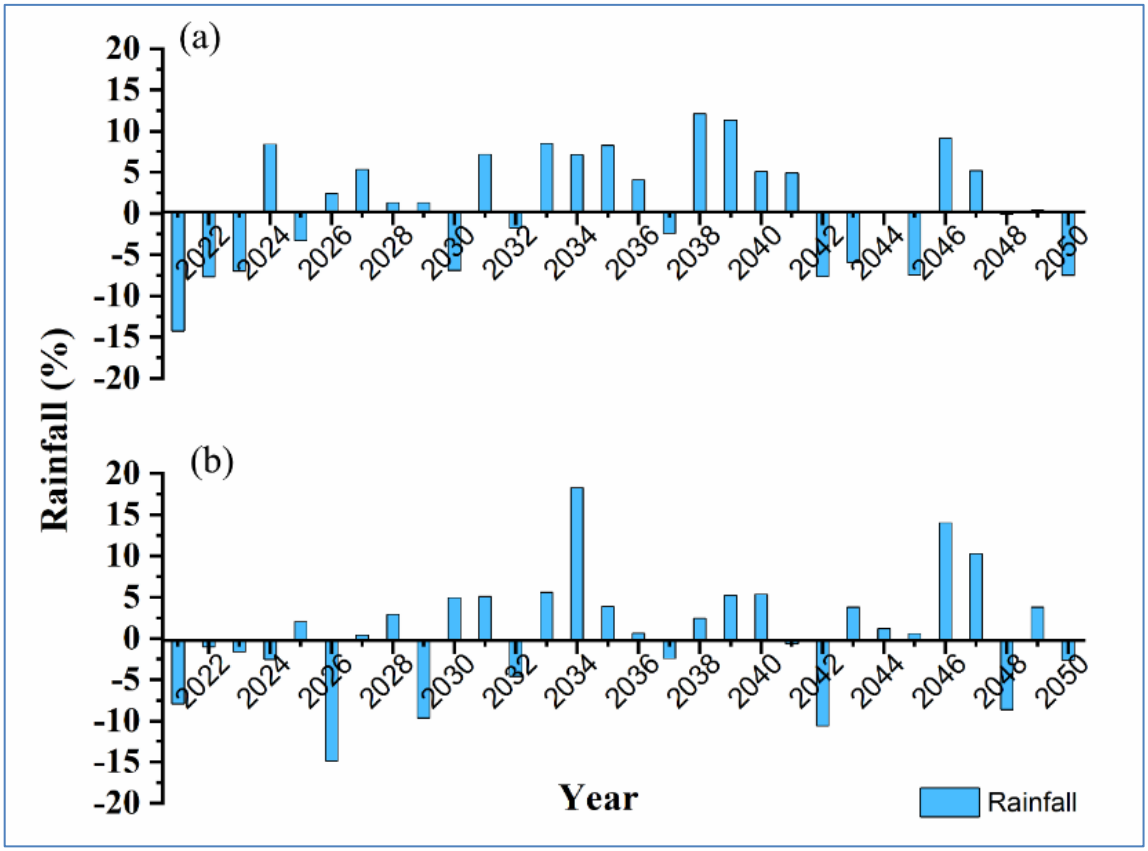


Figure 7.8: Percentage change in rainfall over Tanzanian (a) and Malawian (b) sides of the basin

Seasonally, the rainfall data shows a decrease in seasonal rain by 6.5% and by 49% on the Tanzanian and Malawian sides, respectively. During the November-April (NDJFMA) season in Tanzania (Figure 7.9a) and Malawi (Figure 7.9b), the amount of rain would decrease from February to April on the Tanzania side of the basin. However, the results show that the amount of rain on the Malawian side of the basin goes down in December, February, March, and April.

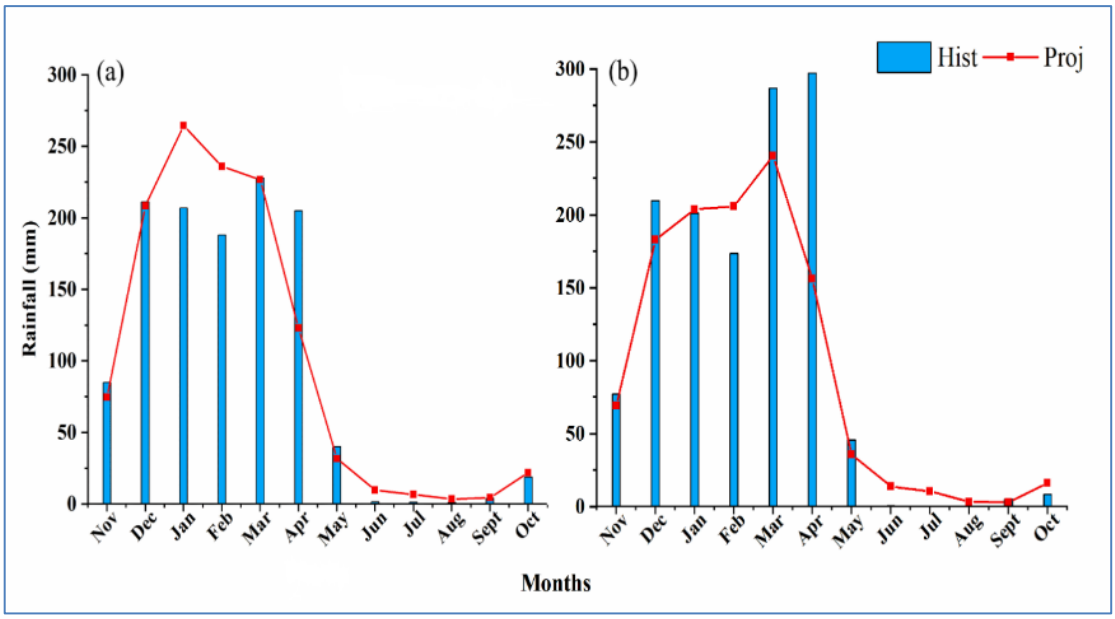


Figure 7.9: Monthly change in rainfall trends for Tanzania (left) and Malawi (right)

7.2.3.2 Rains Seasons Analysis

Onset and cessation of seasonal rains

Figure 7.10 (a and b) represent the changes in the future onset of the seasonal rainfall, and Figure 7.10 (c and d) indicate the cessation during the future (2021-2025) for the Songwe River basin on the Tanzanian and Malawian sides, respectively. Results show that the onset of the NDJFMA rain season at Songwe River Basin during the future period 2021–2050 would vary from the long-term average onset on the 25th day and the 26th on the Tanzanian and Malawian sides, respectively, as shown in Figures 7.10 (a&b). The basin would experience an earlier onset for 22 and 19 years out of 30 years on the Tanzanian and Malawian sides of the basin, respectively.

Furthermore, the results for the future projections in the area show that early cessation of the NDJFMA would dominate on the Tanzanian side of the basin while late secession would dominate on the Malawian side of the basin season, as shown on Figures 7.10 (c&d), respectively. On the Tanzanian side of the basin, the early cessation is on average two days before the baseline cessation date. However, on the Malawian side of the basin, a late cessation of five days on average from baseline cessation day would be experienced. This shows that the onset and cessation of the season may be changing.

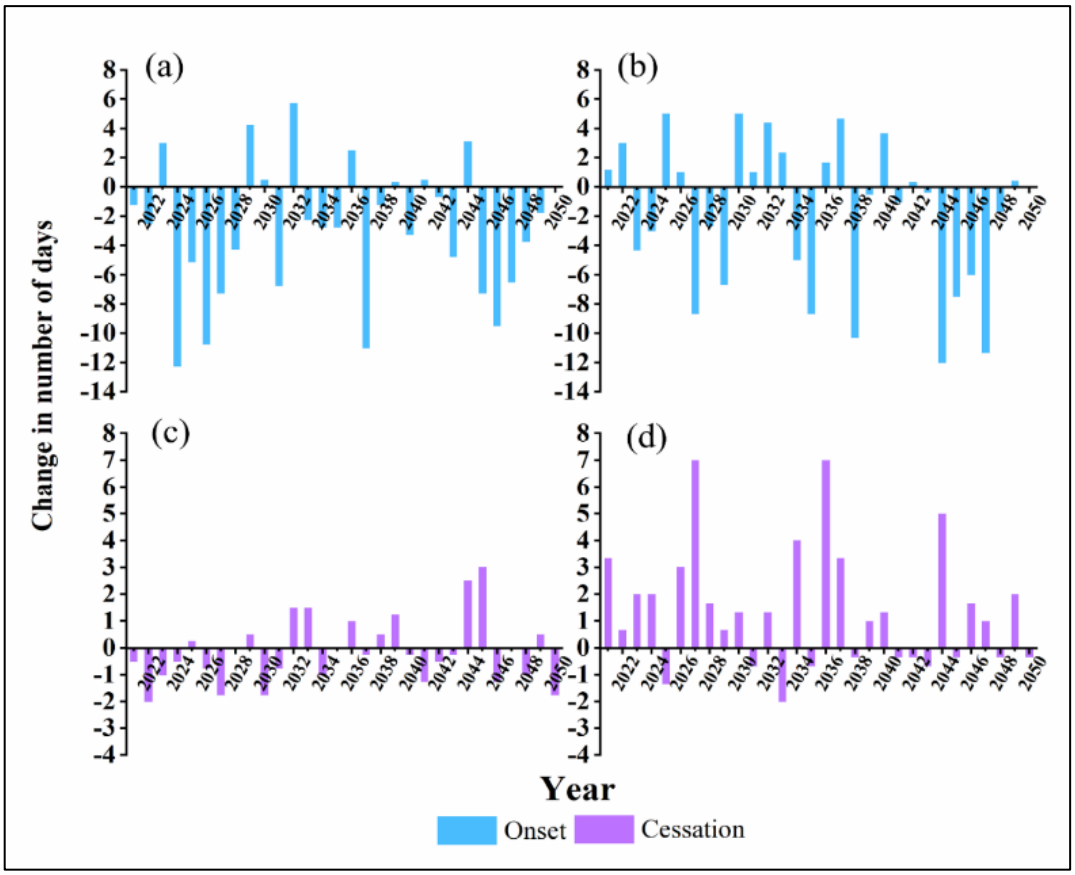


Figure 7.10: Changes in Onset over Tanzania side (a) and Malawian side (b), and change on cessation on Tanzanian side (c) and Malawian side (d)

Changes in seasonal rainfall length and longest dry spells

Figure 7.11a and b indicates the changes in rainfall seasonal length Figure 7.11c and d represent the changes in number of dry spells over Tanzanian and Malawian sides of the basin, respectively. Results shows the variation on rainfall seasonal length; however, the elongated rainfall seasons would dominate on both sides of the basin. This long rainfall season is due to the early onset and late session over the area. Looking on the changes of dry spells results shows that during future projection both sides of the basin would experience a reduction in number of dry spells. The projected increase in seasonal length and reduction on dry spells occurrence suggest possibly good intra-seasonal rainfall distribution and amount over the basin.

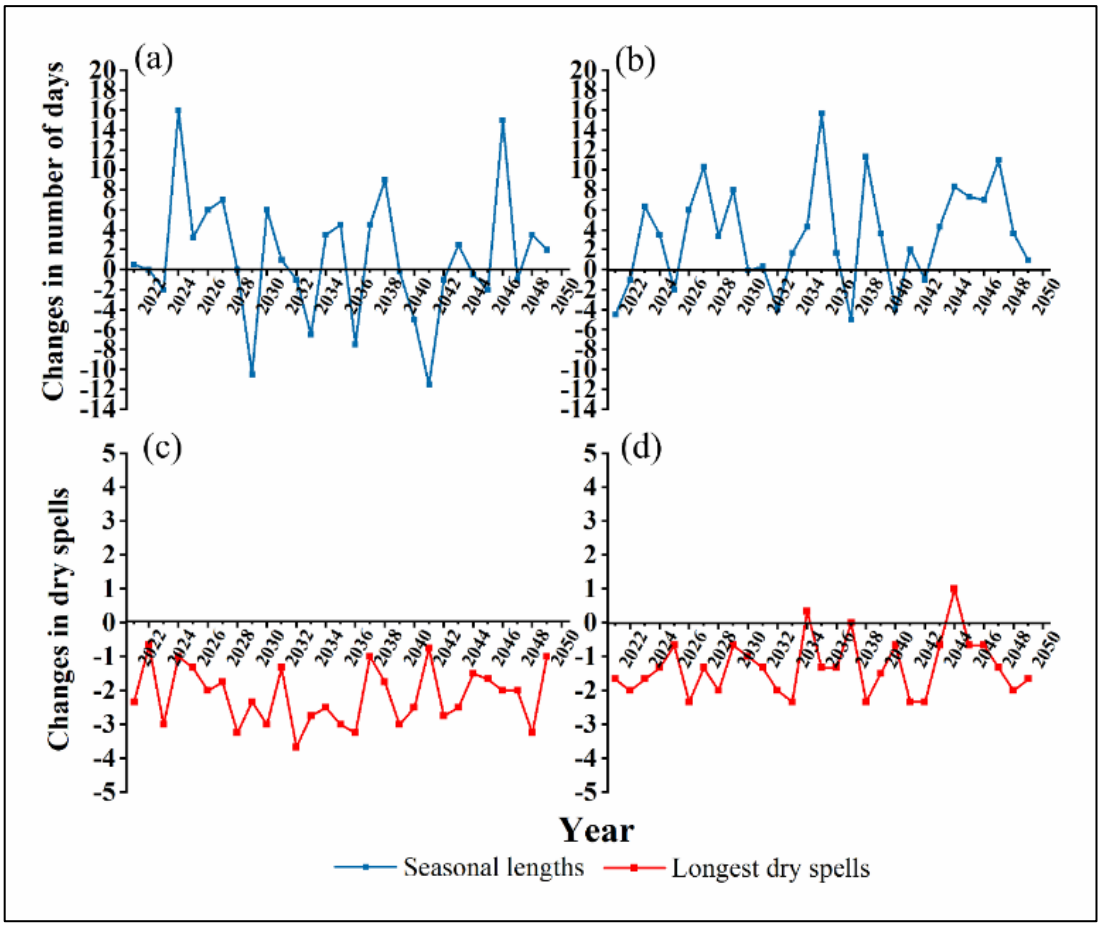


Figure 7.11: Changes in seasonal length for Tanzania (a) and Malawi (b), and changes in number of dry spells for Tanzania (c) and Malawi (d)

Changes Number of Rainy days

Figure 7.12 indicates the number of rainy days for historical (1991-2020) and Future (2021-2050) rainy season at Tanzanian (a) and Malawian (b) sides of the basin. The results indicate the variations in number of rainy days to both historical and future period with increasing trends. Comparing the future (2021-2050) projection with historical (1991-2020) results shows increase in number of rainy days during NDJFMA season in the future period. The projected increase in rainy days suggests possibly good intra-seasonal rainfall distribution around the basin, which is good for social economic development.

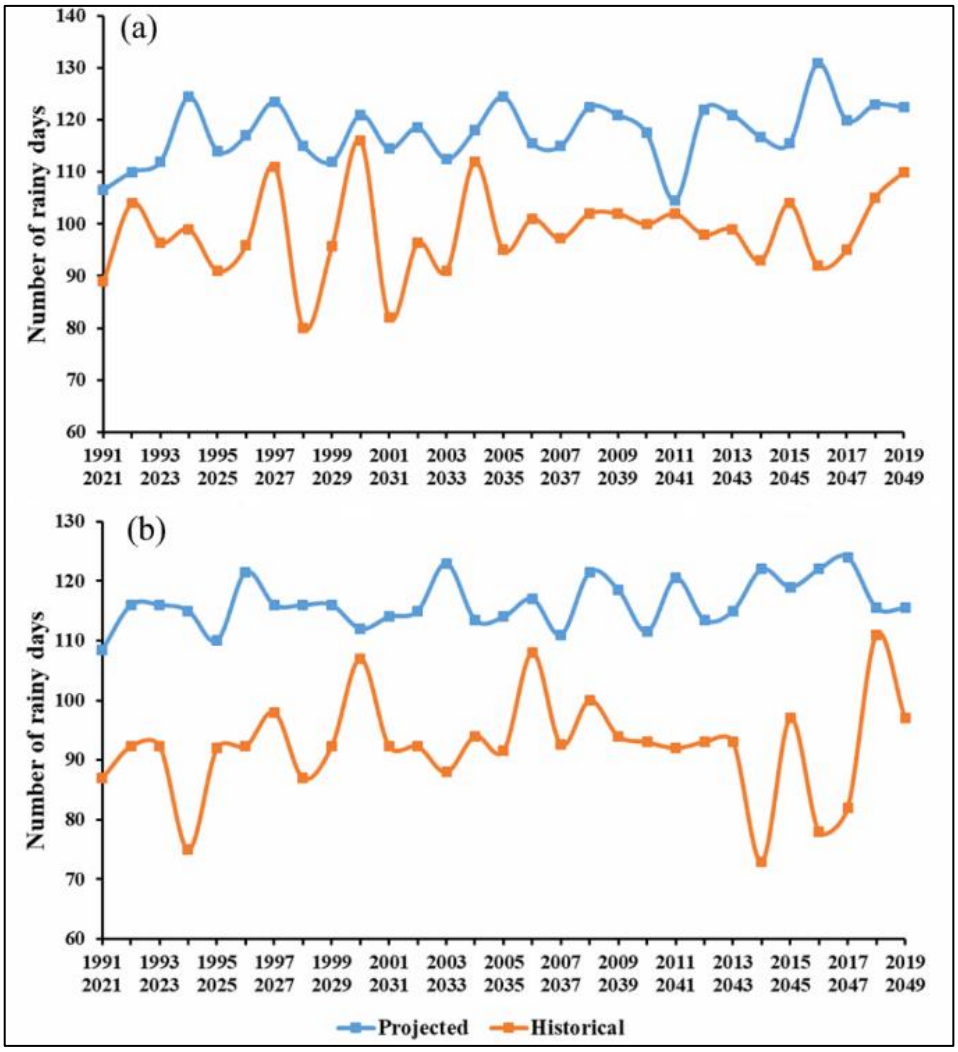


Figure 7.12: Historical and projected number of rainy days for Tanzanian (a) and Malawian (b) sides of the basin

7.2.3.3 Temperature Analysis

The mean annual maximum and minimum mean temperature change in the Figure 7.13. The results indicate an increase in maximum and minimum, by 0.5°C and 0.6°C, respectively on Tanzanian side of the basin. The increase of maximum and minimum temperature by 0.6 °C and 0.7°C respectively would be at the Malawian side of the basin.

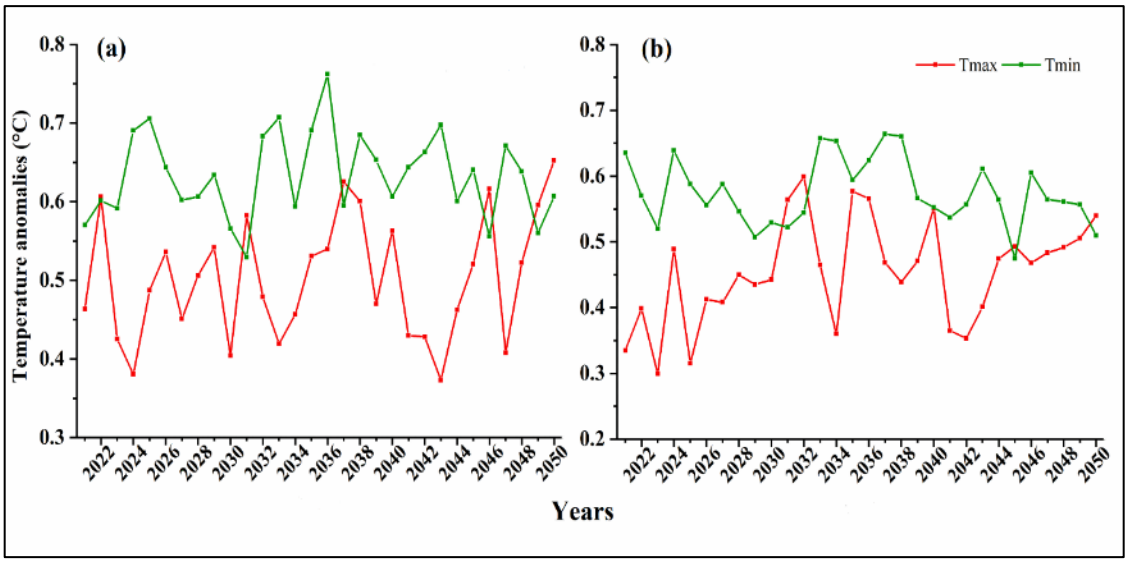


Figure 7.13: Maximum and minimum temperature anomalies on Tanzanian (a) and Malawian (b) sides of the basin

The basin's primary resources and social economy may be at risk from the expected temperature rise. Several studies (Thornton et al., 2011; Guan et al., 2015; Serdeczny et al., 2016) have argued that in different parts of Africa, the projected climate change, warming, variability, and change in precipitation will threaten agriculture, livestock, and hydrological systems. Therefore, the projected increase in temperature, both maximum and minimum, over the study area call for the development of adaptation measures and a strategic plan for the ecosystem management of the SRB and surrounding areas.

7.3 Climate Change: Impacts, Drivers and Solutions

7.3.1 Pathways to Environmental and Socio-Economic Impacts

Climate change impacts the planet and humanity through different pathways. In the context of socio-economic development, climate change has direct effects on the economic sectors that are nature-based such agriculture, fisheries, and forestry. Important socio-economic sectors such as health, transportation and water supply are sensitive to climatic changes. As the local livelihoods and economies are overly nature-dependent, the local communities that rely on climate-sensitive natural resources for livelihoods are at risk.

A study by Muganyizi et al. (2021) in Ileje district, Tanzania, points to the fact that climate change had impacted 36% of the total respondents' livelihoods. Increase in temperature and decrease in rainfall affected farming and other socio-economic activities and thus affecting incomes, food, land productivity, natural capital, human capital, and biodiversity (Muganyizi et al., 2021). As vulnerability due to climate change impacts increase, the livelihood options decrease and communities may resort to using natural resources unsustainably. Malanga (2018) in a study in Chitipa District in Malawi, reported a strong link between poverty and environmental degradation which was also linked to climate change impacts in the area.

The analysis of future climate of SRB points to grim future and further impacts on livelihoods, ecosystems, and overall socio-economic conditions. Projected increase in temperature on both sides of SRB suggest that the basin's primary resources and livelihoods may be at risk. Associated with projected increase in temperature is droughts. Haile et al (2020), using standardized precipitation-evapotranspiration index (SPEI) reported that

droughts in East Africa are likely to increase by 36% under RCP 4.5 climate change scenario by the end of 21 century.

Climate change will also impact lake Nyasa/Malawi and Songwe River ecosystem in terms of water temperature (due to increased temperature), nutrient profile (because of riparian environmental degradation) and column depth, thereby affecting fish stock and composition. Rising surface temperature can lead to hypoxia (deoxygenation) in bottom waters (Kling and Mugidde, 2014). Droughts and receding water levels because of climate change will also affect the fish species and catches. For instance, Simmance et al. (2022) reported reduced catches of favourite fish species in Lake Chilwa, southern Malawi, due to increased drought and lake level recession in recent years, while catfish (*Clarius gariepinus*) catches were not affected.

The elongated seasonal rains projected in SRB may also be important driver of frequent flash flood and fluvial flood in lowlands. The communities who live in flood prone areas may be vulnerable through loss of assets (housing) and failure of infrastructure for example access roads, and sanitation. For instance, a study by Mikova and Ipyana (2019) reported that annual flooding of Songwe River in Kyela district causes outbreak of water-borne diseases such as diarrhoea and typhoid as the flood water wash through latrines, barnyards, and water sources.

7.3.2 Causal Chain Analysis of Climate Change

The impacts of climate change are presented in Table 7.1 under the causal chain analysis. The causes of climate change entail both natural (non-anthropogenic) and anthropogenic drivers – with the latter attributed to human activities. Anthropogenic causes reported by stakeholders include increased demand for irrigation, unsustainable agricultural practices, and a lack of investment in hydropower generation. Natural drivers include an intricate of dynamic changes and feedbacks in the climate and environment systems *inter alia*, including variations solar radiation, continental drifts, sulphate-based aerosols from volcanic activities on the globe (Haunschild et al. 2016[36]).

[36] Haunschild, R., Bornmann, L. & Marx W. 2016. Climate Change Research in View of Bibliometrics. PLoS One, (7). doi:10.1371/journal.pone.016093.

Table 7.1: Causal chain analysis of climate change impacts in SRB

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Scarcity, variability and poor quality of water	Reduced and erratic water flows key demand sectors such as domestic, industrial, hydro-power generation, irrigation and environment	Deforestation	Climate Change	Natural changes and feedbacks in climate systems
Flooding and erosion	Flood related damages	Lack of flood protection	Encroachment of catchments mainly through agricultural expansion	Over-dependency on nature-based livelihood activities
Vulnerability of agriculture and livelihoods	Limited access to energy due to untapped potential of hydropower generation	Watershed and riverbanks degradation	Lack of efficient irrigation infrastructure	Unsustainable agricultural practices
Ecosystem degradation and biodiversity loss	Ecosystem loss	Deforestation	Land degradation	Increased demand for irrigation

Sources: Stakeholders Consultations, 2023. Review of empirical literature and planning documents.

However, anthropogenic driver is of much relevance to climate action. Human related actions that cause climate change over a much longer time through emission of greenhouse gases leading to global warming. Such activities include burning of coal, fossils and natural gas that emit CO_2 and N_2O. Deforestation and forest degradation reduces capacity of forestry systems to sink the carbon. Unsustainable land uses reduce the capacity of land to stock soil carbon which is then released to the atmosphere. Intensive use of N-fertilizers such as in paddy fields emits N_2O and methane. Livestock farming of ruminants emits methane from both enteric fermentation and unsustainable handling of manure. Activities in the agri-food systems and value chains including handling of biowastes in municipal landfills and disposal of wastes such as burning husk and crop residues in the open that lead to emission. For the SRB, anthropogenic drivers are the targets of climate mitigation and adaptations with mitigation co-benefits.

7.3.3 Game-Changing Actions for Addressing Climate Change

The potential game-changing and key stakeholders in the implementation of the actions are presented in Table 7.2.

Table 7.2: Game-Changing Actions and Stakeholders for Addressing Climate Change

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote sustainable Ecosystem-Based and Water Resources Management	NGO (Self-Help Africa), MDA (Environmental Affairs Dept)
2	Increase investment in sustainable, inclusive, efficient, and profitable irrigation sector Increase investment in sustainable, inclusive, efficient, and profitable irrigation sector	MDA (NIRC, DIS)
3	Invest in public flood control infrastructure and mitigation systems with socio-economic co-benefits (e.g., hydro-power generation, downstream irrigation, water supply and fish farming)	MDA (ESCOM, MoE, TANESCO), NGO (Red Cross),
4	Promote circular economy and green practices in the agricultural value chains and non-agricultural economic sectors where energy, nutrients and material are not wasted, and the economic value is added and optimized	MDA (VPO – DoE, Environmental Affairs Dept.), NGO (Refresh Pact)

8 ***Source:*** SONGWECOM TDA 2023

8.1 Linkages of Climate Change and Variations with other Thematic Areas of the TDA

Climate change as a stressor is cross-cutting with a myriad of non-linear relationships on the stressed sectors and systems. Increased temperature and droughts would drive the population to undertake their farming closer to riverbanks, thus causing erosion and siltation. In addition, reduced vegetation cover due to insufficient rainfall may leave soil surface exposed and vulnerable to erosion, whereby nutrients may be carried along runoff water to affect water bodies downstream. As populations get more stressed due to failure of crops farming, people may resort to other activities such as hunting and charcoal burning, thus cause ecosystem degradation and biodiversity loss. As pointed out under policies/strategies on climate change, implementation of the policy is influenced by the donor funding as well as political priorities. Climate change adaptation programs may not be implemented at local level, if donor funding ceases, or the political leadership of the time loses interest. Reduced livelihood options brought about by climate change may be a driver for erosion of social and economic capital, food security and income.

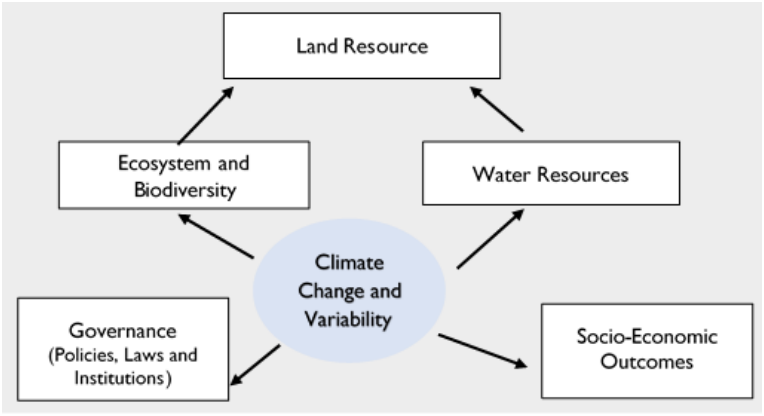


Figure 7.14: Climate Change Linkages with Other Thematic Areas of the TDA

Source: SONGWECOM TDA 2023

PART EIGHT

SOCIO-ECONOMIC ANALYSIS

8.0 An Overview

As an outcome of strategic actions, sustainable and inclusive socio-economic development is the centrepiece of the Strategic Action Planning (SAP) process. Part eight covers the state and development trajectories for Sustainable Food Systems (SFS) in both countries, and in the basin that is part of. Other sections presenting the perspectives at national and basin levels covered under part seven include: 1) economic development and poverty, 2) development mega-trends including population growth, urbanization and youth bulge, 3) development outlook on key growth sectors including agriculture, fisheries, forestry, beekeeping, eco-tourism and mining, 4) Development outlook on key service sectors entailing education, roads and energy, and 5) Socio-economic transboundary problems with their impacts, drivers and potential solutions.

8.1 Sustainable Food Systems

Sustainable Food System (SFS) is the centrepiece of socio-economic development hence relevant to the SRBDP. The socio-economic development outcomes intended in the SRBDP such as reduction of poverty, food and nutrition security, health, sustainable energy, roads, environmental sustainability, social inclusivity and gender equity are all elements of a sustainable food system. Food system links with other productive, extractive and service sectors such as construction, mining, culinary, entertainment and tourism.

Critical drivers of SFS include climatic and environmental factors that are intricately linked with ecosystem and biodiversity. The food system is also shaped by the socio-economic mega-trends such as income growth and urbanization.

In the SRB, the food value chains are mainly derived from the primary sectors dependent on the environment including crop production, livestock, fisheries and forestry. In both countries and the basin in particular, food system activities are overly unsustainable to the environment –from production, processing, distribution, food preparation for consumption to disposal of wastes.

For achieving sustainable and inclusive socio-economic development centred on poverty reduction and enhanced food security at national and basin scales, embracing a food system approach (Figure 8.1) is essential. The components of the SFS are further detailed in the SEA thematic report (SONGWCOM 2023e[37]).

[37] Strengthening Transboundary Cooperation and Integrated Natural Resources Management in the Songwe River Basin (STC&INRM-SRB) Project. Socio-Economic Analysis Thematic Report. SONGWECOM, Kyela. Tanzania.

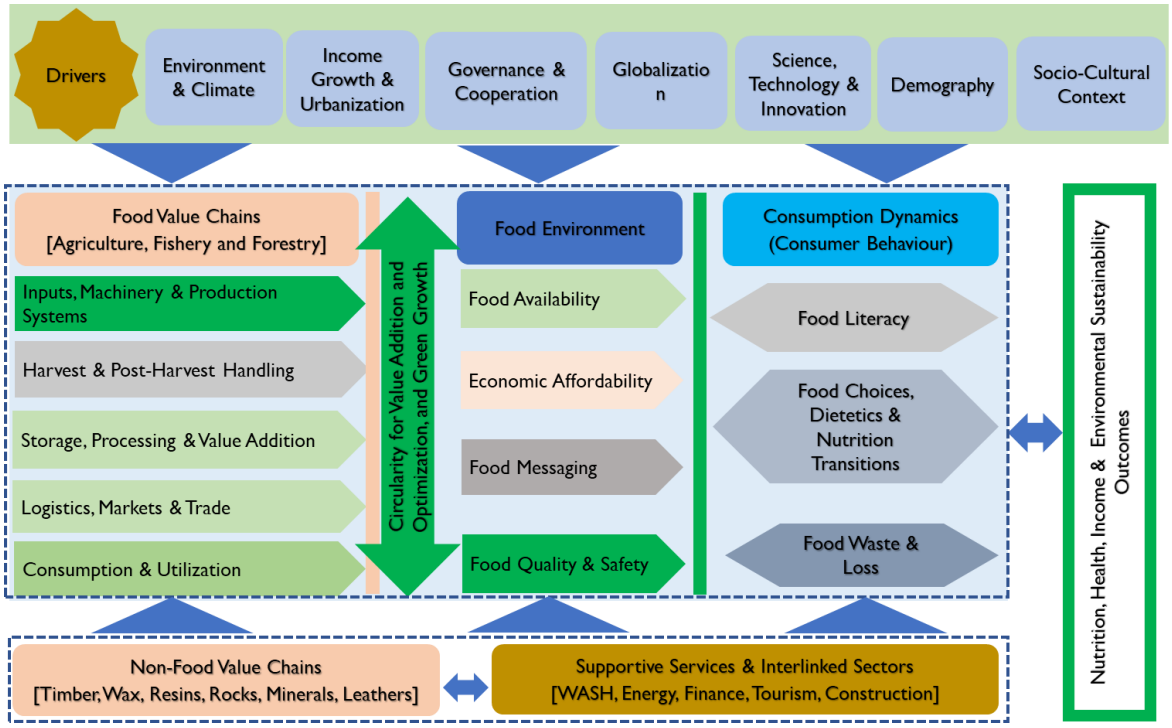


Figure 8.1: Sustainable Food System for Socio-Economic Development
Source: Adapted from Pathways for Sustainable Food Systems 2030.

8.2 Economic Development and Poverty

Over the past decade, the two countries have experienced dynamic patterns of economic growth – but with improving performance overtime. With an exception of 2020 when COVID-19 hit, with recovery prospects thereafter, the real GDP growth rates for Tanzania has been in the range of 6-7% and that of Malawi about 3-4% (URT 2021[38], GoM 2021[39]). In order to realize the long-term ambitious development visions, the economies have to sustain growth rates of 6-10%.

By 2025-2030, the two countries aspire to have attained middle-income status, built semi-industrialized economies, and inclusive high-quality human development. The countries are making progress towards the visionary development targets. In 2019/20, the Tanzania attained the Gross National Income (GNI) per capita of US$ 1,080 that enabled the country to attain the lower-middle income status. Tanzania targets to attain the GNI per capita of US$ 3,000 by 2025 (URT 2021). In Malawi, the GNI per capita in 2020 was estimated at US$ 603, with the target of US$ 1,064 for attaining lower-middle income economy by 2030 (GoM 2020).

At the basin level, urbanized districts tend to have higher income levels hence less income poverty than rural districts. For example, Tunduma town council and Karonga district had higher per capita GDP, disposable income and monthly expenditure than more rural Ileje and Chitipa districts (Figure 8.2). Per capita income and expenditure levels in more urbanized were also above the global poverty line of US$ 2.5 per capita per day.

[38] URT 2021. National Five-Year Development Plan 2021/22 – 2025/26. Ministry of Finance and Planning, Dodoma.
[39] GoM 2021. Malawi 2063 First 10-Year Implementation Plan (MIP-1). National Planning Commission, Lilongwe.

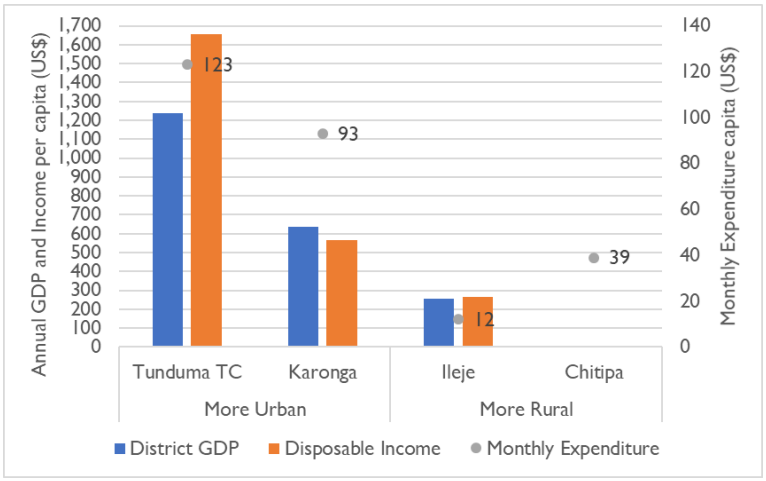


Figure 8.2: Income and Consumption Expenditure in the Basin

Source of Data: District Planning Offices, 2023.
Exchange Rate in 2022: TZS = 0.0004 US$; MK = 0.0013 US$

8.3 Development Outlook of Key Growth Sectors

8.3.1 Agriculture Development

Agriculture contributes significantly to the overall GDP – about 26% for Tanzania and 23% for Malawi. Agriculture supports the livelihoods of over 80% of the rural populations in both countries. The sector employs about 67% and 64% in Tanzania and Malawi, respectively (URT 2022[40], GoM 2021[41]). In Tanzania, agriculture sector contributes about 30% of the total export earnings and supplies 65% of all industrial raw materials (URT 2021[42]). In Malawi, agriculture generates over 80% of national export earnings (JICA 2022[43]).

Agriculture constitutes four subsectors including crop, livestock, forestry and fisheries. In 2020, crop, livestock, forestry and fisheries accounted for 57, 27, 10 and 6% of the agricultural GDP in Tanzania, respectively (URT 2021[44]). In 2020, crop, livestock, forestry and fisheries accounted for 87, 7.3, 0.4 and 5.3% of the agricultural GDP in Malawi, respectively (CGSPACE 2023[45]). In the past decade, agriculture has grown by 3-5% annually in both countries mainly through area expansion rather increased productivity.

8.3.1.1 Crop Sub-sector Development

In both countries, crops are produced for both food security and export. Food security is the national priority. In 2021/22, Tanzania produced about 17 million tons of food crops (URT 2023). In 2021, Malawi produced about 20 million tons of food crops (GoM 2022[46]).

Mainly due to growing population, income and urbanization, the food demand is growing over time. For example, in Tanzania, the food demand is estimated to increase from the

[40] URT 2022. Building a better tomorrow: youth initiative for agribusiness (BBT-YIA), 2022-2030. Ministry of Agriculture. Dodoma.
[41] GoM 2021. The Malawi 2063 First 10-Year Implementation plan (MIP-1), 2021-2030. National Planning Commission (NPC). Lilongwe.
[42] URT 2021. National roadmap to sustainable food systems transformation by 2030.
[43] JICA 2022. Sector Position Paper, Agriculture. JICA Malawi Office. Lilongwe.
https://www.jica.go.jp/Resource/malawi/english/activities/c8h0vm00004bpzlh-att/agriculture.pdf
[44] URT 2021. National Sample Census of Agriculture 2019/20. National Bureau of Statistics (NBS). Dodoma.
[45] https://cgspace.cgiar.org/bitstream/handle/10568/130232/AgGDP+_MWI_Apr2023.pdf?sequence=1
[46] GoM 2022. Malawi in Figures, 2022 Edition

current 15 million tons to 20 and 34 million metric tons by 2030 and 2050 when the population will be about 71 and 136 million people, respectively (URT 2023[47]). Likewise, the future demand for food will be higher to in Malawi when there will be about 23 and over 34 million people to feed by 2030 and 2050, respectively (GoM 2020[48]).

The two countries have been increasingly broadening their exports into non-traditional exports including horticulture, rice, maize and pulses. Expectedly, there will be more investment in food production for regional export in a long-run. For example, in Tanzania, about 441,908 tons of rice worth US$ 207.3 million and 189,277 tons of maize worth US$ 31.5 million were exported in 2021 (URT 2023[49]). In 2020/21, Malawi produced about 4.6 million tons of maize, which was 27 higher than estimated national requirement (FEWS NET 2022[50]).

Cereals particularly maize and rice are the major crops in the basin. Maize is produced in all districts, but rice is predominantly produced in lowland areas of Kyela and Karonga (Table 8.1). Upland rice is produced at a limited extent in the uplands. Mbeya and Chitipa followed by Ileje district are major producers of maize. The importance of rice in the lower part of the basin is apparent, with Karonga and Kyela producing 22,768 and 35,469 tons of rice, respectively. Rice production in the upper-basin was low –ranging between 200 and 2,000 metric tons in 2022/23. There is a potential of promoting high-yielding upland rice varieties in the basin.

Maize yields ranged between 0.9 to 5.4 tons/ha, with higher yields in upper-basin districts. The highest maize yield was reported in Tunduma TC and the lowest in Karonga. Maize is sensitive to waterlogging hence likely to underperform in the lowland floodplains.

Rice yield was around 1.6-1.8 ton/ha in lower-basin districts of Kyela and Karonga. Ileje and Mbeya districts in the upper-basin achieved the highest rice yield of about 4 tons/ha. In the lower-basin, rice is mostly produced under natural flooding system in fields that are poorly levelled and drained, hence contributing to low productivity.

Drought resilient cereal crops such as sorghum and millet are produced at lower levels mainly for a subsistence need. Such crops are traditionally produced under a low-input system resulting into lower yields. In the face of climate change and variability, promotion of such crops is necessary to safeguard local food security. However, through the use of better seeds, improved agronomic practices and value addition, sorghum and millet have the economic potential beyond subsistence.

Apparently, maize and rice have significant economic potential for addressing food insecurity and income poverty. Mbeya and Chitipa districts produced maize worth a total of US$ 105.9 million in 2022/23. Rice production in both Karonga and Kyela districts is valued at a total of US$ 91.5 million in 2022/23. Therefore, the cereal grain sector is economically important in the basin. Wider economic gains would be realized through value addition (industrial milling) for both domestic and regional export.

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[47] URT 2023. Budget Speech 2023/24, Ministry of Agriculture. Dodoma.
[48] GoM 2020. 2018 Malawi Population and Housing Census. Population Projections 2018-2050 Report. National Statistical Office. Lilongwe.
[49] URT 2023. Budget Speech 2023/24, Ministry of Agriculture. Dodoma.
[50] FEWS NET 2022. Malawi Food Security Outlook.
https://fews.net/sites/default/files/documents/reports/MALAWI_Food_Security_Outlook_February%202021_FINAL.pdf

Table 8.1: Production Revenue from Major Cereals for 2022/23 Season

Parameter	Kyela	Ileje	Karonga	Mbeya	Chitipa	Tunduma
Maize						
Cultivated area (ha)	5,478.5	24,176	27,223	58,976.9	34,898	10,935
Production (tons)	10,997	91,869	24,760	201,087.9	117,222	58,530
Yield (tons/ha)	2.0	3.8	0.9	3.4	3.4	5.4
Price (US$/ton)	408	244.4	938.9	400	217.2	220
Revenue (US$. mil.)	4.5	22.5	23.3	80.4	25.5	12.9
Rice						
Cultivated area (ha)	22,475.3	471.5	12,483	59.2	659	NA
Production (tons)	35,468.6	1,886	22,768	230.5	625	NA
Yield (tons/ha)	1.6	4.0	1.8	3.9	0.9	NA
Price (US$/ton)	1,096.8	1,000	2,311.2	1,200	2,139.5	NA
Revenue (US$. mil.)	38.9	1.9	52.6	0.277	1.3	0
Sorghum/Millet						
Cultivated area (ha)	NA	1,311	83	123.2	1,030	19.3
Production (tons)	NA	1,311	53	295.9	597.8	3
Yield (tons/Ha)	NA	1.0	0.6	2.4	0.6	0.2
Price (US$/ton)	NA	640	1,950.2	1,200	732.9	240
Revenue (US$. mil.)	NA	0.839	0.103	0.355	0.438	0.00072
Total Revenue (US$. mil.)	**43.4**	**25.2**	**76**	**81**	**27.2**	**12.9**

Source: District Planning Offices, 2023. **Exchange Rate as an average of 2022:** TZS = 0.0004 US$; MK = 0.0013 US$. **NA** = Data Not Available

Furthermore, other major annual crops grown in the basin include oilseeds mainly sunflower and sesame, pulses, cassava, sweet potato, and potato. Major perennial crops include coffee, avocado and cocoa. The details on hectarage, production, yields and returns are presented in the SEA thematic report (SONGWCOM 2023e).

8.3.1.2 Land Access and Management

Malawi with a total land area of 9.42 million hectares (GoM 2022) has about 7.7 million hectares potentially available for agriculture, of which 1.2 million hectares (16%) is under estates and 6.5 million hectares (84%) are available for smallholder farmers (GoM 2002[51]). Tanzania with a total land area of 89 million hectares, has about 44 million hectares suitable for agriculture of which only 24% is cultivated (URT 2022[52]). The two countries are still endowed with an arable land for agricultural expansion. Access to land resource is increasingly limited as population grows and competing land uses increase. For example, about 75% of Malawian farmers already depend on less than 1 hectare with limited alternative livelihoods (GoM 2021).

Land degradation and deteriorating soil health are already decimating the productive capacity of agricultural land. For example, in Malawi, the average national soil loss rate in 2014 was estimated at 29 ton/ha/year – relatively a higher rate in the Northern Region ranging between 0.4 and 39 ton/ha/year (Vargas and Omuto 2016[53]). Even back to 2001-2009, the economic cost of land degradation in the two countries was significant –estimated

[51] GoM 2002. Malawi National Land Policy. Ministry of Lands, Physical Planning & Surveys. Lilongwe.
[52] URT 2022. National Environmental Master Plan for Strategic Interventions (2022 – 2032). Vice President's Office. Dodoma.
[53] Vargas, R. & Omuto, C. 2016. Soil Loss Assessment in Malawi. FAO, UNEP, UNDP and Ministry of Agriculture, Irrigation and Water Development. Lilongwe.

at US$ 244 million in Malawi and US$ 2.3 billion in Tanzania (Kirui and Mirzabaev 2016[54]). Arguably, there is no land management miracle that may have reversed the land degradation trend as adoption of sustainable land management technologies and practices has remained low while pressure on land has been increasing.

At the basin level, land degradation is reported to be high as revealed through stakeholder consultations and land degradation analysis. The land use and land cover change analysis under land management thematic area (SONGWECOM 2023b) indicates that woodland has shrunk by 62% while land area under cultivation has grown by 200%. The findings reveal that about 31% of the basin faces high to severe soil erosion risks whereas 11% faces very severe to catastrophic soil erosion risks. The data collected from Karonga district indicate that soil loss is in the range of 4-30 ton/ha/year. Soil loss in Chitipa district was estimated at 15.22 tons/ha/year. In Tunduma TC, soil loss due to land degradation was estimated at 105 tons/ha/year. Land degradation and erosion in catchment areas results into increased runoff on fragile land surface leading to floods, sediments in rivers, wetlands, lakes, and dams (URT 2022[55]).

Some districts were able to provide data on some indicators on land access and management. Per capita arable landholding size varied between 1-3 acres across the districts. Per capita arable land size in Karonga, Tunduma and Chitipa was about 1 acre. In Ileje and Mbeya district per capita land size was about 3 acres. In Karonga and Chitipa districts, farmers owned an average of 0.5 – 1 acre of grazing land.

Village land use planning is an important step in sustainable land management. In Karonga district, only 2% of the villages had land use plans. Mbeya had 28% of villages under its jurisdiction with formal land use plans. In Chitipa district, no village was reported to have a land use plan. In Ileje district, 7% of the villages had land use plans. In Tunduma TC, 85% of the streets had land use plans as a requirement for the town council's master plan. Apparently, many villages in the basin do not have land use plans, hence posing a challenge on sustainable management of land resources.

8.3.1.3 Irrigation Development

Irrigation development is at the centrestage of agricultural transformation in the two countries. In Tanzania, irrigated area is less than 2% of potential arable area suitable for irrigation. In 2021/22 irrigated area was estimated at 727,281 with the target of developing additional 95,005 hectares under irrigation. Tanzania targets to increase the area under irrigation to 822,286 hectares by end of the 2022/24 (URT 2023). Such irrigation development achievement will have an economic multiplier effect by creating 475,025 permanent and seasonal jobs. In Tanzania, the long-term target was to irrigate is to have 1.2 million hectares under irrigation by 2025.

Malawi targets to increase the percentage of area under irrigation from the current 34.2% of irrigable land as per 2016 estimate to 60% and 100% by 2030 and 2063 (GoM 2020). The GoM intends to increase the hectarage under large-scale irrigation schemes from 56,856 in 2020 to 73,856 and under smallholder schemes from 61,987 to 101,987 by 2030 (GoM

[54] Kirui, O.K. & Mirzabaev, A. 2016. Cost of Land Degradation and Improvement in Eastern Africa. Invited Poster Presentation at the 5th International Conference of the African Association of Agricultural Economists, September 23-26, 2016, Addis Ababa, Ethiopia.

[55] URT 2022. National Environmental Master Plan for Strategic Interventions (2022 – 2032). Vice President's Office. Dodoma.

2021). In Malawi, the Shire Valley Transformation Program (SVTP) that started in 2018 and ends in 2030, intends to develop an irrigated area of 43,370 hectares.

At the basin level, irrigation potential is not fully utilized. For example, the potential area for irrigation in Karonga is estimated at 13,000 hectares of which only 2,500 hectares (19%) are currently under irrigation. In Mbeya district, a total 2,407 hectares are under irrigation. In Chitipa district, 569 hectares are irrigated. In Ileje district, irrigated land was estimated at 1,560 hectares. Despite of some progress made in terms of public investment in irrigation, the basin's irrigation potential is not fully developed. The proposed irrigation development of 3,150 hectares for Malawi and 3,050 hectares for Tanzania under the SRBDP will be a leverage for both countries toward their irrigation development targets.

8.3.1.4 Agricultural Extension

The two countries oversee extension development as vital in agricultural transformation. In 2017, Tanzania had a gap of 6,244 staff of the needed total of 15,802 crop extension staff (URT 2017[56]). In 2022, number of employed extension staff in Tanzania increased to around 8,000 while the need also increased to around 21,000. Malawian Government targets is to lower the ratio of agriculture extension worker to farmers from the current 1:1929 to 1:1500 by 2030 (GoM 2021). However, even the target ratio of 1:1,500 for Malawi is still far below the World Bank's standard ratio of one extension staff to 200-500 farmers (Busungu et al. 2019[57]). The current transformations in the public extension programmes include increasing employment of staff, equipping them with gears including transport facilities.

At the basin level, the districts were understaffed in relation to the needed number of extension staff for a plausible number of farmers. The total number of extension staff in Karonga was estimated at around 27. In Tunduma TC, there were 23 crop extension staff. For example, with an estimated 88,410 farming households, Karonga had extension staff to farmers ratio of 1:3,275. In Karonga and Mbeya districts, the proportion of agricultural households are 95 and 76%, respectively. In the same districts, farmers with access to public extension services comprise 86% and 52%, respectively. Arguably, access to extension services should not be a single episode of extension staff visiting the farmer but rather continued interactions that enable co-learning in the farming system.

8.3.1.5 Agricultural Inputs

Currently, the two countries have lower application rates of inorganic fertilizer, which is estimated at an average of 19 and 40 kg/ha for Tanzania and Malawi, respectively. Malawi targets to increase the use of inorganic fertilizer from 40 to 200 kg/ha by 2030 (GoM 2020). Tanzania targets to increase fertilizer consumption per capita to at least 50 kg/ha by 2025. However, fertilizers are among major imports that already drain the forex in both countries. In 2022/23, Tanzania imported around 617,079 tons of fertilizer (URT 2023). It is estimated that Tanzania imported fertilizers worth TZS 472,921.4 million in 2021 (BoT 2022). In 2021, Malawi imported fertilizers worth MK 225,853.4 million, far above diesel and petrol imports combined (GoM 2022). The two countries have a common history of rolling out expensive input subsidy programs particularly fertilizer subsidies.

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[56] URT 2017. Agriculture Sector Development Programme II (ASDP-II). Ministry of Agriculture, Dodoma.

[57] Busungu, C., Gongwe, A., Naila, D.L., & Munema, L. 2019. Complementing extension officers in technology transfer and extension services: understanding the influence of media as change agents in modern agriculture. International Journal of Research – Granthaalayah, 7(6).

At the basin level, majority of the farmers (68-95%) were reported to be using inorganic fertilizer across the districts. Consumption of inorganic fertilizers (N, P and K) varied across the districts in the basin. The use of N-fertilizers was estimated between 490-210,268 tons per district – the lowest use reported in Ileje and the highest in Chitipa. Consumption of P-Fertilizers was in the range of 168-4,300 tons, with highest consumption reported in Tunduma TC and the lowest in Karonga district. P-fertilizer was the least consumed type of inorganic fertilizer in the basin, with consumption in the range of 84-1,100 tons per district. The proportions of farmers using manure in the basin ranged between 21-65% – with the highest and lowest use reported in Chitipa and Ileje districts, respectively.

There is a risk of excessive use of fertilizers given lack of extensive soil testing that would have been the basis of recommendations of type of fertilizers and application rates. Excessive use of fertilizers in the riparian agro-landscape is the source of downstream eutrophication in the Lake Malawi/Nyasa. Increased use of fertilizers which is not guided with proper soils tests to guide the application rate would further compromise the health of aquatic ecosystems.

8.3.1.6 Agricultural Finance

Financing is critical for agricultural transformation. However, commercial lending to agriculture lags behind other sectors. For example, in 2019, commercial lending to agriculture in Tanzania was only 16% of the total lending. In Tanzania, the commercial lending interest rates have remained high averaging at 17% within the past decade. The predominantly rainfed smallholder agriculture has remained riskier to commercial lending. Promotion of irrigation and modern technologies in smallholder agriculture would lower the lending risk. The Malawian Government commits to revitalize the Agricultural Credit Facility (ACF) to fund all levels of agriculture value chains.

At the basin level, the available data from districts indicate that significant proportions of smallholder farmers had access to formal credit. Across the districts, the percentage of smallholder farmers with access to credit was between 7.4-59%. Mbeya district had the least proportion of farmers who accessed formal credit (7.4%), while Chitipa district had the highest proportion (59%). Access to affordable and tailored credit by smallholder farmers is crucial for increased investment in sustainable farming technologies.

8.3.1.7 Agro-Processing

Agro-processing is central in upgrading the agriculture value added. Value added activities have multiplier effects in the economy. Most of the agricultural exports from both countries are unprocessed or semi-processed. According to the World Bank database[58] on agriculture value added, between 1990 and 2021, agriculture value added as percentage of the GDP for Malawi and Tanzania averaged at 31 and 30%, respectively. The agriculture value added per capita (per worker in crop production, livestock, forestry and fisheries) between 1991 and 2019 (adjusted to 2015 prices) for Malawi and Tanzania was US$ 313 and 635, respectively. Increasing value addition remains a priority in the agriculture transformation initiatives implemented in both countries. For example, Malawi targets to increase its agricultural value added from MK 406,330 to 2,200,000 million by 2063. Both countries have been promoting agro-processing industry by providing conducive business environment and investment climate for the private sector.

[58] https://data.worldbank.org/indicator/NV.AGR.TOTL.CD?locations=TZ&view=chart

At the basin level, the predominant agro-processing activity in the basin was grain milling – mainly rice and maize. Across the districts, there were more maize than rice mills. Karonga, Tunduma, Mbeya and Ileje districts, each had between 11-13 rice mills while the number of rice mills per district was in the range of 66-228. Chitipa district had about 450 maize mills. Mbozi district has 5 coffee processing factories that produce a range of value-added coffee products –beans (roasted or unroasted) and roasted ground coffee mainly for export. Individual coffee farmers and AMCOS in in the upper-basin operate coffee pulping machines. For example, in Ileje there are about 9 pulping units operated by AMCOS. During village level FGDs, it was noted that some farmers wash pulped coffee in the rivers, hence causing water pollution.

8.3.1.8 Agricultural Commercialization, Trade and Foreign Direct Investments

Tanzania has the strategy of promoting large-scale commercial farms including encouragement of Foreign Direct Investments (FDIs) in agriculture. The flow of Foreign Direct Investments (FDIs) in agriculture would not only increase the governments' taxation base, but foster other benefits including rural employment, technology transfer and markets access to farmers.

Across the districts, farmers marketed between 54-74% of produced food crops. This implies a substantive market participation among smallholder farmers. In terms of large-scale commercial farms, Mbeya district has 5 such farms of which 3 were owned by domestic investors and 2 are owned by foreign investors. Such farms were reported to have created about 230 jobs in Mbeya district. Ileje district, reported the highest number of large-scale commercial farms –14 farms with a total of 1,560 hectares. Out 14 farms reported in Ileje, 6 were owned by domestic investors, 5 were by foreign investors and 5 were joint ventures between domestic and foreign investors. In Ileje district, such large-scale commercial farms created about 1,897 jobs.

8.3.2 Livestock Sub-Sector Development

In 2020, Tanzania had a population of 33.9, 24.5, 8.5 and 87.7 million of cattle, goats, sheep and chickens, respectively (URT 2022[59]). During the same year, Malawi had a population of 1.89, 10.02 and 197 million cattle, goats and chickens, respectively. In addition to genetic and productivity improvements, the MW2063 targets to have 3.0, 25 and 500 million cattle, goats and chickens by 2030 (GoM 2021). Despite of its economic potential, the economic contribution of the livestock sector has remained low. In Malawi, the livestock sector contributes about 36% to the agricultural GDP and 11% to the overall GDP (GoM 2021[60]). In Tanzania, the livestock sector contributes 27% to the agricultural GDP and 7.1% to the overall GDP (URT 2022[61]).

In 2022/23, Tanzania produced about 803,264.3 tons of meat of which 544,983.8 tons are beef; 113,781.8 tons is both goat and sheep meat. During the same year, production of poultry meat and pork was estimated at 96,915.6 and 47,583.1 tons, respectively. Production of milk was estimated at 3.6 billion litres of milk of which 67% was from indigenous cattle. About 14 million pieces of Hides and Skins (H&S) worth TZS 31.1 billion were produced. Tanzania produced about 5.5 billion eggs (URT 2023). In 2018/19, Malawi

[59] URT 2022. Livestock Sector Transformation Plan (LSTP). Ministry of Livestock and Fisheries. Dodoma.
[60] GoM 2021. National Livestock Development Policy, 2021-2026. Department of Animal Health and Livestock Development, Ministry of Agriculture.
[61] URT 2022. Livestock Sector Transformation Plan (LSTP). Ministry of Livestock and Fisheries. Dodoma.

produced 372,371 tons of meat of which 48,620 was beef, 54,014 was both goat and sheep meat, 227,863 was pork and 135,105 was poultry meat. Other livestock products produced in Malawi in 2018/19 included 96,859 litres of milk; 8,897 tons of eggs; and 5.8 million H&S (GoM 2022[62]).

In both Malawi and Tanzania, the domestic consumption per capita of livestock products is still low. In Tanzania, annual per capita consumption of different animal products is estimated at 12 kg of beef, 45 litres of milk and 75 eggs, which is below the world food organization's standard of 50 kg of beef, 200 litres of milk and 300 eggs per annum (URT 2019[63]). In Malawi, in 2016, annual per capita consumption of meat was estimated at 24.06 kg, milk at 5.1 litres, and 5.2 eggs (GoM 2018[64]). Mainly due to increasing income and urbanization, the demand for livestock products is expected to continue growing at national, regional, continental and global levels. Protein of animal source has higher income elasticity of demand compared to plant protein such as pulses. For example, by the year 2031, per capita consumption of beef, milk and eggs in urban areas of Tanzania is projected at 40.41 kg, 126.08 litres and 2.6 eggs; while in rural areas will be 27.64 kg, 144.64 litres and 1.22 eggs, respectively (URT 2017[65]).

At the basin level, livestock production in is small-scale under semi-intensive to intensive systems. Farmers in the lower-basin kept an average of two cattle, which is twice or more than other districts in the basin (Table 8.2). Mbeya and Kyela districts have more exotic cattle than other districts. Exotic cattle are basically improved dairy cattle crossed with a tracked pedigree of identified bulls and/or Artificial Insemination (IA).

Table 8.2: Populations of Different Livestock Species in 2022/23

Parameter	Kyela	Ileje	Karonga	Mbeya	Chitipa	Tunduma
Number of livestock keepers	**26,250**	**NA**	**54,040**	**92,595**	**124,840**	**11,990**
Total cattle	**52,584**	**44,755**	**119,054**	**71,463**	**92,442**	**4,886**
Local cattle	41,257	42,864	118,514	58,729	92,261	4,681
Exotic cattle	3,081	1,233	184	7,206	35	205
Cross bred cattle	8,246	658	356	5,528	146	NA
No. of cattle per farmer	**2.0**	**NA**	**2.2**	**0.8**	**0.7**	**0.09**
Total chicken	**901,495**	**157,259**	**2,020,341**	**555,405**	**1,186,945**	**33,515**
Local chicken	708,996	153,762	1,864,003	498,220	1,104,005	13,989
Exotic chicken	140,139	2,729	142,552	31,940	36,709	19,526
Cross bred chicken	52,360	768	13,786	25,245	46,231	NA
Sheep and Goats	2,687	4,017	98,615	75,341	129,421	1,094
Number of pigs	32,911	6,802	142,534	20,942	352,891	1,455

Source: District Planning Offices, 2023. **NA** = Not Available

Moreover, a total of 4,928.5 metric tons of beef worth US$ 16.6 million produced per year. Mbeya district produced more milk (~3.3 million litres) and beef (2,966 metric tons) than any other district in the basin (Table 8.11). Farmers in Mbeya kept more exotic cattle that are genetically more productive. Despite of its agroclimatic potential for dairying, Chitipa

62 GoM 2022. Statistical Year Book 2022. National Statistical Office. Lilongwe.
63 URT 2019. National Livestock Research Agenda, 2020-2025. Ministry of Livestock and Fisheries. Dodoma.
64 GoM 2018. National Livestock Development Strategic Plan, (2018-2023). Department of Animal Health and Livestock Development. Ministry of Agriculture. Lilongwe.
65 URT 2017. Tanzania Livestock Sector Analysis, (2016/17 – 2031/32). Ministry of Livestock and Fisheries. Dodoma.

district produced the least amount of milk as compared to other districts –the district had fewer exotic dairy cattle. Karonga and Chitipa districts are leading producers of eggs – producing about 106.2 and 34.5 million eggs per year worth US$ 18.4 and 6.7 million, respectively. Apparently, the basin produces about 5.7 million litres of milk (valued at US$ 2.6 million) and 154.5 million eggs (valued at US$ 27.6). The basin also produces about 37,279 pieces of H&S worth US$ 68,496 per annum. Production and income from H&S would be higher than estimated as post-slaughter recovery is estimated at only 25% – meaning that 75% of the H&S is wasted. With full recovery gross revenue from H&S would be estimated at around US$ 273,984.

8.3.3 Fisheries Sub-Sector Development

In 2020, the fisheries sector accounted for 4.9% of the agricultural GDP and 1.1% of the overall GDP in Malawi. The target is to increase share of the fisheries sector to the overall GDP to 2% by 2030 (GoM 2021[66]). In Malawi, fisheries GDP was estimated at MK 109,771.9 million in 2020 (GoM 2022). In 2020, In the fisheries sector contributed about 6.2% to the agricultural GDP and 1.7% of the overall GDP in Tanzania (BoT 2022). The target is to increase the share of fisheries sector to the overall GDP to 10% by 2036 (URT 2022[67]). In Tanzania, fisheries GDP was estimated at TZS 2,494,161.5 million in 2020 (BoT 2022).

The socio-economic significance of the fisheries sector is eminent. In Tanzania, fish contributes 30% of the animal protein hence important in improving nutrition security. In 2022/23, the Tanzanian fisheries sector created direct employment of about 197,763 jobs, involving 58,448 fishing effort/vessels and about 426,556 tons of fish catch worth TZS 2.9 trillion. Freshwater and marine capture fisheries account for 89% and 11% of the total catch in Tanzania, respectively (URT 2023[68]).

In 2020, fisheries catch and aquaculture production in Malawi amounted to 174,900 tons with the target of increasing production to 250,000 by 2030 (GoM 2021). In 2015, direct employment in the capture fisheries and aquaculture in Malawi was estimated at 60,000 fishers and 6,000 farmers, creating over 500,000 secondary employment in activities such as fish marketing and processing (GoM 2016). Fish is the major source of animal protein in Malawi (FS-TIP 2021).

In Malawi, between 1970s and 2015, the consumption of fish has decreased by over 60% from 14 kg/person/year, when fish provided 70% animal protein and supplied 40% of the country's protein, to 8 kg/person/year (GoM 2016). In 2019, per capita fish consumption in Tanzania was estimated at 8.5 kg (URT 2022). Apparently, the consumption fish in the two countries are below the global average per capita consumption of 20.5 kg year based on FAO's estimates.

At the basin level, the major fisheries systems in the basin include riverine and lake capture fisheries, and pond-based aquaculture. Cage-based farming in Lake Malawi/Nyasa is still in the infancy stage – reported to have started in Malawi. Capture fisheries is prominent in the lower-basin. In the upper-basin, riverine capture fishing is done at some spots along the Songwe river. Being informal and done at subsistence scale, riverine fisheries is not adequately monitored by the LGAs. In Chitipa district, riverine fisheries catch in the Songwe river was estimated at only 0.16 ton while involving about 380 riverine fishers in 2022/23. In Kyela, riverine fisheries catch in the Songwe river was estimated at 1.3 ton, with

[66] GoM 2021. The Malawi 2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC). Lilongwe.
[67] URT 2022. Fisheries Sector Master Plan (2021/22 – 2036/37). Ministry of Livestock and Fisheries. Dodoma.
[68] URT 2023. Budget Speech 2023/24. Ministry of Livestock and Fisheries. Dodoma.

estimated 439 fishers involved. The data on riverine capture fisheries may be on the lower side as due to informality and inadequate monitoring by the LGAs.

In 2022/23, lake-based capture fisheries catch in Karonga district was reported to be about 10,976 tons, with 5,067 fishers involved. During the same year, lake-based capture fisheries catch in Kyela district was estimated at 5,778 tons, involving 1,747 fishers.

Pond-based aquaculture is common in the upper-basin. The earth ponds for aquaculture are dug closer to the streams for convenient channelling of water. Data from the districts indicate that there are 39, 74, 91 and 486 earth fish ponds in Kyela, Ileje, Karonga and Chitipa districts, respectively. These ponds produced only 3.6, 2.6, 0.5 and 0.3 tons in 2022/23, respectively. Low aquaculture productivity is mainly due to poorly constructed ponds, unavailability of quality fingerlings and fish feed, and lack of access to aquaculture extension services.

Furthermore, fish markets and value chains are underdeveloped in terms of infrastructure. Kyela district has installed fishing boat yard, fish house and one designated fish market. In Malawi, the Sustainable Fisheries, Aquaculture Development and Watershed Management (SFAD-WM) (2019-2024) project is constructing modern fish landing sites in the project areas including Karonga. Such modern landing sites will have facilities for shelter, sanitation, handling and cold storage. The SFAD-WM project has also procured chilled trucks to support long-distance fish marketing.

8.3.4 Forestry Sub-Sector Development

The forestry sector is critical for providing ecosystem services and contributing directly and indirectly to sustainable socio-economic development. In Tanzania, the forest sector that also include hunting accounted for 10% of the agricultural GDP and 3% of the overall GDP in 2020 (BoT 2022, URT 2021[69]). In Malawi, forest and logging accounted for 0.5% of the agricultural GDP and 0.1% of the overall GDP in 2020 (GoM 2022).

In Malawi, between 1985 and 2017, the area under forest declined by 3,902 km^2 while other Land Use Land Cover (LULC) types mainly cropland increased by 8,105 km^2 and settlement increased by 341 km^2 (GoM 2020[70]). During the same time interval, grasslands declined by 2,248 km2 and wetlands by 2,312 km^2. In Tanzania, agriculture expansion is the major driver of deforestation, between 2008 and 2020 area under cultivation increased from 8.2 to 17.5 million hectares, respectively (URT 2022). Forest and grassland covers are diminishing mainly following expansion of crop agriculture and settlement.

The major drivers of deforestation and forest degradation across the two countries are common – extraction of forests for fuelwood and agricultural expansion. Extraction of forests for woodfuel which is used by majority (>80%) as a primary source of cooking energy. Firewood is mostly used in rural areas while charcoal is the main source of cooking energy in urban areas that constitutes over 80% of the charcoal market (GoM 2022, URT 2021). Charcoal is a big business driven by urban cooking energy demand. For example, in Tanzania, annual charcoal production was estimated at about 1,895,248 tons worth TZS 2.1 trillion in Gross Value Added (GVA) accounting for 44.2% of the overall sectors GVA (URT 2021).

In the basin, the communities are also benefiting from the forests by getting timber and non-timber products for both income and food. For example, in the upper-basin of Malawi,

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[69] URT 2021. The Contribution of the Forestry Sector to the National Economy. Ministry of Natural Resources and Tourism. Forestry and Beekeeping Division. Dodoma

[70] GoM 2020. Malawi National REDD+ Strategy. Department of Forestry. Lilongwe.

the fruits collected from the forests were reported to include *Mafwisa*, *Masuku*, *Isongwi* and *Manguwishi*. In practice, the fruits are mostly collected by children, hence enhancing child nutrition in the local community. In the upper-basin of Malawi, forests were regarded as the source of rains and recharging of the natural springs. The forests are also the source of supply of timber and poles for both own-use and sales.

Deforestation rates in Chitipa and Karonga were reported at 2.4 and 6.5%, respectively. Mbeya district reported deforestation rate of 30% which is mainly due to farming expansion of avocado, potato and coffee –involving conversion of private land that was naturally forested and/or planted with timber trees in the past. Other districts, did not have established deforestation rates. Every year about 1.2, 1.1, 1.5 and 2.0 million trees are planted in Karonga, Chitipa, Mbeya and Ileje districts, respectively. In Tunduma TC, about 21,240 trees are planted every year. However, the districts lack data on the survival rates of the trees planted every year. The tree planting programme lack incentive structures and proper monitoring and evaluation.

8.3.5 Beekeeping Sub-Sector Development

The potential of beekeeping is not yet fully taped for the sector to contribute significantly to sustainable socio-economic development in both countries. Both domestic and export markets for beekeeping products remain under-served. In Tanzania, production of honey and beeswax is estimated at 138,000 tons and 9,200 tons per annum, respectively. However, production of honey stands at about 30,393 tons and that of beeswax at 1,843 tonnes – accounting for only 22 and 20% of the existing potential, respectively (URT 2021). Honey and beeswax are the predominant products traded in Tanzania and Malawi. In Tanzania, it is estimated that annually collected honey and beeswax are worth GVA of TZS 112.1 and 31.1 billion, respectively (URT 2021[71]). In Malawi, beekeeping projects are reported in many parts of the country. In its National Export Strategy II (NES II), Malawi has identified honey among the priority export commodities (GoM 2021[72]).

At the basin level, beekeeping was regarded as an opportunity for income generation, enhanced nutrition and the use of its products such as honey as medicine. There were 83 beekeeping groups with 2,622 beekeepers in the basin. The local beekeepers managed a total of 21,746 beehives of which only 4,764 (22%) were improved beehives. Over three quarters (78%) of the beehives were of a traditional make.

Currently, honey and beeswax are two major beekeeping products in the basin. Three districts that provided production data produced a total of about 30 tons of honey and 23 tons of beeswax –worth US$ 136,035 and 66,770, respectively. Given the number of beehives, it is evident that productivity in the beekeeping sector is low. Most of the beehives are of a traditional make, hence contributing to low productivity. Farmers reported a number of challenges contributing to low productivity. Such challenges included beehives not getting colonized, unaffordability of improved beehives, limited value addition and lack access to beekeeping extension services.

[71] URT 2021. The Contribution of Forest Sector to the National Economy. Ministry of Natural Resources and Tourism. Dodoma

[72] GoM 2021. National Export Strategy II, 2021-2026. Lilongwe.

8.3.6 Eco-Tourism Sub-Sector Development

In Tanzania, tourism accounted for more 17.5% of GDP in 2019, with its share to the GDP anticipated to decrease to 11% by 2025 (URT 2021[73]). Despite the negative growth of the share of the Tanzanian tourism sector to the overall GDP, the sector will grow by 2% by 2025 – above the 1.5 growth of 2019. The negative growth in the share to the GDP is due to anticipated growing shares of other sectors particularly mining, manufacturing, construction, livestock, fisheries and forestry. In Tanzania, tourism sector generated revenue amounting to US$ 2.6 billion in 2019 and it is expected to generate US$ 6.0 billion by 2025 (URT 2021). In 2019, tourism sector created 1,500,000 jobs and it expected that the sector will create 1,750,000 jobs 2025.

In Malawi, tourism contributed about 6.7% of the GDP in 2019 and the target is to increase its share to 11% by 2030 (GoM 2020). World Travel and Tourism Council-WTTC (2022[74]) estimated that in 2021 travel and tourism contributed 5.8% to the Malawian GDP (US$ 512.8 million) while creating 513,200 jobs. The GoM is striving towards rebranding itself as a tourist destination by harnessing its touristic potentials.

At the basin level, the paucity of planning data on eco-tourism existing in the district indicates inadequate development attention accorded to the sector in the basin. There is one heritage site reported in Ileje district. Karonga reported to have 8 heritage sites and one wildlife hunting block. In Chitipa district at Misuku Hills area, the community runs a tourism centre. During a peak season the centre receives up to 50 tourists. Tourism in the central government forests is allowed under co-management arrangement, with 60% of the proceeds going to the community, 30% to the government and 10% to the forest management board. Ileje district also reported to be receiving tourists -the number of tourists was estimated at 1,677 per year. Generally, the basin is endowed with potentials for sustainable eco-tourism that have not been fully exploited.

8.3.7 Mining Sub-Sector Development

The mining sector has made Tanzania to become a non-oil resources intensive economy. In Tanzania, the mining sector is estimated to contribute 6.7% of the GDP –equivalent to TZS 9,947,971.5 million (BoT 2022). In Tanzania, the target is to increase the share of the mining sector in the overall GDP to 10% by 2025 (URT 2021). In 2020, the mining sector contributed only 0.7% to the overall GDP of Malawi –equivalent to MK 62,575.4 million. In Malawi, the target is to increase the GDP's share of the mining sector to 10% by 2030. In 2020, there was no large-scale mining company in Malawi and the target is to have at least 8 such mining companies by 2030 (GoM 2021).

Unsustainable mining is associated environmental degradation problems including among others land degradation, deforestation and water pollution. Sand mining takes place in sand rivers, coastal beaches of lakes and some inland sites. Sand accounts for a big share of ingredients in the construction of roads, bridges, railways, and public and private buildings. For example, in Tanzania, between 1998 and 2018, the sand extraction increased from 2 to 14 million tons per year (Shitima and Suykens 2022[75]).

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[73] URT 2021. National Five-Year Development Plan (2021/22–2025/26). Ministry of Finance and Planning. Dodoma.
[74] WTTC 2022. MALAWI, 2022 Annual Research: Key Highlights.
https://wttc.org/DesktopModules/MVC/FactSheets/pdf/704/154_20220613163251_Malawi2022_.pdf
[75] Shitima, C., and Suykens, B. 2022. River sand commodity chains in Tanzania. Stakeholders, Governance and Environmental Impacts. Governance in Conflict Network, University of Ghent, Belgium.

In the basin, the mining activities taking place including mining of coal, river sand and quarrying. River sand mining is a prominent activity associated with degradation of river banks, sedimentation and pollution. River sand mining employs youths who are involved in excavation, scooping and loading the dump trucks (Figure 8.3). For example, in Ileje district there were 7 sand mines and all of them involved extraction of sand from rivers. The river sand mining activities are not regulated by local governments – despite that some particularly in Tanzania collect mineral levy. The landlord owning land extending into the river owns the sand, hence entitled to selling the sand to customers.

a) River sand mining in Karonga ***b) River sand mining in Ileje***

Figure 8.3: River Sand Mining in the Basin

Photos Credit: *Placid, J. & Mutabazi, K.*

8.4 Development Outlook on Key Service Sectors

Local stakeholders at local community and public level identified a number of key service sectors that faced serious development challenges, hence urging for strategic measures to address them. Such service sectors include education, roads network and sustainable energy.

8.4.1 Education Sector Development

Some key indicators were used to assess the performance of the education sector at the national and basin levels. In Malawi, the literacy rate was estimated at 68.6% in 2020 –with literacy being 71.6% and 65.9% among men and women, respectively (GoM 2021). The target for Malawi is to raise the literacy rate to 81% by 2030. In 2020, the dropout rates for boys and girls from primary school in Malawi were estimated at 4.2 and 4.6%, respectively. In Malawi, the qualified Teacher-Pupil Ratio (TPR) was 1:62 for primary schools and qualified Teacher-Student Ratio (TSR) for secondary schools of 1:37.5 in 2020. In Malawi, there were 6,538 and 1,524 primary and secondary schools in 2020, respectively. Permanent Classroom-Pupil Ratio for primary schools in Malawi is estimated at 1:102.3 (GoM 2022).

In Tanzania, the literacy level was estimated at 77.6% in 2020 –with the target of raising it to 81.6% by 2025. The TPR for primary schools was 1:130 and TSR for secondary schools of 1:23 in 2020 (URT 2021). Between 2011 and 2015, the average dropouts for standard V and VII in primary schools in 2016-2018 was estimated at 7% (USAID 2021[76]). In Tanzania, there were 5,143 and 18,152 primary and secondary schools in 2020, respectively (URT

[76] USAID 2021. Tanzania Education Sector Landscape Analysis.

2020[77]). Between 2020 and 2025, Tanzania planned to establish new incubation centres (2 to 30), and additional Technical and Vocation Education Training (TVET) centres (20 to 40). In Tanzania, the Permanent Classroom-Pupil Ratio was estimated at 1:75 in 2020 – with the plan of improving it to 1:60 by 2025 (URT 2021).

Despite of the progress made by the two countries, there is still much to improve in the education system at the national level. For both countries the TPR exceeds the recommended of 1:40. In Malawi, the major reasons for dropouts were reported to include learners being engaged in family responsibilities, poverty and truancy (GoM 2022[78]). In Tanzania, the main reasons for dropouts from schools included poverty learners engaged in family responsibilities particularly animal grazing, and peer pressure (URT 2017[79]).

Across the districts in the basin, the literate population accounted for 74-93% of the population in the districts. Ileje district registered the lowest literacy rate compared to other districts. Apparently, the Tunduma TC reported higher rate of primary school dropouts for both girls (17.2%) and boys (22.2%). Tunduma TC is a vibrant commercial town at the border of Tanzania and Zambia, this may encourage children dropping out of school to engage in petty businesses for immediate income. In Karonga, the proportion of girls dropping out primary education was less than that of boys.

Across the districts, there are few Vocational Education Training (VET) centres (1-2). Apparently, the TPR were far about the recommended ratio of 1:40. Due to the influence of urbanization and growing population, Tunduma TC has the highest TPR of 1:91. The TSR for secondary school in the range of 1:23-34 were far less than TPR in the range of 1:54-91. Inadequate number of qualified teachers were heartedly raised as a major concern during the village PRA discussions. Rural schools suffer more from shortage of teachers than urban schools. Due to poor social services such as roads, transportation, energy, and other amenities, majority of the teachers posted to rural schools would seek transfers to relocate to urban areas.

8.4.2 Roads Sector Development

An improved roads network is one of the transformation pillars of socio-economic development in both countries. As of 2020, Tanzania had a total road network of 91,049 km of which 33,012 km were national roads, 12,786 km are categorised as trunk roads, 20,226 km as regional roads, and the remaining 58,037 km as district, urban and feeder roads. Proportion of the paved road network paved was estimated at 8.9% in 2020 – with the target of reaching 12% by 2025 (URT 2021). In 2020, Malawi had about 4,772 km of paved road networks which was about 30% of the total road network (GoM 2022[80]). The target is to bituminize 45% of the roads network by 2030 (GoM 2021) [81].

Improved roads networks facilitate marketing and trade logistics while lowering the costs of doing business and living ultimately bolstering growth and competitiveness, and welfare. Quality roads network is important in sustaining in the food systems (FS-TIP 2021) by allowing efficient food trade with reduced transportation costs. Sustaining food prices from hiking reduces inflationary pressure, hence improving macroeconomic stability.

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77 URT 2020. 2020 Tanzania in Figures. National Bureau of Statistics (NBS), Dodoma.
78 GoM 2022. Malawi Education Statistics Report. Ministry of Education. Lilongwe.
79 URT 2017. National Basic Education Statistics in Tanzania (BEST) 2012 – 2016. Ministry of Education, Science and Technology. Dodoma.
80 GoM 2022. Malawi 2022 Voluntary National Review (VNR) Report for Sustainable Development Goals (SDGs). Ministry of Finance and Economic Affairs. Lilongwe.
81 GoM 2021. Malawi 2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. NPC. Lilongwe.

At the basin level, the roads network is the major means of transportation, hence an opportunity for socio-economic development. Moreover, water navigation offers alternative means of transportation particularly in the lower-basin. Navigability of the Songwe river was recognized as a development opportunity. In the lower-basin, the river is used for cross-border transportation of people and cargo using traditional canoes for both regular passenger movements and informal cross-border trade. Currently, riverine transportation is underdeveloped and runs informally (Figure 8.4).

Figure 8.4: Informal crossing of Songwe River with traditional canoes

Photo Credit: *Online, Mwambegele*[82]

Furthermore, increasing concentration of rural motorcycle transportation services was regarded an opportunity in the upper-basin of Malawi. Both informal and formal cross-border trade was an opportunity for development reported during LPDs. Trading across the border involves both exchange of agricultural produce and manufactured goods. Tanzania mainly exports to Malawi assorted manufactured goods and crops such as onions, tomatoes, bananas, and potatoes. Malawi exports to Tanzania sugar and crops such as maize, rice and groundnuts.

At the basin level, most of the road network comprised of earth roads. As of June 2022, the five Tanzanian districts under the basin (i.e., Kyela, Ileje, Mbeya, Mbozi and Tunduma TC) had a total of 3,588.14 km of road network under TARURA of which 35.9 km (1%), 825.01 km (23%) and 2,727.21 km (76%) were paved, gravelled and earthen, respectively[83]. Of the total roads network in the five districts about 1786.6 km (49.8%) were classified to be in poor condition. The poor roads network condition corroborates the information obtained during stakeholder consultations. For Malawi, detailed data on lengths and conditions of roads were not available for a similar analysis. However, given that Tanzania is known to have relatively better roads, the situation on the Malawian side of the basin is not expected to be better either. The poor roads' conditions back the rationale of the SRBDP road construction project and improvement of rural roads in general.

[82] http://mwambegele.blogspot.com/2010/04/mto-songwe.html
[83] https://www.tarura.go.tz/#/trr/council-roads

8.4.3 Energy Sector Development

The energy sector is the powerhouse of economic growth, industrialization and modernity. In Tanzania, the households connected to electricity are estimated at 39.9%, and the target is to increase to 60% by 2025 (URT 2021). In Malawi, about 11.4% of the population have access to electricity from the national grid, with the target of increasing it to 24% by 2026 (GoM 2022[84]). In Malawi, about 6.6% of the population has access to electricity through off-grid solutions (GoM 2022[85]), and the target is to increase off-grid coverage to 42% by 2026 (GoM 2022[86]).

As of 2020, Tanzania had the capacity to generate 1,602.3 MW –with a target to generate 4,915 MW by 2025 (URT 2020[87], URT 2021). In 2020, Malawi generated 521.5 MW, with the target set at generating 1,194.5 MW by 2026 (GoM 2022). Reducing transmission losses in the national grids of the two countries is critical. The overall power loss in transmission is estimated at 16.2% and 19% for Tanzania and Malawi, respectively. Tanzania is targeting to reduce the transmission loss to 12.3% by 2026 (URT 2020). Malawi is aiming at reducing the transmission loss to 17% by 2026 (GoM 2022[88]). Given the power sector development targets in both countries, the stake is high for bolstering power generation, transmission and distribution.

Achieving sustainable and inclusive growth would require the energy mix that is affordable, accessible, reliable and sustainable. The two countries have visionary convergences in their energy sector development futures. Both are diversifying their energy mixes and are increasingly growing green and cleaner by increasing the share of renewables while minimising fossils and biomass-based energies (Figures 8.5 & 8.6). The use of biomass in Tanzania is by Independent Power Producers (IPPs) including those owning tree, sisal and sugar estates that produce woods and by-products used in energy production. The use of diesel in power generation in Tanzania was phased out in 2021. However, Tanzania is planning to introduce the use of coal (300 MW in Mbeya) by 2029 (URT 2020). While Tanzania oversees to a regional power export hub in the near future, Malawi envisions the same path in a long-run.

[84] GoM 2022. Ministry of Energy Strategic Plan (2021-2026). (Draft, still under review). Ministry of Energy. Lilongwe.
[85] GoM 2022. Malawi 2022 Voluntary National Review (VNR) Report of Sustainable Development Goals (SDGs). Ministry of Finance and Economic Affairs. Lilongwe.
[86] GoM 2022. Ministry of Energy Strategic Plan (2021-2026). (Draft, still under review). Ministry of Energy. Lilongwe.
[87] URT 2020. Power System Master Plan 2020 Update. Ministry of Energy. Dodoma.
[88] GoM 2022. Ministry of Energy Strategic Plan (2021-2026). (Draft, still under review). Ministry of Energy. Lilongwe.

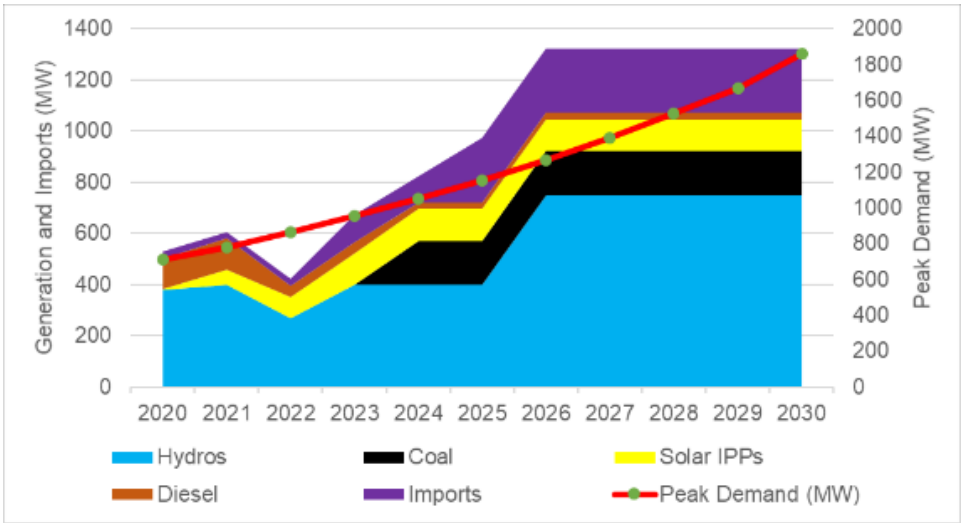

Figure 8.5: Current and Future Energy Generation Mix for Malawi

Source of plotted data: Malawi MoE, 2023

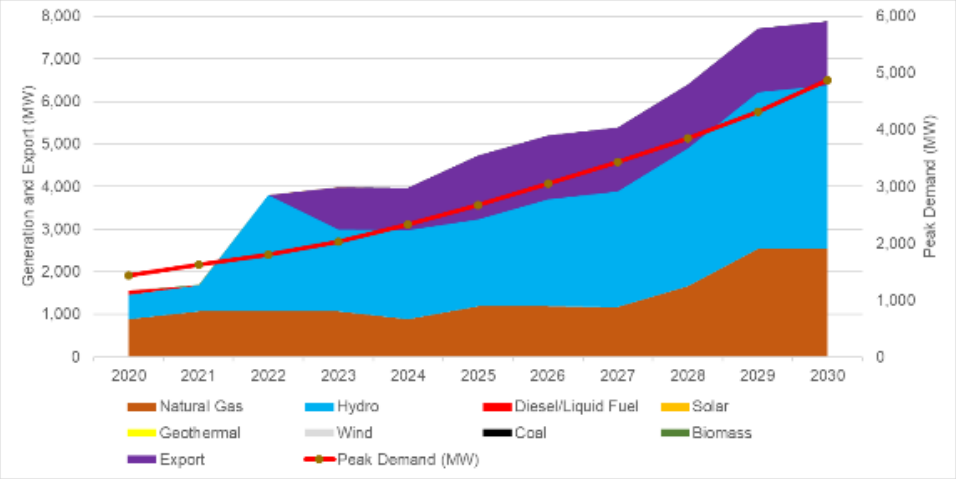

Figure 8.6: Current and Future Energy Generation Mix for Tanzania

Source of plotted data: *URT (2020*[89]*)*

Access to sustainable energies is critical in conserving the environment. In both countries, the biomass provides for over 80% of cooking energy requirement. In Tanzania, the energy access and use situation survey of 2019/20 indicates that the percentages of households using firewood, charcoal, LPG and electricity were 63.5, 26.2, 5.1 and 3.0%, respectively (URT 2020[90]). The GoT aims at reducing the dependence on biomass to below 50% by 2030 (URT 2022[91]). In Malawi, the cooking energy sources include firewood in rural areas (>90%), charcoal mainly in urban areas (> 60%) (GoM 2020[92]), while the use of electricity

[89] URT 2020. Power System Master Plan 2020 update (URT 2020), Ministry of Energy. Dodoma

[90] URT 2020. Energy Access and Use Situation in Tanzania Mainland. National Bureau of Statistics (NBS) and Rural Energy Agency (REA). Dodoma.

[91] URT 2022. Tanzania Rural Energy Master Plan (REMP). Volume 1: Main Report. Rural Energy Agency (REA) & World Bank.

[92] GoM 2020. Malawi National REDD+ Strategy. Department of Forestry. Lilongwe.

and LGP is estimated at about 2% (GoM 2018[93]). The plan in Malawi is to reduce the dependency on biomass cooking energy from 80% to 70% by 2026 (GoM 2022).

Erratic river flows and sediment load into dams affect the efficiency of hydropower generation. Deforestation and forest degradation for cooking energy is one of major sources of anthropogenic emissions. For example, Malawi has estimated degradation related emissions from fuelwood collection for the year 2016 of 2,991,058 tCO_2e ha^{-1} and was projected increase to 4,645,844 tCO_2e ha^{-1} in 2021 (GoM 2020[94]).

At the basin level, specific planning data were sought on key energy indicators from the districts. In Tanzania, the percentages of electrified villages in the basin were estimated between 76-85% (Table 8.3). In Malawi, about 6-20% of the villages in the basin were electrified. Electric energy supplied (KWh) to respective districts was 1.4 million for Kyela, 35,600 for Mbeya and 6,500 for Chitipa – equivalent to energy supply per capita of 5.1, 0.09 and 0.03 KWh, respectively.

With exception of Tunduma TC and Ileje, most of the households across the districts used firewood as a source of heating energy. In Tunduma TC majority use charcoal (85.7%) and LPG (34.8%). In Ileje district, the proportion of households using charcoal is slightly higher than those using firewood (i.e., 48 versus 43%). Significant use of charcoal in districts such as Ileje which is predominantly rural, suggests that as rural areas develop, the cooking energy transition is from firewood to charcoal. Transitioning from firewood to charcoal is not sustainable either. In Tanzania, use of LPG is becoming common in the cities, towns and rural centres.

Moreover, the use of electricity for cooking was very uncommon. Electricity is mainly used for lighting. Limited use of electricity for cooking is mainly due to limited accessibility, reliability and affordability. According to the higher-level consultations with officials at the key energy institutions in Malawi (MoE, ESCOM and MERA), the GoM is developing strategies to promote the LPG sector to increase access, safety and public awareness. Transitioning to sustainable and clean energies is necessary for sustainable management of the environmental resources in the basin.

Table 8.3: Energy Sector Key Performance Indicators

Indicator	Kyela	Karonga	Mbeya	Tunduma	Ileje	Chitipa
% of villages electrified (ESCOM/TANESCO)	85	20.3	75.65	84.5	72.2	5.6
Electric energy supplied (KWh)	1,351,188	NA	35,600	NA	NA	6,500
Population (2021 for Malawi and 2022 for Tanzania)	266,426	388,780	371,259	219,309	125,869	247,514
Electric Energy supplied per capita (KWh/person)	5.1	NA	0.09	NA	NA	0.03
% of households using firewood	70	83	65	9.3	43.3	92.2
% of households using charcoal	25	17	5	85.7	48.3	7.3
% of households using electricity for cooking	2	NA	NA	NA	NA	0.3
% of households using gas (LPG)	3	NA	30	34.8	7.3	0.2

Source: District Planning Offices, 2023. **NA** = Not Available

[93] GoM 2018. National Energy Policy. Ministry of Natural Resources, Energy and Mining. Lilongwe.
[94] GoM 2020. Malawi National REDD+ Strategy. Department of Forestry. Lilongwe.

8.5 Poverty Problem: Impacts, Drivers and Solutions

8.5.1 Impacts and Causal Chain Analysis of Poverty

The impacts of poverty as reported by the dialogues' participants are poor wellbeing and living standards, unsustainable land uses and management, and unsustainable extraction of forestry resources (Table 8.4). The better wellbeing and living standards are mainly vested in affording a living income that guarantees access to services and amenities such as decent food, housing, water and sanitation, health, education, clothing, and safety nets against unanticipated shocks.

The four major root causes of poverty underscored during the LPDs include large family size, limited knowledge and skills, dependency syndrome, and poor mindsets and laziness (Table 8.4). Given the general trends of resource pressure, large-sized families tend to be further resource-constrained with higher costs of living. The dialogues' participants felt that majority of the people particularly youths, lacked appropriate knowledge and skills in relation to the livelihood activities they are engaged in.

Majority of the people also lacked the right mindsets or were inflicted by laziness behaviour of not working hard to achieve their socio-economic development goals. In Malawi, the dialogues' participants felt that majority of the people have developed the syndrome of dependency on the government, which has killed the spirit of hard-working and self-reliance. The MW2063 has addressed the aspects of dependency syndrome and lack right mindsets by proposing actions that enhance self-reliance and positive thinking – *ndizotheka* initiative (GoM 2021[95]).

Table 8.4: Causal Chain Analysis of Poverty

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Unsustainable land uses and management	Poor wellbeing and living standard	Poor road network	Limited access to extension services	Large family size
Unsustainable extraction of resources (forestry, fisheries etc.)		Lack of irrigation infrastructure	Lack of electricity	Limited knowledge and skills
		Lack of improved varieties and breeds	Unavailability of inputs	Dependency syndrome
			Scarcity of arable land	Poor mindset/laziness
			Higher interest rates	

Source: Stakeholders' Consultations, 2023

[95] GoM 2021. MW2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC), Lilongwe.

8.5.2 Game-Changing Actions for Poverty Reduction

The potential game-changing solutions and key stakeholders in the poverty reduction initiatives are presented in Table 8.5. Poverty can have roots in the mindset and attitude hence one's path out of poverty would start from having the right mindset. However, everyone in humanity has strengths that can be harnessed to make that person attain better outcomes of his or her decisions. The local communities should be empowered through a Strength Based Approach (SBA) by strengthening their literacy, skillsets and competences. Development of strategic value chains in the key growth sectors would enhance poverty reduction. Reduced poverty and improved wellbeing would mean accessing decent diet, which requires nutrition education and food literacy. This means, it is important to promote household and community nutrition education in the basin. The key stakeholder categories pertinent for successful implementation of the actions are listed as well.

Table 8.5: Game-Changing Actions for in Crop and Livestock Sub-Sectors

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote sustainable agricultural intensification of crop and livestock systems	MDA (DAHLD, Livestock Dept, LGA, MLF, Dept of Crop Production)
2	Develop strategic agricultural value chains with high economic and social returns on investments	MDA (LGA, MoA, Dept of Crop Production)
3	Optimize green growth and circular economy opportunities in the crop and livestock commodity value chains	MDA (LGA, MoA, Dept of Crop Production, Livestock Dept, Dept of Fisheries) Local Communities (Livestock keepers, Farmers)
4	Strengthen formalized efficient of cross-border trade of crop and livestock inputs and outputs, including developing joint modern markets with state-of-the-art facilities	MDA (LGA, Immigration Dept, NFRA), Local Communities (Livestock keepers, farmers, AMCOS)

Source: SONGWECOM TDA 2023

8.6 Poverty Reduction through Key Growth Sectors

The key growth sectors that employ majority of the poor in the basin are central in poverty reduction efforts. In the SRB, the key growth sectors include: 1) crop and livestock sub-sectors, 2) forestry sector including mainly forestry and associated activities such as beekeeping and eco-tourism, and 3) fisheries subsector comprised of lake and capture fisheries, and aquaculture. However, such growth sectors face a daunting array of challenges that limit their poverty reduction potentials. Thus, it is imperative to understand the critical challenges, their drivers and effective actions for unlocking the poverty reduction potentials of the growth sectors.

8.6.1 Unlocking Poverty Reduction Potentials in Crop and Livestock Sub-sectors

The critical issues facing crop and livestock production reported by stakeholders included: 1) Low and unsustainable productivity and production, 2) Unsustainable farming practices that do not integrate ecosystem consideration, 3) Poor plant and health due to insect pests and diseases, 4) Poor animal genetics hindering livestock productivity, 5) Lack of modern livestock services infrastructure, 6) Climate change and variability, 7) Limited capacity of farmers for efficient O&M of developed irrigation schemes, and 8) Underdeveloped grain

legume seed system. The stakeholders proposed a range of solutions for addressing challenges facing the crop and livestock sub-sectors (see Annex 8a).

Moreover, the game-changing solutions and with key stakeholders for effective implementation are presented in Table 8.6. Actions with rather new transformational avenues, hence deserving an extended account include green growth and circular economy (action 3), and joint industrial investment (action 4).

Exploitation of green growth and circular economy opportunities that optimize value and create more jobs would be game-changing. Such opportunities are vested in nature-based solutions and circularity involving recycle, reuse, reduce and remanufacture (4Rs). In rice production systems technologies such as System of Rice Intensification (SRI) optimizes use of water and reduce emission. However, SRI needs assured supply of irrigation water for regular drying and wetting of the paddy fields. Rice husks that are currently burnt in the open causing emission can be utilized for value addition and optimization in the manufacturing sectors including ceramics, cementitious material (green concrete), briquetting, and boards.

There is a potential for joint industrial agro-processing infrastructure development such as co-owned modern rice mill facility. This will optimize the benefits in other projects under the SRBDP particularly the energy project and irrigated rice schemes of about 6,000 hectares that can produce an additional 30,000 tons of paddy that can be milled at the facility. Due to its agro-ecology, the lower-basin entailing both Kyela and Karonga, is renowned for producing aromatic rice that can be branded for premium export markets. For example, in 2022/23 both Karonga and Kyela districts produced around 60,000 metric tons of rice.

Table 8.6: Game-Changing Actions for in Crop and Livestock Sub-Sectors

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote sustainable agricultural intensification of crop and livestock systems	MDA (DAHLD, Livestock Dept, LGA, MLF, Dept of Crop Production)
2	Develop strategic agricultural value chains with high economic and social returns on investments	MDA (LGA, MoA, Dept of Crop Production)
3	Optimize green growth and circular economy opportunities in the crop and livestock commodity value chains	MDA (LGA, MoA, Dept of Crop Production, Livestock Dept, Dept of Fisheries) Local Communities (Livestock keepers, Farmers)
4	Strengthen formalized efficient of cross-border trade of crop and livestock inputs and outputs, including developing joint modern markets with state-of-the-art facilities	MDA (LGA, Immigration Dept, NFRA), Local Communities (Livestock keepers, farmers, AMCOS)

Source: SONGWECOM TDA 2023

8.6.2 Unlocking Poverty Reduction Potentials in Fisheries

Based on stakeholder consultations, the critical problems limiting the potential of the fisheries sub-sector address poverty in sustainable manner include: 1) Unsustainable capture fisheries, 2) Underdeveloped aquaculture, 3) Degradation of riparian watershed impacting negatively on downstream aquatic ecosystem, 4) Improper management of hazardous wastes in the riparian watersheds, 5) Underdeveloped fisheries value chains, 6) Weak local fisheries management institutions including Beach Management Units (BMUs) and Riverine

Village Committees (RVCs), and 7) Inadequate coordination of transboundary fisheries management and technical cooperation. The stakeholders proposed a range of solutions for addressing challenges facing the crop and livestock sub-sectors (see Annex 8b)

Furthermore, based on the solutions proposed by stakeholders and expert judgement a few game-changing actions are proposed as presented in Table 8.7. The second action would be an outstanding game-changer for transforming the fisheries sector in the basin. The fish value chains upgrading should among others focus on: 1) developing modern landing sites with facilities for handling, bulky cold storage, and portable water and sanitation services; 2) value addition, and 3) development of cold chain facilities such as access to refrigerated vans. Such fish value chain upgrading activities can be integrated in the joint modern Industrial Fisheries Park (IFP). The joint IFP facility would enable the two countries transform their economies through fishery resources in the shared Lake Malawi/Nyasa. Arguably, unilateral investments in the fisheries industry that depends on shared fisheries stock may fail or have limited scope of economic payoffs.

Table 8.7: Game-Changing Actions for Fisheries Sub-Sector

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote ecosystem-based fisheries development including building the capacities of the communities and technocrats	MDA (TAFIRI, LGA, Dept of Fisheries) NGO (Refresh Pact), Local Communities (BMU, BVF, Fishermen, Fish farmers)
2	Develop of fish value chains in capture fisheries and aquaculture including mega-joint investment in industrial fisheries park	MDA (TAFIRI, Dept of Fisheries) NGO (Refresh Pact) Local communities (BMU, BVF, fishermen, fish farmers)
3	Promote development of fish-based food products with social entrepreneur women and youth groups for agribusiness outreach aimed at improving community nutrition	MDA (TAFIRI, LGA, Dept of fisheries) NGO (Refresh Pact), Local Communities (Local fish traders, fishermen, fish farmers)
4	Strengthen transboundary cooperation in sustainable fisheries management	MDA (TAFIRI, LGA), Local Communities (Fish farmers)

Source: SONGWECOM TDA 2023

8.6.3 Unlocking Poverty Reduction Potentials in the Forestry Sub-sector

The major critical issues undermining the development and poverty reduction potential of the forestry sector include: 1)Deforestation and forests degradation, 2) Biodiversity degradation and loss, 3) Underdeveloped eco-tourism and beekeeping sectors, 4) Inadequate armed forestry guards for effective patrols and protection, and 5) Limited budget for employing guards, equipping and running effective forestry patrols and protection. The stakeholders proposed actions for addressing such critical issues to unlock the poverty reduction potential of the forestry sector (See Annex 8c)

The game-changing actions to unlock growth and poverty reduction potential and key stakeholders are presented in Table 8.8. The UNFCCC's CDM instrument allows companies to investment in mitigation projects in developing countries such as those involving Afforestation and Reforestation (AR). Investing companies then receive Certified Emission Reductions (CERs) or carbon credits that are traded globally through commodity exchange markets. Realization of the AR-CDM projects in developing countries such as Malawi and Tanzania have remained limited due to lack of institutional and legal frameworks

to govern the mechanisms. The administrative mechanism and operationalization of the AR-CDM have remained a challenge.

Table 8.8: Game-Changing Actions for the Forestry Sub-sector

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote tree planting, reforestation, afforestation and farmer-based natural regeneration with tailored incentives structures and M&E system	NGO (Vi Agroforestry, CADECOM/CARITAS, Synod of Livingstonia) MDA (DoF, TFS, PMO-LYED, LGA) Local communities (Chitipa Ecotourism initiative)
2	Develop forestry value chains including eco-tourism and beekeeping that are inclusive of women and youths	MDA (DoF, TFS, MNRT), Local communities (Beekeepers, Chitipa Ecotourism)
3	Strengthen forestry governance at all levels: local community, subnational, national, bilateral, regional (SADC) and International (e.g., CDM)	MDA (MNRT, DoF, TFS, LGA)

Source: SONGWECOM TDA 2023

8.7 Critical Issues, Drivers and Solutions in Key Service Sectors

8.7.1 Education Related Critical Issues, Drivers and Solutions

The critical education related problems include limited reproductive health education in formal school and vocational training centres leading to rapid increase in population growth; high number of out-of-school children and out-of-college youths; and lack of linkages between research, vocational training and extension system across the growth sectors (Table 8.9).

Higher number of out-of-school children coupled with limited enrolment capacity in vocational education and training seem to contributing to low skills and unemployment of youths. Out-of-school children and out-of-college youths include children and youths in official range of age not attending particular education level and college. As of 2022, in Malawi, 6% of children of age to go to primary school were out of school. At the junior and senior secondary school levels 16 and 34% of children were not attending schools at these levels, respectively (GoM 2022[96]). The data is critical to benchmark education for all against SDG 4.1.4 on reducing out-of-school rate. The actions proposed by stakeholders to address poverty related problems are presented in Annex. 8d.

As indicated through causal chain analysis, the major root causes of poor education included limited investment in school infrastructure and facilities, poor cooperation of parents with teachers, and poor civility and conduct of pupils and students (Table 8.9). Construction of more primary and secondary schools, and equipping the schools with necessary teaching facilities were critical measures required in both countries. The participants felt that the parents were not cooperating adequately with teachers for monitoring and managing both progress and behaviour of pupils and students. Poor civility and conduct of pupils and students were mainly associated with poor parenting. Lack of adequate number and

[96] GoM 2022. Malawi Education Factsheet|2022. Analyses for learning and equity using MICS data. Ministry of Education. Lilongwe.

qualified teachers was reported as the underlying cause of poor education. Absenteeism from schools was regarded as an immediate cause of the impacts related with poor education.

Table 8.9: Causal Chain Analysis of Poor Education

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
None directly linked to the environment	Low literacy	Absenteeism or truancy	Lack of adequate and qualified teachers	Poor civility and conduct
	Dropouts from schools			Limited investment in infrastructure and facilities
	Poor performance results			Poor cooperation of parents with teachers

Source: Stakeholders' Consultations, 2023

Furthermore, three major socio-economic impacts associated with poor education reported by stakeholders include low literacy, poor performance and increased dropouts from schools. The potential game-changing solutions to addressing poor education and the list of key stakeholders are presented in Table 8.10. The countries must develop policies, strategies and programs to ensure out-of-school children and out-of-college youths can access education and vocational training. The TVET education system is helpful in enrolling and imparting education and skills to youths. The stakeholders also suggested that the education curricula should be enriched with requisite skills needed for the fourth-generation industries through digitization.

Table 8.10: Game-Changing Actions for Addressing Poor Education

SN	Game-Changing Action	Key Stakeholder Categories
1	Formulate policies, strategies and programs to ensure out-of-school children and youths have access to education and vocational training	MDA (MoEST, LGA, PMO-LYED)
2	Re-design education curricula to incorporate the requisite skills needed for the fourth industrial revolution	MDA (VETA, NACTVET, MoEST, PMO-LYED)
3	Promote technical education and vocational training and apprenticeships in high-value labour intensive agro-processing and manufacturing sectors	MDA (VETA, NACTVET) Private Sector (Agro-processor)

Source: SONGWECOM TDA 2023

8.7.2 Poor Roads Network Related Critical Issues, Drivers and Solutions

The quality roads network plays an important role in achieving sustainable socio-economic development. In the basin context, the roads network envisages both the main and feeder roads. Poor physical accessibility was the critical problem associated with poor roads

network. The solutions proposed by stakeholders in addressing the problem associated with poor roads network include:

- Increasing public investment in the roads (incl. feeder roads)
- The local government expanding its revenue base to afford investments in roads
- Sensitising community participation in roads construction
- Close supervision of road contractors by involving local communities
- Providing quality construction services
- Providing regular road workers for continuous maintenance

The causal chain analysis indicate that limited public investment in roads construction and maintenance was the root cause underlying the problem of poor roads network (Table 8.11). The socio-economic impacts of poor roads network include poor physical accessibility, high prices of consumables that aggravate the costs of living and limited eco-tourism. Poor roads construction was the underlying cause of the poor roads network. Limited repair and maintenance of roads, and inadequate and poor feeder roads were the immediate cause of negative impacts of poor roads network.

Table 8.11: Causal Chain Analysis of Poor Roads

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
None was directly linked to the environment	Poor physical accessibility	Poor road repair and maintenance	Substandard constructed roads	Limited public investment
	High prices of consumables	Inadequate and poor feeder roads		
	Limited eco-tourism			

Source: Stakeholders' Consultations, 2023

Moreover, the stakeholders identified three socio-economic development impacts associated with poor roads network to be poor physical accessibility, high prices of consumable merchandises and underdeveloped eco-tourism sector due to poor accessibility. The suggested game-changing actions to address the problems associated with poor roads and key stakeholders to be engaged with in the implementation are presented in Table 8.12.

Table 8.12: Game-Changing Actions for Addressing Poor Roads Network

SN	Game-Changing Action	Key Stakeholder Categories
1	Fast-tracking the completion of on-stop border customs post on Malawian side	MDA (Immigration Dept, TRA, MRA)
2	Upgrading district and rural feeder roads network	MDA (TARURA, LGA)
3	Develop robust roads repair and maintenance system including involvement of local communities in rural roads governance	MDA (TARURA, LGA, RA)
4	Increase roads financing through adequately financed road funds, PPP arrangements, concessional loans, and funding by development partners	Dev Partners (AfDB, GEF), MDA (TARURA, LGA, RA)

Source: SONGWECOM TDA 2023

8.7.3 Unsustainable Energy Related Critical Issues, Drivers and Solutions

Feedbacks from stakeholder consultations underpinned three major socio-economic impacts associated with unsustainable cooking energy: deforestation, loss of habitats for beekeeping and overharvesting of some trees (e.g., *Nguti* and *Mtondo*) that are best for charcoal. As the demand for charcoal remains high, tree species targeted for producing quality charcoal are potentially pushed to the blink of extinction. The actions proposed by stakeholders for addressing unsustainable energy related challenges are presented in Annex 8e.

Furthermore, the causal chain of the unsustainable energy problem is rooted in population growth (Table 8.13). The underlying and immediate causes identified include: high demand for woodfuel; limited supply, affordability and reliability of electricity; lack of energy-efficient technology including improved cookstoves; and lack of affordable alternative sustainable energies such as LGP and biogas.

Table 8.13: Causal Chain Analysis of Unsustainable Energy

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
Deforestation	None directly linked to socio-economic but they do exist such as health risk of unclean energy	Lack of efficient energy technologies	High demand for firewood and charcoal	Population growth
Loss of habitats for beekeeping		Lack of affordable alternative energies	Limited supply of electricity	
Overharvesting of some tree species for good charcoal (e.g. *Nguti* and *Mtondo*)				

Source: Stakeholders' Consultations, 2023

Potential game-changing solutions to unsustainable energy related problems were suggested by stakeholders (Table 8.14). presents four actions that potentially standout as game-changing solutions setting pathways to sustainable energy futures. Conserving the environment would require making alternative sustainable clean energies available, accessible and reliable. Scaling up availability and affordability of LPG would substitute the use of wood fuel particularly charcoal in the urban areas. Reliable and affordable electricity in rural and urban areas is critical to increase the use of electricity as the source of cooking energy.

Other alternative cooking energy such as biogas would require R&D interventions to develop low-cost biogas plants. However, hydropower generation will remain a major source in the energy mixes of the two countries, this urges for effective management of the riparian watersheds to assure quality and quantity of water flows into the hydro-power dams. As still a sizeable rural population is not yet electrified, intensifying rural electrification initiative is critical. Opportunities for carbon trade in the energy sector must be explored as can help to finance the sustainable energy sector.

Table 8.14: Game-Changing Actions and Stakeholders for Addressing Unsustainable Energy

SN	Game-Changing Action	Key Stakeholder Categories
1	Make alternative sustainable clean energies available, accessible, affordable and reliable	NGO (Choose Water, Self-help Africa, Vi-Agroforest), MDA (MoE, ESCOM, TANESCO, EWURA, MERA)
2	Promote integrated management of catchments supplying water for hydropower generation (watersheds)	MDA (NRWA, Lake Nyasa Water Board, DoF, NEMC)
3	Intensify rural electrification programs	MDA (REA, ESCOM, MERA, EWURA)
4	Explore carbon trade opportunities in the energy sector	NGO (Choose Water) Local Communities (Tree Crop farmers, Timber farmers)

Source: SONGWECOM TDA 2023

8.7.4 Youth Bulge Related Critical Issues, Drivers and Solutions

Currently, in both Tanzania and Malawi, the youth bulge is rather a challenge as it is yet adequately harnessed as a demographic dividend. In cognizance of this reality, the two governments are increasingly promoting youth-centric development transformations. Likewise, the SRBDP should strengthen the focus on youth for sustainable development in the basin. Youth bulge related critical issues identified by stakeholders include: 1) High population growth, 2) High youth unemployment, 3) Limited access to productive resources such as land and financial capital, and 4) Disinterest of youth to engage in agriculture. The stakeholders also proposed a number of solutions to address these challenges (see Annex 8f).

The causal analysis indicates the negative socio-economic impacts related with youth bulge as a problem rather than a demographic dividend to include: youth unemployment, drunkardness and substance use specifically marijuana (Table 8.15). The major root causes of youth bulge as a problem rather than a demographic dividend include lack of civic education and poor parenting. Pedagogically, civics education is part of the curricula of primary and secondary schools in both countries. A range of issues can be integrated into

the civics course including issues of ecological civilization. However, the feedback from the local public dialogues underpins that youths not adequately civic-educated. Furthermore, underlying causes include lack of access to land among youths, lack of right mindsets and lack of appropriate skillsets.

Table 8.15: Causal Chain Analysis of Youth Bulge Problem

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Cause
None was directly linked to the environment	Youth unemployment	Lack of rural job opportunities	Scarcity of land to youths	Lack of civic education
	Alcoholism/drunkardness		Lack of right mindsets	Poor parenting
	Substance use (marijuana)		Lack of skills	

Source: Stakeholders' Consultations, 2023

The game-changing actions for addressing problems associated with youth bulge and harnessing it a demographic dividend are presented in Table 8.16. Promoting life skills education at different levels of formal and vocational training will shape the innovativeness and creativity of youths in their life courses. Intensive hands-on technical education and vocational training will improve the practical skillsets and competences in lucrative sectors such as manufacturing and services. Decent job opportunities in the key growth sectors will attract entry of youths.

Given the affinity of youths to ICT, an integration of digital technologies can influence the participation of youths in the sectors. Engagement of youths in sustainability programs and projects will make them develop interest in sustainable management of the environment. Arguably, harnessing youth bulge as a 'demographic dividend' would require transforming youths to have the right mindsets, upgrading their skillsets and granting them secured means production and trade including land, capital and profitable markets.

Table 8.16: Game-Changing Actions for Addressing Youth Bulge Problem

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote life skills education at different levels is important to prepare the youth towards self-identification, vision setting and rational decision making	MDAs (PMO-LYED, VETA, LGA) NGO (TGNP, Refresh Pact)
2	Promote intensive technical and vocational education and training	MDAs (PMO-LYED, VETA, LGA)
3	Promote decent jobs for youths in agriculture, livestock, fisheries and forestry sectors	MDAs (PMO-LYED, LGA,) Local communities (BMU, BVF, farmers, fishermen), NGO (Refresh Pact, Vi Agroforest, Self-help Africa)
4	Engage youths in environmental sustainability programs	MDAs responsible for Agriculture, Fisheries, Forestry, LGAs, SONGWECOM

Source: SONGWECOM TDA 2023

8.8 Mainstreaming Socio-Economic Development Enablers

The pathways to sustainable socio-economic development through key growth and service sectors, will be supported by an array of enablers. The key enablers considered for mainstreaming include – gender, Research and Development (R&D) and Information and Communication Technology (ICT).

8.8.1 Mainstreaming of Gender Related Issues

Two gender related critical issues raised by the stakeholders include the broad issue of gender inequality and less empowerment of girls and women, and relatively high dropouts of girls from schools mainly due to poverty and early pregnancies.

In order give girls access to education, both Tanzania and Malawi have re-admission policy involving post-pregnancy re-integrating student mothers into schooling. However, not all adolescent mothers reintegrate back into schools after giving birth, this means majority will remain in the community as single parents taking care of themselves and their children, and more likely than not socially stigmatized. This means, socially-constructed gender inequality and discrimination still exists in many local societies.

In Tanzania, annual adolescent birth rate of teenagers aged 15-19 years was estimated at 112 births in 2022 (URT 2023[97]). In Malawi, the adolescent annual birth rate of was 136 births in 2020 (GoM 2021[98]). This means, there is a significant number of adolescent mothers in the communities that require improved skillsets and economic empowerment.

8.8.2 Mainstreaming of ICT/Digitalization and R&D

The critical issues in digitalization and R&D reported by stakeholders included: 1) inadequate digitalization of the growth and service sectors with apparent gendered digital divide, and 2) Limited budgetary support for R&D in different growth sectors. Digitization of various growth sector is still limited with a digital divide against women. For example, in Tanzania, proportion of women owning mobile phone was 9-percent points behind that of men in 2019 – that is 77% versus 86%. And only 17% of women had internet access compare to 35% of men[99]. Therefore, addressing gendered digital divide is pertinent in advancing inclusive digital revolution. And both countries are investing less than 1% of their GDPs in R&D.

8.8.3 Game-Changing Actions for Mainstreaming of Key Enablers

A number of strategic actions that would potentially make a difference in advancing enablers of sustainable development are proposed (Table 8.17). It would be a game-changing step to scale-up the use of Science, Technology and Innovation (STI) within an advancing ICT in the planning, implementation and M&E of environmental management actions in the basin. Addressing gendered digital divide will be critical to ensure access to ICT and digital technologies is inclusive. In this era of evidence-based planning and digitization, there is a need for the two countries to strengthen technical cooperation in R&D and digitization for efficient management of shared natural resources.

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[97] URT 2023. Demographic and Health Survey and Malaria Indicator Survey. Key Indicators. Ministry of Health. Dar es salaam

[98] GoM 2021. Multiple indicator cluster survey 2019-2020. National Statistical Office. Lilongwe.

[99] https://www.unesco.org/en/articles/adolescent-girls-and-young-women-tanzania-expand-digital-literacy-and-skills

Table 8.17: Game-Changing Actions for Mainstreaming Enablers

SN	Game-Changing Action	Key Stakeholder Categories
1	Promote the use of Science, Technology and Innovation (STI) within the ICT environment in the planning, implementation, and M&E of actions	MDA (PMO-LYED, LGA), NGO (Synod of Livingstonia, CADECOM/CARITAS)
2	Address gendered digital divide against women and girls	MDA (PMO-LYED, LGA) NGO (TGNP)
3	Strengthen technical cooperation in R&D and digitization for efficient transboundary management of the shared resources	MDA (MoEST, PMO-LYED, LGA)

Source: SONGWECOM TDA 2023

PART NINE

GOVERNANCE ANALYSIS

9.0 An Overview

The part covers a range of governance issues at global, regional and national levels organized around nine sections namely: 1) Policy, Institutional and Legal Frameworks for Sustainable Development, 2) Governance Frameworks for Sustainable Management of Key Natural Resources, 3) Governance Frameworks for Sustainable Development in Key Growth Sectors, 4) National Governance Frameworks for Poverty Reduction, 5) Governance Frameworks for Addressing Youth Bulge, 6) National Governance Frameworks for Development of Key Service Sectors Poverty, 7) Governance Framework for Climate Change Actions, 8) Governance Frameworks for Sustainable Development Enablers, and 9) Inadequate Governance Related Impacts, Drivers, and Game-Changing Solutions. Furthermore, respective sections address the implications of the governance frameworks on sustainable management of the shared natural resources in the basin.

9.1 Policy, Institutional and Legal Frameworks for Sustainable Development

The governance for sustainable development covers issues related with sustainable development policy landscape, environmental frameworks, institutional arrangements and implications of such governance frameworks on the joint management of the shared natural resources for achieving sustainable and inclusive socio-economic development.

9.1.1 Policy Landscape for Sustainable Development

The key governance frameworks for sustainable development at global, regional and national levels are presented in Table 9.1. The UN's 2030 Agenda entailing 17 Sustainable Development Goals (SDGs) succeeded the Millennium Development Goals (MDGs) that ended in 2015. All 17 SDGs[100] are relevant to the SRBDP. The two countries as part of the global community are pursuing development policies, plans, strategies and projects to achieve the SDGs (URT 2022[101], GoM 2017[102]).

The two countries are also the part of the AU's Agenda 2063 that was adopted in 2015. Under this pan-African agenda, the aspirations relevant to the SRBDP include: 1) Sustainable natural resource management and biodiversity conservation; 2) Sustainable consumption and production patterns; 3) Water security; 4) Climate resilience and natural disasters preparedness and prevention; and 5) Renewable energy.

In both Tanzania and Malawi, the national development visions – Tanzania Development Vision 2025 (TDV 2025) and Malawi Vision (MW2063) – align with the global and regional

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[100] SDG1 – No poverty, SDG2 – Zero hunger; SDG3 – Good health and well-being; SDG4 – Quality education; SDG5 – Gender equality; SDG6 – Clean water and sanitation; SDG7 – Affordable and clean energy; SDG8 Decent work and economic growth; SDG9 – Industry, innovation and infrastructure; SDG10 – Reduced inequalities; SGD11 – Sustainable cities and communities; SDG12 – Responsible consumption and production; SDG13 – Climate action; SDG14 – Life below water; SDG15 – Life on land; SDG16 – Peace, justice, and strong institutions; and SDG17 – Partnerships.

[101] URT, 2022 High Level Political Forum on SDGs

[102] GoM (2017). Statement by Honourable Cecilia E. Chazama, Minister of Civic Education, Culture and Community Development on Progress on Implementation of Sustainable Development Goals in Malawi at High Level Political Forum on Sustainable Development 1 IH - 19th July 2017 ' New York, USA on UN 2030.

sustainable development agendas. The national visions observe sustainable management of natural resources being critical to achieve the desired economic transformation of the strategic growth and service sectors.

Table 9.1: Higher-Level Sustainable Development Visions for the two countries

Governance Level	Agreement/Convention	Provisions Relevant for SRBDP
Global	UN Agenda 2030 (2015)	All 17 Goals
Regional	AU Agenda 2063 (2015)	Inclusive and sustainable development, centric on empowerment of women and youth
	African Convention on the Conservation of Nature and Natural Resources (1969)	Promote the unity, solidarity, cohesion and cooperation among the peoples of Africa and African States
	Southern African Development Community (SADC) Vision 2050 (2021)	The Pillars: 1) Industrial development and market integration, 2) Infrastructure development, 3) Social and human capital development Enablers: 1) Gender, 2) Youth, 3) Environmental and Climate Change, and 4) Disaster Risk Management
	SADC Green Economy Strategy and Action Plan for Sustainable Development (2015)	A new planning paradigm based on the Green Economy (GE) approach pivotal at addressing regional and national issues including transboundary ones. Aims s to catalyse the socio-economic transformation of the SADC Region towards a resource efficient, environmentally sustainable, climate-change resilient, low-carbon development path and equitable society.
	SADC Regional Indicative Strategic Development Plan (RISDP) 2020–2030	Addresses social, economic, political, and governance issues in the region underpinned by peace and security
	SADC Water Energy and Food Nexus (2020)	Aims to support the transformation required to meet increasing water, energy and food security demand in a context of climate change and growing population.
	East Africa Community (EAC) (1999)	Sustainable development in the region Committed to making every effort to ensure the effective implementation of Multilateral Environmental Agreements (MEAs) signed and ratified by the EAC Partner States Provides useful lessons to the established SONGWECOM through Lake Tanganyika Authority (LTA), Lake Victoria Basin Commission (LVBC) and the Nile Basin Initiative
Bilateral	SONGWECOM Convention (2017) Shared Vision 2025 Songwe River Basin Development Programme (SRBDP)	The Convention offers the legal framework for advancing the Shared Development Vision 2050 through SRBDP to attain sustainable and inclusive economic growth, reduced poverty, improved health and living conditions of communities, while reducing the adverse impacts associated with floods and changing River course of the shared Songwe River
National	Tanzania Vision 2025 (1999)	Envisions Tanzania "a developed, semi-industrialized economy, people-centred, peaceful, stable and united society with a high-quality livelihood and a high level of human development by 2025". Long-Term Perspective Plan (LTPP) of 2011/12-2025/26 for realizing the TDV2025 through three five-year development plans (FYDPs) Third 5-Year Development Plan (2020/21-2025/26)
	Malawi Vison 2063 (2020)	Envisions Malawi "a wealthy and self-reliant industrialized 'upper middle-income country' by the year 2063". First 10-Year Implementation Plan (MP-1) 2021-2030

Source: SONGWECOM TDA 2023

9.1.2 Environmental Governance Frameworks for Sustainable Development

The 1992 'Earth Summit' in Rio de Janeiro, which resulted in Agenda 21, played a significant role in promoting sustainable development and environmental conservation. Agenda 21 focused on preserving natural resources, combating deforestation, protecting biodiversity, and controlling pollution. It also spurred the creation of other global environmental initiatives like the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, and the Declaration on Forest Management Principles. Both Malawi and Tanzania adopted and ratified Agenda 21 along with subsequent conventions.

Building upon Agenda 21, the African Union developed the Climate Change and Resilient Development Strategy and Action Plan (2022-2032) to support Africa's Agenda 2063 and enhance regional cooperation on climate change. Its main objective is to bolster the resilience of African communities, ecosystems, and economies while planning for a low-emission future. At the regional level, the Southern African Development Community (SADC) Region formulated the SADC Climate Change Strategy and Action Plan (CCSAP) to coordinate climate change actions, with a focus on adaptation measures in sectors like agriculture, water, biodiversity, energy, tourism, and human health. Both Malawi and Tanzania have established national governance frameworks (Table 9.2) to address environmental challenges such as land degradation, deforestation, pollution, and water quality concerns, contributing to their commitment to sustainable natural resource management.

Table 9.2: National Environmental Governance Frameworks

Country	Governance Frameworks	Provisions Relevant for SRBDP
Tanzania	National Environmental Policy (NEP), 2021	Sustainable management of the natural and environmental resources for ensuring environmental integrity, food security, poverty alleviation and economic growth.
	National Environmental Master Plan for Strategic Interventions (NEMPSI) (2022 – 2032)	Underscored environmental problems including new contemporary environmental challenges on the rise such as deterioration of coastal and marine ecosystem; wetland deterioration; inadequate waste management; urban environmental challenges; biofuels, genetically modified organisms (GMOs), Invasive Alien Species (IAS); and inadequate environmental governance.
	Environmental Management Act (EMA), No. 20 of 2004	Provides both legal and institutional framework for the sustainable management of the environment, mainstreaming of environmental issues into national development frameworks, sectoral policies, and local government plans; environmental quality standards, public participation, environmental compliance and enforcement.
Malawi	National Environmental Policy (NEP) of 1996 and revised in 2004	Provides an overall framework for the sectoral policies to be consistent with the principles of sound environmental management and sustainable development.
	National Environmental Action Plan (NEAP) of 1994	Identifies environmental problems as major drivers of poverty, such problems include: soil erosion, deforestation, water resources degradation, threats to fish resources and biodiversity, and climate change.
	The Malawi Environment Management Act (MEMA), 2017 (No. 19 of 2017)	Makes provisions for the protection and management of the environmental and natural resources, environmental standards, biological (genetic) resources; and addresses climate change, capacity building and skills development on environmental issues.

9.1.3 Institutional Arrangements for Sustainable Development

The development policies are coordinated through the sector Ministries, Departments and Agencies (MDAs). Different development sectors constitute different line Ministries. The

institutional structures, powers and functions MDAs are stipulated in the constitution. However, the institutional and administrative set-ups are vested in the Presidency. The two countries have devolved the governance of development to the Local Governments with Local Government Authorities (LGAs) under the auspices the Ministry responsible for Local Government. The sector policies, strategies and plans are implemented through legal instruments. The Constitution is the supreme law. In the constitution, the sustainable development is vested in the provisions addressing environmental issues. The constitutions of the two countries addresses the issues of environment.

9.1.4 Challenges in Sustainable Governance Frameworks and implications for Cooperation in the Basin

Generally, the national sustainable development governance frameworks have not delivered expected outcomes, particularly on shared environmental resources due to a number of factors including:

i. Inadequate coordination among sectors in managing environment;
ii. Low public awareness and knowledge on environmental management;
iii. Inadequate land use planning at various administrative levels;
iv. Inadequate enforcement and compliance of various legislation related to environmental management;
v. Overdependence on woodfuel as the source of heating energy amidst of inadequate, inaccessible, unaffordable and unreliable alternative energies, hence causing deforestation which is the major feature of environmental degradation;
vi. Increased encroachment of water sources;
vii. Limited capacity in terms of human, financial, infrastructure, technology, and tools;
viii. Inadequate research, data and information on environmental issues; and
ix. Inadequate regional cooperation and coordination for sustainable management of shared natural and environmental resources.

Such governance challenges have to be addressed for to ensure the shared environmental resources in the basin are sustainably managed to achieve sustainable and inclusive socio-economic development. The SONGWECOM Convention, the Shared Vision 2050 and the SRBDP as the vehicles for realization of joint sustainable development vision align with national visions toward sustainable and inclusive development.

9.2 Governance Frameworks for Sustainable Management of Key Natural Resources

The focus of the TDA synthesis report is focused on the national level governance frameworks, the gaps and implications on sustainable management of the shared natural resources in the basin. The detailed coverage of global and regional governance frameworks to which the national frameworks are mostly aligned are addressed the governance thematic report (SONGWECOM 2023f). The key natural resources in the shared basin include land, water, wetland and biodiversity. The forestry and fisheries resources are covered as growth sectors.

9.2.1 National Land Governance Frameworks

9.2.1.1 National Land Governance Frameworks in Malawi

The Malawi National Land Policy of 2002 provides the guidance for development and administration of land. The policy also addresses the land tenure system under three jurisdictions – public, private and customary systems. The goal of the policy is to ensure tenure security and equitable access to land, to facilitate the attainment of social harmony and broad based social and economic development through optimum and ecologically

balanced use of land and land-based resources. The policy has the following specific objectives:

i. To promote tenure reforms that guarantee security and instil confidence and fairness in all land transactions;
ii. To promote decentralized and transparent land administration;
iii. To extend land use planning strategies to all urban and rural areas;
iv. To establish a modern land registration system for delivering land services to all;
v. To enhance conservation and community management of local resources; and
vi. To promote research and capacity building in land surveying and land management.

The Land Act, No. 16 of 2016 (revised in 2022) is a crucial legal instrument for implementing land policies in Malawi. This act covers various aspects related to customary land, private land, and public land, as well as outlining the powers of the Minister in regard to these types of land. Additionally, the Land Laws (Amendment) Act of 2016 introduced amendments to the Land Act of 2012, the Land Registration Act of 2012, and the National Land Commission Act of 2012. These legal frameworks collectively govern land rights, land registration, and land management in the country.

The Customary Land Act (CLA) is particularly noteworthy as it enables smallholder farmers to convert their customary land rights into private land rights with registered titles. This transition provides landholders with increased tenure security, which is expected to encourage greater investment in land improvements and development.

Malawi's land administration operates within this legislative framework, aiming to ensure the sustainable management of land resources. The Commissioner for Lands plays a pivotal role in land administration, with responsibilities including the administration of all land, granting leases and dispositions, and managing agreements or licenses related to water use and rights. The Minister has the authority to delegate specific functions to the Commissioner, either through general or special directions.

9.2.1.2 National Land Governance Frameworks in Tanzania

The Tanzania's National Land Policy of 1995 avails the development policy direction for land management and administration. Among the key objectives of the land policy is to protect land resources from degradation and manage it sustainably. The policy statements address the following areas, among others: 1) Protection of sensitive areas, 2) Village land demarcation, 3) Managing unplanned settlements, 4) Village land use planning, 5) Managing conflict in land uses, and 6) Protection of fragile and sensitive lands.

The Land Act No. 4 of 1999 and the Village Land Act No.5 of 1999 are the centrepiece of the legal framework for land management and administration. The Land Act No. 4 of 1999 as amended in 2004 forms the principal Act guiding land matters in the country. The current Acts declare that all land in the country is public land divided into Village Land, Reserved Land and General Land which is neither of the former two major land forms. The legislation also recognizes as another form of land called hazardous land – that poses danger if developed such as lands 60 meters from rivers, wetlands and fragile steep slopes.

Another important piece of land legislation is the Land Use Planning Act, Act No. 6 of 2007. The Act provides procedures for the preparation, administration and enforcement of land use plans. The Act sets out matters to be included in all land use plans (also relating to water and forest resources) and sets out requirements of environmental protection (URT, 2007). The Act identified the authorities to be involved in land use planning – (i) a village council; (ii) a district council; (iii) the National Land Use Commission; and (iv) any such

body or organ which the Minister may, by order published in the Gazette, declare to be a planning authority.

9.2.1.3 Implications of National Frameworks on Land Governance in the Basin

Arguably, though land is place-fixed, the effects on how the resource is managed are transboundary. Land degradation and unsustainable farming practices in the riparian agro-landscape contribute to siltation and eutrophication of waters downstream. The land governance frameworks provide avenues for sustainable management of the land resources in the basin. Land use planning is the foundation of sustainable land management. Most of the villages in the basin have not yet developed their land use plans which undermines effective land management strategies. Scaled-up land use planning remains the stepping stone for the SRBDP sustainable land management strategies.

9.2.2 National Water Governance Frameworks

9.2.2.1 National Water Governance Frameworks in Malawi

Water resources are at the heart of Malawi's development agenda for 2063. They are crucial for the growth of key sectors like agriculture, livestock, and industrial manufacturing, as well as for improving public health, modernizing cities, and boosting tourism. Ensuring a stable supply of high-quality water is essential not only for these sectors but also for maintaining the health of ecosystems, biodiversity, and the overall environment. To address these priorities, the Malawian government has developed and implemented various policies, strategies, and plans aimed at sustainably managing water resources.The National Sanitation Policy of 2008 is one such initiative, with the goal of ensuring that all Malawians have access to improved sanitation facilities, practice safe hygiene, and participate in environmentally sustainable liquid and solid waste recycling for socio-economic development.

In terms of water governance, the Ministry of Water and Sanitation (MoWS) takes the lead in providing water supply and sanitation services. However, multiple agencies also play regulatory roles in this sector. While MoWS focuses on regulating Malawi's five parastatal water boards, the Water Services Association of Malawi (WASAMA)[103] carries out essential regulatory functions, including water quality audits and performance benchmarking of these boards. Other agencies involved in regulation include the Ministry of Health (MoH), the Ministry of Local Government (MoLG), local government authorities, the National Water Resources Authority, the Environmental Protection Agency (EPA), and more. Malawi is currently in the process of reforming its regulatory framework and is considering establishing a dedicated water supply services regulator.

The Water Resources Act of 2013 governs the management, conservation, use, and control of water resources, along with the acquisition and regulation of water rights and charges. Additionally, the Local Government Act of 1998 empowers District Assemblies to provide water and sanitation services to consumers at reasonable costs and to negotiate terms with

[103] WASAMA is an association of WASH practitioners and organisations. It is not a formal regulator but plays an important benchmarking and reporting role, especially for water supply services delivered by Malawi's five parastatal water boards

water undertakings or authorities for the supply of water to various outlets and facilities. This approach devolves water management to District Assemblies, Traditional Authorities, user groups, and local communities, facilitating community involvement in addressing water-related issues.

The major challenges facing the Malawian water sector are highlighted in the Malawi's National Water Policy of 2023 including:

i. Water catchment degradation;
ii. Deteriorating water quality;
iii. Inadequate water services coverage;
iv. Inadequate financing;
v. Increasing water demands across different sectors;
vi. Lack of integrated approach to water resources management;
vii. Climate change and variability;
viii. Lack of mitigation measures for extreme water-related disasters.

9.2.2.2 National Water Governance Frameworks in Tanzania

Water resource is pertinent in realizing the sustainable development. The importance of water resource spans a range spectrum of development spheres entailing WASH, transformation of growth sectors, energy, and health of the terrestrial and aquatic ecosystems. In this context, Tanzania has developed and implemented a range of water related policies, strategies, plans and legislations.

The National Water Policy (NAWAPO) of 2002 guides the development of the water sector. The policy upholds the IWRM principles and advocates devolution of responsibility for water resources to River/Lake Basins and catchment management entities with active participation of local government and community-based organizations (URT, 2002). The Policy also guides on how to cooperate with other countries in managing transboundary waters.

The legal framework under which the management of water resources in the country operates is contained in the two pieces of water legislation namely; the Water Resources Management Act (WARMA), No. 11 of 2009 and the Water Supply and Sanitation Act (WASSA), No. 5 of 2019. The legislations provide mandates for various water governance institutions. WASSA establishes the Rural Water Supply and Sanitation Agency (RUWASA) and the National Water Fund. It further provides a clear division of responsibilities among the Ministry of Water, WSSA, and EWURA. EWURA under the EWURA Act, Cap. 414 in 2001, and become operational in 2006. Apart from Water and Sanitation, EWURA also regulates the energy sector, to ensure that the delivery of energy and water utilities is effective, efficient, meets quality standards and affordable.

In Tanzania, the water and sanitation sector are under the purview of the Ministry of Water (MoW), which is responsible for overall strategy, policy direction, and resource mobilisation. It relies on other ministries, departments, and agencies (MDAs), as well as regional and district- and community-level institutions to deliver on water resource management and water supply services. The main regulatory structure for Tanzania's water supply and sanitation (WSS) services is regulation by agency, implemented through the Energy and Water Utilities Regulatory Authority (EWURA). New institutions have been created comprising of the National Water Board, Basin Water Boards, Catchment Water Committees, and Water Users Associations (WUA) and District Facilitation Teams.

Coordination of transboundary water activities in Tanzania are vested under Transboundary Section in the Water Resources Division of the Ministry of Water.

Despite a number of water and other government reforms that have been made in Tanzania some water governance related issues deserve attention and these revolve around the following:

i) Erratic flow of funds or underfunding of planned government projects;
ii) Inadequate regulations to monitor groundwater resources development causing water underutilization and or over utilization in some areas;
iii) Presence of weak water governance structures and institutions that cannot influence water users' behaviour;
iv) Inadequacies in the capacity of the water basin governance structures to monitor water quality;
v) Inadequacies in internal capacity for effective management, development and utilisation of transboundary water resources underpinned by with insufficient knowledge and skills amongst water resources management staff; and
vi) Neglect of the role of informal institutions (e.g., culture and value systems) in water governance –referring to the activities of a particular institution related to the facilitation of decision making and implementation of policies.

9.2.2.3 Implications of National Frameworks on Water Governance in the Basin

The global, regional, bilateral and individual partner states' water frameworks provide enabling policy, institutional and regulatory environment for joint governance of transboundary waters in shared basins. Extending governance scope of shared waters by embracing the ecosystem-based approach would be a way of bringing in other water related natural resources in the watersheds.

Importantly, the two countries have ratified a Convention that enabled establishment of the joint SONGWECOM in 2017. The Convention is underpinned by the General Co-operation Agreement between Tanzania and Malawi 1991 (enforce) and Memorandum of Understanding between Tanzania and Malawi for the Implementation of Phase III of Songwe River Basin Development Programme (SRBDP), 2017. The General Co-operation Agreement between Tanzania and Malawi 1991, among others, provided the basis for a feasibility study to stabilise the course of the Songwe River. Given the centrality of water resource as a fulcrum of joint cooperation, it is imperative to explore critical challenges that need to be addressed for effective governance of shared waters in the basin:

- Weak institutional governance for managing transboundary water resources systems of the basin (including institutional arrangements, to monitor, regulate and provide advisory services; and rudimentary transboundary coordination and management);
- Lack of formalised mechanisms for stakeholder engagement, promoting gender equality and community involvement in decision making;
- Inadequate long funding mechanisms for the SONGWECOM and the SRBDP;
- Insufficient institutional capacity, inadequate enforcement of regulations, and insufficient capacity to implement the environmental regulations on land use and water management;
- Inadequate measures for the control of pollution; and
- Lack of public awareness.

9.2.3 National Wetlands Governance Frameworks

9.2.3.1 National Wetlands Governance Frameworks in Malawi

Malawi's wetlands are managed in line with the Ramsar Convention on Wetlands and other relevant global, regional and country specific frameworks like the CBD, SADC Biodiversity Action Plan and NBSAP. The NBSAP II (2015-2025) outlines the status of the biological resources in Malawi and provides strategies, targets and actions to be taken to ensure their sustainable management. In Malawi, the Elephant Marsh, situated in the lower Shire Valley, is designated as a Ramsar site. This site is closely associated with the Songwe River, which flows into Lake Malawi/Nyasa and ultimately feeds into the Shire River. Additionally, Lake Chilwa, located in the southern region of Malawi, is another Ramsar site. Various policies in the country are relevant to the utilization of wetlands, including the National Water Policy, National Forest Policy, National Environment Policy, and National Agricultural Policy. Nevertheless, stakeholders have expressed a strong need for a specific policy framework to provide guidance for the management and development of wetlands.

9.2.3.2 National Wetlands Governance Frameworks in Tanzania

Tanzania is highly concerned with management of wetland hence its full commitment to ensure that are effectively conserved. Despite their importance, the extent of degradation is alarming due to use of destructive fishing methods, beach erosion and excessive sedimentation caused by deforestation and overgrazing of catchment areas. Given the lack of specific policy on wetlands, the Government was compelled to put in place Guidelines for Sustainable Management of Wetlands (URT, 2014) supported by sector specific policies such as National Agriculture Policy (2013), National Environment Policy (2021), Fisheries policy (1998) and National Water Policy (2002). The Guidelines are supported by the Environmental Management Act (2004) Section 56, Subsection (5) which states that "The Minister in consultation with other sector ministries may make regulations and guidelines on sustainable management of wetlands protected under this Act".

9.2.3.3 Implications of National Frameworks on Wetlands Governance in the Basin

Wetlands are important for many ecosystem services, such as fisheries, agriculture, livestock grazing, eco-tourism, water supply, water purification, carbon sequestration, wildlife goods, natural products, biodiversity, recreation, and transport. The benefit of wetlands for reducing poverty depends on the effectiveness of governance systems that influence peoples' behaviour in the wise use of wetlands. Both riparian countries do not have specific policy on wetlands but make use sector specific policies guided by the Ramsar Convention (1971) and national guidelines. Given the inadequacies of the existing policy and legal frameworks; and the increasing pressure on wetlands due to rising pressures from population growth, poverty, overexploitation, changing climate and agricultural conversion as is the case in the SRB, there is need for both riparian countries to come up an ecologically sound framework for managing the wetlands.

9.2.4 National Biodiversity Governance Frameworks

9.2.4.1 National Biodiversity Governance Frameworks in Malawi

In Malawi, ratification of the CBD provided a springboard for launching of the National Environmental Action Plan (2004) and National Biodiversity Strategy and Action Plan (NBSAP) II 2015-2025 (GoM 2006). The Strategy strives to attain improved capacity and knowledge on biodiversity management; increased mainstreaming of biodiversity in sectoral and local interventions. The development goal of the NBSSAP is to enhance the

management of biodiversity for economic growth and well-being of the present and future generations.

In the context of legal framework, the Cartagena Protocol motivated the Government of Malawi to establish the National biosafety framework and to enact the Biosafety laws and regulations (Biosafety Act No. 13 of 2002 and the Biosafety Regulations of 2007). Ratification of the CBD paved way for the review of Forestry Act, National Parks and Wildlife Act and Fisheries Act; and establishment of the Environmental Act and institutions such as Malawi Biodiversity Committee; and National Committees for GEF, IUCN, MAB, CITES and RAMSAR.

9.2.4.2 National Biodiversity Governance Frameworks in Tanzania

Following ratification of the CBD as per requirements of Article 6 of the Convention, Tanzania formulated her first National Biodiversity Strategy and Action Plan (NBSAP) in 2001. This was later followed by the NBSAP 2015-2020 that sought to address national biodiversity targets based on the national priorities that contribute to the global targets. Tanzania has taken a number of measures including development and implementation of strategies for conservation of biodiversity. However, the degradation and loss of biodiversity resources have persisted.

Accordingly, Tanzania formulated different Acts and Regulations and establishment of institutions and agencies mandated to manage biodiversity. Some of the institutions that were established by Act of Parliament were such as Tanzania Forestry Research Institute (TAFORI) (Act No. 5 of 1980), the Tanzania Fisheries Research Institute (TAFIRI) (Act No. 6 of 980, and repealed by Act No.11 of 2016; and the Tanzania Wildlife Research Institute (TAWIRI) (Act No. 4 of 1980).

9.2.4.3 Implications of National Frameworks on Biodiversity Governance in the Basin

The respective Tanzanian and Malawian NBSAPs provide an avenue for achieving long term goals on conservation and sustainable use of biodiversity in accordance with the specific country's Constitution, National Environmental Policy and Environment Management Act and other national and sectoral policies, plans and strategies. Despite these initiatives, the challenges facing biodiversity conservation in both countries and in particular in the SRB are enormous hovered around habitat loss and degradation, deforestation, pollution, overexploitation and illegal resource extraction, wildfires, human population growth, among others. The existing challenges reflect the inherent weaknesses that should be strategically and tactically addressed by SONGWECOM if the SRBDP is to be effectively implemented. This requires strengthening institutions and working very closely with communities throughout to devise readily acceptable solutions.

9.3 Governance Frameworks for Sustainable Development in Key Growth Sectors

The sustainable and inclusive socio-economic development in the two countries is mainly dependent on the transformation of the key growth and service sectors. In the context of the shared SRB, the key growth sectors include: 1) crop agriculture, 2) livestock, and 3) mining. The fishery and forestry growth sectors, and ecology-based subsectors such as beekeeping and eco-tourism are already covered as part of the ecosystem and biodiversity. Education, roads network and energy were the priority service sectors in the basin. Moreover, the youth bulge was identified as the socio-economic development challenge in the basin and country levels.

9.3.1 Governance Frameworks for Agriculture Development

9.3.1.1 National Governance Frameworks for Agriculture Development in Malawi

Malawi's agricultural development policies and strategic frameworks are rooted in global and regional agricultural governance frameworks, along with emerging issues at various levels. The National Agriculture Policy (NAP) of 2016 serves as a guiding document that envisions the development of the agricultural sector. It aims to increase farm household incomes, enhance food and nutrition security, and promote the sustainable use of natural resources. The NAP aligns with the Agriculture Sector Wide Approach (ASWAp) and addresses sector-specific challenges, including low agricultural productivity, vulnerability to weather shocks, limited irrigation, weak farmer organizations, inadequate quality control, information asymmetry in markets, and inefficient land, water, and soil management.

The policy also emphasizes the previously neglected areas of livestock and fisheries, as well as issues related to environmental degradation and climate change, all of which have relevance to the Songwe River Basin (SRB). NAP takes into consideration key sub-sectoral and cross-sectoral policies such as the National Land Use Planning and Management Policy (2005), the Agriculture Sector Food and Nutrition Strategy (ASFNS) 2020-2024, the National Gender Policy (2015), National Youth Policy (2013), National Irrigation Policy (2016), and the National Climate Change Management Policy (2016).

The NAP holds significance for the SRBDP, as it provides insights into critical areas essential for achieving the program's objectives, such as improving food and nutrition security through irrigated agriculture and integrated natural resource management. However, it's crucial to acknowledge that despite government initiatives to develop various policies and strategies to enhance the sector's performance, implementation has remained a major challenge. This is often due to issues in the conceptualization, development, and design of policies and strategies, as well as enforcement of related laws, such as the Agriculture (General Purposes) Act of 1987 and the Special Crops Act. Addressing these challenges is essential for effective policy implementation and the success of agricultural development initiatives.

9.3.1.2 National Governance Frameworks for Agriculture Development in Tanzania

In Tanzania, agricultural development policies and strategies are framed within the National Agriculture Policy (NAP) of 2013, which primarily focuses on the crop subsector. The NAP aims to transition from subsistence farming to commercialization and modernization by intensifying crop production, diversifying crops, adopting technology, and enhancing infrastructure. This aligns with national and international development agendas, including the Tanzania Development Vision 2025 and the UN 2030 Agenda for Sustainable Development.

The NAP recognizes key challenges within the crop subsector, such as low productivity, land tenure issues, crop pests, diseases, and environmental degradation, all of which have relevance to the Songwe River Basin (SRB).

A major concern highlighted by the policy is the need for a favorable land tenure system to attract investments in agriculture. However, the existing system faces challenges related to

inadequate enforcement of land laws, land conflicts, delays in issuing title deeds, and the absence of detailed land use plans at district and village levels. These issues emphasize the importance of implementing sustainable agricultural practices in the SRB.

The NAP is implemented through the Agricultural Sector Development Strategy Phase II (2016) and the Agricultural Sector Development Programme Phase II. This approach aligns with various agricultural development initiatives, such as the Comprehensive Africa Agriculture Development Programme (CAADP) and the Tanzania Agriculture and Food Security Investment Plan (TAFSIP 2011). Additionally, the NAP is supported by other policies and related laws in areas like livestock, marketing, irrigation, and the environment.

The Agricultural Sector Development Programme Phase II (ASDP II) encompasses multiple subsectors, including crops, livestock, and fisheries. It operates as a long-term process with a Sector Wide Approach (SWAp), connecting district planning processes, mobilization of agricultural investments, and monitoring. At the local government level, the ASDP II is implemented through District Agricultural Development Plans (DADPs) in line with the Decentralization Policy, promoting agricultural development at the grassroots level.

A succinct assessment of the governance frameworks on crop agriculture for both countries indicates that there have been tendencies of developing and or reviewing existing policies and instituting legal reforms without putting in place robust mechanisms for enhancing their implementation and/or strengthening the enforcement. It is argued that the situation has been aggravated by:

i. Lack of appropriate mechanisms for enhancing effective coordination within the crop agricultural sector and amongst the Agricultural Sector Lead Ministries;
ii. Existence of a number of inconsistent and non-coherent policies (including plans and strategies) in the agricultural sector that are not consistent with each other (e.g., NAP and Health policies in Tanzania);
iii. Inadequate access by smallholder farmers/livestock keepers/fisherfolks to improved productivity-enhancing technologies and services, including unresponsive research and extension linkages and services, involving ineffective mode of extension services; weak research-extension-farmer linkages; and deficient demand-driven research;
iv. Persistence of land tenure insecurity, inequitable land access, and increasing land/natural resource conflicts arising from competition between farmers and livestock keepers/pastoralists; among other interested parties;
v. Poor rural market infrastructure, including inadequate access to markets by smallholder farmers/producers/ processors/traders, compounded by weak regulatory and market linkages;
vi. Existence of multiple regulations in the agricultural sector under different regulatory bodies/ agencies such as TFDA, TBS, and TPHPA resulting in increased or high operational and transaction costs making the business environment hostile or unfriendly to investors
vii. Lack of effective mechanisms for enforcing the environmental regulatory framework; and
viii. Uncalled for political interference.

9.3.1.3 Implication of Governance Frameworks on Crop Production in the Basin

The critical issues raised above have far reaching implications for effective implementation of the irrigated agriculture and food security components of the SRBDP and the overall realization of its 2050 Vision. Hence, SONGWECOM and its strategic partners should work very closely with the leadership of respective sectors of both countries in an attempt to resolve a number if not all of the issues raised above.

9.3.2 Governance Frameworks for Livestock Development

9.3.2.1 National Governance Framework for Livestock Development in Malawi

The National Livestock Development Policy (2021-2026) is consistent with CAADP and other regional frameworks. It is also aligned with the Malawi 2063, which emphasises wealth creation and contributes to the National Agriculture Policy. The policy focuses on transforming the livestock sector towards farmer-led agricultural commercialization to achieve sustainable growth of the sector, nutrition security and increased livestock exports (GoM, 2021). The policy aims to address inherent livestock challenges such as: (i) livestock diseases and parasites, (ii) increasing human population, (iii) reduced public sector funding, (iv) minimal involvement of the private sector and NGOs, (v) low generation of technologies and innovations in livestock value chains, (vi) poor management practices and (vii) lack of commercialization among livestock farmers.

Among other relevant policies like the 2016 National Irrigation Policy and the Land Resources Management Policy and Strategy (2000), the policy is further informed by provisions of the National Land Policy (2002) which recognizes the competing land uses between livestock, crops, and other national investments. This calls for improved management and proper land use (GoM, 2021). The National Livestock Development policy is supported by such laws as: Control and Diseases of Animals Act (1967 and amendments made in 2017); and the Meat and the Meat Products Act, 1975. The Control and Diseases of Animals Act makes provision for measures to prevent the spreading of diseases affecting animals in Malawi; while the Meat and the Meat Products Act provides for the improvement and control of the production, processing, manufacture, grading, sale, marketing and distribution of meat, and meat products and for other related matters.

9.3.2.2 National Governance Framework for Livestock Development in Tanzania

The national governance frameworks for the development of the livestock sector revolve around policies, strategies, programmes, initiatives and relevant laws all aiming at addressing the existing challenges while striving to transform the livestock industry. The National Livestock Policy (2006) is operationalized through the Livestock Development Strategy (2010) and the Livestock Sector Development Programme of 2011, while attempting to transform the livestock sector from its current status to a modern one with potential for a progressive livestock sector which is economically, socially and environmentally sustainable (URT, 2011). The policy is aligned with the TDV 2025 and other policies listed under the crops agriculture governance frameworks; and supported by the Tanzania Livestock Master Plan (TLMP) (2017/2018 – 2021/2022). The TLMP provides the roadmap for implementing the above frameworks and sets out livestock-sector investment interventions on improved genetics, feed and water resources, health services, huge investment on industry and factory, private sector investment and business environment. Effective implementation of the above policy and strategic frameworks is to be achieved by the enforcement of existing laws such as the Grazing-land and Animal Feed Resources Act,

2010 (No. 13 of 2010), Animal Diseases Act, 2003 (No. 17 of 2003), Livestock Identification, Registration and Traceability Act No.12 of 2010, Dairy Industry Act (Act No. 8 of 2004) and Meat Industry Act, 2006 (No. 10 of 2006).

9.3.2.3 Implications of Governance Framework on Livestock Development in the Basin

Given the importance of livestock to the people in the riparian districts in terms of food and nutrition security, manure, income, animal traction and social security, the SRBDP needs to complement Government initiatives by promoting livestock alongside crop agricultural interventions in its areas of jurisdiction. This will require SONGWECOM to work closely with relevant central and local government authorities of both riparian countries in an attempt to address typical livestock related challenges in the SRB such as trans-boundary animal diseases, feed and water resources and degradation of grazing lands. The SRBDP and its projects hovered around strengthening of livestock keepers' groups and Irrigator and/or Water User Associations will have to be empowered in line with the respective countries' cooperative development Policies and legal framework to effective implementation of such interventions.

9.3.3 Governance Frameworks for Fisheries Development

9.3.3.1 National Governance Frameworks for Fisheries Development in Malawi

The Malawian fishery sector development is guided by the National Fisheries and Aquaculture Policy of 2016 (GoM 2016c). The goal of the policy is to promote sustainable fisheries resource utilization and aquaculture development with the aim of contributing to "food and nutrition security and economic growth of the country. The fishery sector has not contributed to economy at the extent of it potential. The sector is facing many challenges including unsustainable fishing, overfishing, climate change and degradation aquatic ecosystems due to pollution including nutrients enrichment leading to eutrophication of Lake Malawi/Nyasa.

Despite the fact that fish provides about 60% of animal protein uptake in Malawi and is a source of employment for many Malawians (GoM, 2021a), the fish population is declining rapidly due to climate change as well as non-climate factors such as rapid population growth, resulting in unsustainable levels of fish harvesting. Hence, institutional strengthening and capacity building of the Department of Fisheries and other stakeholders in the sector, in particular fishing communities is essential including development of adequate human resources and skills to restore fish population and enhance pond and cage fish farming in the country. The legal framework governing the Malawian Fishery sector is based on the Fisheries Act (cap 66.05) of 1949, revised in 1965, 1973 and 1997 (GoM 1997[104]). The Act spells out among other issues the fishery administration, local participation in fishery management and cross-border fishery cooperation. The Act therefore, offers the mechanism for transboundary sustainable fishery management.

[104] GoM 1997. Fisheries Conservation and Management Act, No. 25, 1997. Lilongwe.

9.3.3.2 National Fishery Governance Frameworks in Tanzania

In Tanzania, the fishery sector is governed by the Fisheries Policy of 2015 (URT, 2015a[105]). The policy vows to develop a robust, competitive and efficient fisheries sector that contributes to food and nutrition security, growth of the national economy and improvement of the wellbeing of fisheries stakeholders while conserving environment. Specifically, the policy intends to ensure effective management and sustainability of fisheries resources and aquatic environment, while promoting investment in fisheries and aquaculture infrastructure. The policy underscores the importance of regional and international cooperation particularly in transboundary waters. The fishery regulatory framework is governed by the Fisheries Act, No. 22 of 2003 (URT 2003)[106] which makes provision for sustainable development, protection, conservation and regulation and control of fish, among other things.

9.3.3.3 Implications of Governance Frameworks on Fisheries Development in the Basin

Apart from the SADC fishery protocol, there is no binding bilateral agreement specifically setting out governance mechanisms for sustainable fishery in basin. During higher-level consultations, stakeholders urged for cooperation in fishery management extended to Lake Malawi/Nyasa beyond the Songwe River as the two waters form inseparable aquatic ecosystem. Some fish species in the Lake ascend to estuaries of the Songwe River for breeding. Also, unsustainable land uses and management of the riparian watershed in the basin affects the health of the aquatic ecosystem and biodiversity downstream in the Lake. Generally, the fishery governance frameworks would be generally supporting of sustainable fishery initiatives in the basin. However, a number of governance challenges in the national fishery governance framework need to be addressed. The major governance challenges particularly for transboundary sustainable management of fishery resources in the two countries include:

i. Environmental degradation enhanced by intensification of human activities particularly farming in the riparian watersheds leading to siltation and eutrophication of waters downstream;
ii. Budgetary constraints limiting investment in sustainable fishery management at the local level;
iii. Inadequate development of capture fishery and aquaculture value chains, including key infrastructure such as landing sites for proper handling and cold chain; and
iv. Inadequate bilateral cooperation for effective mechanisms of planning and enforcing sustainable fishery management in the shared waters.

9.3.4 National Governance Framework for Forestry Development

9.3.4.1 National Governance Frameworks for Forestry Development in Malawi

The development of the forestry sector in Malawi is vested in the National Forest Policy of 2016 which underscores the major challenge to be deforestation and forest degradation

[105] URT (2015a). National Fisheries Policy

[106] URT (2003). Fisheries Act, 2003 (No. 22 of 2003)

(GoM 2016d)[107]. The annual deforestation rate is estimated at 2.8% equivalent to annual average loss of 250,000 hectares of forest cover. The direct drivers of deforestation include agricultural expansion; human settlement; uncontrolled bush fires; and unsustainable harvesting of woodfuel for energy. Thus, the policy advocates for sustainable development of the forestry sector to increase its contribution to the economy while conserving forestry resources.

The wildlife, beekeeping and eco-tourism subsectors are interrelated with the forestry sector mainly through provision of ecological habitats, biodiversity and aesthetics. Protected forestry areas provide wildlife sanctuaries, habitats for biodiversity including bees, and aesthetics for eco-tourism. Relevant policies for such subsectors include:

i. Wildlife Policy of 2018 (GoM 2018)[108] – among others, promotes participatory and joint management of wildlife with local communities including sharing of benefits;
ii. Beekeeping or apiculture within the agricultural policy context is one of the industries that is being promoted in the rural areas around natural forest reserves and large mountains to improve off farm incomes and employment in keeping with the MW 2063. Beekeeping is a traditional part time occupation practiced throughout the country by the rural people is in line with the SRBDP initiatives; and
iii. National Tourism Policy of 2019 – aiming at *inter alia* creating an enabling environment for the development, regulation, and promotion of a sustainable tourism sector for improving the socio-economic well-being.

Moreover, key national strategies have been devised in the course of sustainable forestry management including National Forest Landscape Restoration Strategy (NFLRS) of 2017 and the National Charcoal Strategy (NCS) 2017-2027. The intended breakthrough stipulated in the NFLRS is to achieve the restoration commitment of 4.5 million hectares by 2030. The NCS envisions curbing deforestation through comprehensive actions for sustainable and efficient energies in order to address the demand-pull factors of deforestation.

In Malawi, the Forestry Act, No. 5C of 1997 amended in 2019 offers the institutional frameworks for sustainable forestry management. The key amendment with relevance to the SRBDP include the provision for collaborative forestry conservation arrangements including sustainable commercial extraction and utilization of the resource between the central government, local government, private sector and local communities.

National Parks and Wildlife (Amendment) Act, No. 11 of 2017 makes relevant provisions regarding wildlife impact assessments, protected species, endangered species or list species. The Monuments and Relics Act of 1991 has a provision for the preservation and protection of places of distinctive natural beauty and of sites, archaeological, historical and heritage sites. These are critical for eco-tourism which is among proposed projects under the SRBDP.

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[107] GoM (2016d). National Forest Policy. Lilongwe. Malawi

[108]

the SRBDP include the provision for collaborative forestry conservation arrangements including sustainable commercial extraction and utilization of the resource between the central government, local government, private sector and local communities.

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9.3.4.2 National Governance Frameworks for Forestry Development in Tanzania

The Tanzania's National Forest Policy of 1998 is aimed at enhancing the contribution of forest sector to sustainable development through conservation and management of forestry resources (1998a). In 2010, Tanzania had about 24.7 million hectares of natural forests covering about 26% of its land area. In 2021, the deforestation rate was estimated at 165,000 hectares per year, which is estimated to an equivalent of equivalent to 59.9Mt of CO_2 emissions (GFW, 2021[109]). Deforestation is caused by clearing forest for agriculture, overgrazing, bushfires, charcoal burning and over-exploitation of wood resources. Some of the key specific objectives of the policy relevant to the SRBDP include the following: (i) to ensure sustainable supply of forest products and services by maintaining sufficient forest areas under effective management; and to ensure ecosystem sustainability through conservation of forest biodiversity, water catchments and soil fertility.

The policies for other forestry related sub-sectors include:

i. Wildlife Policy of 1998 (revised in 2007) calls for better management of the protected estate, sustainable use of wildlife resources, and devolution of wildlife user rights to communities and sharing of benefits derived from wildlife uses and resources;
ii. Beekeeping Policy of 1998 implemented through National Beekeeping Implementation Strategy (2021-2031) strives to promote management of bee and bee fodder resources for sustainable socio-economic development and enhanced environmental conservation; and
iii. The National Tourism Policy of 1999 seeks to promote the economy and livelihood of the people, essentially poverty alleviation, through encouraging the development of sustainable and quality tourism that is culturally and socially acceptable, ecologically friendly, environmentally sustainable and economically viable.

The Tanzania Forest Act No. 14 of 2002 addresses critical issues such as licencing, governance of forest reserves, private forest, sensitive forest and environmental impact assessment of projects implemented in forest reserves. The Wildlife Conservation Act No. 5 of 2009 asserts a provision for management and conservation of biodiversity and wildlife. It underpins that any wild and indigenous animals and plants, and their constituent habitats and ecosystems found on or in land or water, and provides for establishment and management of protected areas in mainland Tanzania. It also provides rules relative to trade in wildlife products and to breeding of wildlife.

[109] Tanzania Deforestation Rates & Statistics | GFW

The Tanzania's Beekeeping Act, 2002 (Act No. 15 of 2002) provides for the orderly conduct of beekeeping and for the improvement of products of beekeeping. In principle, it aims at promoting and enhancing the contribution of the beekeeping sector to the sustainable development of Tanzania and the conservation and management of her natural resources for the benefit of present and future generations. On the other hand, the Tourism Act, 2008 (No. 29 of 2008) provides for institutional framework, administration, regulation, registration and licensing of tourism facilities and activities; and for related matters. The Act requires the promotion of ecotourism, cultural tourism and other forms of tourism that provide better sectoral linkages, create employment, support conservation of natural resources and foster sustainable development.

9.3.4.3 Implications of Governance Frameworks on Forestry Development in the Basin

The forestry policies of the two countries do not explicitly lay frameworks for joint management shared forestry ecosystem such as carrying out joint surveillance and patrols. Also, joint efforts to crackdown cross-border charcoal trafficking are still inadequate. Wildlife subsector faces challenges including competition with other forms of land use, conflicts between, private investors and local communities, endangerment of some wild species and lack of policy for sustainable management of wetlands. Forestry, wildlife, beekeeping and eco-tourism are areas that need to be revisited for devising joint cooperation for effective governance.

9.3.5 National Governance Frameworks for Mining Sector Development

9.3.5.1 National Governance Frameworks for Mining Sector Development in Malawi

Malawi is one of the countries whose economy has for a long period been dependent on agriculture with tobacco as the main export commodity. However, the anti-smoking lobby affected Malawi's economy base; and effective from 2004, government policy instruments focused on economic diversification and mining was identified as a potential sector for economic growth. The Malawi's Mines and Minerals Policy of 2013 strives to enhance the contribution of mineral resources to the national economy so as to move from being agro-based to mineral based economy. The Policy seeks to stimulate and guide private mining investment by administering, regulating and facilitating the growth of the sector through a well-organized and efficient institutional framework (GoM, 2013).

The Mines and Minerals Policy provides for artisanal and small-scale mining (ASM) including women miners and its significance to economic growth and poverty reduction. The Policy, however, fails to outline the legal, financial, commercial, technological and human resources challenges faced by ASMs. Additionally, despite the pivotal role of the mining industry to the national economy, CEPA (2014) observes that the policy does not adequately address governance issues and fails to provide mechanisms for enhancing capacity, accountability or transparency in decision-making in view of a decentralized governance framework. It is contended that the policy needs to articulate the levels of decision making for resource utilization and management including setting guidelines for appropriate taxation regimes. It is important that these issues are taken care of by both the policy and legislation while mandating specific institutions that can deliver these and provide for coordination between training and research institutions on one hand and the mining institution on the other hand.

In order to enhance effective implementation of the Mines and Minerals Policy, the Mines and Minerals Act (MMA), of 2023 repealing the Mines and Minerals Act of 2019 has been put in place incorporating provisions for the establishment of an independent regulatory

authority of the mining and mineral resources (GoM, 2023a). According to this Act, the regulatory authority will be responsible for, among other things, granting of mining licenses, inspection of mining activities and advising the Minister on policy matters of the mining sector. The MMA is further regulated by the subsidiary legislations such as: the Mines and Minerals (Disputes) Regulations; the Mines and Minerals (Miscellaneous Fees) Regulations; the Mines and Minerals (Claims) Regulations; the Mining (Safety) Regulations; the Mines and Minerals (Non-Exclusive Prospecting License) Regulations.

9.3.5.2 National Framework for Mining Sector Development in Tanzania

Mining and quarrying activities are one of the key contributing growth sectors to the national economy. During 2016 to 2019, the growth of mining sector averaged 8 percent and its contribution to GDP increased from 4.6 percent in 2015/16 to 5.9 percent in 2019/20 (URT, 2021b)[110]. Additionally, it is one of the sectors that remains attractive to investors, given the next few years of significant diversification to the mining of nickel, uranium and coal (URT, 2021)[111]. The sector comprises small- and large-scale operations. Given its nature and the need to carry out sustainable mining with the intent of reducing negative environmental, social and governance impacts of mining operations, sound governance frameworks are essential. The National Mineral Policy of 2009 aims at strengthening integration of the mineral sector with other sectors of the economy; improving the legal and regulatory environment; and strengthening capacity for administration of the mineral sector. The policy objectives relevant to SRBDP are as follows:

i. To strengthen cooperation with the regional and international bodies to take advantages of facilities, resources and information provided by the organisations;
ii. To promote safety and maintain hygiene conditions and protect the environment in mining areas; and
iii. To encourage and promote women's participation in mining activities and strengthen enforcement of laws and regulations against child labour in mining activities.

As much as the Government has taken steps to improve and formalise the sector, small-scale miners still face many challenges, including difficulty in obtaining mining land and licences; inadequate support to improve skills and protection of the environment; limited access to tools and technology; and difficulty in accessing markets (UNEP/IIED, 2018). Implementation of the National Mineral policy is supported by the Mining Act, 2019 and the Natural Wealth and Resources (Permanent Sovereign) Act No.12 of 2022. The 2019 Act regulates all forms of rock, stones, gravel, sand, clay, volcanic ash or cinder, or other minerals being used for the construction of buildings, roads, dams, aerodromes, or similar works. The Act also makes provisions on grant, tenure, terms and conditions, renewal and termination of mineral rights, payment of various taxes, fees, duties, royalties and other applicable charges. The relevance of the Act to the SRBDP relates to the sourcing of mineral

[110] URT (2021b). The National Five-Year Development Plan Phase III (2021/22-2025/26). MoF

[111]

materials especially stones, aggregates and sand for dam, irrigation schemes, and hydro-power plant construction. Hence, this calls for paying due attention to the law of the land.

9.3.5.3 Implications of Governance Framework on the Mining Sector in the Basin

Within the Songwe River Basin a number of mining activities are being carried out by different types of businesses including the artisanal miners which the SRBDP needs to be aware of. Sand mining in rivers and lake beaches is widespread, unsustainable and locally unregulated. Given high and increasing demand for sand and aggregates due to a growing construction sector, governance of sand mining needs a serious consideration. Even the SRBDP's infrastructural projects – the dams, irrigation canals, roads and hydropower plants that would claim substantial amount of sand and aggregate.

9.4 National Governance Frameworks for Poverty Reduction

9.4.1 National Governance Frameworks for Poverty Reduction in Malawi

Poverty reduction and ultimate eradication of the same remains the focus of the development efforts in Malawi. Malawi has made Little to No Progress on the SDG 1 aimed at ending poverty as underscored in the 2022 VNR. Other SDGs that Malawi made Little of No Progress include Goal 10 for Reducing Inequalities and Goal 15 addressing Life on Land. Limited progress in the reduction of extreme poverty was attributed mainly to poor performance of the agriculture sector which is the major source of income for majority of Malawian population. The proportion of Malawian population below the international poverty line of US$ 1.9 per person per day increased from 17.4% in 2015 to 73.5% in 2019 (GoM 2022[112]). The national poverty rate was 50.8% in 2020 and has been around this magnitude over the past decade (IFAD 2022[113]). Major interventions under Goal 1 included: 1) National Social Support Programmes aimed at reducing hunger, improving school enrolment for ultra-poor and labour constrained households and credit provision; and 2) Rolling out the Affordable Inputs Program (AIP) aimed at increasing agricultural production for increased household incomes.

The development policies, strategies, plans, programmes and projects are mainly preoccupied with the thrust of reducing and finally eradicating poverty. Currently, the MW2063 and its first 10-year implementation plan is the development framework targeting wealth creation among other development targets. In Malawi, the institutional arrangements for poverty reduction under the auspices of SDGs involve institutions across governance levels from village to district and to national planning scales, and to the global SDGs. The planning outputs include: 1) Village Action Plan, 2) District Development Plan, 3) Sector Plans and Strategies, 4) National Level Medium-Term Plan (e.g., MIP-1), 5) National Development Vision (MW2063), and 6) SGDs. Non-state stakeholders in poverty reduction vested in SDG 1 include development partners, NGOs and the private sector.

The Constitution of Malawi published in 1994 with Amendments in 2017 recognized the 'right to development' to enjoy economic, social, cultural and political development. The Constitution promotes inclusive 'rights to development' with special attention to women, children and persons with disability. A myriad of legislations supporting poverty reduction

[112] GoM 2022. Malawi 2022 Voluntary National Review Report for Sustainable Development Goas (SDGs). Lilongwe.
[113] IFAD 2022. Republic of Malawi, Country Strategic Opportunities Programme 2023-2030. Rome.

initiatives are vested in respective growth and service sectors, and governance of the environment.

9.4.2 National Governance Frameworks for Poverty Reduction in Tanzania

In Tanzania, poverty reduction rate has been marginal. Between 2017 and 2019 the poverty incidence decreased from 26.4 to 26.1 (URT 2019[114], AfDB 2023). In 2020, the poverty rate increased to 27.7%, mainly due to COVID-19 pandemic related economic downturn (AfDB 2023). However, as the economy has been recovering from the impacts of the pandemic, the poverty rate is estimated to have fallen marginally to 27.0% in 2021 (World Bank 2022[115]).

Thus, reduction and finally eradication of poverty constitutes the focal target of most development policies, strategies, plans, programmes and projects. The TDV 2025 and its third 5-year Development Plan offer the direction for delivery of poverty reduction and other SDGs in general. Under the auspices of local government reforms, the Community Planning Process (CPP) which is part of the Community Development Process (CDP) starts from the level of the Village/*Mtaa* in which people have to participate in analysing their felt problems and felt needs. Needs analysis is carried out by the communities themselves through the improved Opportunities and Obstacles to Development (O&OD) bottom-up participatory methodology. The Tanzanian Constitution which is the Supreme Law of the Land, urges the state authority and all its agencies to direct their policies and programmes towards ensuring, *inter alia*:

i. That national economy is planned and promoted in a balanced and integrated manner;
ii. That every person who is able to work does work, and work means any legitimate activity by which a person earns a living; and
iii. That the use of national wealth places emphasis on the development of the people and in particular is geared towards the eradication of poverty, ignorance and disease.

Such supreme constitutional provisions set legislative grounds for inclusive economic development and poverty reduction.

9.4.3 Implications of Governance Frameworks on Poverty Reduction in the Basin

The two governments are concerned with higher poverty rates and growing inequality. Such common ground offers a window of opportunity of cooperation for reduction and eradication of poverty. Thus, the development projects under the SRBDP fit well in the national poverty reduction efforts that are also aligned to global and regional development initiatives. Optimal poverty reduction outcomes and impacts would require strategic alignment from planning to implementation, monitoring and evaluation, of the SRBDP and projects by the government and other development stakeholders in the basin.

[114] URT 2019. Voluntary National Review (VNR) 2019. Dodoma.
[115] World Bank 2022. Empowering Women, Expanding Access to Assets and Economic Opportunities. Tanzania Economic Updata. Washington DC.

9.5 Governance Frameworks for Addressing Youth Bulge

The governance issues related with youth bulge are covered at global, regional and national level as there were not addressed in the governance thematic report submitted (SONGWECOM 2023f)[116].

9.5.1.1 Global and Regional Governance Framework for Addressing Youth Bulge

The African continent is characterized by a youthful population and a rapid population growth. While its population had reached 1.2 billion in 2015, is projected to reach 3.1 billion by 2063 (UNFPA, 2017)[117]. The United Nations 2017 World Population Prospects reveal that about 60% of Africa's population is under 25 years, and given relatively high fertility rates compared to other regions, the population under 25 is expected to keep rising for the coming decades from 721 million in 2015 to 1.4 billion by 2063 (UN, 2017). With the exception of a few countries, most countries in Sub-Saharan Africa (SSA) are in the early stages of their demographic transition; and are characterized by high fertility rates and young populations.

These young African populations are also characterized by high youth dependency rates, exposing the region to higher poverty rates, lower labour productivity, high unemployment or underemployment, and the risk of political instability. SSA is the youngest of all regions of the world (with median age of 17.6 years), making it a region that can benefit the most from a demographic dividend provided necessary policy actions are taken now (Simelane, 2023). African Union Agenda 2063 demonstrates that:

> "*In the next 50 years Africa's biggest single asset but also its potential Achilles heel will be its youthful population. The upside risk of the youth population is their contribution to economic growth resulting in increased incomes and employment. The downside risk is the inability to provide gainful employment for them thus creating a potential source of instability.*" (Agenda 2063, First Ten-Year Implementation Plan 2014–2023, p. 127).

Studies indicate that most countries in Africa will enter the window of opportunity for harnessing a demographic dividend between 2040 and 2050 (UN, 2013) making it a promising development agenda for the region. The intent for harnessing a demographic dividend is in line with existing development agendas, including the International Conference on Population and Development Programme of Action (ICPD-PoA, 1994), the UN 2030 agenda for sustainable development, and Africa's agenda 2063. In respect to UN 2030 Agenda, for example, four goals – SDG 3 (good health and wellbeing); SDG 4 (inclusive and equitable quality education and lifelong learning opportunities for all); SDG 5 (gender equality); and SDG 8 (decent employment and economic growth) demonstrate the requirements for the demographic and gender dividends (Simelane, 2023).

African Union first committed itself to the demographic dividend agenda in 2013 during their regional conference on the International Conference on Population and Development (UNFPA, 2017; Simelane, 2023). The ICPD was followed by a resolution to develop

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[116] SONGWECOM (2023f). Part Nine: Governance Analysis

[117] UNFPA, 2017. The Demographic Dividend Atlas for Africa: Tracking the Potential for a Demographic Dividend

demographic dividend profiles and the AU Roadmap on Harnessing the demographic Dividend through Investments in Youth in 2017 (UNFPA, 2017). The AU roadmap identified four pillars for harnessing a demographic dividend as follows: (i)Employment and entrepreneurship; (ii) education and skills development; (iii) health and wellbeing; and (iv) rights, governance and youth empowerment.

The above global and regional frameworks for harnessing the youth bulge are further supported by the Universal Declaration of Human Rights (UDHR) (UN, 1948), ILO Minimum Age Convention (1973), Convention on the Rights of the Child (CRC, 1989), African Youth Charter (2006). African Youth Decade Plan of Action (2009-2018) and SADC Youth Protocols.

9.5.1.2 National Governance Frameworks for Addressing Youth Bulge in Malawi

While there is no universally accepted definition of youth, the Government of Malawi defines youth as individuals aged between 10 and 35 years, which differs from the definitions used by international organizations like the UN and AU. The country is experiencing a significant youth bulge, with 51% of its 17.6 million population being under 18 years old. This demographic dividend, if effectively harnessed, could contribute significantly to Malawi's development goals. The National Youth Policy (2013) provides the overarching policy framework to create an enabling environment for youth to contribute to national development.

Malawi's Vision 2063 (MW2063), aligned with global and regional agendas like the UN 2030 Agenda, AU Agenda 2063, and SADC Protocols, focuses on youth-centric strategies for inclusive wealth creation and self-reliance by 2063. The National Youth Council Act (1996) established the National Youth Council of Malawi (NYCOM) to promote, coordinate, and implement youth development programs. This legal framework is complemented by other legislation such as the Vocational, Entrepreneurial and Technical Training Act (1999), the Prevention of Domestic Violence Act (2006), the Employment Act No. 6 (2006), the Childcare, Protection and Justice Act (2010), the Gender Equality Act (2013), and the Marriage, Divorce and Family Relations Act (2015).

The Ministry of Youth and Sports (MoY&S) serves as the lead government agency responsible for coordinating youth development programs, with support from the National Technical Working Group (TWG) on Youth within the Gender, Children, Youth and Sports Sector Working Group. Various other ministries, including Education, Labour, Gender, Health, Agriculture, and Forestry, also play roles in youth-related initiatives. At the sub-national level, District Youth Officers coordinate youth programs.

Despite the supportive policy and legal framework, Malawi's youth face multiple challenges, including disparities in health, education, and employment opportunities, often influenced by age, gender, and geographic factors. For example, a significant portion of school-aged children lacks access to primary and secondary education. Climate change further complicates these challenges, making the implementation of mitigation policies more difficult.

9.5.1.3 National Governance Frameworks for Addressing Youth Bulge in Tanzania

Unlike Malawi, Tanzania defines youth as young men and women from the age group of 15 to 35 years in line with the AU definition of youth (URT, 2007c)[118]. Tanzania is one of the countries in the world with the youngest population having a median age of 18 years while youth and children accounting for 31% and 44% of population respectively (https://twitter.com/UNICEF Tanzania/ status; URT, 2022c). It is argued that reductions in mortality rates as a result of health improvements have created a cohort of young people which is much larger than preceding generations (British Council, 2016)[119]. In principle, a demographic dividend requires both favourable demographic conditions and economic and social policies that make the most of demography.

The National Youth Development Policy (NYDP, 2007) focuses on youth development issues which include; economic empowerment, environment, employment promotion and youth participation, among others. The NYDP takes youth development as a cross-cutting issue calling for a multi-sectoral approach for effective implementation (URT, 2007c). The policy takes on board macro-economic and sectoral policies; and emerging global issues of interest to the youth such as the social dimensions of globalization, regional, international cooperation, African Youth Charter and the World Program of Action for Youth. The policy asserts further that the pattern of employment, underemployment and unemployment in Tanzania suggests the need for an integrated employment-oriented development framework in the key areas of agriculture and urban employment, information, labour intensive works, mining sector, natural resources and tourism infrastructure development, education and training and services.

Alongside the NYDP, other policies and strategies are considered important for youth development. For example, the Small and Medium Enterprise Development Policy (2002), the National Employment Policy (2008) and the National Strategy for Youth Involvement in Agriculture (NSYIA) (2016-2021). The NSYIA paved way for the launching of the programme known as "*Building a Better Tomorrow: Youth Initiative for Agribusiness (BBT-YIA) (2022 - 2030)*[120]" under the Ministry of Agriculture. The BBT-YIA intends to inspire and empower youth through implementation of a behaviour/attitude changing communication strategy that would rebrand agriculture and make it more appealing to youth while engaging them in profitable and sustainable management of agribusinesses. Given the slow implementation of the NYDP, a Youth Council of Tanzania Act was passed in 2015, with the aim of raising awareness of the National Youth Development Policy and putting into action the commitments therein (URT, 2015; British Council, 2016).

The Prime Minister's Office Labour, Youth, Employment and People with Disabilities is the lead Government agency responsible for coordinating youth development programmes in Tanzania. The PMO works closely with the President's Office Regional Administration and

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[118] URT (2007c). The National Youth Development Policy. PMO

[119] British Council (2016). British Council and UK Aid Youth Voices in Tanzania (2016)

[120] URT (2022c). Building a Better Tomorrow: Youth Initiative for Agribusinesses in Agriculture. MoA

Local Government, Ministries responsible for agriculture, livestock and fisheries; land, industries and trade; and executive agencies like the National Economic Empowerment Council (NEEC); local authorities, private sector agencies, development partners, financial institutions and NGOs. Notwithstanding initiatives made, youth generally continue to face challenges hovered around lack of employment opportunities, the overall hardship of life (especially those in rural areas) including financial difficulties, lack of working capital for the employed ones; and lack of access to good education (British Council, 2016).

9.5.1.4 Implications of Governance Frameworks for Addressing Youth Bulge in the Basin

The SONGWECOM documents demonstrate prevalence of increased population in both sides of the Basin and most of whom are youth. Additionally, it has been demonstrated that the basin population is characterized by poverty, low incomes and limited access to social services such as potable water, health, sanitation and education facilities (DDIP-SRBDP, 2015).

Given the levels of poverty, the increasing population is exerting pressure on the basin natural resources especially forests due to demand for construction materials and biomass energy (charcoal and firewood). Based on these conditions, the SRBDP outcomes one and three intend to achieve: "*Improved Living Conditions and Quality of Life"* and "*Manageable Population and Demography"* respectively with the overall intent of realizing "*a manageable, healthy, adequately educated society enjoying high quality of life and with full and equitable access to appropriate health, education and social infrastructure"*. It is against this background that the SONGWECOM through the SRBDP intends to bring tangible benefits to the SRB population as early as possible by starting with health and education investment (DDIP-SRBDP, 2015). Given this desire, it is essential that SONGWECOM familiarizes itself with the existing governance frameworks and on-going initiatives targeting the development of youth in the basin.

Therefore, for the sustainability of the SRB, the SONGWECOM in collaboration with key stakeholders, needs to invest in and build a strong, healthy, well educated, dynamic and innovative youth segment of basin's population. This calls for the development of a sound framework for promoting entrepreneurship skills training, youth empowerment, education (including lifelong and continuing education), gender equity, and environmental sustainability, among others.

9.6 National Governance Frameworks for Development of Key Service Sectors Poverty

9.6.1 Governance Frameworks for Education Development

9.6.1.1 Global and Regional Governance Frameworks for Education Development

At global, regional and national levels the emergence of the importance of new governance actors, processes and structures brought about by globalization has questioned many conventional and well-established ways of looking at governance of education. Accordingly, non-state actors are now increasingly engaged in education governance and education policies and priorities are increasingly negotiated beyond and alongside the nation-state

(UNESCO, 2020)[121]. At the global level education is governed by the *Incheon Declaration: Education 2030: Towards Inclusive and Equitable Quality Education and Lifelong Learning for All* underpinned by SDG4 "*Ensure inclusive and equitable quality education and promote life-long learning opportunities for all"* and its corresponding targets. This declaration is implemented through "*Education 2030 Framework for Action for the implementation of Sustainable Development Goal* 4" (UNESCO, 2015), oriented at providing guidance for the implementation of SDG4 - at a global but also at a regional and national levels (UNESCO, 2016).

At regional level, the ten-year Continental Education Strategy (CESA 2016-2025) is a response to the AU Agenda 2063; and is in line with the Global Education 2030 Programme and contributes to the achievement of objective 4 of the SDGs. The CESA's implementation is enhanced by the Continental Strategy for Technical and Vocational Educational and Training (TVET) aimed at fostering youth employment (AU, 2007)[122]. TVET insists that TVET national policies and strategies must not only be based on related international best practices, but should also be firmly rooted in indigenous knowledge and learning systems that reflect cultural practices and local values, technological preferences, the challenges of globalization and national development priorities.

9.6.1.2 National Governance Frameworks for Education Development in Malawi

The Government of Malawi recognizes that education is the backbone for socio-economic development and a major source of economic empowerment for all people especially women, the youth and the physically challenged. Aligned to international and regional policies as stated above, Malawi's legal and policy framework is guided by the Government of Malawi Constitution in which education is a human right.

Accordingly, the National Education Policy (NEP) of 2016 outlines the sector's priorities and defines the country's education policies that will guide the development of the education sector in Malawi (GoM, 2016e)[123]. The National Education Sector Investment Plan (NESIP 2020-2030) sets out the Government's education sector goals, objectives and strategies; and how these will be realized. The NESIP focuses on expansion of equitable access to education, improvement of quality and relevance of education and better governance and management (GoM, 2020)[124]. Being the main planning tool, MoE and all education sector stakeholders are required to plan and implement programmes based on the priorities highlighted in this plan.

In support of these frameworks, the National Education Act (2013) provides legal guidance to establishment, administration and management of primary, secondary and teacher training schools. Besides this Act, there are other legal instruments that guide the

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[121] UNESCO (2020). The Global Governance of Education 2030: Challenges in a Changing Landscape

[122] AU (2007). The Continental TVET Strategy

[123] GoM (2016e). National Education Policy

[124] GoM (2020). The National Education Sector Investment Plan (NESIP 2020-2030)

implementation of technical and vocational training and higher education institutions. Despite existence of the above-mentioned education governance frameworks, it is argued that the NEP has set out ambitious objectives and priorities which do not have much to do with inclusive education that the policy purports to promote, whose implementation leave much to be desired (Ben de Souza, 2022)[125]. Ben de Souza contends that the brevity is understandable as the NEP is a broad policy encompassing all issues in education. Other challenges facing the implementation of the NEP revolve around inadequate teaching and learning infrastructure, inadequate accessibility of children with special needs to resources for education and high–pupil teacher ratios, among others (GoM, 2016e).

9.6.1.3 National Governance Framework for Education Development in Tanzania

Tanzania recognizes the central role of the education sector in improving the quality of life of its people in keeping with the Tanzania Development Vision 2025 and the National Five-Year Development Plan 2021/2022-2025/2026 as well as the Education and Training Policy (ETP-2014). The ETP 2014 aims to guide education provision from pre-primary to tertiary levels along with vocational, non-formal, and special education sectors. The mission of the ETP 2014 strives to "*improve the quality of education and training and put in place structures and procedures that will enable the country to get educated Tanzanians who are yearning to continue learning to add value in achieving national development goals"* underpinned by seven main policy objectives all of which are relevant to the SRBDP (MoEST, 2014).

The main legislation underpinning the ETP of 2014, after the nation's Constitution, is the national Education Act (No. 25 of 1979 amended as Act No.10 of 1995), which is however pending revision and enactment. ETP is also supported by the Education Fund Act (2001), which describes the role of the Tanzania Education Authority (TEA) (World Bank, 2021)[126]. Notwithstanding the ambitious policy objectives, there has been a concern among education stakeholders that ETP does not meet the current demands of education and training in the country required to strengthen economic, social, scientific, and technological transformation (HakiElimu, 2021).

According to the World Bank, key factors affecting the progress towards education sector results and service delivery targets revolve around the resource constraint on Government basic education financing compounded by the adoption of the Fee-Free Basic Education Policy (FFBEP), which triggered a massive surge in enrolment at all levels in the 2016 school year (World Bank, 2021). Additionally, other factors are said to include the following:

i. Weak linkages between (i) education policy reforms (ii) Public Financial Management (PFM) reforms, and (iii) reforms in decentralized governance resulting in overlapping mandates between the main actors in basic education service delivery involving the Ministry of Education, Science and Technology (MoEST) and the President's Office – Regional Administration and Local Government (PO-RALG), the Local Government Authorities (LGAs), as well as a lack of interface between these and

[125] Ben de Souza (2022). Policy Responses to Inclusive Secondary Education in Malawi. Rwandan Journal of Education, Vol.6, No 1(2022) 18

[126]World Bank (2021). Tanzania: Education Sector Institutional and Governance Assessment. Prepared jointly by the Governance Global Practice and the Education Global Practice

the Ministries responsible for Finance and Planning. As such policy strategies are fragmented across ministries and LGAs, resulting in a weak 'culture' for results-oriented planning, as well as a lack of clarity on specific policy reforms;

ii. Inadequacies of the1998 Decentralisation by Devolution (D by D) policy including limited capacities for LGAs' implementation (activity) planning, matching school needs and LGA priorities; and

iii. School communities' engagement in education development is driven by the need to fill resource gaps.

Consultations made during fieldwork and access to key Government documents reveal that a number of policy gaps and other challenges stated above are adequately captured by the National Decentralization Policy to be launched soon (PO-RALG, 2020). The MoEST is responsible for determining the policies and direction of the higher education system in Tanzania, while the PO-RALG and other key stakeholders are responsible for the implementation of the policies, plans and strategies.

9.6.1.4 Implications of Governance Frameworks on Education Development in the Basin

The overarching goal of the SRBDP is to contribute to improved living conditions of basin population and socio-economic development in the two riparian countries. However, the Programme document indicates that up to 80% of the basin population are rural poor with average incomes below the international poverty line. Addressing underlying causes or drivers of poverty in the SRB calls for due attention if SONGWECOM is to realize its vision while ensuring sustainable livelihoods in keeping with the 2030 UN Agenda, the MW 2063 and TDV 2025.

Among other things, promotion of socio-economic development in the SRB requires educated and enlightened or empowered basin's communities that can make informed and timely decisions with abilities to determine their own destiny. The SONGWECOM Business Plan document contends that "*Education is a precursor to improvement in quality of life and sustainable development. It has a bearing on awareness levels, access to information, with positive impacts on health, production, conservation and the general wellbeing of the population. It addresses ignorance, lack of awareness and the sense of disempowerment, which affects effective participation of people in development process, particularly in addressing poverty" (*DDIP – SRBDP, 4-28). Hence, SONGWECOM needs to acclimatize itself with the respective education governance frameworks of both countries while articulating the inherent challenges before coming up with a tailor-made education and training programme for different cohorts of the target beneficiaries in the SRB.

9.6.2 Governance Frameworks for Roads Development

9.6.2.1 Global and Regional Governance Frameworks for Roads Development

The UN Decade of Action for Road Safety 2021-2030 has a goal to reduce road traffic deaths and injuries globally by at least 50% by 2030. The initiative is guided by the Global Plan, which offers governments a roadmap for achieving this target within their specific contexts. It focuses on various aspects of road safety, including multimodal transport and land-use planning, road safety management, user behavior, vehicle safety, road infrastructure, and post-crash response. The Global Plan is supported by international legal instruments such as the Vienna Convention on Road Traffic of 1968, which outlines rules for cross-border vehicles and technical requirements.

At the regional level, key road governance frameworks include the third African Road Safety Action Plan 2021-2030, the 2016 African Road Safety Charter, and the 1996 SADC Protocol on Transport, Communications, and Meteorology. These frameworks align with the pillars of the Decade of Action and address various aspects of road safety, including management, infrastructure, vehicles, road users, and post-crash response. Additionally, the SADC Protocol aims to harmonize vehicle and driver safety regulations and promote cooperation among member states in managing road traffic quality and road safety management. These regional efforts complement the global initiative to enhance road safety and reduce traffic-related injuries and fatalities.

9.6.2.2 National Governance Frameworks for Roads Development in Malawi

Road infrastructure is crucial for transportation in Malawi, handling the majority of internal freight and passenger traffic. However, many district roads, especially in rural areas, are in poor condition, posing limitations to the country's economic growth. To address these issues, governance frameworks, including policies, laws, and institutions, need to be established.

The 2015 National Transport Policy (NTP) aims to create an efficient and coordinated transport infrastructure that supports safe and competitive transport services. It is complemented by the National Transport Master Plan (NTMP), which outlines a 20-year investment plan to enhance the transport sector, benefiting sectors like agriculture, tourism, mining, trade, and potentially oil and gas, all of which are relevant to the SRBDP. The NTMP requires significant investments, estimated at USD 9.15 billion, to be sourced from public and private funding, with a focus on improving roads and rail infrastructure.

Supporting these policies, the Public Roads Act (2014) classifies public roads and emphasizes the protection and management of these roads, including communication with local councils for construction and maintenance activities. The Act also allows the Minister to designate roads as public, making them public land under the President's ownership. The NTMP aligns with the National Decentralization Policy by devolving transport planning and coordination to district, city, and municipal councils, promoting local community involvement through District Transport Infrastructure and Management Plans (DTIMPs). The Ministry of Transport and Public Works (MoTPW) and the Ministry of Local Government and Rural Development (MoLGRD) are expected to collaborate to build the capacity of districts in preparing effective DTIMPs and engaging the private sector in transport provision.

9.6.2.3 National Governance Frameworks for Roads Development in Tanzania

The development and maintenance of road infrastructure play a crucial role in Tanzania's national development, aligning with the TDV 2025 and the National Five-Year Development Plan (2021/22 – 2025/26). The National Transport Policy (NTP) places a strong emphasis on bituminizing trunk roads and ensuring the rehabilitation and maintenance of regional, district, and urban roads for efficient traffic flow. Environmental protection is also prioritized in the policy, integrating sustainability into transport infrastructure design and development. This comprehensive approach to road infrastructure development is supported by various policies, including the Construction Industry Policy, National Road Safety Policy, National Land Policy, National Environmental Policy, National Forest Policy, and Wildlife Policy. These policies all recognize the involvement of the private sector, including women, and are further reinforced by relevant laws such as the Roads Act,

Standard Specifications for Road Works, National Occupational Health and Safety Act, and Environmental Management Act.

Institutions responsible for road infrastructure in Tanzania include the Tanzania National Roads Agency (TANROADS), overseeing trunk and regional road networks, and the Tanzania Rural and Urban Roads Agency (TARURA), tasked with developing and maintaining district road networks, including collector, feeder, and community roads. Collaboration between TARURA, TANROADS, the President's Office – Regional Administration and Local Government (PORALG), Ministry of Works and Transport (MoWT), Roads Fund Board (RFB), and ministries responsible for finance and planning strengthens the implementation of road infrastructure policies and projects.

9.6.2.4 Implications of Governance Frameworks on Roads Development in the Basin

SONGWECOM identifies roads transport as the dominant mode of transport in Songwe River Basin. However, most of the rural roads in the SRB are earth roads and the majority of which are in poor state making it difficult to access social services and productive areas all year round. The situation is aggravated by the ad-hoc maintenance and spot improvements of the roads (DDIP-SRBDP, 2015). One of the SONGWECOM studies had earlier pointed that the improvement of road network infrastructure is the precondition for the investment, trade, social and economic development in general within the Basin. Hence, prior to and during construction and rehabilitation of key main and access or feeder roads in the Basin, SONGWECOM has to make sure that all provisions of the Acts are adhered to.

9.6.3 Governance Frameworks for Energy Development

9.6.3.1 National Governance Frameworks for Energy Sector Development in Malawi

The Malawi 2063 (MW 2063) vision places industrialization as one of its key pillars, recognizing the pivotal role of energy in socio-economic development. The policy aims to enhance the accessibility and reliability of energy nationwide, with a target of achieving 80% electricity access by 2035. This objective involves substantial investments in solar and renewable energy sources. The energy policy of Malawi also has strong ties to various sectors, including health, climate, forestry, and gender equality. Its overarching goal is to stimulate economic growth and rural development, with a focus on poverty reduction and increased private sector involvement. This policy framework creates a conducive environment for the Sylvan River Basin Development Project (SRBDP), particularly in the context of hydroelectric power generation.

Despite these efforts, Malawi faces ongoing challenges related to limited access and unreliable energy supply, primarily due to financial constraints affecting the Electricity Supply Corporation of Malawi (ESCOM). Furthermore, the nation's heavy reliance on hydropower for electricity generation makes it vulnerable to climate-related events such as droughts and floods, exacerbated by infrastructure breakdowns.

To support the implementation of this policy, several legal frameworks are in place, including the Electricity Act, 2004 (amended in 2016), the Energy Regulation Act, 2004 (revised in 2014/2015), and the Rural Electrification Act, 2003 (revised in 2014). These laws regulate various aspects of the energy sector, including licensing, safety, and regulation.

Malawi actively participates in regional, continental, and global organizations advocating for sustainable energy development. Regionally, it is a member of the Southern African Development Community (SADC), which has established institutional mechanisms like the SADC Energy Protocol and the Southern African Power Pool (SAPP) to promote energy trade, investment, capacity building, and information exchange. Additionally, Malawi's membership in the African Union (AU) and the African Energy Commission (AFREC) entails certain responsibilities under various protocols and conventions. Therefore, the SRBDP should consider not only its bilateral context but also its regional and global implications, drawing inspiration and guidance from these organizations' frameworks.

9.6.3.2 National Governance Frameworks for Energy Sector Development in Tanzania

The Tanzania Development Vision 2025 underscores the critical importance of energy in driving social and economic activities and highlights the necessity of effective energy governance for enhancing the quality of life for its citizens. The development of national policies and strategic frameworks in Tanzania is informed by global and regional frameworks such as the UN 2030 Agenda, the Paris Agreement, the AU 2063 Agenda, the 1996 SADC Protocol on Energy, and the EAC 2018 Energy Security Policy Framework.

The 2015 National Energy Policy (NEP) in Tanzania, implemented through the Power System Master Plan (PSMP) in 2020, is focused on expanding access to modern energy services and improving the availability, reliability, and affordability of power supply across the country. This policy actively involves various stakeholders in the energy sector to implement cost-effective generation and transmission projects. The PSMP outlines a power generation mix that varies over the planning period until 2044.

A key emphasis of the PSMP is the promotion of renewable energy sources within the grid to achieve the planned generation mix. As of now, Tanzania has a total installed capacity of 1,602.32 MW, with the majority (1,565.72 MW) connected to the National Grid System. This grid includes hydro and thermal generation units owned by TANESCO and independent power producers (IPPs). Notably, the PSMP aligns with the intentions of the Sylvan River Basin Development Project (SRBDP) to invest in hydroelectric power, demonstrating timely synergy.

Supporting the PSMP are the 2015 Tanzania Sustainable Energy for All (SE4All) Action Agenda and the Electricity Act, No. 10 of 2008, which governs the generation, transmission, transformation, distribution, supply, and use of electric energy. This act also facilitates cross-border electricity trade and regulates rural electrification planning. The Tanzania Electric Supply Company (TANESCO) oversees all matters related to electricity and reports to the Energy and Water Utilities Regulatory Authority (EWURA) and the Minister Responsible for Energy.

9.7 Governance Framework for Climate Change Actions

Climate change impacts the key growth and service sectors either directly or indirectly. Such sectors include agriculture, livestock, fisheries, forestry, water resources, eco-tourism, biodiversity and roads. Thus, climate change is a stumbling block to achieving sustainable

development, hence require climate actions for both adaptation and mitigation required effective governance frameworks.

9.7.1 Global and Regional Governance Frameworks for Climate Change

Details of the global and regional governance frameworks for climate change are provided in the Thematic Report on Governance Analysis (SONGWECOM, 2023f)[127]. hence, the following sections focus on national governance frameworks on climate change.

9.7.2 National Governance Frameworks for Climate Change in Malawi

Malawi's climate change governance is influenced by global and regional agreements like the UNFCCC, Kyoto Protocol, and the Paris Agreement. The National Climate Change Management Policy (NCCMP) guides the integration of climate change considerations into development planning at various levels. It aims to stimulate socio-economic growth and secure resources from both public and private sectors. The 2021 Strategy on Climate Change and Learning focuses on capacity building and resource mobilization for climate change learning. The Updated Nationally Determined Contributions (NDC) outlines Malawi's climate priorities from 2020 to 2040, aligning with the Paris Agreement.

These frameworks are bolstered by the National Environment and Climate Change Communication Strategy (NECCS) and the National Meteorological Policy. Nevertheless, Malawi faces ongoing climate change challenges like floods, droughts, pests, and diseases.

The Environmental Affairs Department (EAD) coordinates climate change learning activities in line with the NCCMP. Through its Outreach Programme, EAD promotes climate change awareness within the National Environment and Climate Change Communication Strategy. EAD collaborates with relevant stakeholders, including the Department of Climate Change and Meteorological Services and ministries responsible for agriculture and water, to address climate change impacts comprehensively.

9.7.3 National Governance Frameworks for Climate Change Actions in Tanzania

Tanzania formulated its first National Climate Change Strategy in 2012 aiming at enhancing technical and institutional capacity of the country to address the impacts of climate change; and participate in global climate change efforts. In 2021, the National Climate Change Response Strategy (NCCRS) 2021-2026 was developed. The NCCRS 2021-2026 has been prepared in the wake of growing concerns of the negative impacts of climate change and variability on the country's social, economic, ecological and physical environment amid the COVID-19 challenges (URT, 2021a). The NCCS covers adaptation, mitigation and cross-cutting interventions that focused on enabling Tanzania to tackle challenges emanated from climate change at all fronts. The NCCRS is in line with the 2015 Paris Agreement on Climate Change; the United Nations Agenda 2030; the 2014 SADC Protocol on Environmental Management for Sustainable Development and the EAC Climate Change Master Plan (2011-2031), among others.

[127] SONGWECOM (2023f). Part Nine: Governance Analysis

In 2021, Tanzania also developed its Nationally Determined Contribution (NDC) (URT 2021[128]). The Tanzania's NDC underscore pledged adaptations and mitigation in different sectors including agriculture, livestock, energy, forestry, fisheries, water, tourism, land use, health, waste management, transport, infrastructure.

9.8 Governance Frameworks for Sustainable Development Enablers

The development enablers include gender mainstreaming, Information Communication Technology (ICT) and Research for Development (R&D). These are critical cross cutting factors that are enabling integrals of the sustainable development agenda.

9.8.1 Governance Frameworks for Gender Mainstreaming

9.8.1.1 Global and Regional Governance Framework for Gender Mainstreaming

Gender mainstreaming involves integrating a gender equality perspective into all government actions and decisions, aiming to achieve gender equality in policies and spending(OECD, 2021[129]). This approach has its roots in international agreements like the Universal Declaration on Human Rights, which asserts that all individuals are born free and equal in dignity and rights, regardless of gender. The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) is a key instrument in promoting gender equality globally. Additionally, various UN conferences and agreements, including the UN 2030 Agenda with its Sustainable Development Goal 5, emphasize the importance of gender equality as a human right.

At the regional level, the African Union (AU) aligns its approach to women's rights and gender equality with UN frameworks. The AU's Constitutive Act recognizes the promotion of gender equality as one of its principles. The adoption of the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa in 2004 marked a significant step in addressing women's rights in the region. However, challenges remain, including the need for member countries to submit implementation progress reports and the absence of sanctions for non-compliance with gender mainstreaming obligations. Various regional governance frameworks, such as the AU Gender Policy and Action Plan and the African Women's Decade declaration, further support gender equality efforts in Africa. The establishment of the Women and Gender Development Directorate within the AU aims to build capacity and promote gender mainstreaming across AU organs and member states. While progress has been made in developing gender policies and strategies, effective implementation remains a challenge, partly due to the absence of enforcement mechanisms

9.8.1.2 National Governance Framework for Gender Mainstreaming in Malawi

The Government of Malawi recognizes the importance of gender mainstreaming as a key strategy for bridging disparities between men and women; while striving to achieve gender equality for purposes of strengthening democracy and advancing overall human development. Existing national policies and frameworks support gender mainstreaming. For example, the Constitution of the Republic of Malawi guarantees equal rights to men and

[128] URT 2021. Nationally Determined Contribution. Vice President's Office. Dodoma.
[129] The Policy Framework for Gender-sensitive Public Governance was approved by the Public Governance Committee on 27 August 2021.

women and this is further elaborated in Chapter IV Section 20 (1) and (2) and Section 24 (1) (a) (i) and (ii).

The National Gender Policy (2016) aims "*to mainstream gender in the national development process to enhance participation of women and men, girls and boys for sustainable and equitable development for poverty eradication or wealth creation"* (GoM, 2016). On the other hand, the National Gender Machinery reaffirms the need to achieve gender equality and women empowerment, and this is further supported by the Malawi Vision 2063 (MW2063). Implementation of national gender policies is enhanced by the Gender Equality Act (2013) whose purpose is to promote gender equality, equal integration, influence, empowerment, dignity and. opportunities, for men and women in all functions of society, among other things.

9.8.1.3 National Governance Framework for Gender Mainstreaming in Tanzania

Like Malawi, Tanzania is also committed to the implementation of the global, regional and EAC governance frameworks on gender equality and women empowerment. As such. Tanzania has several frameworks that require the integration of gender and women empowerment. The Constitution of the United Republic of Tanzania 1977 stipulates the need for gender equality and women empowerment. The Tanzania Development Vision 2025 and the Third National Five-Year Development Plan (FYDP III) 2021/22 to 2025/26 also highlight the need to integrate gender equality and women empowerment (URT, 1999; 2021); while according gender equality one of the top priorities. To operationalise some of its gender commitments, the Government developed a Women and Gender Policy (2000), and a National Strategy for Gender and Development (2002), let alone sectoral/institutional gender policies and strategies. The Government has also recently developed a National Plan of Action to End Violence Against Women and Children 2017/18 to 2021/22) supported by laws that were enacted to protect women and girls from sexual harassment and abuse, and to give them more land rights. For example, the Tanzania: Act No. 4 of 1998, Sexual Offences Special Provisions Act.

The Ministry of Community Development, Gender, Women and Special Groups in Mainland Tanzania is responsible for all matters related to gender and women's empowerment including overseeing development of policies, strategies and action plans for gender equality and women's empowerment to be implemented jointly with other sectors. The Ministry is also mandated to coordinate the implementation of the national policies on gender equality and women empowerment with the support of gender focal points (GFPs) or committees that have been established in all Ministries, Departments and Agencies (MDAs), regional secretariats, and councils and institutions.

9.8.1.4 Implications of Governance Framework for Gender Mainstreaming in the Basin

The SONGWECOM Business Plan demonstrates existence of gender inequalities, gender insensitive cultures, early marriages among communities, inadequate support for the marginalized and people with special needs including HIV/AIDS victims in the SRB (DDIP-SRBDP, 2015). Hence, SONGWECOM should strive to integrate gender equality in its operations and programmes to respond to global and national development frameworks. A critical aspect of promoting gender equality in the SRB is women's empowerment, focusing on identifying and redressing power imbalances and giving women more autonomy to manage their own lives while striving to conserve the basin's ecosystems in a sustainable manner. Accordingly, SONGWECOM should aim at:

i. Strengthening management systems to enhance gender equality;
ii. Instituting enabling environment for gender equality;
iii. Supporting gender equality communications and knowledge management;
iv. Integrating gender in the design, implementation, monitoring and reporting of programmes and projects; and
v. Establishing and/or strengthening strategic partnerships to accelerate gender equality.

Gender equality in the SRB means that women and men, girls, and boys, can enjoy equal status and have equal entitlements and opportunities to realize all human rights, make choices fully, and access assets, services and public goods without limitations imposed by legislation, policies, gender norms and stereotypes brought about by local culture or otherwise.

9.8.2 Governance Frameworks for ICT Integration

9.8.2.1 Global and Regional Governance Framework for ICT Integration

Governments worldwide have recognized the pivotal role of information and communications technologies (ICTs) in economic and social development. They have developed comprehensive ICT strategies to address various regulatory requirements related to data protection, financial accountability, data retention, and disaster recovery. International agreements like the World Trade Organization's Information Technology Agreement (ITA) and ITA 2 have played a significant role in facilitating the use of IT technologies by eliminating import duties and charges on information technology products. These agreements have spurred the growth of IT-enabled industries and services by reducing the cost of IT equipment and communication networks. The International Telecommunication Regulations (ITR) have also contributed to the liberalization of pricing and services in the telecommunications sector, supporting the rapid growth of the Internet.

9.8.2.2 National Governance Frameworks for ICT Integration in Malawi

The 2013 National ICT Policy for Malawi aims to foster the development of the ICT sector, promote the use of ICT across all sectors, and ensure widespread access to ICT services to drive socio-economic development. This policy also underscores the importance of e-Government and data governance, drawing insights from previous policies such as the Digital Broadcasting Policy of 2013 and the Science and Technology Policy. It is supported by legislative acts like the Electronic Transactions and Cyber Security Act (2016) and the Communications Act (2016), supplemented by the Information Technology Regulations (2021). The Electronic Transactions and Cyber Security Act addresses electronic transactions, criminalizes offenses related to computer systems and information communication technologies, and the Communications Act regulates various communication services while establishing the Malawi Communications Regulatory Authority (MACRA) to oversee these sectors.

Despite these initiatives, Malawi faces challenges such as inadequate ICT infrastructure in rural areas, limited research and development capacity in ICT, a shortage of specialized ICT professionals, and a lack of locally relevant Internet content and e-services, particularly for rural communities. To tackle these issues, Malawi is implementing the Malawi ICT and Digitalization Policy Roadmap (2022-2026). The Ministry of Information and Digitalization is responsible for policy formulation, monitoring, and evaluation, while the Malawi

Information and Technology Agency (MITA) is tasked with accelerating ICT development and implementing the National ICT Policy. MACRA continues its role as the regulatory body overseeing ICTs in the country.

9.8.2.3 National Governance Frameworks for ICT Integration in Tanzania

The National ICT Policy 2016 recognizes the crucial role that the development, deployment and the exploitation of ICTs within the economy and the society can play towards the achievement of the nation's socio-economic goals enshrined in the National Development Vision 2025 (URT, 2016)[130]. According to TDV 2025 (URT, 1999):

> "*These technologies are a major driving force for the realization of the Vision. They should be harnessed persistently in all sectors of the economy. "…This task demands that adequate investments are made to improve the quality of science-based education and to create a knowledge-based society in general."*

To achieve the Government's desire of ICT utilization, a number of reforms have been undertaken in the legal framework, by putting in place cyber and other related laws. First and foremost, the Government through the Tanzania Communication Regulatory Authority (TCRA) Act No. 12 of 2003, established a converged regulatory authority named TCRA to regulate the communications sector, which includes telecommunication, broadcasting and postal services. Additionally, this was followed by the amendments of Evidence Act No. 15 of 2007, Act No. 3 of 2011 and other amendments; and enactment of the Electronic and Postal Communications Act No. 3 of 2010, the Universal Communications Service Access Act. No. 11 of 2006; and e-Government Act No. 10 of 2019 and e-Government regulations of 2020 (URT, 2020). Despite efforts made there remains a major challenge hovered around the inability to maintain a proactive legal framework that can keep pace with the rapidly changing technological environment. Among the areas that need attention include data access rights, privacy protection, computer fraud and crime, security and privacy of e-transactions, establishment of rules governing e-transactions, and delivery of e-opportunities to the wider population technology (URT, 2016).

The Ministry responsible for communication is answerable for the overall coordination of policy implementation, monitoring, evaluation, and periodic review of the policy, strategies; and initiates legislation for policy implementation; and development of e-government policy and to facilitate its implementation in Government institutions. The Ministry also works with sectoral ministries including the Ministry responsible for regional administration and local government to ensure the integration of ICT in their sector specific policies and development initiatives. The e-Government Authority (e-GA) established under the Government Act, No. 10 of 2019 is responsible for coordinating, overseeing, promoting and enforcing e-government in public institutions (URT, 2019). TCRA is an independent government agency responsible for regulating the communications and broadcasting sectors in Tanzania.

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[130] URT (2016). The National ICT Policy 2016

9.8.2.4 Implications of Governance Frameworks for ICT Integration in the Basin

SONGWECOM recognizes the need to pay due attention to internal and external communications while making effective use of available information and communication technologies (ICTs). SONGWECOM stresses that all communication with its audiences should focus on corporate objectives and messages; be clear, honest and open; be easily understandable, timely and up to-date, including written, spoken, visual and electronic communication. In order to realize its communication objectives, SONGWECOM will have to internalize and comply to the existing ICT governance frameworks alluded to earlier including issues related to data governance and use of e-Government.

Accordingly, SONGWECOM in collaboration with its key stakeholders will have to address existing challenges hovered around the use of ICT and in particular such issues as research and development in ICT, intellectual property protection, digital security and national security in order to pave way for smooth data access and sharing critical for fostering data-driven innovations across the private and public sectors including the development partners. SONGWECOM will need to come up with data governance policy and strategy in line with its envisaged Communications and Public Relations Strategy. For the benefit of the beneficiaries in the SRB, some SRBDP critical information will have to be translated into *Chichewa* and *Kiswahili* languages and disseminated through a variety of communication and outreach channels including seminars, training, media (including folk media), leaflets, and other promotional materials. The ICT technology provide efficient means of communication and outreach for the commission. The TDA process has produced a web-based platform for stakeholders' communication and engagement.

9.8.3 Governance Frameworks for R&D

9.8.3.1 Global and Regional Governance Framework for R&D

The 2030 Agenda for Sustainable Development places Science, Technology, and Innovation (STI) at the heart of global efforts to achieve prosperity, inclusivity, and environmental sustainability, as encapsulated in the 17 Sustainable Development Goals (SDGs). Goal 9 specifically highlights the importance of fostering innovation and technological advancement for sustainable industrial development. To align with these objectives, developing countries must enhance their technological capabilities. Innovation systems, shaped by various economic, political, societal, and environmental factors, consist of multiple actors, connections, and enabling framework conditions. These actors include research and education institutions, businesses, entrepreneurs, intermediary organizations, consumers, civil society, and governments. Governments play a central role in setting priorities, allocating resources, promoting collaboration, and creating an environment conducive to innovation. Framework conditions encompass policies, regulations, institutions, entrepreneurial ecosystems, funding access, human capital, and research infrastructure. The 2030 Agenda serves as a guiding framework for STI policies, enabling transformative change and integration of sustainable development into national plans.

In Africa, both the African Union (AU) and the Southern African Development Community (SADC) recognize the critical role of STI in addressing multifaceted challenges such as poverty, climate change, food security, health, and peace. The AU's Agenda 2063 underscores STI as a universal enabler for realizing African citizens' aspirations and global sustainable development goals. Key AU policies and strategies, including the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024), prioritize socio-

economic needs and increased investment in research and development (R&D) and patents. Additionally, the SADC's Regional Indicative Strategic Development Plan (RISDP) 2020–2030 places substantial emphasis on STI to bolster technological capabilities in the region. These regional and continental initiatives align with the global commitment to harness STI for sustainable development.

9.8.3.2 National Governance Framework for R&D in Malawi

The Malawi 2063 (MW2063) vision aims to transform the country into an inclusive, wealthy, and self-reliant nation with a strong focus on developing a vibrant knowledge-based economy and competitive manufacturing industry. Central to achieving this vision is the National Research Agenda (NRA), which outlines themes and priority areas for research, innovation, and technology development. These initiatives align with MW2063's key pillars, including Agricultural Productivity, Industrialization (including Mining), Urbanization, Mindset Change, Governance Systems, Economic Infrastructure, Human Capital Development, Private Sector Dynamism, and Environmental Sustainability. Despite this focus on Science, Technology, and Innovation (STI), Malawi faces challenges related to funding, human resources, and research competencies in both national and sub-national research bodies.

The NRA's implementation will be coordinated by the National Commission for Science and Technology (NCST) and the National Planning Commission (NPC), each operating within its respective mandates and procedures. The NPC, responsible for overseeing medium and long-term development plans, will ensure that research, innovations, and technologies align with MW2063 and the Malawi Implementation Plan-Phase I (MIP-1). The NCST will facilitate quality scientific research, technology development, and innovation, fostering collaboration with researchers and innovators. Additionally, it will uphold standards for scientific outputs to address Malawi's development challenges. The primary source of financing for NRA implementation will be the Malawian government, channeled through the Science and Technology Fund coordinated by the NCST, as established under the Science and Technology Act.

9.8.3.3 National Governance Frameworks for R&D in Tanzania

The National Research and Development Policy of 2010 in Tanzania emphasizes the role of Science, Technology, and Innovation (STI) in national development. It seeks to integrate research into the national development vision and strategies, setting clear priorities aligned with the Tanzania Development Vision 2025 and Five-Year Development Plans. Many of these research priorities, spanning agriculture, livestock, fisheries, water, environment, and industries (including mining), are relevant to the objectives of the Songwe River Basin Development Program (SRBDP). While the policy has yielded some successes, such as the development of improved crop varieties and livestock breeds, several challenges persist. These include weak leadership in the research and development (R&D) system, limited interdisciplinary collaboration, insufficient socio-economic research, difficulties in incorporating emerging research areas into the national agenda, low private sector involvement in research, funding shortages, a shortage of skilled personnel, and limited mechanisms for technology transfer and commercialization of research results.

The National Commission for Science and Technology (COSTECH) plays a pivotal role in advising the government on scientific research and technological development matters. COSTECH, established by Act No. 7 of 1986, coordinates research activities and oversees institutions like the Centre for Development and Technology Transfer (CDTT), responsible for technology transfer and adaptation. Additionally, the Tanzania Industrial Research and Development Organization (TIRDO), operating under the Ministry responsible for industries and trade, conducts industrial research and provides consultancy services to industries. Research planning and implementation primarily involve public research institutions, higher learning institutions, and private research institutions in Tanzania. However, there are challenges related to funding, research capacity, and technology transfer that need to be addressed for a more effective research ecosystem.

9.8.3.4 Implications of Governance Frameworks for R&D in the Basin

It is acknowledged that while science, technology and innovation hold key answers to the new, complex challenges facing governments, these cannot be stand-alone processes (Bokova in Guillermo and Susan, 2014). Bokova contends that these should *be integrated into societies through partnerships, through strong links between science, policy and society, through effective national policies and robust systems of governance and through science education*. Innovation is seen as not being a decision but an ecosystem that is a foundation for knowledge societies and sustainable development (*op.cit.*).

Given the fact that SONGWECOM is a knowledge-driven organization, it observes areas of research that may be required in the course of implementation of the SRBDP. These are hovered around socio-economic, agricultural, technological including ICT, ecosystems, IWRM and overall natural resource management calling for the services of local, regional and international research organizations in keeping with their mandates. Hence, SONGWECOM needs to acclimatize itself with existing policy, strategy and legal frameworks as well as competitive STI (R&D) institutions where expertise can be drawn when need arises. SONGWECOM asserts that national training and research institutions with important supportive functions for the basin; and which have relevant training and research capacities will be effectively utilized (DDIP-SRBDP, 2015 p. 8-3).

9.9 Inadequate Governance Related Impacts, Drivers, and Game-Changing Solutions

9.9.1 Impacts and Drivers of Inadequate Governance

The impacts of inadequate governance revolve around environmental degradation and decimated livelihoods that are mainly dependent of the environment (Table 9.3). The root causes of inadequate governance that contribute to degradation and disrupted livelihood include: unharmonized and uncoordinated policy and institutional frameworks at both country and bilateral cooperation levels, inadequate sensitivity of politics on environmental sustainability issues, limited awareness and participation of stakeholders, and inadequate capacities and resources. The underlying and immediate causes bridging root causes to impacts are also presented.

Table 9.3: Causal Chain Analysis of Inadequate Governance

Environmental Impacts	Socio-Economic Impacts	Immediate Causes	Underlying Causes	Root Causes
Environmental degradation	Disrupted and decimated livelihoods and economy	Unsustainable exploitation and management of transboundary natural resources Inadequate disaster preparedness and response systems Inadequate institutional, human, and financial capacities and resources Low adoption of sustainable environmental management technologies Inadequate bilateral cooperation in sustainable management of transboundary natural resources	Shortage of qualified personnel equipped with the right competencies Conflicting and duplicated institutional mandates Uncoordinated and harmonized bilateral governance of transboundary natural resources Inadequate implementation of the decentralization policy in both countries Limited stakeholder involvement including local community, private sector or NSAs/civil society Inadequate consideration of sustainability issues in politics	Uncoordinated, un harmonized and un-enforced policies and regulations at all levels within each country and at bilateral cooperation level Inadequate sensitivity of politics on environmental sustainability Low public awareness and participation Inadequate resources including funds, personnel and equipment

Source: Stakeholders' Consultations, 2023

9.9.2 Potential Game-Changing Actions for Addressing Inadequate Governance

Strengthening sustainability and green growth focus in governance is critical for sustainable development in the basin (Table 9.4). The green growth elements include nature-based solutions, low-carbon growth and reduced environmental footprints including efficient use of resources such as water. Arguably, an existing landscape of policy and legal frameworks provides action spaces for sustainable management of natural resources – but

implementation and enforcement have been inadequate and need to be enhanced. Other important game-changing actions include building capacities and incentive structures for local communities and their institutions, advancing ICT and build partnerships for sustainable management of natural resources.

Table 9.4: Governance actions for inclusive green growth in the basin

	Game-changing Actions	Stakeholders
1	Strengthen green growth focus in the national and cooperation development policies and practices	MDAs (Ministries responsible for water, agriculture, forestry, livestock, fisheries, land, finance, environment, local government, communications; public agencies R&D institutions (national, regional and international) Private sector such as FIs and Investors NSAs and Development Partners (DPs)
2	Effective implementation and enforcement of policies and regulations preceded with raising awareness among the local community and the general public	
3	Build the capacity and create tailored incentive structures for local communities and their institutions to participate in sustainable management of natural resources	
4	Taking advantage of ICT and digital advancement, create joint systems and increase investment in data monitoring, bigdata systems and real-time capture and storage of data for evidence-based governance of the shared natural resources	
5	Build partnerships with global, regional and bilateral R&D, NSAs and private sector to mobilize expertise and resources for implementing sustainable management of natural resources	UN agencies like IPCC and UNEP, AU, UN, Consortium of International Agricultural Research (CGIAR) centres, SADC, IW-GEF, WMO, IRI, NGOs and NSAs, and Financial institutions with interest in sustainability finance such as CRDB

Sources: Stakeholders Consultations and Reviewed Planning Documents

PART TEN

LINKAGES OF THEMATIC AREAS, PATHWAYS TO THE SAP AND CONCLUSION

10 An Overview

Part ten presents the linkages of different thematic areas of the TDA. In a nutshell, this is parts sums up the information presented for different themes of the TDA. The part ends by consolidating broader pathways and strategic actions for the next SAP process.**Linkages Among TDA Thematic Areas**

The six thematic areas are interlinked. The productivity of land including soil health contribute to socio-economic development outcomes through production of food, fibre and feed (Figure 10.1). The socio-economic status such as income and knowledge would determine the kind of management practices that land users will apply on the land resource. Poor farmers cannot afford fertilizers and costly land management technologies such as bench terraces, hence determining state of the land resource. Water resource provides soil water for crop production and watering of animals contributing to socio-economic status in terms food security and income generation. A number of socio-economic sectors such as domestic, industrial and water and sanitation require water. In return, the socio-economic status will determine the state of water resource through alternative management. The society benefits socio-economically from a range of ecosystem services – regulating, supporting, provisioning and cultural.

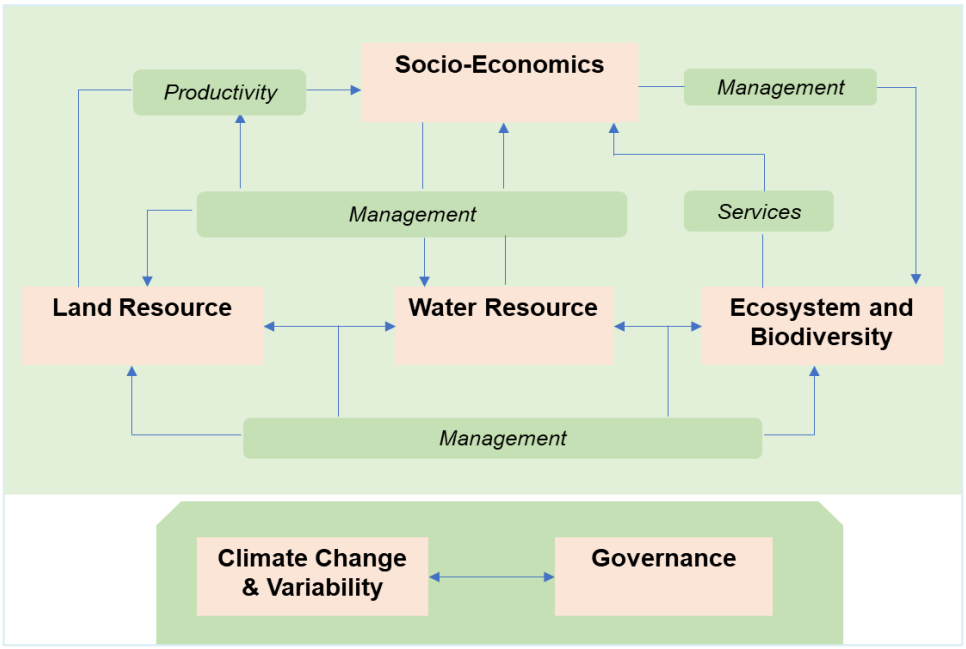

Figure 10.1: Linkages Among Thematic Areas

Furthermore, the socio-economic status will determine how people will manage the ecosystem and biodiversity. For example, extreme poverty tends to be associated with unsustainable extraction leading to ecosystem degradation and biodiversity loss. The management of land, water, and ecosystem and biodiversity are complexly related. Land degradation in the riparian watersheds will increase river siltation and sediments in the downstream waters. For example, eutrophication of Lake Malawi/Nyasa which affect the aquatic ecosystem and biodiversity is attributed to intensive use of fertilizers for land

management in the riparian agro-landscapes including the SRB. Management of watersheds and river systems including environmental flows will determine the health of the ecosystem and biodiversity. Climate change impacts through raising temperature, droughts and floods will affect the natural resources and socio-economic sectors. Extreme climatic events affect the aquatic ecosystem that support fish including breeding habitats. Floods and droughts are also leading to devastating socio-economic loss and damage. Rising water temperature will affect the biodiversity through altered biological and physiological processes of flora and fauna. Moreover, governance entailing policies, institutions and regulations shapes how the natural resources and the socio-economic development are managed in the context of political ecology.

10.2 Pathways to the SAP: Key Nine Results Areas

The thematic TDA can be reduced into five broad sustainable development results areas that can be realized through strategic game-changing actions and engaging with key stakeholders. These areas forging pathways and game-changing actions into the SAP process include: 1) Integrated Ecosystem and Biodiversity Restoration and Management, 2) Water Resource Management, 3) Sustainable Land Management, 4) Poverty Reduction, 5) Education and Skills Development, 6) Improved Roads Infrastructure, 7) Harnessing Youth Bulge as a Demographic Dividend, 8) Transitioning to Sustainable and Clean Energy for All, and 9) Promoting Sustainable Socio-Economic Development Enablers (Gender Mainstreaming, R&D and ICT).

Pathway 1: Integrated Ecosystem and Biodiversity Restoration and Management

Game-Changing Actions:

- Promote and scale-up integrated Ecosystem-Based Approach in natural resources management
- Inculcate the ecological civilization culture in the citizens at the basin level and country at large
- Promote community-based regeneration and restoration of severely degraded ecosystems including forests, fragile hills, riverbanks and fish breeding sites
- Re-engage with key stakeholders that most programs have tended to ignore in the past in the planning, implementation, and monitoring and evaluation of environmental management programs
- Re-envision coordinated transboundary planning, actions and investment in management of shared ecosystems

Pathway 2: Integrated Water Resource Management

Game-Changing Actions:

- Promote integrated Ecosystem-Based management of watersheds and catchments
- Promote water use efficiency and productivity across major water demand sectors
- Addressing climate change and related impacts on water resources
- Promote mutual enforcement of agreed vision for transboundary management of the water and related resources

Pathway 3: Sustainable Land Management

Game-Changing Actions:

- Implement land use and management planning in the basin
- Promote agribusiness and market access for farmers to realize the benefits of land management
- Setting up a robust land management M&E system with targets and performance indicators
- Commit government investment in structural land conservation in degradation hotpots within the catchment which are beyond the ability and scope of local conservation
- Develop innovative incentive schemes for promoting sustainable land management practices such as robust terracing
- Strengthen cooperation between two countries on harmonized sustainable land management

Pathway 4: Poverty Reduction through Key Growth Sectors

Pathway 4.1: Agriculture for Poverty Reduction

Game-Changing Actions:

- Promote sustainable agricultural intensification of crop and livestock systems
- Develop strategic agricultural value chains with high economic and social returns on investments
- Optimize green growth and circular economy opportunities in the crop and livestock commodity value chains
- Strengthen formalized efficient of cross-border trade of crop and livestock inputs and outputs, including developing joint modern markets with facilities

Pathway 4.2: Forestry Sector for Poverty Reduction

Game-Changing Actions:

- Promote tree planting, reforestation, afforestation and farmer-based natural regeneration with robust incentives and M&E system
- Develop forestry value chains including eco-tourism and beekeeping that are inclusive of women and youths
- Strengthen forestry governance at all levels: local community, subnational, national, bilateral, regional (SADC) and International (e.g., CDM)

Pathway 4.3: Fisheries for Poverty Reduction

Game-Changing Actions:

- Promote ecosystem-based fisheries development including building the capacities of the communities and technocrats
- Develop of fish value chains in capture fisheries and aquaculture
- Promote development of fish-based food products with social entrepreneur women and youth groups for agribusiness outreach aimed at improving community nutrition
- Strengthen transboundary cooperation in sustainable fisheries management

Pathway 4.4: Overall Poverty Reduction

Game-Changing Actions:

- Empower local communities particularly the most vulnerable including youths, women and people with disability through Strengths Based Approach (SBA) by strengthening their literacy, skillsets and competences
- Promote profitable and sustainable income generating activities in strategic value chains in the key growth and service sectors
- Promote household and community nutrition education to improve health and nutrition security
- Strengthen bilateral cooperation in strategic poverty reduction programs and projects

Pathway 4.5: Education Development

Game-Changing Actions:

- Formulate policies, strategies and programs to ensure out-of-school children and youths have access to education and vocational training
- Re-design education curricula to incorporate the requisite skills needed for the fourth industrial revolution
- Promote technical education and vocational training and apprenticeships in high-value labour intensive agro-processing and manufacturing sectors

Pathway 4.6: Roads Network Development

Game-Changing Actions:

- Fast-tracking the completion of on-stop border customs post on Malawian side
- Upgrading district and rural feeder roads network
- Develop robust roads repair and maintenance system including involvement of local communities in rural roads governance
- Increase roads financing through healthy road funds, PPP arrangements, concessional loans, and funding by development partners

Pathway 4.7: Harnessing Youth Bulge as a Demographic Dividend

Game-Changing Actions:

- Promote life skills education at different levels is important to prepare the youth towards self-identification, vision setting and rational decision making
- Promote intensive technical and vocational education and training
- Promote decent work of youths in agriculture, livestock, fisheries and forestry sectors
- Engage youths in environmental sustainability programs
- Promote life skills education at different levels is important to prepare the youth towards self-identification, vision setting and rational decision making
- Promote intensive technical and vocational education and training
- Promote decent work of youths in agriculture, livestock, fisheries and forestry sectors
- Engage youths in environmental sustainability programs

Pathway 4.8: Transitioning to Sustainable and Clean Energy for All

Game-Changing Actions:

- Make alternative sustainable clean energies available, accessible, affordable and reliable
- Adoption of energy-efficient technologies as a solution for sustainable watershed management
- Promote integrated management of catchments supplying water for hydropower generation
- Intensify rural electrification programs
- Explore carbon trade opportunities in the energy sector

Pathway 4.9: Promoting Sustainable Socio-Economic Development Enablers (Gender, R&D and ICT)

Game-Changing Actions:

- Promote the use of Science, Technology and Innovation (STI) within the ICT environment in the planning, implementation, and M&E of actions
- Address gendered digital divide against women and girls
- Strengthen technical cooperation in R&D and digitization for efficient transboundary management of the shared resources

Pathway 4.10: Strengthening regional or bilateral collaboration in governance, policies, and policy enforcement

Game Changing Actions:

1. **Harmonized Policies and Regulations:** Collaboratively align water-related policies, regulations, and legal frameworks to create a consistent and efficient regulatory environment, facilitating decision-making and enforcement.
2. **Conflict Resolution Mechanisms:** Establish transparent and equitable dispute resolution mechanisms to address potential conflicts related to water use and management between the two countries, promoting cooperation.
3. **Community Engagement and Public Awareness:** Involve local communities and stakeholders in decision-making processes and governance structures, ensuring that policies and enforcement actions are in line with local needs and priorities. Launch public awareness campaigns to educate citizens about sustainable water management and conservation.
4. **Capacity Building and Environmental Conservation:** Invest in capacity-building programs for relevant stakeholders, enhancing their skills and knowledge for effective basin management. Implement joint environmental monitoring and conservation initiatives to protect the Songwe basin's ecosystem and biodiversity, addressing issues like deforestation, soil erosion, and habitat degradation.

PART ELEVEN

CONCLUSION AND RECOMMENDATIONS

11 Overview

This part offers conclusions and provides broader recommendations concerning the implementation of sustainable river basin management and development in the Songwe River Basin. These recommendations are essential as they address critical governance issues encompassing policies, strategies, plans, values, legislation, and institutions.

11.1 Conclusions

The Songwe River Basin (SRB) is a region rich in natural resources and abundant biodiversity, essential for sustaining livelihoods and driving the local economy. However, this basin faces a complex web of interconnected environmental and socio-economic challenges that demand immediate attention. On the environmental front, the SRB grapples with urgent issues such as deforestation, land and water resource degradation, and the alarming decline of ecosystems, resulting in a loss of biodiversity. These challenges are exacerbated by intensified human activities, leading to siltation and soil erosion.

Simultaneously, the basin contends with significant socio-economic issues, including widespread poverty, inadequate education systems, an underdeveloped road network, a burgeoning youth population, and unsustainable energy practices. These problems have far-reaching consequences, both directly through cross-border actions and indirectly through localized activities with transboundary repercussions.

However, the most critical factors, spanning across all thematic areas, are governance issues encompassing policies, strategies, plans, values, legislation, and institutions. Assessments during this assignment have revealed significant mismanagement of environmental threats originating from human activities and have highlighted weaknesses in existing institutions responsible for the overall management of SRB natural resources. These include:

i. Existence of national policy incoherencies; and in particular absence of coherent national policies and strategies for river basin management;
ii. Inadequate implementation and enforcement of relevant policies and laws/regulations, such as environmental, water, and land regulations.
iii. Inadequate implementation and enforcement of relevant policies and laws /regulations and by-laws (e.g environment, water and land) respectively;
iv. Weak institutional capacity and coordination aggravated by political interference in regulation and enforcement. Governance of key sectors (e.g., water, land and agriculture) in the SRB was based on a sectoral approach; each managed separately through dedicated policy, institutional and legal/regulatory frameworks aggravated by existence of overlapping mandates and responsibilities of such stakeholders;
v. Insecurity of land tenure and inadequate titling of land for agricultural (including crops, livestock, fisheries and forestry) investment; delays in issuance of title deeds; and absence of detailed land use plans at district and village levels; and
vi. Lack of adequate scientific and socio-economic data and information to support policy making, monitoring and enforcement of relevant legislations; and
vii. Inadequate financial mechanisms and resources for addressing transboundary river basin related issues; and

viii. Inadequate awareness, understanding and appreciation of the cultural and economic value of SRB ecosystem goods and services among policy makers and legislators, the civil society and the private sector in general.

While existing conventions and regional treaties and institutions play a vital role in promoting transboundary cooperation and integrated natural resource management, some deficiencies were identified:

i. Lack of robust enforcement mechanisms in conventions such as UNFCCC and Kyoto Protocol;
ii. The influence of major powers (e.g., USA and Japan);
iii. Biodiversity issues require a cross-sectoral and system-thinking approach and greater public participation, which have been lacking;
iv. A proliferation of conventions; and
v. Insufficiently trained professionals in areas such as biodiversity, climate change, transboundary water, and natural resource management

11.2 Recommendations

Addressing the root causes of these multifaceted challenges is of paramount importance if the Songwe River Basin (SRB) is to realize its shared Vision 2050 and achieve sustainable socio-economic progress. Recognizing the interplay between environmental and socio-economic factors is essential, as sustainable development in this context hinges on striking a balance between the preservation of the basin's natural resources and the improvement of the quality of life for its inhabitants. By tackling deforestation, resource degradation, and ecosystem loss alongside poverty alleviation, educational enhancement, infrastructure development, and sustainable energy initiatives, the SRBDP can pave the way for a more prosperous and harmonious future for the entire region. Tackling these issues in the SRB requires existence of ecologically sound and harmonized policies and laws/regulations that are effectively implemented and enforced respectively underpinned by properly coordinated and strengthened institutions at global, regional, national and sub-national levels. Based on the conclusions stated above and a drive for harmonized policies, the following recommendations deserve due attention:

i. **High level of Government commitment by both countries**: Governance issues raised above are transboundary in nature and call for high-level commitment and political goodwill (including resources) both at national and regional levels; and require that these commitments be sustained in order SONGWECOM to realize its shared vision 2050. Success of the proposed game-changing actions critically depends on the commitment of the riparian countries to the proposed collaborative/cooperative institutional frameworks (see Table 9.4); and to achieving the objectives of the SRBDP. This calls for a paradigm shift in both riparian countries requiring mutual respect, building trust, political and government accountability, among other things. Both Governments of Malawi and Tanzania should see the proposed interventions as offering the possibility of moving beyond isolated planning and unilateral actions (silo mentality) towards cooperative development planning in the utilization of trans-boundary resources in an equitable manner.

ii. High level Government commitment should pave way for **formulation and implementation of an Integrated Ecosystem-Based Management Plan**, harmonization of existing policies, laws and institutional frameworks and mandates to facilitate sharing of information and research data; strengthening of regional and national government policies and management procedures; expansion of areas of international and regional cooperation, including technology transfer, personnel and information exchange; development of regional policies that addresses various sectors within the SRB.
iii. Accordingly, efforts should be made by both Governments (relevant MDAs and LGAs) to **promote sustainable land use management** by designing and implementing integrated watershed management, developing capacity in land use planning, massive tree planting and protection (including reforestation, afforestation and farmer-based natural regeneration with robust incentives and M&E system), controlling livestock overstocking and encouraging people-public-private partnership (4Ps).
iv. Develop a community-based participation programme to enhance **sustainable environmental management**, which should, among other things, include strengthening, monitoring and control of human activities causing the loss of important ecosystems within the SRB; conducting public awareness on trans-boundary environmental issues; incorporation of regionally harmonized principles, policies, strategies, laws and other agreements into national legislation to enhance enforcement; and increasing environmental education and awareness among communities. Positive attributes from the informal institutions hovered around values, customs and traditions should be factored into the harmonization processes of policies and the like.
v. **Sustainable access to clean and safe water in the SRB**: Water security, quality and proper decision on use of water requires ample and correct water quantity information gathered from regular and continuous data collection on climate, hydrology, inflows, outflows and water balance in both countries. This should be enhanced by standardization of data collection equipment and instruments to ensure data uniformity; collection of more data on water circulation so as to understand the dynamics within the Songwe River; as well as reviewing and strengthening of existing Songwe River/Lake Nyasa/Malawi Basin Agreements; monitoring the water quantity, quality and utilization taking care of construction of water reservoirs, dams and flood protection devices along flood prone river tributaries.
vi. Both Governments of Malawi and Tanzania should conserve **biodiversity** through development and implementation of national and regional biodiversity strategies including specific action plans espousing integrated Ecosystem-Based Management Approach. These require putting in place mechanisms for prevention of adverse human activities on ecologically fragile areas and to reduce impacts of poor agricultural practices such as shifting cultivation, cultivation along river banks, overgrazing and hunting practices including bush fires.

ANNEXES

Annex 1: Fish Species as per AUCN's Red List Assessment for Malawi

SN	Family	Binomial	EX	CR	EN	VU
1	Cyprinidae	*Labeo worthingtoni*	√			
2	Bagridae	*Bagrus meridionalis*		√		
3	Cichlidae	*Aulonocara baenschi*		√		
4	Cichlidae	*Aulonocara kandeense*		√		
5	Cichlidae	*Aulonocara maylandi*		√		
6	Cichlidae	*Chindongo saulosi*		√		
7	Cichlidae	*Copadichromis nkatae*		√		
8	Cichlidae	*Corematodus shiranus*		√		
9	Cichlidae	*Mchenga conophoros*		√		
10	Cichlidae	*Melanochromis chipokae*		√		
11	Cichlidae	*Melanochromis lepidiadaptes*		√		
12	Cichlidae	*Metriaclima koningsi*		√		
13	Cichlidae	*Metriaclima usisyae*		√		
14	Cichlidae	*Nyassachromis breviceps*		√		
15	Cichlidae	*Oreochromis chungruruensis*		√		
16	Cichlidae	*Oreochromis karongae*		√		
17	Cichlidae	*Oreochromis lidole*		√		
18	Cichlidae	*Oreochromis squamipinnis*		√		
19	Cichlidae	*Pseudotropheus cyaneorhabdos*		√		
20	Cichlidae	*Serranochromis robustus*		√		
21	Cyprinidae	*Labeo mesops*		√		
22	Cichlidae	*Aulonocara guentheri*			√	
23	Cichlidae	*Champsochromis spilorhynchus*			√	
24	Cichlidae	*Labidochromis zebroides*			√	
25	Cichlidae	*Nyassachromis boadzulu*			√	
26	Cichlidae	*Placidochromis phenochilus*			√	
27	Cichlidae	*Pseudotropheus brevis*			√	
28	Cichlidae	*Trematocranus microstoma*			√	
29	Cichlidae	*Chindongo demasoni*				√
30	Cichlidae	*Cynotilapia chilundu*				√
31	Cichlidae	*Cytocara mooni*				√
32	Cichlidae	*Metriaclima flavicauda*				√
33	Cichlidae	*Nimbochromis fuscotaeniatus*				√
34	Cichlidae	*Otopharynx pachycheilus*				√
35	Cichlidae	*Ramphochromis esox*				√
36	Cichlidae	*Ramphochromis longiceps*				√
37	Cyprinidae	*Enteromius seymouri*				√
38	Cyprinidae	*Opsaridium microlepis*				√
39	Nothobranchidae	*Nothobranchius kirki*				√

Source: Fisheries Department, Malawi.

Annex 2(a): Consulted Regional Planners and Technocrats, Mbeya Region

S/N	Name	Position	Contacts
1.	Said J. Maditto	AAS-EPSS	0756327998
2.	Emmanuel Kilumby	AAS-PL	0754048116
3.	Stanley Kibakaya	Ag: AAS	0767396924
4.	Marietha Kereti	RBO	0766111993
5.	Zabron Mwalyasi	Valuer	0755690763
6.	David Muloba	Mining Officer	0766991133
7.	Adam Mhagama	Fisheries Officer	0765015090
8.	Simon Parmet	Forest Officer	0768599101
9.	Judica Kibona	Game Officer	0763065051

Consulted Participants Group Picture, RS Mbeya
Photo Credit: *Placid Jumanne*

Annex 2(b): Consulted Regional Planners and Technocrats, Songwe Region

S/N	Name	Position	Contacts
1.	Juma S. Mwanyange	Ag: AAS-PC	0755166370
2.	Vansicar A. Kulanga	AAS & DPSS	0623999093
3.	Lazaro Melchizedek	Ag: AAS-IT&I	0715741670
4.	Omari A.R. Kapeyu	PLO	0718653399
5.	Zachayo F. Mwaitosya	RNRA	0755658990

Consulted Participants Group Picture, RAS Songwe
Photo Credit: *Placid Jumanne*

Annex 2(c): Consulted District Planners and Technocrats, Kyela DC

S/N	Name	Department	Contacts
1.	Pantaleo Mushi	Ag. DED	0757912616
2.	Keneth Nzilano	DAICO	0762719044
3.	Waziri Mwakiborwa	DPCO	0655454388
4.	Gerald Mlelwa	TEO	0754952106
5.	Godwin Gozibert	Environmental Health	0763818939
6.	Chata A. Mwaifunga	EC	0784747187
7.	Elias G. Awari	DIITO	0736625282
8.	CPA Manda S.A.	District Treasury	0754823720
9.	Arnold Celestine	DLDO	0676965114
10.	Milly John Masare	HPMU	0754697373
11.	Grace F. Wiranga	Secondary Education	0746552020
12.	Dr. Sunday Mwakyusa	Medical	0769861848
13.	Geofrey S. Paul	Primary Education	0755578308
14.	Antukene B. Rashidi	Secretary to the CMT	0762209866
15.	James Kaema	DIA	0757046466
16.	Denis Rweyemamu	DE	0758383998
17.	Arnold Bachubira	Irrigation Engineer	0756047170
18.	Zawadi Sinkwembe	Human Resource	0765312714

Consulted CMT Participants Group Picture, Kyela DC
Photo Credit: *Placid Jumanne*

Annex 2(d): Consulted District Planners and Technocrats, Karonga

S/N	Name	Department	Contacts
1.	Victor Phiri	Meteorology	0999652020
2.	Austin Komwa	Trade	0991627280
3.	Malani Chivula	Museum	0994235969
4.	Blessing Kayiva	Community Development	0999768660
5.	Henry Mshanga	Social Welfare	0995278472
6.	Mirabel Munthali	Gender	0995432727
7.	Yamikani Bokosi	Irrigation Office	0999600038
8.	Shephered Jere	Disaster Management	0996365347
9.	Lewis Tukula	District Health Officer (DHO)	0999206298
10.	Christopher Chirwa	Forest	0999299108
11.	Mabvuto Mzomera		0997207363
12.	Patrick Moy	Fisheries	0999106679
13.	Foster Katope	Environment	0992648058
14.	Keston Sinkhondi	Land Resource	0993901586
15.	Innocent Chavula	Extension officer	0994146048

Consulted CMT Participants Group Picture, Karonga DC
Photo Credit: *Placid Jumanne*

Annex 2(e): Consulted District Planners and Technocrats, Ileje DC

S/N	Name	Position	Contacts
1.	Kaini S. Mwangosi	Livestock Officer	0754605905
2.	Alkadi F. Mnzava	Agricultural Officer	0621412125
3.	Frank Kisanga	Environmental Officer	0747085209
4.	Elimetindi Tesha	Forest and Beekeeping Officer	0764938922
5.	Lucia Mwami	Community Development Officer	0782844266
6.	Denis Mtega	Ag: DITRIO	0621052351
7.	Joel Lyoto	Ag: DPLO	0746254332
8.	Emanuel Panday	Livestock and Fisheries Officer	0679546424
9.	Erisia Mkumbwa	Ag: DM RUWASA	0765827739
10.	Herman Njeje	DALFO	0757050087

Annex 2(f): Consulted District Planners and Technocrats, Mbeya DC

S/N	Name	Position	Contacts
1.	Stephen E. Katemba	DED	0653375260
2.	Filbert Mbwilo	DPLO	0625839242
3.	Gidion Mapanda	DALFO	0755559849
4.	Alpin D. Mwidami	DEMO	0769218090
5.	Elizabeth Lyombe	DITRIO	0767793512
6.	Dr. Fredrick Moshi	DMO	0756357116
7.	Agnes F. Elikunda	DCDO	0768753441
8.	Gerald E. Shayo	Ag: DNRO	0762471373
9.	Timoth M. Mpangala	WAEO	0754532849

Consulted CMT Participants Group Picture, Mbeya DC
Photo Credit: *Placid Jumanne*

Annex 2(g): Consulted District Planners and Technocrats, Mbozi DC

S/N	Name	Position	Contacts
1.	Pius M. Sayayi	Ag: DED	0752684908
2.	Bunka Matogoro	DPP&O	0744587883
3.	Tumaini L. Yohana	Ag: DTRIO	0769352202
4.	Theotim Mwamwongi	Ag: DMO	0763414247
5.	Frank H. Mwashibanda	CC	0769177847
6.	Emmanuel Mamkwe	DLDO	0742784210
7.	Ramadhani Yusuph	PLO	0713549272
8.	Hamis P. Nzunda	DNRECO	0759511772
9.	George Nipwapwacha	DALFO	0752358235

Consulted CMT Participants Group Picture, Mbozi DC
Photo Credit: *Placid Jumanne*

Annex 2(h): Consulted District Planners and Technocrats, Chitipa

S/N	Name	Department	Contacts
1.	Steven Musopole	Desk Officer	0996289886
2.	Prince Shaibu	Agriculture	0884340120
3.	Frank Kamanga	Land	0995422725
4.	Xievier Mhango	Fisheries	0992580764
5.	Judith Banda	Irrigation	0880199264
6.	Joyce Luhaza	Social Welfare	0999064185
7.	Sitwell Banda	Forestry	0999600238
8.	Powex Musopole	Community Development	0996641632
9.	Hustings Nyiango	DAEMR	0999327382
10.	Boldwin Kitamula	LRCO	0882428484
11.	Willy Kanyoka	Environmental Health	0999193260
12.	Sam Chirwa	CPHO	0999263287
13.	Emmanuel Musukwa	Statistician	0994621855
14.	Cosmas Chikapa	Agriculture	0998188886
15.	Joseph Manda	Hydrology	0995656596

Consulted CMT Participants Group Picture, Chitipa DC
Photo Credit: *Placid Jumanne*

Annex 2(i): Consulted District Planners and Technocrats, Tunduma TC

Consulted CMT Participants Group Picture, Tunduma TC
Photo Credit: *Placid Jumanne*

Annex 3(a): List of Community PRA Participants in Ndwanga village in Kyela DC

Sn.	Name	Hamlet	Age	Gender	Contact
1.	Augustine K. Mwakatimbo	Ndanganyika	53	M	0716412008
2.	Daniel K. Mwantali	Ndwanga "B"	32	M	-
3.	Benjamin A. Mwakaponda	Ndwanga "A"	34	M	0718523939
4.	Joseph S. Mwaijega	Usalama	45	M	0789573210
5.	Dura E. Mwanta	Ndanganyika	34	M	0627364988
6.	Joshua T. Mwaseba	Katumbati	22	M	0764159165
7.	Yuster A. Mwakasonda	Ndwanga "A"	26	F	0789614626
8.	Elen N. Kajongolo	Ndwanga "B"	35	F	0656591490
9.	Loveness D. Samola	Katumbati	18	F	0713132016
10.	Yuster F. Mbeje	Ndanganyika	41	F	0623596818

Community PRA Participants Group Picture, Ndwanga Village, Kyela DC
Photo Credit: *Placid Jumanne*

Annex 3(b): List of Community PRA Participants in Karongolera village in Karonga

S/N	Name	Position	Sex	Phone Number
1.	Enock Mwailubi	P/School Headteacher	M	0999662019
2.	Afenanse Mwaseba	Village Head	M	0994475932
3.	Enita Ipopo	Farmer	F	
4.	Tulambe Ngairo	Farmer	M	
5.	Evidas Ndemele	Farmer	M	
6.	Oda Mwakanyamale	Farmer	F	
7.	Joster Mwaungulu	Farmer	F	
8.	Bester Katika	Farmer	F	
9.	Wakisa Mwaseosa	Farmer	M	
10.	Joster Mwabungulu	Farmer	F	
11.	Sifa Lupai	Farmer	F	
12.	Onesmo Mwakanyamale	Farmer	M	
13.	Innocent Chavura	Extension Officer	M	0881942244

Community PRA Participants Group Picture, Karongorela Village, Karonga DC
Photo Credit: *Placid Jumanne*

Annex 3(c): List of Community PRA Participants in Isoko village in Ileje DC

S/N	Name	Hamlet	Sex	Phone Number
1.	Noah L. Kibona	Kalola	M	0756462911
2.	Alosi N. Kibona	Katete	F	0766218793
3.	Maida M. Kaminyoge	Kalola	F	0756936487
4.	Stivini Mshani	Kalola	M	0764791111
5.	Anna Luka	Kalola	F	0762507410
6.	Osiaya Kabuje	Kalola	M	0765832455
7.	Laison Kibona	Kalola	M	0767836736
8.	Asajile Kibona	Kalola	M	0765929521
9.	Fikiria E. Kibona	Kalola	M	0759661476
10.	Eston M. Kibona	Lupembe	M	0763329951

Community PRA Participants Group Picture, Isoko Village, Ileje DC
Photo Credit: *Placid Jumanne*

Annex 3(d): List of Community PRA Participants in Iwiji village in Mbeya DC

S/N	Name	Position	Contacts
1.	Daniel K. Tete	Farmer	
2.	Daniel S. Mwampamba	AMCOS Chairman	
3.	Jacob Mtafya	AMCOS Secretary	
4.	Adam B. Kibona	AMCOS Secretary	
5.	Kalinga M. Kalinga	Farmer	
6.	Peter Michael	AMCO Accountant	
7.	Lowland Lucas	AMCOS Secretary	
8.	Hana Msika	Farmer	
9.	Hezron Kibona	Farmer	
10.	Eliza Isaya	Farmer	
11.	Eda Mwendeleghe	Farmer	
12.	Patson M. Mwazembe	Farmer	
13.	Fahari Yoram Mzumbweti	Farmer	

Community PRA Participants Group Picture, Iwiji Village, Mbeya DC
Photo Credit: *Placid Jumanne*

Annex 3(e): List of Community PRA Participants in Idiwili village in Mbozi DC

S/N	Name	Position	Contacts
1.	Watsom N. Mwashibili	Village chairman	0767507053
2.	Nebart N. Shonza	VEO	0755555011
3.	Nico T. Nyeza	Security committee	0762114260
4.	Raulenti H. Hasunga	Hamlet chairman	0754813665
5.	Samson M. Mwambogoo	Welfare committee	0764433271
6.	Julius Mwahalendo	villager	0624523628
7.	Doctor M. Mkondya	Environment committee	0764933420
8.	Silvana H. Mwampamba	villager	0754205429
9.	Agness T. Ntandala	villager	0625331824

Community PRA Participants Group Picture, Idiwili Village, Mbozi DC
Photo Credit: *Placid Jumanne*

Annex 3(f): List of Community PRA Participants in Cheni village in Chitipa

S/N	Name	Position	Contacts
1.	Kondwani Nyondo	Farmer	
2.	Moses Munkondya	Farmer	
3.	Sarah Munkondya	Farmer	
4.	Lonis Nyondo	Farmer	
5.	Ethel Mulenga	Farmer	
6.	Elizabeth Simwayi	Farmer	
7.	Atupiye Kamwanga	Farmer	
8.	Benwell Kapesa	Farmer	
9.	Hurry Kabaghe	Farmer	
10.	Veliness Nambaye	Farmer	

Annex 3(g): List of Community PRA Participants in Isinde street in Tunduma TC

S/N	Name	Position	Contacts
1.	Paul T. Sichalwe	Farmer	0759799046
2.	Stewart J. Simkoko	Farmer	0753351881
3.	Given J. Simkoko	Farmer	0742748718
4.	Tyson J. Lavelwa	Farmer	-
5.	Linesi Sikaponda	Farmer	-
6.	Mickson N. Simkamba	Street committee member	0753054931
7.	Enson S. Simkoko	Farmer	0653548019
8.	Edina F. Mwampashi	Farmer	-
9.	Esther J. Simbeye	Farmer	-
10.	Daud N. Sichwale	Farmer	0719652464

Community PRA Participants Group Picture, Isinde Street, Tunduma TC
Photo Credit: *Placid Jumanne*

Annex 4: List of Attendants of the Inception Workshop (SONGWECOM and JSC)

17RD & 18TH February 2022 Usungilo Hall Mbeya, Tanzania

SN	Full Name	E-mail address	Country/Institution
1	Biswick Mlaviwa	bismlaviwa@gmail.com	Malawi MoNR
2	Max Wengawenga	maxwengawenga@gmail.com	Malawi MoW
3	Solomon Kalima	solomonkalima@gmail.com	Malawi MoW
4	Winston Sataya	wsataya@gmail.com	MoA (Irrigation)
5	Bigsings Sosowili	sosobkiss@gmail.com	MoA
6	Rehema Omindo		Joint SRBC
7	Hyde Sibande	hydesibande@gmail.com	SRBC
8	John Kavishe	john.kavishe@maji.go.tz	LNRBWB
9	Antony Nsisimu	antonyndembella@gmail.com	LNRBWB
10	Eliofou Hango	eliofoughata@gmail.com	LNRBWB
11	Linus Kidwangise	kidwangiselj@gmail.com	LNRBWB
12	John Mthandi	johnmthandi@yahoo.com	
13	Golden Nyasulu	osengoa@gmail.com	MoE
14	Chikondi Mbemba	chikondimbemba@gmail.com	Malawi MoW
15	Siya Mamiro	siyamamiro@gmail.com	LNRBWB
16	Brown Mphalo	mphalobrown@gmail.com	Ministry of Lands
17	Chrigine Kalunzulu	kalunzuluC@gmail.com	MoLG
18	Boniface Nthakomwa	Bnthakomwa31@gmail.com	SRBC
19	Sadic Lotha Laiser	bussersadic@yahoo.com	SRBC
20	Tumaini Mwaijaya	tumainimwaiaya@gmail.com	LNRBWB
21	Lameck Fiwa	lameckfiwa@gmail.com	SUA-Malawi
22	Claude Maeda	maedaclaude@yahoo.com	SUA-TZ
23	Winfred Mbungu	winfredm@gmail.com	SUA-TZ
24	Jumanne Placid	kjplacid@gmail.com	SUA-TZ

Inception Workshop Participants Group Picture
Photo Credit: *Placid Jumanne*

Annex 5(a): List of Local Public Dialogue Participants in Kyela DC

Sn.	NAME OF STAKEHOLDER	SEX	ORGANIZATION	TEL.	INTERESTS/ACTIONS IN BASIN
1.	Innocent A. Mwankemwa	M	Kabanga	0764212028	Farming
2.	Emmanuel M. Mwambeta	M	Matema BMU	0784017233	Fishing
3.	Kennedy D.N. Korosa	M	TCCIA	0754835650	Private Sector
4.	Simon Mkanya	M	KYENGONET	0755785328	Capacity Building
5.	Newton Mwakabambo	M	Kyela Enviro	0765293710	Environ. conservation
6.	Joseph Mwaipopo	M	Mpunguti	0714379466	Farming
7.	Ena Kalonge	F	Ikimba	0753001070	Farming
8.	Judith L. Mfundo	F	Sauti ya Mwenani	0754348526	Beekeeping
9.	Donath H. Sanga	F	Ufugaji nyuki	0754410310	Beekeeping
10.	Panga E. Mwakajumbe	M	Chairman Kabanga	0713068803	Village chairman
11.	Janeth Burton Silyimbo	F	Youth Group	0713212183	Youth
12.	Ale Volume Mwakakiko	M	Katumba	0718302852	Farming
13.	Martha Luganomwari	F	Kajunjumele	0768190741	Fish processing
14.	Eng. Arnold Bachubira	M	Kyela UDC	0756047170	Focal Person
15.	Amos Kayembele	M	Kyela D.C.	0767566611	Disaster management
16.	Chata A. Mwaifunga	M	Kyela D.C.	0784747187	Committee Clark
17.	Adelina Kabefu	F	Kyela D.C.	-	Hall Attendant

Dialogue Participants Group Picture, Kyela DC
Photo Credit: *Placid Jumanne*

Annex 5(b): List of Local Public Dialogue Participants in Karonga DC

Sn.	NAME OF STAKEHOLDER	SEX	ORGANIZATION	TEL. PHONE	INTERESTS/ACTIONS IN BASIN
1.	Innocent Chavula	M	Agriculture	0994146248	Crops
2.	King N. Mvula	M	Tourism	0999609510	Crops and Livestock
3.	Lyson A. Mwakabole	M	CBO Chair	0999192118	Crops
4.	Edward T. Chitete	M	ADC Mwakabika	0994981668	Crops
5.	Mike Mwakunda	M	GVH	0994051250	Crops
6.	Mdhaka Mwakaboko	M	P.G.V.H.	0992930674	Crops
7.	Atusaye Mwenifumbo	M	P.E.A. REPR	0998436776	Private sector
8.	Chimwemwe Shora	M	NGOs Representative	0995122301	Crops and Livestock
9.	Jonas Kasanga	M	WUWA Irrigation	0993836646	Chair person
10.	Idaya Ndenuka	F	Chair U.A.C	0998459626	Chair person
11.	Fainess Ntende	F	Chair person	0993204136	Chair person
12.	Renson A. Mbale	M	Farmer	0999182290	Crops
13.	Moshi Fundi	F	Crops Farmer	0995830513	Forest

Dialogue Participants Group Picture, Karonga DC
Photo Credit: *Placid Jumanne*

Annex 5(c): List of Local Public Dialogue Participants in Chitipa DC

Sn.	NAME OF STAKEHOLDER	SEX	ORGANIZATION	TEL. PHONE	INTERESTS/ACTIONS IN BASIN
1.	Gunnet Mazanga	M	Misuku Ecotourism	0992466755	Tourism Business
2.	Len Kanyika	M	Mwamalangu DC	0980523183	Local Leadership
3.	Winstone B.C. Silungwe	M	Banana Co-operatives	0991990640	Agriculture protection
4.	Raymond Kanyika	M	TDI	0999169023	Agriculture/Afforestation
5.	Jane Mwafwongo	F	Farmer	-	Agriculture
6.	Jane Mbukwa	F	Mondo CBO	0882670838	Community development
7.	Simon Mwanguku	M	Honey Cooperative	0998433534	Natural Resource Management
8.	Zachari Kilembe	M	Carpentry Business	0997711655	Timber productions/use
9.	Fackster Simwela	M	Smallholder Farmer	0990915576	Agriculture
10.	Lameck Kayuni	M	Misuku WUA	0993889494	Water Resource Management
11.	Lyforce Chizumila	M	Kakomo ADC	0996938078	Area Leadership
12.	Sir Chief Mwenemisuku	M	Local Government	0981844745	Leadership / etc.
13.	Edson Ndawe	M	Timber production	0991859997	Timber production
14.	Clement Simkonda	M	Forestry Department	0996910445	Forest conservation
15.	Bristone L.M. Kanthunga	M	Wells for ZoE	0994795006	Tree planting & conservation
16.	Steven Musopole	M	SRBDP Focal point	0996289886	Program/Project coordination

Dialogue Participants Group Picture, Chitipa DC
Photo Credit: *Placid Jumanne*

Annex 5(d): List of Local Public Dialogue Participants in Ileje

Sn.	NAME OF STAKEHOLDER	SEX	ORGANIZATION	TEL. PHONE	INTERESTS/ACTIONS IN BASIN
1.	Maiko Ndimbwa	M	Ilondo	0754913348	Fisheries, water resource
2.	Pokea Ndimbwa	M	Ilondo	0752391717	Beekeeping/Coffee/Fisheries
3.	Telezia E. Kapesa	F	Bulanga	0746134373	Poultry
4.	Huruma H. Mtawa	F	Bulanga	0743382335	Poultry
5.	Joel E. Msomba	M	Bulanga	0752766887	Conservation
6.	Kenison M. Mtafya	M	Ilondo	0755658625	Beekeeping/Avocado
7.	Atamigwe L. Rungwe	M	Ilondo	0752089308	Herbalist/Livestock keeping
8.	Subira Kasekwa	F	Bulanga	0748978357	Coffee/Miller
9.	Julius Mbwele	M	Bulanga	0757362678	Maize/Beans
10.	Justa Mtafya	F	NGO/Ilondo	0766646130	Avocado/Coffee
11.	Tugeligwe Ndimbwa	F	Ilondo	0753524392	Avocado/Coffee
12.	Anangisye Kajinga	M	Ilondo	0768745819	Coffee
13.	Rehema Mtafya	F	Ilondo	0743939282	Poultry/Commercial Farmer
14.	Sumagha Mshani	F	NGO Bulanga	0763133577	Coffee
15.	Stanely Mtawa	M	Ilondo	0762334846	Beekeeping/Carpenter
16.	Frank A. Kisanga	M	Ileje DC	0747085209	SRBDP
17.	Deonatus M. Komba	M	Malangali Ward	0757251830	Site Focal Person

Dialogue Participants Group Picture, Ileje DC
Photo Credit: *Placid Jumanne*

Annex 6(a): Consulted Higher-Level Stakeholders in Malawi

Sn.	Date	Name of Stakeholder	Organization	Position	Address/E-mail/Phone
1.	26/04/2023	Priscilia Mkangawire	MERA	EA	0999 923189
2.	26/04/2023	Chimwemwe S. Ndhlovu	CADECOM	ND	0999 303710
3.	26/04/2023	Dr. Julius Churu	DAHLD	Director	0991 277492
4.	26/04/2023	Innocent Nkangala	DAHLD	Deputy Director	0999 202887
5.	26/04/2023	Gift H. Kamwamba	DAHLD	Planning Officer	gkamwamba2010@yahoo.co.uk
6.	26/04/2023	Gertrude Kambagwa	DLRC	PLRCO	gkambagwa@gmail.com
7.	26/04/2023	Kefasi Kamoyo	DLRC	PLRCO	kamokefa@yahoo.com
8.	26/04/2023	Julius Ng'oma	CISONECC	Coordinator	julius@cisoneccmw.org
9.	27/04/2023	Francis Chilimampunga	Forestry	Deputy Director	fchilima@gmail.com
10.	27/04/2023	Teddie Kawo	Energy	Deputy Director	teddiecawo@yahoo.com
11.	27/04/2023	Stella F. Gama	Forestry	Director of Forest	fumesonstella@gmail.com
12.	27/04/2023	Chrispine Kalungulu	Ministry of lands	Economist	kalunguluc@gmail.com
13.	27/04/2023	Golden Nyamlu	Ministry of Energy	Chief Energy Officer	golden.nyamlu@yahoocom
14	27/04/2023	Happy Kadewere	Ministry of Energy	Energy Officer	happykadewere@gmail.com
15.	27/04/2023	Amos Milonde	MoE	Energy Officer	amilonde@gmail.com
16.	27/04/2023	Petros Nyirenda	MoE	Energy Officer	petrosnyirenda@gmail.com
17.	27/04/2023	Aaron Kalua	MoE	Economist	akaluac@gmail.com
18.	28/04/2023	Maurice Makuwila	Dept. of Fisheries	Senior Deputy Director	mau_maka@yahoo.com
19.	28/04/2023	Davison Khumbayiwa	Dept. of Fisheries	Principal Fisheries Officer	khumbanyiwadavis@gmail.com
20.	28/04/2023	Ida Mwato	Dept. of Crops	Deputy Director	idamwato10@gmail.com
21.	28/04/2023	Elida Kazim	Dept. of Crops	Director	elidakazim2020@yahoo.com
22.	28/04/2023	B. Mphalo	MoL	PMO	mphalobrown@gmail.com
23.	28/04/2023	Charles Mkoka	M.J	Head of Depart.	c.mkoka@gmail.com
24.	28/04/2023	Winston Sataya	DOI	Deputy Director	wsataya@gmail.com
25.	02/05/2023	David Mbamba	MAC-DOF	Zone Manager	dgmbamba32@gmail.com
26.	02/05/2023	Gerald Kamanga		DGT	kamangagerald@yahoo.com
27.	02/05/2023	Rev. Isayah V. Mhome		Deputy General	isayahmhome@yahoo.com
28.	02/05/2023	Francis N.C. Gondwe	MERA	Electricity Analyst	fgondwe@mera.mw
29.	02/05/2023	Dr. Asumani Langowe	NRWB	Director of Operations	anaungwe@yahoo.com
30.	02/05/2023	George Makukuta	ESCOM	Regional Manager	gmakukuta@escom.mw
31.	03/05/2023	Kenneth Sakala	SOLDEV	Executive Director	kensakala2000@gmail.com
32.	03/05/2023	Lameck Kayira	SOLDEV	Province Manager	Lameck.kayira@synadev.org
33.	03/05/2023	David Kamangra	DARE	Senior Deputy Director	davidkamangra@gmail.com

SN	Name	Institution	Email
1	Mr Biswick Mlaviwa	Environmental Affairs Department	bismlaviwa@gmail.com
2	Mr Patrick Mtingwi	Department of Climate Change and Meteorological Services	pmtingwi@yahoo.com
3	Ms. Patricia Zimpita	Ministry of Finance	pdzimpita@yahoo.com

Annex 6(b): Consulted Higher-Level Stakeholders in Tanzania

Sn.	NAME OF STAKEHOLDER	SEX	ORGANIZATION	TEL. PHONE	INTERESTS/ACTIONS IN BASIN	E-mail
1.	Dr. Victor Kongo	M	Global Water Partnership	0783376717	Water Resources	Vickongo@gmail.com
2.	Florah Ndaba	F	Tanzania Gender Network Partnership	0658590561	Gender	florah.ndaba@tgnp.or.tz
3.	Zainab Mmary	F	Tanzania Gender Network Partnership	0767911021	Gender	zainab.mmary@tgnp.or.tz

Sn.	Date	Name of Stakeholder	Organization	Position	Address/E-mail/Phone
1.	16/05/2023	Zainabu Shabani Bungwa	TFS-HQ	Ag. MFR	0714 522939
2.	16/05/2023	Juma Ramadhan Mwangi	TFS-HQ	PCO	0787 889977
3.	16/05/2023	John Rutagwaba	TFS-HQ	PCO	0752 904308
4.	16/05/2023	Kassim Ally	TFS-HQ	PCO	0786 22582

Sn.	Date	Name of Stakeholder	Organization	Position	Address/E-mail/Phone
1.	05/05/2023	Bwai M. Biseko	RUWASA	DAHRM (Ag. DG)	bwai.biseko@ruwasa.go.tz
2.	05/05/2023	Gerald M. Maganga	EWURA	Ag. DG	gerald.maganga@ruwasa.go.tz
3.	05/05/2023	Violet N. Iramu	EWURA	Ag.TMWS	violet.iramu@ruwasa.go.tz
4.	08/05/2023	Joseph Paul	NLUPC	Director Research	joseph.layson@nlupc.go.tz
5.	08/05/2023	Obed Henry Katonge	NLUPC	Assistant Director	obed.katonge@nlupc.go.tz
6.	08/05/2023	Dioscory Kanuti	NLUPC	Assistant Director	dioskori.urassa@nlupc.go.tz
7.	08/05/2023	Charles Mkalawa	NLUPC	TP	charles.cosmas@yahoo.com
8.	08/05/2023	Elmerinda Faustine	NLUPC	ADRD	elmerinda.faustine@nlupc.go.tz
9.	08/05/2023	Dr.Thomas Bwana	VPO-DOE	Ag. Director	thomas.bwana@vpo.go.tz
10.	09/05/2023	Bure I. Nassibu	MNRT	ADME	bure.nassibu@maliasili.go.tz
11.	09/05/2023	Biswalo M. Makwasa	MLHHSD	PLO	makwasa.biswalo@lands.go.tz
12.	09/05/2023	Godfrey Machabe	MLHHSD	Princip-Economist	godfrey.machabe@lands.go.tz
13.	09/05/2023	Fainahappy Kimambo	VPO	PLT	fainahappy.kimambo@vpo.go.tz
14.	09/05/2023	Said Athumani	VPO	PTP	athumani.said@vpo.go.tz
15.	10/05/2023	Robert K.M. Sunday	MoW	AD	robert.sunday@maji.go.tz
16.	10/05/2023	Mwanamkuu Mwanyika	MoW	P.H.	mwanamkuu.2mwanyika@maji.go.tz
17.	10/05/2023	Enock Nyanda	PO-RALG	ASSN-Director	brenyanda@gmail.com
18.	10/05/2023	Rogasian Lukoa	PO-RALG	ASSN-Director	rogasian.lukoa@tamisemi.go.tz
19.	11/05/2023	Emilian Nyanda	MoE	D. of Env.	emilian.nyanda@nishati.go.tz

SN	Name	Institution	Email
1	Dr. Victor Kongo	Global Water Partnership	Vickongo@gmail.com
2	Florah Ndaba	Tanzania Gender Network Partnership	florah.ndaba@tgnp.or.tz
3	Zainab Mmary	Tanzania Gender Network Partnership	zainab.mmary@tgnp.or.tz

Annex 7(a): Soil erosion risk classes and their corresponding land areas

District	Erosion Rate (t/ha/yr)	Erosion Class	Area (ha)	Proportion (%)
Ileje	< 2	Very slight	65,155	44
	2 - 5	Slight	3,549	2
	5 - 10	Moderate	3,972	3
	10 - 50	High	24,592	17
	50 - 100	Severe	23,793	16
	> 100	Very severe to Catastrophic	26,113	18
	Total		**147,174**	**100**
Kyela	< 2	Very slight	10,479	78
	2 - 5	Slight	845	6
	5 - 10	Moderate	761	6
	10 - 50	High	761	6
	50 - 100	Severe	423	3
	> 100	Very severe to Catastrophic	85	1
	Total		**13,352**	**100**
Mbeya	< 2	Very slight	7,352	46
	2 - 5	Slight	85	1
	5 - 10	Moderate	254	2
	10 - 50	High	4,141	26
	50 - 100	Severe	2,789	17
	> 100	Very severe to Catastrophic	1,521	9
	Total		**16,141**	**100**
Mbozi	< 2	Very slight	19,437	44
	2 - 5	Slight	761	2
	5 - 10	Moderate	2,028	5
	10 - 50	High	15,042	34
	50 - 100	Severe	5,577	13
	> 100	Very severe to Catastrophic	1,521	3
	Total		**44,366**	**100**
Tunduma	< 2	Very slight	3,127	67
	2 - 5	Slight	930	20
	5 - 10	Moderate	423	9
	10 - 50	High	85	2
	50 - 100	Severe	85	2
	Total		**4,648**	**100**
Tunduma	< 2	Very slight	1,366	43
	2 - 5	Slight	169	5
	5 - 10	Moderate	592	19
	10 - 50	High	531	17
	50 - 100	Severe	507	16
	Total		**3,165**	**100**
Chitipa	< 2	Very slight	74,789	47
	2 - 5	Slight	16,056	10
	5 - 10	Moderate	12,000	8
	10 - 50	High	26,958	17
	50 - 100	Severe	12,845	8
	> 100	Very severe to Catastrophic	15,380	10
	Total		**158,029**	**100**
Karonga	< 2	Very slight	17,662	52
	2 - 5	Slight	1,944	6
	5 - 10	Moderate	2,451	7
	10 - 50	High	9,296	27
	50 - 100	Severe	1,775	5
	> 100	Very severe to Catastrophic	761	2
	Total		**33,887**	**100**
	Grand Total		**420,763**	

Source: SONGWECOM TDA 2023. Soil Classification based on Morgan et al. 2004[131]

[131] Morgan, R.P.C., Hann, M.J., Shilston, D., Lee, E.M. et al. (2004). Use of terrain analysis as a basis for erosion risk assessment: a case study from pipeline rights-of-way in Georgia. Paper presented to International Conference on Terrain and geohazard challenges facing onshore oil and gas pipelines. BP/ICE, London.

Annex 7(b): Soil Loss Tolerance Limits (Ton/Ha/Year)

District	Soil Erosion/Loss (Ton/Ha/Year)	Tolerance Limit Class	Area (Ha)	Proportions (%)
Ileje	0 - 2	Acceptable Soil Loss for Tropical Soils	65,155	44.3
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	3,549	2.4
	> 5	Unacceptable Soil Loss for Tropical Soils	78,470	53.3
		TOTAL	**147,174**	**100**
Kyela	0 - 2	Acceptable Soil Loss for Tropical Soils	10,479	79
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	845	6
	> 5	Unacceptable Soil Loss for Tropical Soils	2,028	15
		TOTAL	**13,352**	**100**
Mbeya	0 - 2	Acceptable Soil Loss for Tropical Soils	7,352	45.5
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	85	0.5
	> 5	Unacceptable Soil Loss for Tropical Soils	8,704	54
		TOTAL	**16,141**	**100**
Mbozi	0 - 2	Acceptable Soil Loss for Tropical Soils	19,437	44
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	761	2
	> 5	Unacceptable Soil Loss for Tropical Soils	24,168	54
		TOTAL	**44,366**	**100**
Momba	0 - 2	Acceptable Soil Loss for Tropical Soils	3,127	67
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	930	20
	> 5	Unacceptable Soil Loss for Tropical Soils	591	13
		TOTAL	**4,648**	**100**
Tunduma	0 - 2	Acceptable Soil Loss for Tropical Soils	1,366	43
	> 5	Unacceptable Soil Loss for Tropical Soils	1,799	57
		TOTAL	**3,165**	**100**
Chitipa	0 - 2	Acceptable Soil Loss for Tropical Soils	74,789	47
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	16,056	10
	> 5	Unacceptable Soil Loss for Tropical Soils	67,745	43
		TOTAL	**158,029**	**100**
Karonga	0 - 2	Acceptable Soil Loss for Tropical Soils	17,622	52
	2 - 5	Acceptable Soil Loss for Shallow Highland Soils and Edible Soils	1,944	6
	> 5	Unacceptable Soil Loss for Tropical Soils	14,321	42
		TOTAL	**33,887**	**100**

Source: SONGWECOM TDA 2023. Classification according to Hudson (1986[132]); Lal (1980[133]) and Lal (1983[134])

[132] Hudson, N.W. (1986). Soil conservation. Batsford Limited, London, UK: 324 pp.

[133] Lal., R. (1980). Soil Conservation: Preventive and control measures. In: Morgan RPC (ed.): Soil conservation, problems and prospects. Proc. International conference. Soil Conservation, Silsoe, UK. John Wiley& Sons, New York: 175-181.

[134] Lal, R. (1983). Soil erosion and its relation to productivity in tropical soils. In: El-Swaify, SA., Moldenhauer, W.C. and Andrew, L.O. (eds.): Proceedings of the International Conference of Soil Erosion and Conservation, Hawaii: 237-247

Annex 8(a): Crop and Livestock Related Issues and Proposed Actions

Critical Issues	Proposed Actions
Low and unsustainable productivity and production	Promote sustainable intensification of crop and livestock systems
Unsustainable farming practices that do not integrate ecosystem consideration	Improved crop protection and plant health including IPM
Poor plant and health due to insect pests and diseases	Promote climate smart agriculture in crop and animal production
Poor animal genetics hindering livestock productivity	Develop strategic crop and livestock value chains with high economic and social returns on investments
Lack of modern livestock services infrastructure	Optimize green growth and circular economy opportunities in the major crop and livestock value chains
Climate change and variability	Promote profitable community-based legumes seed production
Limited capacity of farmers for efficient O&M of developed irrigation schemes	Installation of borehole watering points with watering troughs for animals
Underdeveloped grain legume seed system	Animal genetics improvements through breeding and access to AI services
	Development of one-stop livestock development centres with all services such as vet clinics and quarantine services
	Increase investments in R&D particularly in seed development, crop production and protection, and animal genetics improvements

Source: Stakeholders' Consultations, 2023

Annex 8(b): Fisheries Related Critical Issues and Proposed Actions

Critical Issues	Proposed Actions
Unsustainable capture fisheries	Promote ecosystem-based fisheries development including building the capacities of the communities and technocrats
Underdeveloped aquaculture	Development of fish value chains in capture fisheries and aquaculture
Degradation of riparian watershed impacting negatively on downstream aquatic ecosystem	Strengthen capacities of local fisheries management institutions
Improper management of hazardous wastes in the riparian watersheds	Embark of effective management of hazardous wastes in the riparian watersheds
Underdeveloped fisheries value chains	Promote transboundary trade of fisheries inputs and products
Weak local fisheries management institutions including Beach Management Units (BMUs) and Riverine Village Committees (RVCs)	Development of water-resource specific policies such as wetland management policy
Inadequate coordination of transboundary fisheries management and technical cooperation	Strengthen transboundary cooperation in sustainable fisheries management

Source: Stakeholders' Consultations, 2023

Annex 8(c): Forestry Sector Issues, and Proposed Actions

Critical Issues	Proposed Actions
Deforestation and forests degradation	Promote tree planting, afforestation and farmer-based natural regeneration with robust incentives and M&E system
Biodiversity degradation and loss	Develop forestry value chains involving women and youth groups and associated sectors such as beekeeping and eco-tourism
Underdeveloped eco-tourism and beekeeping sectors	Promote the Public-Private-Community Partnership (PPCP) arrangements in eco-tourism development in reserved central Government and community forests
Inadequate armed forestry guards for effective patrols and protection	Increased forestry budgets for effective forestry patrols and protection
Limited budget for employing guards, equipping and running effective forestry patrols and protection	Establishing Forestry Management Fund
	Strengthened enforcement of forestry conservation laws through well-trained and equipped armed guards
	Development and institutionalization of frameworks and guidelines for sustainable inclusive forestry management including verified carbon trade and payment for ecosystem services
	Strengthen transboundary cooperation including regular meeting of the Joint Permanent Commission on Cooperation (JPCC) where among others issues of transboundary forestry and wildlife are discussed
	Strengthen forestry governance at all levels: local community, subnational, national, bilateral, regional (SADC) and International (e.g., CDM)

Source: Stakeholders' Consultations, 2023

Annex 8(d): Education Related Critical Issues and Proposed Actions

Critical Issues	Proposed Actions
Limited reproductive health education leading to higher fertility rate hence rapid growth of population	Promote girl child education to reduce fertility rate as more time will be spent at school
High number of out-of-school children[135]	Increase awareness of family planning to reduce natural population growth using a multisectoral approach which involves roles of health sector, culture, religion and political will
Lack of linkages between research, vocational training, and extension	Formulate targeted policies, strategies and programs to ensure out-of-school children and youths have access to education and vocational training
	Strengthen linkages between research, vocational education, and extension services[136]
	Re-design education curricula to incorporate the requisite skills needed for the fourth industrial revolution[137]
	Promote technical education and vocational training and apprenticeships in high-value labour intensive agro-processing and manufacturing sectors such as fisheries, horticulture, species, leather, dairy and carpentry

Sources: Stakeholders Consultations and Reviewed Planning Documents

[135] GoM 2022. Malawi Education Factsheet|2022. Analyses for learning and equity using MICS data. Ministry of Education. Lilongwe.
[136] GoM 2021. MW2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC), Lilongwe.
[137] GoM 2021. MW2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC), Lilongwe.

Annex 8(e): Critical Issues and Proposed Actions for Addressing Unsustainable Energy

Critical Issues	Proposed Actions
Unsustainable heating energy	Promotion of affordable alternative cleaner energies by making them accessible and affordable through duty waivers and subsidies
Limited rural electrification	Intensification of rural electrification programme
Degradation of riparian watersheds capturing and releasing water for hydropower generation downstream	Increased investment in energy generation and distribution
High energy demand-supply gap	Explore verified carbon trade opportunities in the energy sector
Unexplored verified carbon trade opportunity if the energy sector such as the use of sustainable and energy-efficient technologies such as ICS in carbon offsets schemes	Promote integrated management of catchments supplying water for hydropower generation
Highly centralized energy governance	Promote PPP in electrification programs
	Decentralize energy governance to ensure the presence of energy officers in the districts

Source: Stakeholders' Consultations, 2023

Annex 8(f): Youth Bulge Critical Issues, and Proposed Actions

Critical Issues	Proposed Actions
High population growth	Promote mechanization and digital agriculture to raise productivity and attract youths with high affinity to digital technology into agriculture[138]
High youth unemployment	Improving youth employment through youth-centric reforms in key growth sectors including agriculture, livestock, fisheries, and forestry
Limited access to productive resources such as land and financial capital	Promote technical and entrepreneurship training to youths including youth-centric Field Schools (FSs) and incubation programs
Disinterest of youth to engage in agriculture	Engage youth in environmental sustainability programs
	Develop youth tailored mechanisms and financial products in collaboration with the private financial sector, and develop financial literacy of youths.
	Promote universal access to youth friendly health services and age-appropriate Sexual and Reproductive Health (SRH), including family planning methods in schools and youth friendly health centers[139]
	Promote decent work for youths in key natural resource-based growth sectors including agriculture, livestock, fisheries and forestry[140]
	Promote participation of youths in agro-industries, agri-SMEs, and expand labour intensive manufacturing such as leather sector
	Promote intensive technical and vocational education and training for youths
	Promote life skills education at different levels is important to prepare the youth towards self-identification, vision setting and rational decision making[141]

Sources: Stakeholders Consultations and Reviewed Planning Documents

[138] GoM 2021. MW2063 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC). Lilongwe.
[139] GoM 2021. MW2030 First 10-Year Implementation Plan (MIP-1) 2021-2030. National Planning Commission (NPC), Lilongwe.
[140] URT 2016. National Strategy for Youth Involvement in Agriculture (NSYIA) 2016-2021.
[141] URT 2021. National Five-Year Development Plan 2021/22 – 2025/26. Ministry of Finance and Planning. Dodoma.

Annex 9: Checklist for Participatory Rural Appraisals

1. The overall approach

During this TDA fieldwork all activities will be done through a participatory and collaborative process with stakeholders. Three communities per country along the SRB landscape – upstream, midstream and downstream. In this context, a community is not from a certain topographical location would envisage one or more village communities to ensure representation over space. For both countries, a total of 6 communities will be engaged in the participatory TDA through Focus Group Discussions (FGDs). Differential spatial endowments shape environmental and socio-economic outcomes.

The FGDs will be guided by the detailed processes across different steps. Parallel to the FGDs, 6 participatory transect walks will be carried out, 3 in Tanzania and 3 in Malawi – covering the SRB topography. The routes for transect walks will be decided upon after a participatory resource mapping exercise during the FGD.

Each FGD will involve 8-10 community members representing socio-demographic differences – the elderly, young, women and men. Representations by other social differentiations such as such as farmers, pastoralists and fishers will be considered. The consultant in collaboration with the SRBC and village governments to identify the FGD participants.

2. TDA exercises with FGDs

The TDA is a stakeholder-based process. A number of TDA exercises will be carried out through Focus Group Discussions (FGDs). The FGD results will be supplemented by Key Informant Interviews (KII) on specific issues that will more technical and/or would require in-depth assessments. The actual TDA process will be preceded by a quick resource mapping and ascertaining the transect walk route. Thus, this step is combined with the 4 TDA activities as follows:

1. Participatory resource mapping and identification of transact walk route
2. Identification and prioritisation the transboundary problems in the SRB;
3. Analysis of the impacts of the prioritized transboundary problems
4. Causal chain analysis to underpin immediate, underlying, and root cause of each priority problem
5. Development of thematic areas, gap analysis and reporting

2.1 Participatory resource mapping and identification of transact walk route

The facilitator will handle over the marker pen and large plain paper to the participants to lead the drawing exercise. The participants will draw a sketch of their area – downstream, midstream or upstream – indicate a range of **ecosystem** and **socio-economic** features.

- **Ecosystem:** biodiversity, topography, soils, land uses, rivers, streams, dams, crops, vegetations (incl. pasture/fodder, forests), animal and plant species, resource degradations, and resource management systems etc.
- **Socio-economics:** settlements and housing, ethnicity, crop farming, animal rearing, fishing, health centres, schools, processing plants (e.g., mills, oil press), market centres, electricity connections, use of renewable energy such as solar power, roads, footpaths, animal corridors, machineries, presses, shops, market centres), electrification, network of rural roads and footpaths, animal corridors etc.

Moreover, the discussions and reflections associated with the mapping is even the most interesting part of the exercise. Thus, taking an account of such discussions is critical in order to capture important information. During the mapping the facilitator seek interesting information through probing and interjections. The mapping will end with participants, drawing a representative transect route that if walked will reveal the features on the ground. A photo of sketched map will be taken by the transect walk team to guide that exercise. Then, the participants will continue with the actual TDA processes as follows.

2.2 Identification and prioritization of transboundary problems

The FGD participant will have to comprehend operational definitions and distinctions of key concepts at this TDA stage: transboundary problem, and a distinction between causes, impacts and the problem.

> ***A transboundary problem*** is an environmental problem that is transboundary in scale – originating in, or contributed by, one country and affecting (or impacting) another
>
> ***Impacts*** are manifesting effects of a problem, and ***Causes*** are underlying drivers of the problem.

Identification of the transboundary problems

In order for this step to be pragmatic, the facilitator of the FGD will use any prior knowledge of key transboundary problems to an informed process without pre-empting the discussion. The key facilitation points to note include:

- The facilitator will work with the participants to brainstorm and generate a list of the transboundary problems in the basin. To ensure a comprehensive listing, brainstorming can in the first place be aligned to key growth sectors: crop agriculture, animal agriculture, fisheries, energy, environment etc.)
- Inevitably, some of the problems that will be listed as a result of brainstorming would definitely include non-transboundary, and causes and impacts rather than problems per se could be listed. In this regard, the facilitator will cautiously work with participants to filter out any inconsistencies
- Through the facilitation by the TDA expert, the participants will ascertain the geographical scale of major transboundary problems on a sketched resource map drawn in the preceding step. This sketched map could be further upgraded through GIS and remote sensing underpin spatial scale of the transboundary problems in the SRB;

Prioritization of the transboundary problems

The identified and proven transboundary problems will be prioritized based on a set of criteria agreed upon by the participants. Prioritization is critical for optimization of efforts and resources – which is the foundation of strategic actions in the SAP. Some potential prioritization criteria reported in the TDA literature and expounded through expert judgement include:

- Transboundary nature of a problem – on both spatial and temporal scales
- Future risk of the problem
- Linkages with other transboundary problems
- Expected benefits that might be achieved by addressing the problem
- Existing inadequacy/gap in addressing the problem across planning scales: local, basin, national and regional scales
- Recognized bi-lateral water conflicts associated with the problem
- Reversibility/irreversibility of the problem

During the FGD, the list of prioritization criteria above will be revisited, refined and enriched further for a credible prioritization process of transboundary problems. Prioritization here underpins perceived effect and the urgency of addressing the problem – i.e., relative importance.

The prioritization will be based on scoring each problem across the criteria on a 0-3 scale (0 = not importance, 1 = low importance, 2 = moderate importance, and 3= high importance). The stakeholders will need to agree whether prioritization should involve each member scoring or a consensus score assigned to problems across the criteria.

Notably, although the prioritization will involve numeric scoring, key narrative discussions along the process will be captured. Such invaluable insights will be reflected in the TDA report.

2.3 Analysis of environmental and socio-economic impacts of prioritized transboundary problems

The environmental impacts are the effects of a transboundary problem on the integrity of an ecosystem. The socio-economic impacts are a change in the welfare of people attributable to the transboundary problem or its environmental impacts. There will be 2 key steps in this process:

Identification of the impacts of each priority transboundary problem

In carrying out this task the TDA facilitator will work with the participants for each priority transboundary problem to:

- Identify associated environmental impacts
- Identify associated socio-economic impacts

Further description of key environmental and socio-economic impacts

The purpose of this step is to describe the problem itself and the impact of the problem on the environment and socio-economically. The following are critical aspects for adherence at this phase:

Gender lens to underpin the differences between women and men, and other social differentiation

Illuminating impact pathways of transboundary problems and associated relationships[142].

[142] For example, an environmental impact would initiate or exacerbate a socio-economic impact and vice versa. For example, water pollution can affect fish population that lead to loss of income by small fishers – or the same can health effects from polluted drinking water

2.4 Causal chain analysis for each priority problem

The participants will be facilitated to carry out a causal chain analysis for each priority transboundary problem with its associated environmental impacts and socio-economic consequences.

Undertaking Causal Chain Analysis (CCA)

In practice, a causal chain is an ordered sequence of events linking the causes of a problem with its effects. Each link in the causal chain is created by repeatedly answering the question "why?" until the root causes are reached. The overall task will be simplified into a participatory problem tree analysis. The problem tree analysis undertakes a structural analysis of the causes and effects/impacts of problem. The following steps will be followed during facilitation:

- List all priority transboundary problems listed by growth sectors (crop, livestock, fisheries, energy, environment etc)
- Explain the participatory problem tree concept to the participants. Draw a tree on a large piece of paper/white board. The tree drawn must have the shoots with leaves on top, the trunk in the middle followed by primary and secondary roots at the bottom
- Present as specific **problem** in the middle as trunk, **immediate causes** as primary roots and secondary roots as **root causes**, and **impacts/effects** on the top of the tree
- Let the participants brainstorm and discuss while writing down all causes of the problem. The guiding question to ascertain the causes of the problem: What immediately brings about this problem (underlying causes)? Then, what are the root causes of each of the underlying causes of problem?
- Facilitate the participants to brainstorm and discuss while writing down all effects of the problem. The key causality question to capture impacts/effects: what does this problem lead to?
- Capture by taking notes and/or recording (upon consent), summarize and highlight the most important findings in terms of causes and effects of the priority transboundary problems.

Identifying leverage points (solutions/actions) to the transboundary problems

Furthermore, it is indispensable to identify leverage points where changes can be optimized even with a modest intervention. The leverage points concept will be simplified by facilitating the community participants to list strategic solutions/actions to root causes of the priority transboundary problems.

This activity basically addresses the 'Solutions Tree' by identifying solution to each root cause of the problem. The solutions will turn undesirable effects/impacts in the problem tree into desirable 'Solutions Effects' in the solution tree.

Identification of key stakeholders and their roles in implementing the key solutions

This will involve identification of key stakeholders and their roles for effective outcomes of each the key solution/action to the priority transboundary problems.

2.5. Resource Mapping and Transect Walk

The main objective of the transect walk exercise will be to characterize and map ecosystem and related services (incl. biodiversity, soils, land uses), and socio-economics (incl. livelihoods, infrastructure and institutions). The characterization will involve apart from observation, the expert will probe from the locals the underlying drivers of the state and changes in the landscape. Mapping will involve taking photos, drawings and georeferencing that will be upgraded into participatory GIS maps. During the transect walks critical transboundary problems and underlying drivers will be mapped. Critical information to be sought across the two focal areas include:

- **Ecosystem:** biodiversity, topography, soils, land uses, rivers, streams, dams, crops, vegetations (incl. pasture/fodder, forests), animal and plant species, resource degradations, and resource management systems etc.
- **Socio-economics:** settlements and housing, ethnicity, crop farming, animal rearing, fishing, health centres, schools, processing plants (e.g., mills, oil press), market centres, electricity connections, use of renewable energy such as solar power, roads, footpaths, animal corridors, machineries, presses, shops, market centres), electrification, network of rural roads and footpaths, animal corridors etc.

The transect walk team will be comprised of 3-4 people: 2 experts of socio-economics and ecosystem, and the 1-2 local facilitators that will guide the team during the walks. It is estimated that a single transect walk across each of the three topographical locations will be accomplished in a day from morning to noon. The key tools for the exercise will include – note book, A3 papers for sketch maps, pens, pencils, camera, GPS and a voice recorder. Consent will be sought from the respondent before any conversations/interviews is recorded.