



UNITED REPUBLIC OF TANZANIA
VICE PRESIDENT'S OFFICE

NATIONAL ENVIRONMENTAL MASTER PLAN FOR STRATEGIC INTERVENTIONS (2022 – 2032)



JUNE, 2022



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FOREWORD



Environmental degradation in the Country has continued to threaten livelihood and the economy. The Government has made considerable efforts to reverse the situation which include putting in place policy, legal, institutional and regulatory instruments. These efforts have lessened the impacts of environmental degradation. However, the environment has continued to deteriorate partly due to inadequate strategic and specific interventions for the different localities and ecosystems.

In this regard, there is a need to design and deploy a comprehensive environmental master plan that provide strategic interventions to address environmental challenges based on their spatial variations in particular localities. To meet this end, the Government has developed the Environment Master plan that will guide implementation of environmental interventions for the period of 10 years (2022-2032).

The Master Plan considers the aspirations and milestones charted out by national and international frameworks particularly, the Tanzania Development Vision 2025; Five Year Development Plan (FYDP-III) (2021/22-2025/26); National Environment Policy of 2021; Multilateral Environmental Agreements; and Sustainable Development Goals (SDGs). The Plan will also be an instrumental tool in excuting and operationalising the National Determined Contribution, and hence play a great role to Tanzania's contribution in achieving global ambitions for addressing climate change.

Successful implementation of this plan will require an improved governance and coordination of all key actors and mainstreaming environmental considerations into social and economic decisions at all levels. Effective implementation of the Plan will also require adequate, predictable and accessible financing from the Government, and other partners such as private sector, development partners and civil society organizations.

I therefore, call upon all stakeholders at national, regional and international level, to provide strong commitment for partnership and cooperation in implementation of the master plan.

A handwritten signature in black ink, appearing to read 'Mpango', written in a cursive style.

Dr. Philip Isdor Mpango
Vice President of the United Republic of Tanzania

PREFACE



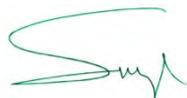
Effective conservation and management of the environment requires robust interventions and plans. The Government in collaboration with stakeholders have undertaken a number of initiatives including strategies and plans to address the environment challenges in the country. However, these strategies have not yielded the desired outcome. This situation is attributed to differences in climatic conditions, topography and socio-economic background of communities in the delineated areas. Further, limited spatial information of environmental degradation and their appropriate intervention options exacerbates the situation. Such limited information has contributed to interventions that are generic and at times inappropriate to specific areas. This has resulted into duplication of similar projects in the same localities resulting into less impact and misallocation of limited resources.

Therefore, addressing these challenges would require strategic and specific interventions for the different localities and ecosystems, and thus the need for their comprehensive identification and mapping. Considering this, the development of a National Master Plan for Strategic Environmental Interventions and Projects that considers spatial variation and appropriate intervention options guiding environmental stewardship at all levels is necessary.

The Master Plan has identified a total of twelve (12) key environmental challenges facing the country including land degradation; deterioration of water sources; impacts of climate change; environmental pollution; deforestation and forest degradation; loss of wildlife habitat and biodiversity; deterioration of coastal and marine ecosystem; wetland deterioration; inadequate waste management; urban environmental challenges; proliferation of invasive species; and inadequate environmental governance.

In achieving the priority areas of the Master Plan, it is intended to take strategic and effective intervention options at all levels. Such options include sustained public awareness, increased and effective participation of all stakeholders, instituting land use plans, restoration programmes for degraded ecosystems, provision of waste collection and disposal facilities, upgrading of law enforcement regime, and adoption of cleaner production technologies,

I therefore invite all stakeholders to join forces with the Government to mitigate the environmental challenges through effective implementation of this robust Master plan.



Dr. Selemani Saidi Jafo

Minister of State

Vice President's Office – Union and Environment

ACKNOWLEDGMENT

The development of this First National Master Plan for Strategic Environmental Interventions and Projects is a result of commitment and collective efforts of key stakeholders who deserve a vote of appreciation. I would like to express my sincere gratitude to the Team of Experts, under the coordination of the Vice President's Office, for their dedication in overall planning, compiling and synthesizing national baseline environmental information, drafting of the Master Plan and conducting stakeholder consultations. The experts were drawn from the President's Office - Regional Administration and Local Government Authorities (PO-RALG); Vice President's Office; National Environment Management Council (NEMC) and Nelson Mandela African Institution of Science and Technology (NM-AIST).

I also wish to express my appreciation to key stakeholders from Ministries, LGAs, Departments and Agencies who participated in the review of the Draft Master Plan through numerous consultative meetings and provision of data. Successful implementation NEMPSI will require a governance paradigm shift. In this regard, more efforts will be undertaken to enhance institutional capacity focusing on strengthening: coordination, communication and information sharing system; enforcing EMA Cap 191; availability and access to environment data, statistics and research and monitoring and evaluation,

Other priorities areas will be devising resources mobilization strategies to ensure adequate financial resources are allocated to the implementation of NEMPSI; ensure actors mainstream NEMPSI interventions in their policies and strategies; and enhancing human resource capacity through provision of requisite knowledge and skills and recruiting staff to institutions with high shortage of staff.

The Master Plan is accompanied by a data driven interactive tool (the NEMPSI Dashboard), which will be accessed through online platforms and will allow stakeholders to easily accesses environmental data and information and enhance streamline the decision making processes. The Master Plan will serve as a strategic intervention tool for environmental management.

The Vice President's Office is committed to ensure that the aspirations outlined in the NEMPSI are fully realised in collaboration with all environment stakeholders.



Mary Ngelela Maganga
Permanent Secretary
VICE PRESIDENT'S OFFICE

EXECUTIVE SUMMARY

Tanzania's economy is largely dependent on natural resources including forest, water, marine and freshwater bodies, wetlands, wildlife, land, natural gas and minerals. However, unsustainable utilization driven by over-dependence on natural resources has increased pressure on these resources resulting into environmental degradation. This affects a range of ecosystems that subsequently results to an economic loss of at least five percent (5%) of the national Gross Domestic Product (GDP). Despite Government initiatives put in place including national policies and legislations, environmental challenges persist. One of the factors exacerbating this situation is limited spatial information on environmental degradation and their appropriate intervention options resulting into formulation of interventions that are generic, inappropriate to specific areas and duplication and misallocation of limited resources at local and national level. In view of that, the Government has developed this National Environmental Master Plan for Strategic Interventions (NEMPSI). The overall objective of the NEMPSI is to guide strategic and coordinated environmental interventions at all levels, based on spatial variation of environmental challenges and intervention options. The specific objectives of the master plan are to:

- i) Provide the existing status of environmental challenges, indicating the causal effect, existing initiatives and constraints;
- ii) Provide the direction of required changes;
- iii) Indicate priority focus areas for interventions; and
- iv) Establish realistic and fact-based intervention options for addressing the environmental challenges.

The NEMPSI covers all regions of the mainland Tanzania and zooms-in at a local scale and ecosystem level. It addresses environmental challenges identified by the National Environment Policy, 2021 and other relevant national policies. It has been developed through a collaborative process which involved a review of the background studies, consultation workshops, preparation of baseline report on environmental status and ultimately development of the Master Plan.

This environmental Master Plan is structured around 14 chapters, Chapter one provides general introduction, including the rationale, objectives, scope and process for the development of the Master Plan. This chapter also highlights the baseline information focusing on country topography, climate, population size and natural resources endowment. Chapters two to twelve form the basis of the Master Plan as they describe the environmental challenges associated with land degradation; deforestation and forest degradation; deterioration of water sources; wetland degradation; invasive species; loss of wildlife habitat and biodiversity; degradation of coastal and marine ecosystem; pollution management; and waste management and environmental challenges in urban and cities. These chapters further describe status, cause, impacts, existing initiatives, interventions and associated target in each environmental challenge.

On Land degradation, the analysis is based on the status of the land degradation report for Tanzania in 2014, which revealed that the extent of land degradation has increased from 42% in 1980 to 50% in 2012. Further analysis was based on 2018 data, which showed that the level of land degradation has increased to 80% (whereby 46% is moderate and 34% is highly degraded). The highly degraded areas are found in Tabora, Dodoma, Singida, Shinyanga, Lindi, Pwani Simiyu, Manyara, Arusha, and Ruvuma regions while the moderately degraded areas include Iringa, Songwe, Katavi, Mara, Mwanza, Tanga and Morogoro. **On Deforestation and Forest Degradation** the analysis shows that currently, Mainland Tanzania's annual deforestation rate is estimated to be about 469,420 ha per year, with highest deforestation rate found in Western zone (2,222, 561 ha); followed by Southern zone (1,053,784 ha); Central zone (1,031, 316ha); and Southern highlands (1,030,732 ha).

Moreover, **on Deterioration of Water Sources**, analysis reveals that there have been fluctuations in water levels in all major lakes. Since 2010, the water level has changed dramatically in every major lake in the country. In addition, river discharge in the nine water basins showed a fluctuation in water flow for a period between 2010 and 2021, whereby steady rising of water level was observed in Lake Rukwa and Tanganyika and Victoria, thus confirm highest rising rate of 48.8 cm and 14.8 per year observed in Lake Rukwa and Tanganyika, respectively. The sharp increase of water levels in Lake Rukwa could be attributed to increased sediments load due to unsustainable human activities in the catchment's areas. **On wetland degradation**, the analysis shows that wetlands covers 10% of the country's total area, with most of them are under intense pressure due to encroachment and unsustainable human activities. However, the size of wetlands is continuously shrinking due to expansion of other land uses emanating from increasing demand for arable land and settlement. The drying of wetlands such as Ihefu wetlands has consequential ecological impact not only in the Usangu plain wetland and Ruaha river, but also to Ruaha National Park and other downstream ecosystem in the Rufiji basin where important Hydropower plants, including Mtera dam, Kidatu and Julius Nyerere Hydropower Plant are situated.

On invasive species, the plan shows that currently, Tanzania has a total of 220 invasive and potentially invasive species. Seventy-five (75) are invasive species, of which 87% are aliens and 13% native. These Invasive species have negatively impacted the livestock sector by causing loss of grazing land in Kongwa ranch and other areas, wildlife and tourism sector through loss of grazing land in Ngorongoro and Serengeti, agricultural land and crop loss all over the country, and loss of biodiversity and fisheries, transport and nuisance caused by Indian house crow. In Kongwa, the Kongwa weed is reported to occupy more than 26,600 hectares (70%) of the entire Kongwa Ranch area which is 38,000 hectares. **On loss of wildlife habitat and biodiversity**, the plan reveals that Tanzania is a home to the 10th highest total number of IUCN Red Listed threatened species in the world, and there are about 2,100 threatened species on which 895 are plants, 841 are non-plants and the remaining 364 are other small groups of species. **On Coastal and Marine ecosystems**, it is revealed that there is substantial decrease in mangrove cover in the Mangrove Northern and Southern zones from 11,159 (ha) to

1,701 (ha) and from 35,159 ha to 0,981(ha) in the year 1991 to 2015, respectively. On the other hand, analysis shows a gradual increase of coral cover in Mafia Island Marine Park (MIMP), Tanga Coelacanth Marine Park (TACMP), and a slight increase has been observed in Dar es Salaam Marine Reserves (DMRS).

On Climate Change Impacts, Tanzania is experiencing changes in climate in many parts of the country, whereby, temperature increases by 1°C has been observed since the 1960s. Both land and sea temperatures in the country have been increasing since 1980 and rainfall shift and changes is evidenced by increasing and decreasing trends and strong variability since 1970s. The observed adverse impacts of climate change impacts include: extreme precipitation that cause flooding; prolonged drought; sea level rise leading to submerging of small Islands, coastal and low-lying areas, spread of bush fires and invasive species; biome or ecosystem shifts or transformation. From 1990 to 2014 about 62% natural disasters are caused by flood accounting to 17 to 122 deaths from 2017 to 2020. In Dar es Salaam, Sea water level is rising at a rate of 0.492, equivalent to 6mm per annum from 2002 to 2018 and has led to beach erosion and destruction of coastal infrastructure. On the other hand, water levels in major lakes has been observed to rise , whereby, Lake Tanganyika recorded highest water levels by almost 3 meters (from 772.85 m in 2006 to 776.04 m in June, 2020) and 3.62 meters (772.85 m in 2006 to 776.47 m in May 2021); Lake Victoria by 0.53 m (from 1134.27 m in 1965 to 1134.8 m in June, 2020. Lake water levels rise has caused submerging or intrusion of water at Kasanga Landing site, Lake Tanganyika, Kalambo district, Kigoma region.

On environmental pollution, the forms of pollution experienced countrywide include air quality; noise and vibration; surface water pollution; land and soil pollution; marine and coastal pollution; chemical pollution; and waste pollution. Eighty percent of the Local Government Authorities (LGAs) have inadequate waste treatment facilities and therefore dispose off untreated sewage into the open environment and water bodies such as rivers and the ocean. **On solid waste,** Solid waste generation is nearly 7 million tons per annum. However, it is only 32.72% of the generated waste is collected countrywide. **On Environmental Challenges in Cities and Municipalities,** the plan reveals that Tanzania cities and urban areas face challenges which include solid waste management, whereby solid waste generated in cities accounts for nearly 10 per cent of the total generated waste in the country. Other challenges are degradation of urban forests, inadequate urban green landscapes and recreational parks; inadequate storm water management, environmental pollution. **Environmental challenges facing Dodoma Capital City,** include pollution, land degradation, waste management, and deforestation. Specifically, land degradation is more pronounced in Mtumba, Chang'ombe, Nala, Zuzu, Nzuguni, Ntyuka, Ihumwa, Makutopora, Kikombo, Chihanga, Ipala, and Chahwa wards.

On environmental governance, even though policy, legal and institutional frameworks for environment governance in the country have yielded some positive results and lessened the impacts of environment degradation, there are number of factors

including; Inadequate institutional capacity; Inadequate enforcement and human resource; and low public awareness which impede successful environmental governance in Tanzania.

The Master plan proposes goals, and expected results, interventions and associated targets in each environmental challenge. The Master Plan is accompanied by a **data driven interactive tool – dashboard**, which will be accessed through online platforms. The dashboard allows stakeholders to easily access environmental data and information for decision makers and practitioners. Successful implementation of this plan is envisioned through improved governance and coordination of all key actors and mainstreaming environmental considerations into social and economic decisions at all levels.

In achieving the priority areas, the Master Plan underlines strategic and effective intervention and targets to be implemented by all actors. Such intervention options include sustained public awareness, increased and effective participation of all stakeholders, instituting land use plans, restoration programmes for degraded ecosystems, provision of waste collection and disposal facilities, upgrading of law enforcement regime, and adoption of cleaner production technologies, gender empowerment and capacity building.

The plan will be implemented for a period of 10 years from July 2022 to June 2032. The institutions arrangement for implementation shall be in accordance with EMA Cap 191. Implementation arrangements, action planning, monitoring, evaluation and reporting is provided. Effective implementation of the Plan will also require adequate, predictable and accessible financing from the Government, and other partners such as the private sector, development partners and civil society organizations.

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ABBREVIATIONS AND ACRONYM

| | |
|----------|---|
| ARD | Acid Rock Drainage |
| 3R | Reduce, Reuse and Recycling |
| AQHI | Air Quality Health Index |
| ASGM | Artisanal and Small-scale Gold Mining |
| BMUs | Beach Management Units |
| BRELA | Business Registration and Licensing AgencyCBFM |
| CAG | Controller And Auditor General |
| CBFM | Community Based Forest Management |
| CBOs | Community Based Organizations |
| CD | Critical Endangered |
| CSOs | Civil Society Organizations |
| CWMC | Community Wetlands Management Committees |
| DD | Data Deficiency |
| DMRS | Dar es Salaam Marine Reserves System |
| EMA | Environmental Management Act |
| EN | Endangered |
| FYDP | Five Year Development Plan |
| GBIF | Global Biodiversity Information Facility |
| GBV | Gender Based Violence |
| GDP | Gross Domestic Product |
| HRE | Heavy Rainfall Events |
| IOD | Indian Ocean Dipole |
| IRDP | Institute of Rural Development Planning |
| IS | Invasive Species |
| IUCN | International Union for Conservation of Nature |
| IWRM | Integrated Water Resources Management |
| JFM | Joint Forest Management |
| JMA | Joint Management Agreement |
| KCCMP | Kihansi Catchment Conservation and Management Project |
| KWC | Kwakuchinja Mbugwe |
| LATAWAMA | Lake Tanganyika Water Management |
| LC | Least Concern |
| LGAs | Local Government Authorities |
| LPG | Liquefied Petroleum Gas |
| LVEMP | Lake Victoria Environmental Management Programme |
| m.a.s.l | meters above sea level |
| MC | Municipal Council |
| MDAs | Ministries, Departments and Agencies |
| MIMP | Mafia Island Marine Park |
| MNRT | Ministry of Natural Resources and Tourism |
| MPRU | Marine Parks and Reserve Unit |
| MSP | Marine Spatial Plan |

| | |
|----------|--|
| NAFORMA | National Forest Monitoring and Assessment |
| NCAA | Ngorongoro Conservation Area Authority |
| NCMC | National Carbon Monitoring Center |
| NDC | Nationally Determined Contribution |
| NE | Not Evaluated |
| NEAC | National Environmental Advisory Committee |
| NEMC | National Environment Management Council |
| NEP | National Environment Policy |
| NEMPSI | National Environmental Master Plan for Strategic Interventions |
| NETF | National Environmental Trust Fund |
| NGOs | Non-Governmental Organizations |
| NM-AIST | Nelson Mandela African Institution of Science and Technology |
| NT | Near Threatened |
| PIC | Particulate Inorganic Carbon |
| PMO | Prime Minister's Office |
| POC | Particulate Organic Carbon |
| POPs | persistent organic pollutants |
| PO-RALG | President's Office - Regional Administration and Local Government |
| RCP | Representative Concentration Pathway |
| REA | Rural Energy Agency |
| REDDs | Reduced Emission from Deforestation and Forest Degradation |
| REMEs | Regional Environmental Management Experts |
| RUMAKI | Rufiji Mafia Kilwa |
| SDG | Sustainable Development Goal |
| SHW | Solar for Hot Water |
| SLM | Sustainable Land Management |
| SST | Sea Surface Temperature |
| SUA | Sokoine University of Agriculture |
| SWIOFish | South West Indian Ocean Fisheries Governance and Shared Growth Project |
| SWM | Solid Waste Management |
| TACMP | Tanga Coelacanth Marine Park |
| TANAPA | Tanzania National Parks Authority |
| TANROADS | Tanzania National Roads Agency |
| TARI | Tanzania Agricultural Research Institute |
| TARURA | Tanzania Rural and Urban Roads Agency |
| TC | Town Council |
| TGDC | Tanzania Geothermal Development Company Ltd |
| TSS | Total Suspended Soil |
| TZS | Tanzanian Shillings |
| TFS | Tanzania Forest Service |
| TGDC | Tanzania Geothermal Development Company Limited |
| TMA | Tanzania Meteorological Authority |

| | |
|-------|---|
| TSCF | Trillion Standard Cubic Feet |
| TSDI | Tanzania Sustainable Development Initiative |
| UPOPs | Unintended Persistent Organic Pollutants |
| URT | United Republic of Tanzania |
| USD | United States Dollar |
| VPO | Vice President's Office |
| VU | Vulnerable |
| WHO | World Health Organization |
| WMA | Wildlife Management Area |

1 INTRODUCTION

1.1 Background

Tanzania's economy is largely dependent on natural resources including forest, water, marine and freshwater bodies, wetlands, wildlife, land, natural gas and minerals. The Third Five Year Development Plan (FYDP-III) 2021/22-2025/26 reiterates that environment and natural resources are a national asset and the basis for sustainable development. The development and utilization of these resources have contributed positively toward economic growth and reduction of poverty in the country. However, unsustainable utilization driven by over-dependence on natural resources has increased pressure on natural resources and consequently resulting in environmental degradation. This impacts a wide range of ecosystems which amount to an economic loss of at least five percent (5%) of the National Gross Domestic Product (GDP).

The Government, in collaboration with stakeholders, instituted several initiatives to address environmental challenges including having in place policy and legal instruments as well as development and implementation of programmes and projects to address the challenges. Despite these initiatives, environmental challenges persist in the country. One of the factors exacerbating the situation is limited spatial information on environmental degradation and their appropriate intervention options. Such limited information has contributed to formulation of interventions that are generic, inappropriate to specific areas and duplication of similar projects in the same localities resulting into less impact and misallocation of limited resources.

Effective identification and mapping of environmental challenges is a prerequisite for designing appropriate measures to address the challenges at local and national level. Based on that, the Government decided to develop the National Environmental Master Plan for Strategic Interventions (NEMPSI).

The NEMPSI provides the status of environmental challenges and the intervention required to address these challenges effectively. The Master Plan is aligned with the National Environmental Policy and its implementation strategy. It is also aligned to Tanzania Development Vision 2025, Five Year Development Plan (FYDP) 2021/2022-2025/2026 and the Sustainable Development Goals (SDG) as well as various strategies and plans. The Master Plan's vision, goals, and targets describe the desired future state of the environment, with an accompanying set of initiatives designed to elevate the country toward environmental sustainability.

1.2 Country Profile

The United Republic of Tanzania is located in Eastern Africa between longitudes 29° and 41° East and latitudes 10° and 12° South (Figure 1.1) and is bordered on the north by Kenya and Uganda; on the west by Rwanda, Burundi, and the Democratic Republic of the Congo; on its southwestern side by Zambia and Malawi; in the south by Mozambique and in the east by the Indian Ocean (Figure 1.1). The country is constituted by Mainland Tanzania and Zanzibar with a total area of 945,249 km² Tanzania.



Figure 1-1: Administrative regions and international boundaries of the United Republic of Tanzania

1.2.1 Topography

The terrain of Tanzania comprises plains along the coast; a plateau in the central area that ranges between 1,000 and 1,500 meters above sea level (amsl.); highlands in the north-east and southwest are characterized by mountain ranges and peaks; river and lake basins and the Great East African Rift Valley (Figure 1.2).



Figure 1-2: The topography of Tanzania with major Lakes and River Network

1.2.1.1 Coastal Plains and features

Mainland Tanzania has a coastline of over 800 km stretching from Tanga to Mtwara Regions (Figure 1.2). About two-thirds of the coastline has fringing reefs, often close to the shoreline, broken by river outlets such as the Rufiji Delta, Pangani, Ruvuma, Wami and Ruvu. The continental shelf extends 5.8–10 km offshore, with exception of the Zanzibar and Mafia channels where the shelf extends for more than 25 km.

1.2.1.2 Plateaux

The Plateau is in the central area of the country, which is part of the East African Plateau (Figure 1.2). It ranges between 1,000 and 1,500 meters above sea level (m.a.s.l.) and is characterised by gently sloping plains and plateau broken by scattered hills and low-lying wetlands. The southern half of this plateau is grassland within the Eastern Miombo woodlands ecoregion, the majority of which is covered by the Selous Game Reserve.

1.2.1.3 Highlands and Mountains

Tanzania is characterized by highlands with several mountain ranges and peaks. The northeast is dominated by Mt. Meru (4,565 m.a.s.l.) and Mt. Kilimanjaro (5,895 m.a.s.l.) the latter being the highest point in Africa. Both mountains are dormant volcanic mountains. In the eastern part of the country there are two important block mountains (the Usambara and Pare), famously known as the Eastern Arc Mountains. In the south, the country is dominated by the mountain range of the Southern Highlands which separates the Eastern plateau from the rest of the country, and they include Livingstone, Kipengere, Udzungwa and Uluguru. Southwards, is the Central Plateau reaching elevations 2,000 m.a.s.l.

1.2.1.4 River and Lake basins

The country is divided into nine (9) drainage water basins which are Pangani Basin, Wami/Ruvu Basin, Rufiji Basin, Ruvuma and the Southern Coast Basin, Lake Nyasa Basin, the Internal Drainage Basins (Lake Eyasi, Manyara and Bubu depression), Lake Rukwa Basin, Lake Tanganyika Basin, and Lake Victoria Basin. Tanzania's main rivers include the Pangani, Wami, Ruvu, Rufiji, Malagarasi, Kagera, Songwe, Mara, Ruhuhu and Ruvuma.

1.2.1.5 Rift valley

The Great Rift Valley which runs from North-East of Africa through Central Tanzania, is another landmark that adds to the scenic view of the country. The rift valley runs south of Tanzania splitting at Lake Nyasa; The Eastern Rift Valley runs through central Tanzania dotted with lakes such as Lake Natron, Manyara and Eyasi, while the Western branch runs from Lake Nyasa along Lake Rukwa and Tanganyika and ends the western part of Uganda. Volcanics and carbonatites are associated with both the Eastern and the Western Rift. Lacustrine sediments fill large parts of the rift valleys.

1.2.2 Climate

The climate of Tanzania is influenced by the monsoon winds, the southerly monsoons and the northerly monsoons. The southerly monsoons begin in April ending in September and they are usually strong and predominantly southerly. They are characterised with lower temperatures (approximately 25°C) and bring the long rains (Masika) from March to May. The northerly monsoons begin in November ending in February. These are lighter winds and are predominantly northerly. The northerly monsoon are characterised with high air temperatures (>30°C) and bring the lighter rains (Vuli) from November to December. The mean relative average humidity in Tanzania is recorded as 44.6% and on monthly basis, it ranges from 30% in September and October to 58% in March. The coastal areas are more humid compared to the rest of the country.

1.2.3 Population Size

According to the National Bureau of Statistics, the Tanzania population projection was estimated at 52.6 million people for Mainland-Tanzania in the year 2018. The National projections, further showed that, with a population growth rate of 3.1%, the projected population by 2025 will be 65.1 million.

1.2.4 Natural Resources Endowment

Tanzania is endowed with various treasures of unique natural resources. These include forest, woodlands, water, marine and freshwater bodies, wetlands, wildlife, land, energy sources, natural gas and minerals. Some of these resources are found in protected areas. Tanzania's rich natural resources are also fundamental for the country's growth and economic development.

1.2.4.1 Forest

The 2015 forest inventory estimated forests and wooded areas coverage in Tanzania to be over 48.1 million hectares. Three main types of natural forests found in Tanzania include miombo woodlands, montane forests, and mangroves. About 44.6 million hectares an equivalent to 93% of the total forest area in Tanzania is covered by woodlands, followed by lowland forests (3.4%), Humid Montane Forest (2.0%), Plantation Forest (1.2%) and Mangroves comprise only 0.3%. In terms of usage, the productive forest area comprised 60.3% of the total forest area while 39.7% of the forest areas are reserves and protected forests.

1.2.4.2 Land

Tanzania possesses about 945,087 km² (94,508,700 ha) of territorial area, out of which nearly 89 million ha is land, and the remaining is covered by water. About 44 million ha are classified as suitable for agricultural production and only 24% of arable land is being utilized. Land under medium and large-scale farming is 1.5 million ha and land under smallholder farmers is about 8.6 million ha. The urban areas occupy 2% of the total geographical area which accommodates approximate 30% of the population.

1.2.4.3 Wildlife

Tanzania is endowed with unique diverse wildlife attractions which include National Parks, Game Reserve, Game Controlled Areas, Marine Parks and Forest and Nature Reserves. Tanzania has a total of 22 gazetted national parks which comprise a total area of 104,578 km² which is equivalent to 11.6% of the country area. Ruaha National Park is the largest in the country with an area of 20,300 km², which is about 35.4 % of total area of National Parks. Serengeti is the second largest national park with an area of 14,763 km² and accounts for about 25.7% of the total area of Tanzania's national parks. Saanane Island in Lake Victoria is the smallest national park covering 50 km². Tanzania has a total of 27 game reserves covering an area of 117,755.4 km². Game reserves are wildlife protected areas which are declared for the purpose of conservation. Selous is the largest game reserve with an area of 50,000 km² and accounts for about 42.5% of the total area under game reserves. The remaining game reserves individually constitute less than 10% of the total game reserve area.

1.2.4.4 Natural gas

Tanzania counts on four tectonic groups of natural gas basins (Coastal, Karoo rift, the East African valley and Cratonic sag basins) of which, so far, only two have become productive. These corresponds to the fields at Songo Songo Island in Lindi and those of Mnazi Bay in Mtwara. As of 2016, the confirmed quantity of discovered gas was 57.25 trillion Standard Cubic Feet (TSCF).

1.2.4.5 Minerals

Tanzania is endowed with vast quantities and types of minerals whose extraction has been central to the country's economic growth, GDP growth and employment opportunities. The country has various mineral resources found on the surface of the earth and in the subsoil. The minerals are distributed in different localities depending on geomorphological features and type of rocks. These include metallic minerals, gemstones, industrial minerals, building materials and energy minerals.

1.3 Rationale for the Master Plan

The major environmental challenges in Tanzania include land degradation, deforestation, biodiversity loss, climate change, deterioration of water sources, coastal and marine degradation, waste management, environmental pollution, biotechnology and invasive species. However, the extent of impacts varies from one part of the country to the other. This is attributed to differences in climatic conditions, rainfall, topography, and socio-economic variations.

Addressing these challenges require strategic and specific interventions for the different ecosystems and thus the need for their comprehensive identification and mapping. In light of this, the development of a National Environmental Master Plan for Strategic Interventions that considers spatial variation and appropriate intervention options to guide environmental stewardship at all levels is necessary. Thus, the Master Plan will provide input into the Government planning and budgeting and serve as a guiding tool in developing major environmental projects and programmes at local, regional and national level. It will serve as a strategic intervention tool for environmental management and avoid duplication of efforts and resources in addressing environmental challenges.

1.4 Objectives of the Master Plan

The overall objective of the Master Plan is to guide strategic and coordinated environmental interventions at all levels, based on spatial variation of environmental challenges and intervention options.

The specific objectives of the master plan are:

- i) Provide the existing status of environmental challenges, indicating the causal effect, existing initiatives and constraints;
- ii) Provide the direction of required changes;
- iii) Indicate priority focus areas for interventions; and
- iv) Establish realistic and fact-based intervention options for addressing the environmental challenges.

1.5 Scope of the Master Plan

Environmental Master Plan covers all regions of the mainland Tanzania and zooms-in at a local scale and ecosystem level. It addresses environmental challenges identified by the National Environment Policy, 2021 and other relevant national policies. This covers, but not limited to, land degradation; environmental pollution (air, water, land, noise, and vibration); climate change impacts; deforestation and forest degradation; loss of wildlife habitat and biodiversity; waste management; invasive species; deterioration of aquatic systems; and deterioration of water sources. It will be implemented for a period of 10 years from July 2022 to June 2032.

1.6 Process for Development of the Master Plan

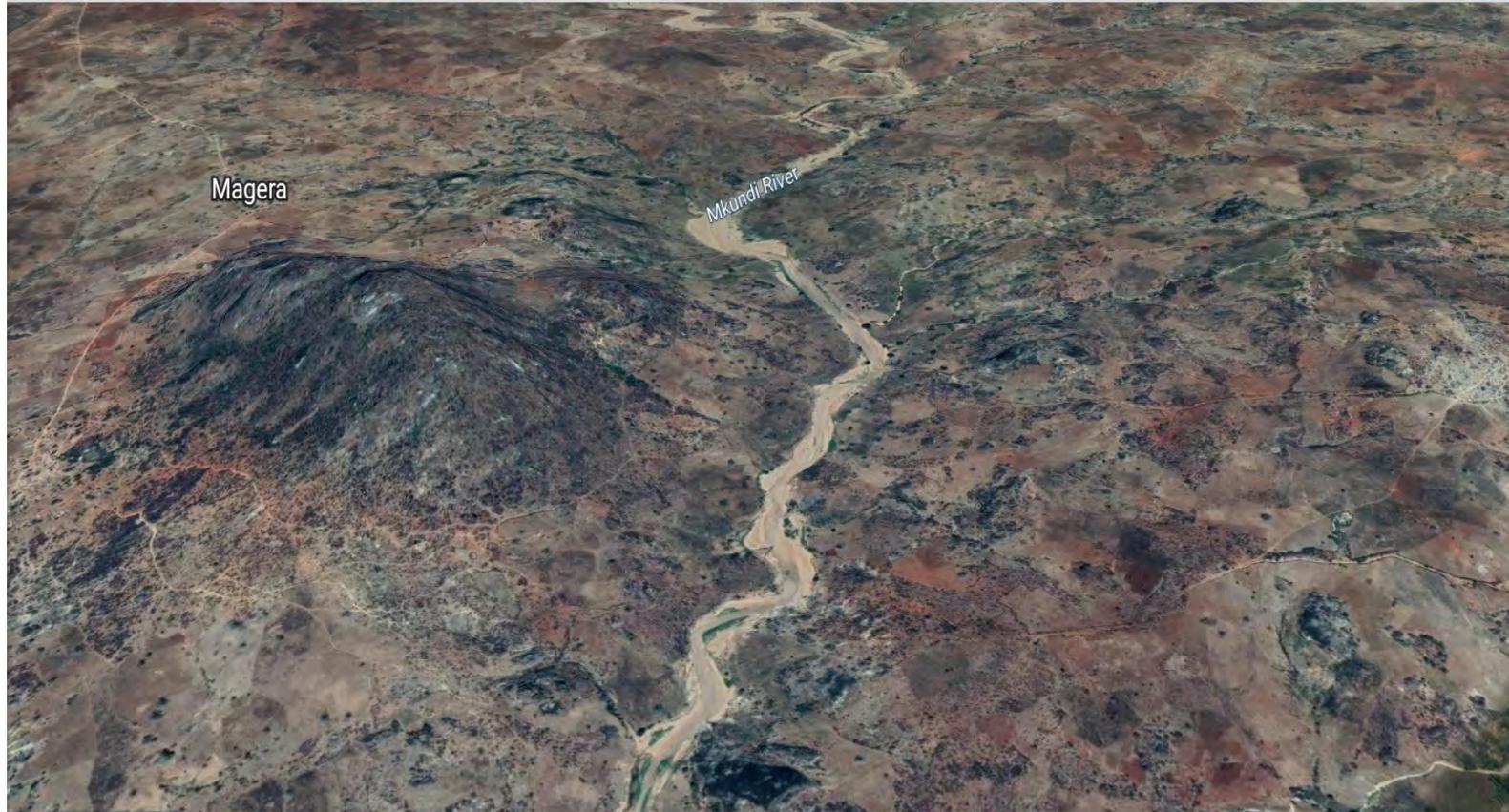
This Master Plan was developed by a team of experts (Appendix 1) through collaborative process which involved a review of the background studies, consultation workshops, preparation of baseline report on environmental status and final development of the Master Plan. The development of a baseline report involved gathering and analysis of data on the current situation, as well as a review of numerous reports, national policies, strategies and other documents in order to identify environmental challenges, initiatives and best practices on environmental interventions. It further, involved stakeholder engagement in gathering data and information from MDAs, LGAs, Research institutions, academia, NGOs, CBOs, subjectmatter experts and stakeholders to gain input into the development of the NEMPSI focus areas and associated actions.

1.7 Arrangement of the Master Plan

This environmental Master Plan is structured around 14 chapters. Chapter one provides general introduction including the rationale, objectives, scope and process for the development of the Master Plan. This chapter also highlights baseline information focusing on country topography, climate, population size and natural resources endowment. Chapter two to twelve form the basis of the Master Plan describing the environmental challenges associated with Land degradation, deforestation and forest degradation, deterioration of water sources, wetland degradation, invasive species, loss of wildlife habitat and biodiversity, degradation of coastal and marine ecosystem, pollution management, waste management and environmental challenges in urban and cities. These chapters further describe status, cause, impacts, existing initiatives, interventions and associated target in each environmental challenges. A discussion on environmental governance and implementation arrangements is provided in chapter thirteen and fourteen respectively.



LAND DEGRADATION



2 LAND DEGRADATION

Land degradation refers to any biophysical disturbance on the land that leads to the inability of the land to perform its natural functions such as supporting crop and livestock production, provide habitat to various species and providing other economic and social goods and services. Land degradation is a significant contributor to biodiversity and habitat loss, changes in species abundance, and aggravation of climate change impacts and hence decline ecosystem services. Land Degradation leads to reduction in infiltration and ground-water recharge and increase in run-off and siltation, in both cases contributing to important down-stream effects of droughts and floods.

2.1 Status of land degradation

Based on the status of land degradation report in Tanzania in 2014, the extent of land degradation has increased from 42% in 1980 to 50% in 2012. However, the analysis made based on 2018 data, the level of land degradation has increased to 80% (46% being moderate and 34% highly degraded). The highly degraded areas in the country are Tabora, Dodoma, Singida, Shinyanga, Lindi, Pwani Simiyu, Manyara and Arusha. Moderately degraded areas include Iringa, Songwe, Katavi, Mara, Mwanza, Tanga and Morogoro. Very few areas in the country have low level of degradation. These include Kagera, Geita, Kigoma, Njombe Kilimanjaro and Ruvuma.

2.2 Causes of land degradation

Land degradation is associated with unsustainable human activities that cause removal of land cover, soil loss and loss of soil quality. The activities include unsustainable agriculture, deforestation, overgrazing, unsustainable mining activities, bush fires and proliferation of invasive species. Human activities and climate change influence the changes in land use and land use cover which affects the status of land degradation. As indicated in Figure 2-1, the spatial land degradation pattern correlates with spatial human activities (agriculture, mining and livestock) affirming the contribution of such human activities to land degradation.

2.2.1 Unsustainable agriculture

The unsustainable agricultural activities include agricultural expansion, cultivation on steep slopes, cultivation within 60m from river banks, cultivation in valley bottom (vinyungu) and river banks (Plate 2-1), misuse of agrochemicals (Fertilizers and pesticides) and mismanagement of irrigation water. Between 2008 and 2020 an increase in expansion of agricultural land was observed in the country, whereby, 11 regions (Mtwara, Lindi, Ruvuma, Mbeya, Rukwa, Dodoma, Singida, Tabora, Kigoma, Shinyanga, Simiyu) had an expansion of more than 100%, nine regions (Geita, Katavi, Songwe, Njombe, Iringa, Morogoro, Pwani, Tanga and Manyara) had between 50 – 100% increase, Kilimanjaro and Arusha had an increase between 0 – 50 % while Mara has no increase in agricultural land.

The expansion is linked to shifting cultivation due to loss of land productivity as practised in Lindi and Mtwara, and increased demand for establishment of new crops as evidenced in Singida, where 17,000 hectares (12,000 in Manyoni and 5000 in Ikungi) of land has been cleared for Cashewnuts production between 2017 and 2022. In the

same period, a sharp increase in irrigated land was evident in Dodoma (75%), Mbeya and Songwe (58.1%), Kagera (37%), Tanga (23.4%), Kigoma, (19.3%) and Iringa and Mbeya (12%). Valley bottom cultivation “*vinyungu*” which has now changed to commercial level, contributes to land degradation through obstruction of water flow downstream, sedimentation, and contamination of river water by agrochemicals. Areas affected most are Iringa, Njombe, Mbeya and Songwe. Cultivation in riverbanks, is mostly evidenced in Morogoro, Pwani, Mbeya, Njombe, and Iringa.

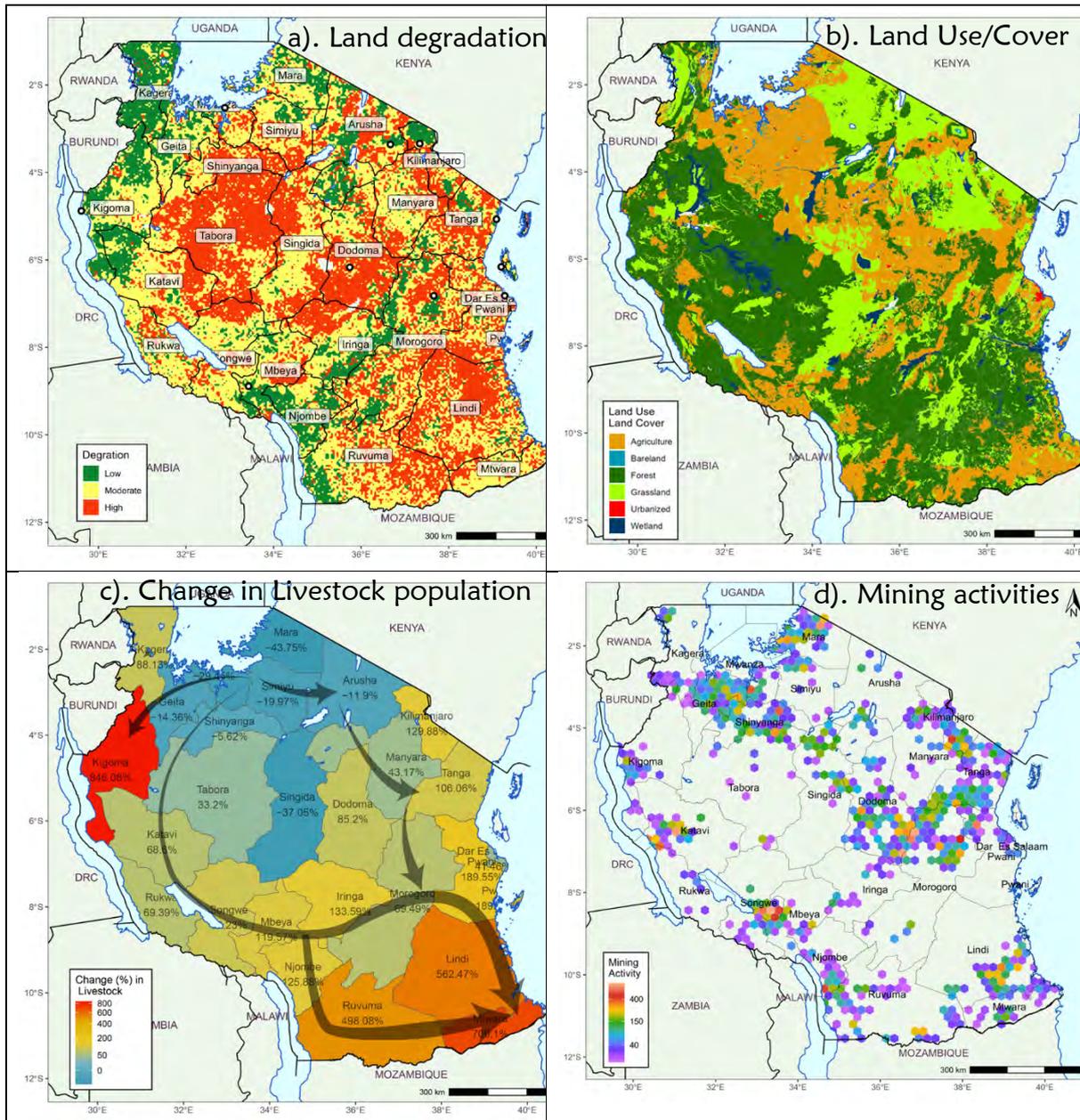


Figure 2-1: Land degradation severity map (a) as compared to Land use/cover (b), change in livestock population (c) and distribution of mining activities (d).

2.2.2 Overgrazing

Livestock grazing when sustained at acceptable levels has ecological importance in terrestrial ecosystems. However, overgrazing causes ecological consequences in the ecosystem and contributes to land degradation. The livestock population has

dramatically increased contributing to reduced land cover, increase soil erodibility and making the land fragile and prone to other agents of degradation (Plate 2-1).



Plate 2-1: Cleared forest for Simsim production at Nandimba village, Liwale (a), Cultivation in Ngerengere riverbank, Morogoro (b), degraded livestock route in Monduli (c), and Livestock grazing in Lake Rukwa mashland (d).

The livestock census in 2008 and 2020 shows that livestock population has increased dramatically in the southern part of the Country as there has been increasing migration from the northern semi- arid areas to the southern part. There has been very high increase in livestock population in Kigoma (846.1%), Mtwara (700.1%), Lindi (562.47%), Ruvuma (498.1%), Pwani (189.6%), Iringa (133.6), (Njombe (125%), Mbeya (119.5%), and Tanga (106.1%). During this period, regions in the northern part of the country experienced a decrease in cattle population as compared to the southern part. These include Mara (-43.8%), Mwanza (-29.5), Geita (-14.4%), Simiyu (-19.9%), Shinyanga (-5.6), Arusha (-11.9) and Singida (-37.1). The drastic increase in cattle population has aggravated land degradation to the southern part of the country.

2.2.3 Mining activities

Unsustainable mining activities cause serious physical disturbance to the land, river banks and bed, hence accelerate soil erosion and siltation. Abandoned open pits, tailings and waste rocks which remain after mining of metallic, gemstones and building materials in areas such as in Buhemba Gold Mining sites, Kunduchi and Bunju quarrying sites (Plate 2-2) contributes to land degradation through reduced land functionality. Mining activities also contribute to erosion and sedimentation in rivers and river banks. This is evident in Lake Rukwa basin where Artisanal and Small Gold Miners (ASGM) activities in Chunya, Mpanda and Songwe Districts has contributed to excessive sediment load in lake Rukwa. The other factor that contributes to land degradation includes deforestation, which involves forest clearing for timber, fuelwood and

construction material. Deforestation removes the land cover and leaves the land unprotected and prone to other agents of land degradation.



Plate 2-2: Sand mining in Dar es Salaam (a) and Alluvial gold mining in Nsimbo District (b).

2.3 Impacts of land degradation

2.3.1 Loss of agriculture and grazing land

Land degradation causes decline in soil fertility and productivity, crop and pasture production hence diminishing arable land. Degradation can also cause decrease in arable land through physical soil removal and formation of gullies (Plate 2-3). The loss of land productivity further leads to limited growth of pasture and hence reduce grazing land. This is evidenced in most dryland areas of Arusha, Manyara, Simiyu, Dodoma, Shinyanga and Singida.



Plate 2-3: Degraded agricultural/grazing land in Ngarash village Monduli District

2.3.2 Deterioration of water sources

Land degradation is associated with catchment degradation which leads to soil erosion and sedimentation in river beds that cause degradation of water quality. Degradation of catchments reduce the catchment capacity to retain rainwater and maintain gradual water flow downstream. This reduces perennial flow of water which makes some rivers to become seasonal and increase flood incidences due to increased surface runoff.

2.3.3 Sedimentation in rivers, wetlands and water bodies

The impact of widespread erosion in catchment areas is manifested by deposition of sediments in rivers, wetlands, lakes, and dams that lead to increased flooding and diverted water during high peak rainfall. The most affected water bodies are Lake Rukwa, Lake Manyara, Lake Jipe, Lake Babati and Nyumba ya Mungu Dam where sediment deposit is estimated to be 13 t/ha/yr. Plates 2-4 and 2-5 show the evidence of sedimentation in Lake Tanganyika, Lake Victoria, Lake Nyasa and Rufiji as shown by the lake and river water colour.

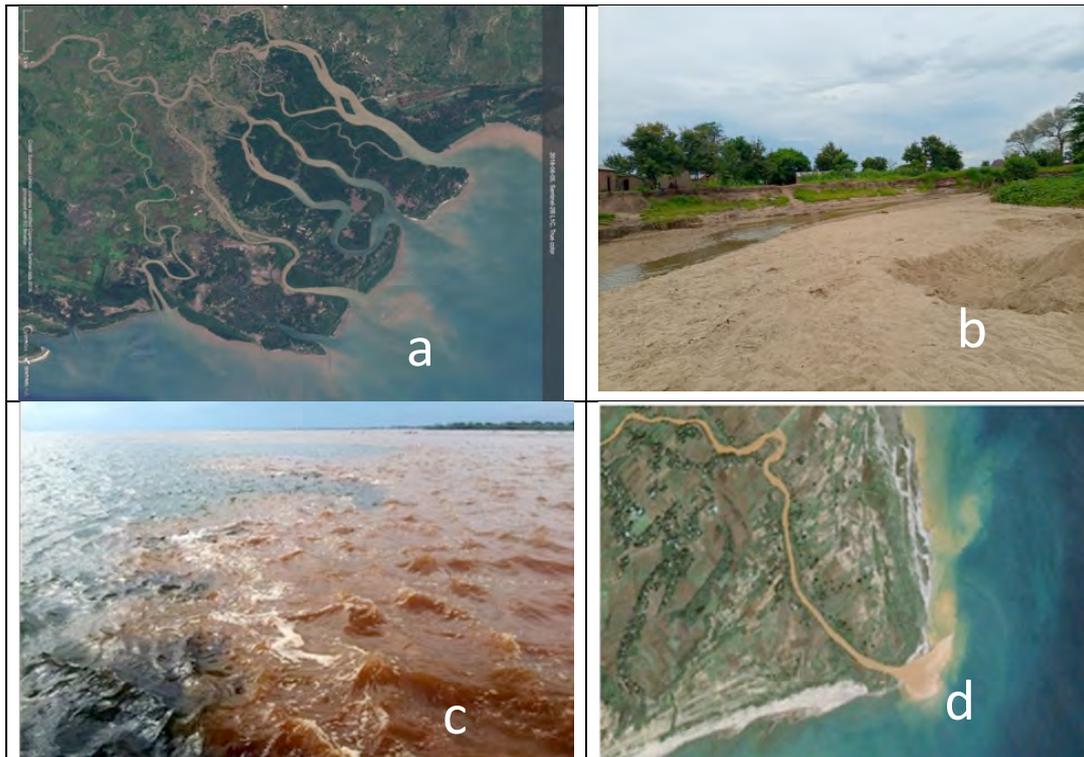


Plate 2-4 Plate Evidence of sedimentation in Rufiji delta (a), Mbarali River (b), Lake Tanganyika (c) and Nyasa (d),

Sediment load is also evidenced in Mkundi River catchment in Wami sub-basin, where excessive vegetation clearance in the catchment, cultivation in the river banks and rapid settlement have increased runoff and soil erodibility. This has caused excessive sediment deposition along the river at Magole/Dumila bridge, which diverts the river flow and hence more flood risks that leads to destruction of infrastructures. If no action is taken, the rate of erosion and soil loss will continue and therefore increasing the risk and severity of flood events.

Another serious case on the impact of siltation is evidenced in Mirongo River in Mwanza, where the Mirongo river mouth has clogged due to sediment deposition leading to change of its flow towards Mwanza Port. As shown in plate 2-5, in the year 2014 the river was flowing straight into the Lake, in 2016 the river was narrowed due to sediment deposition and subsequent vegetation growth, in 2017 the entrance is clogged and diverts the flow to the south, in 2021 further clogging of the river mouth diverts

flow towards Mwanza port, and Kirumba shore. Continuous sediment deposition if not addressed, will likely affect the performance of the port due to reduced port depth and port operations.



Plate 2-5: Dynamics of Mirongo River flow due to sedimentation at its River mouth, Mwanza.

Similarly, in Lake Jipe, high level of erosion and sediment load from its catchments in Pare and Kilimanjaro Mountains, has caused siltation and increased sediment and nutrient load in the lake leading to rapid growth and expansion of water weeds (*Typha domingensis*) and diversion of the major feeder rivers. Consequently, the lake is estimated to have reduced from its original cover of 100 km² to the present size of 30 km².

2.3.4 Loss of biodiversity

Land degradation leads to removal of vegetation cover which consists of a number of species. The vegetation is also a habitat to a number of faunas which when the vegetation is removed, their habitat is lost and hence their survival is threatened.

2.3.5 Internal migration

Loss of agriculture and grazing land due to land degradation has caused hostile environment to the surrounding community leading to some of them to move to other parts of the country. In Shinyanga, Mwanza and Simiyu for example, during the dry season, grazing areas are very scarce, pastoralists have to depend on crop residues in the harvested fields of maize, cotton and rice. On the other hand, water is also scarce and pastoralists rely only on dams (locally known as Malambo) and boreholes. Under

such circumstances, pastoralists opt to move or spread their herds to different locations to reduce the risk of livestock mortality from drought. This is evidenced in (Figure 2-1c) in which movement of cattle is seen from dryland regions to Kigoma, Mtwara, Lindi, Ruvuma, Katavi, Rukwa, Mbeya, Morogoro and Tanga.

2.4 Existing initiatives

Some measures have been taken in different areas in the country to mitigate land degradation impacts which include the Lake Victoria Environment Management Programme (LVEMP), which among others, focused on reducing land degradation in the Lake Victoria catchment areas; Greening Dodoma; Sustainable Land Management (SLM) in Kilimanjaro and Nyasa regions; Sustainable Management of Miombo Ecosystems in Western Tanzania; Land Management projects in Kilombero and Rukwa and the Sustainable Management of Mount Kilimanjaro Ecosystem in Kilimanjaro. In the process of addressing land degradation and other environmental challenges, the Government in partnership with other stakeholders has managed to facilitate the development of land use plans for 2,556 villages out of the 12,318 villages.

2.5 Interventions for Land degradation

2.5.1 Goal

To maintain, restore and enhance the land resource base and ecosystem services that flow from the land resources.

2.5.2 Expected results

Degraded landscapes in all basins are revitalized to maintain their functionality in supporting biodiversity and ecosystem services. River catchments, flood plains, agricultural and grazing lands are conserved, soil erosion is reduced, infiltration and ground-water recharge improved, run-off and siltation are reduced, and the downstream effects of drying of rivers and floods are minimized.

2.5.3 Priority areas

Degraded hotspots: Highly degraded Regions (Tabora, Dodoma, Shinyanga, Singida, Pwani and Manyara) and Ecologically important watershed/landscapes/catchments/ecosystems

2.5.4 Interventions and targets

- i. Restoration of highly degraded areas and enhance Sustainable Land Management (SLM) in moderately and low degraded areas**
 - a. Develop and implement Programme(s)/Project(s) to restore agro-ecosystem services in degraded agricultural land in seriously degraded watersheds of great Ruaha River, Wami-Ruvu river sub-basins, Uluguru Mountains, Eastern watershed of Lake Victoria, by undertaking best agricultural practices and agroforestry in at least 70% of the degraded landscape by 2032.

- b. Develop and implement Programmes(s)/Projects(s) to undertake landscape restoration in at least 50% of the other landscape (non-agriculture and grazing) in the degradation hotspots (Dodoma, Singida, Tabora, Shinyanga, Pwani and Manyara) through vegetation regeneration, afforestation, and gully rehabilitation by 2032.
 - c. Undertake Soil erosion control in 50% of degraded mountain ecosystem/landscape which are important watershed/catchment areas through Soil conservation, agroforestry and best agricultural practices by 2032.
 - d. Undertake SLM in 50% of the moderately degraded areas in the Pangani basin, the western watershed of Lake Victoria, Kigoma, Katavi, Njombe, Iringa, Kilimanjaro, Manyara and Morogoro through soil erosion control practices, Soil fertility management, and Climate Smart Agriculture by 2032.
 - e. Undertake Rangeland management to restore pastureland and reduce livestock feed/water stress and livestock migration in the Lake Victoria and dryland zones of Mara, Mwanza, Simiyu, Shinyanga, Tabora, Singida, Manyara, Arusha and Dodoma regions by 2032.
 - f. Develop land use plans in at least 50% of the remaining 9,762 villages with no land-use plans to reduce competition and conflict over natural resources by 2032
- ii. Strengthen sustainable mining activities to minimize impact on land and restore impacted area**
- a. Develop and implement programmes to ensure 25% of excavated pits are refilled and vegetated after mining is complete by 2032
 - b. Build and strengthen capacity of LGAs in potential gold rush areas to develop and implement response plans to ensure rehabilitation of degraded areas resulting from unregulated mining rush by 2027.
 - c. Develop and implement Programmes for rehabilitation of 50% degraded landscape due to mining in Geita, Chunya, Nzega, Mara, Singida, Shinyanga Katavi and Mwanza by 2026.
 - d. Develop and implement plans for promotion and use of plantation trees as an alternative supporting poles in mining areas, for at least 50% of the 12,000 primary mining licenses by 2032.
- iii. Promote economic incentives that encourage investments in restoration of degraded land**

- a. Conduct assessment to identify investment opportunities in sustainable land management (SLM) by 2024;
 - b. Establish and promote Business models for attracting investment in SLM activities in degraded landscape by 2025; and
 - c. Strengthen capacity for access to finance for land management by 2026.
- iv. Awareness raising and capacity building for environmental stewardship for communities in degraded and other landscapes**
- a. Develop and implement a sensitization and outreach program on environmental stewardship and landscape management by 2027; and
 - b. Promote community participation in environmental management through the existing the national campaign on environmental management by 2025.



DEFORESTATION AND FOREST DEGRADATION



3 DEFORESTATION AND FOREST DEGRADATION

Deforestation can be described as direct human-induced conversion of forested land to non-forested land. Generally, it is a change of forests to other land uses. Deforestation and forest degradation has been observed to be rampant in many parts of Tanzania mainland (Figure 3-1).

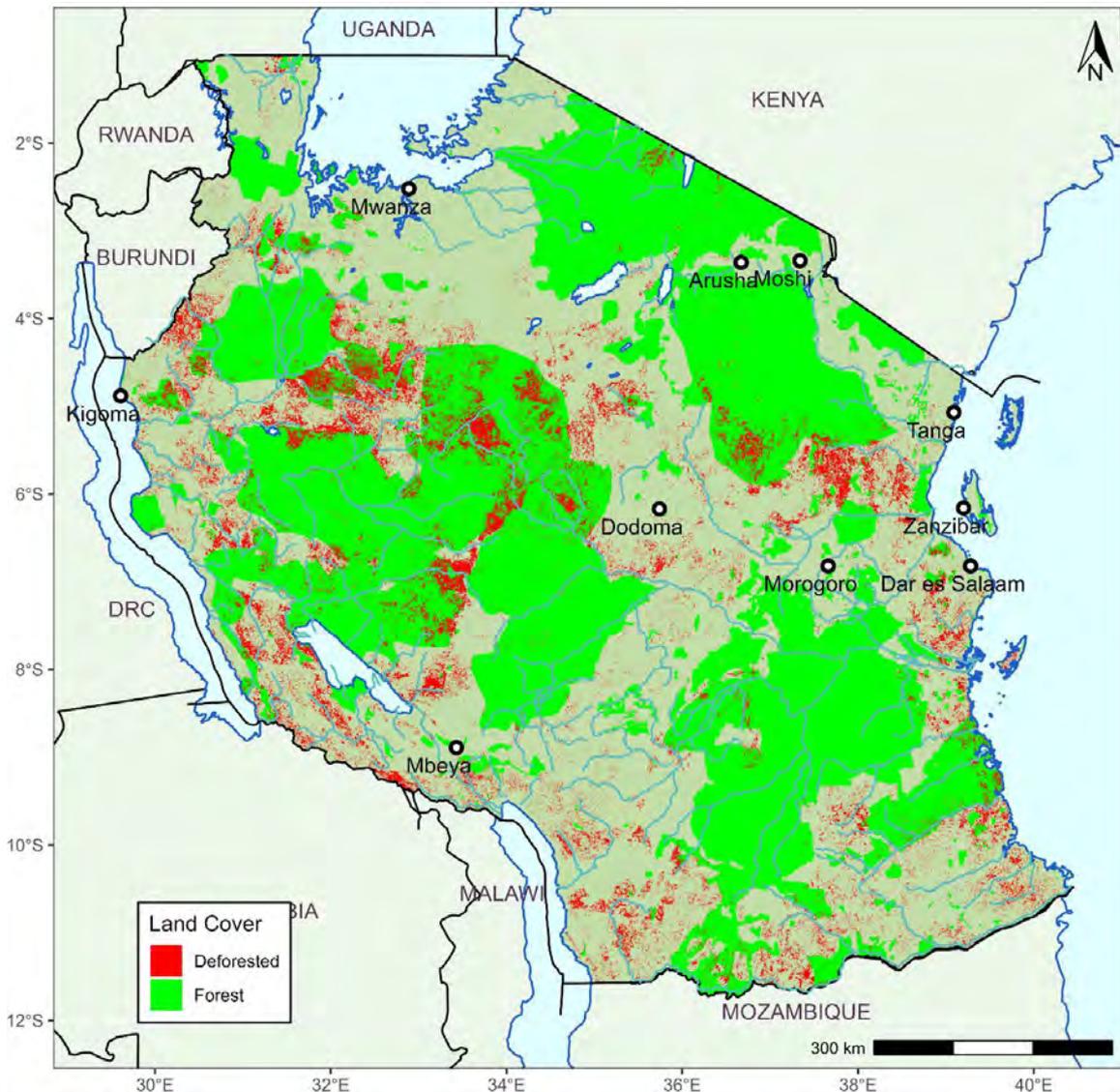


Figure 3-1: Map of Tanzania showing Deforestation areas between 2002 - 2013

3.1 Status of forest degradation

Forest area covers 48.1 million hectares (ha) equivalent to 55% of the total surface land area of Mainland Tanzania. Deforestation and forest degradation has been observed to be rampant in many parts of Mainland Tanzania with annual deforestation rate estimated to be about 469,420 ha per year. Nevertheless, the zonal assessment shows that deforestation is very rampant in Western zone of the country. The Western zone comprises regions of Tabora, Shinyanga, Kigoma and Katavi with total deforestation of 2,222, 561 ha; followed by Southern zone which include Kilwa, Ruvuma, Lindi and Mtwara at 1,053,784 ha; Central zone (Singida, Manyara, Dodoma) with 1,031, 316ha; Southern highlands (Rukwa, Mbeya, Njombe and Iringa) with 1,030,732 ha; Eastern

zone (Morogoro, Pwani and Dar es Salaam) with 491, 487 ha; Northern zone (Arusha, Tanga and Kilimanjaro) with 377,403ha; and Lake zone (Geita, Kagera, Mara, Simiyu) with 193,424 ha (Figure 3.2).

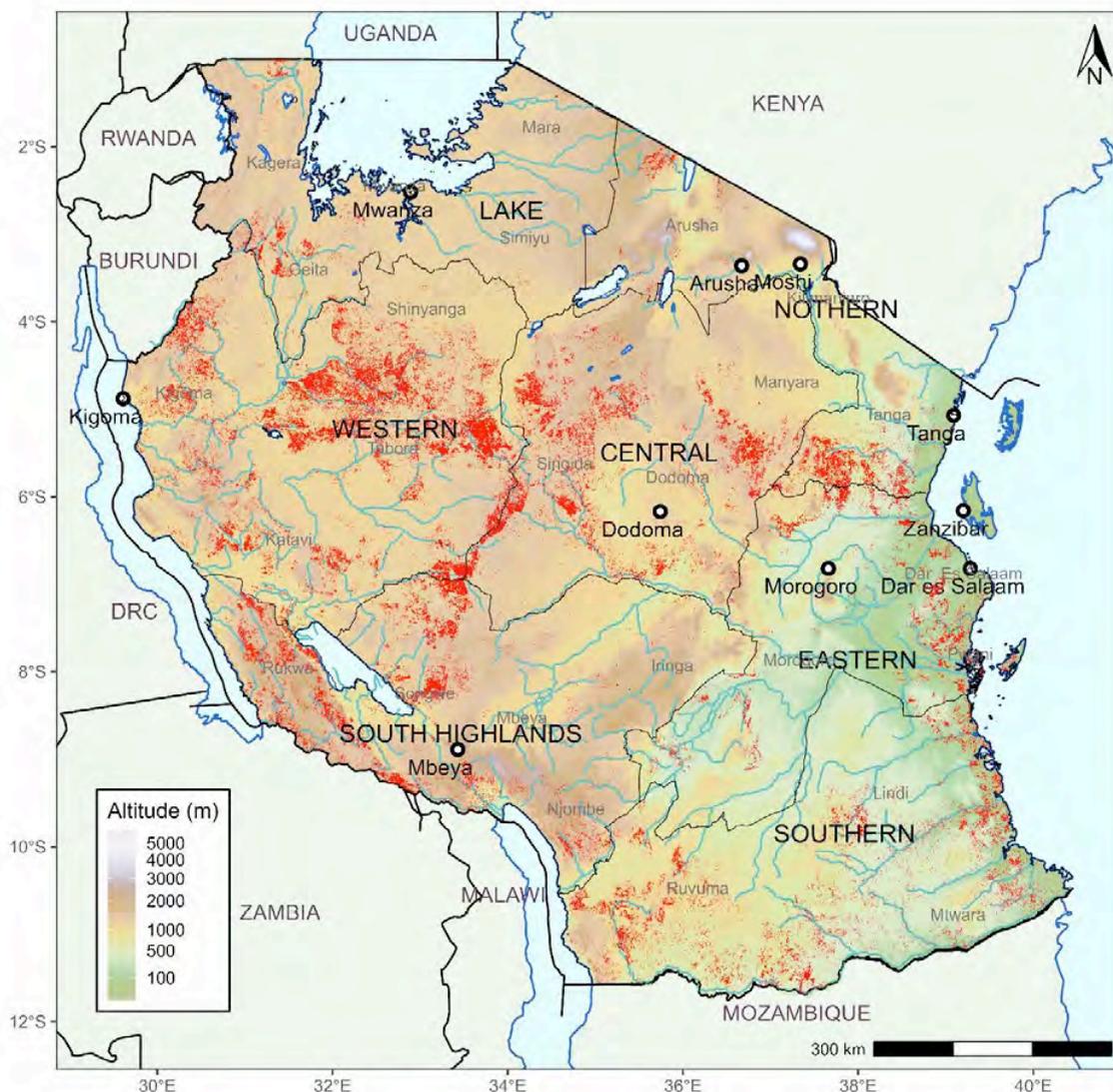


Figure 3-2: Map of Tanzania showing deforestation by geographical zones

3.2 Causes of Deforestation

There are many drivers of deforestation which include, expansion for agricultural land, unsustainable agriculture such as shifting cultivation, logging for tobacco curing, uncontrolled fires, overdependency of biomass as a source of energy for cooking, unplanned settlement due to increasing population, overgrazing, and illegal logging.

3.2.1 Clearing land for agricultural activities

The impact of agriculture on deforestation is attributed to several factors including human population growth and poverty. Agriculture is among the biggest driver of deforestation in the country. For instance, within twelve (12) years, the area under cultivation increased to 17,496,984 ha in the year 2020 from 8,267,544 ha in the year 2008, which is an increase of about 111%.

The assessment of cultivated land shows that in regions with high changes of agricultural land is where deforestation and forest degradation is occurring. The assessment shows that, there are about eleven (11) regions with high percentage change in agricultural land of more than 100 percent. These include Tabora, Kigoma, Shinyanga, Simiyu, Singida, Dodoma, Rukwa, Mbeya, Ruvuma, Lindi, and Mtwara regions. On other hand, there are ten (10) regions with change of agricultural land between 50 – 100% these regions are Njombe, Iringa, Morogoro, Pwani, Dar es Salaam, Tanga, Manyara, Songwe, Katavi and Rukwa regions. Whereas in Arusha, Kilimanjaro, Kagera and Mwanza the change in agriculture land is between 0 and 50%, while in Mara region the change in agriculture land is minimal (Fig: 2.4).

3.2.2 Wildfire/Bush fire

Tanzania forests and woodlands are susceptible to destruction due to wildfires various reason. The motive for setting wildfires normally include opening land for farming, improving pasture quality for grazing, facilitating wildlife hunting, honey collection, and charcoal burning. This challenge has been increasing over time hence contributing to increasing rate of deforestation in the country. The regions which are prone to bush fire include Tabora, Katavi, Kigoma, Simiyu and Geita in Western Zone; Singida and Dodoma in Central Zone; Pwani, Morogoro and Tanga in Eastern zone; Lindi, Ruvuma and Mtwara in the Southern; Songwe and Rukwa in Southern highland as indicated in Figure 3.3.

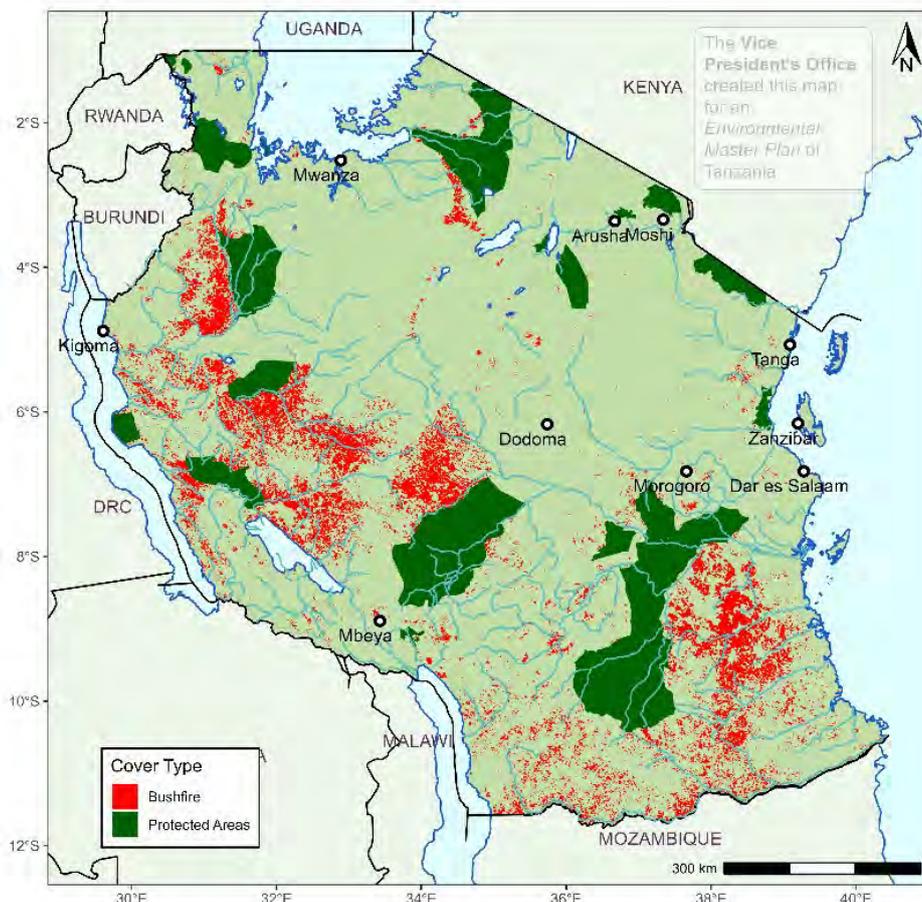


Figure 3-3: Map of Tanzania Showing Bush fire distribution

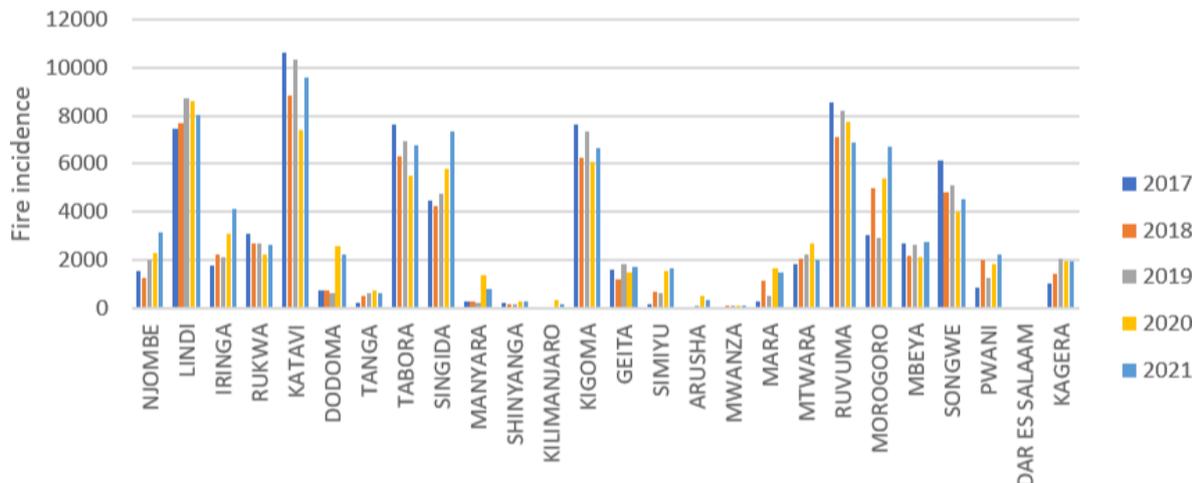


Figure 3-4: Tanzania mainland fire incidents by region for the period of 2017-2021

The fire incidences data obtained from Tanzania Forest Service (TFS) for the period between 2017 to 2021 in Njombe, Katavi, Tabora, Singida, Kigoma, Ruvuma, Morogoro and Songwe regions shows that there are more fire incidents over 4,000 compared to other regions. Katavi region experienced more fire incidents of about 10,603 while Dar es Salaam, Kilimanjaro, and Mwanza regions experienced 18, 32, and 59 fire incidences respectively (Figure 3.4). It is reported that fire incidences happen more in non-reserved forests compare to reserved forests.

3.2.3 Mining Activities

Mining operations have been one of the major factors that contributes to deforestation. The population increase in these mining areas creates high demand for forest products to satisfy population within the area (Logs used in stabilization of mining pits, furniture, building materials, fuelwood etc.). The recent assessment has shown direct correlation between mining and deforestation as represented in chapter two (Figure 2-1d). The assessment of mining activities in the country shows that deforestation is increasing with increasing mining activities. Areas with active mining activities, especially, artisanal and small scale gold mining (eg Katavi and Geita regions and Nzega district), are associated with forest clearing and converted into other land uses.

3.2.4 Overdependency on Biomass Fuel

Charcoal and firewood are the major sources of biomass energy in terms of demand and use in Tanzania. Charcoal is produced in rural areas and consumed mainly in cities and towns, while fuelwood is the main source of energy in rural areas. It is estimated that more than 90% of households in Tanzania use firewood and charcoal as their source of energy for cooking. This situation is contributed by high price of alternative energy sources and inaccessibility, if the existing status quo continues, it is evident that the demand for charcoal is unlikely to decline in the near future. The country's reliance on the biomass energy indicates a potential over exploitation of natural forests and at the same time a potential extinction of tree species.

In general percentage distribution of household by main sources of energy for cooking in Tanzania mainland show that the main source of energy for cooking in Tanzania Mainland is firewood (60.9% of households) followed by charcoal (28.8%), industrial gas (3.2%), electricity (2.1%), paraffin (1.3%) and solar (1.1%) (figure 6-5). Kagera region had the largest percentage of households (87.5%) using firewood as the main source of energy for cooking while for Dar es Salaam has the smallest (5.9%). Use of charcoal is highest in Dar es Salaam region (58.9%) and lowest in Kilimanjaro region (6.8%) (Figure 3.5).

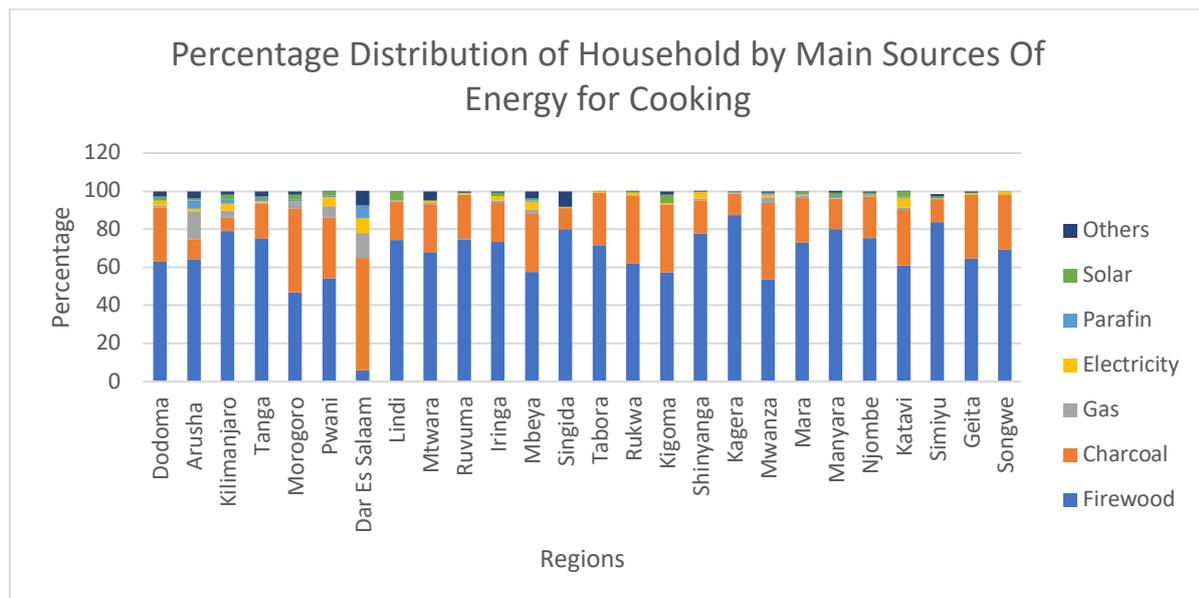


Figure 3-5: Percentage of Household by main sources of cooking energy

Urbanization creates high demand of energy for cooking, especially charcoal and the total annual charcoal consumption in Tanzania is estimated to be 1,000,000 tonnes. The analysis indicate that Dar es Salaam City consumes almost half of the charcoal produced in Tanzania with an annual consumption of 500,000-700,000 tonnes.

The National Bureau of Statistics data for Household survey for 2019 shows that almost 59% of House Hold use charcoal for cooking in Dar es Salaam City (Fig: 3-6). There is a perception that the use of charcoal for cooking is cheaper than the use of LPG. However, a recent study conducted in refugee camps in Kigoma shows that the monthly cooking fuel cost for an average household with 5 members is 93,600TZS for charcoal while it is 57,500TZS for LPG.

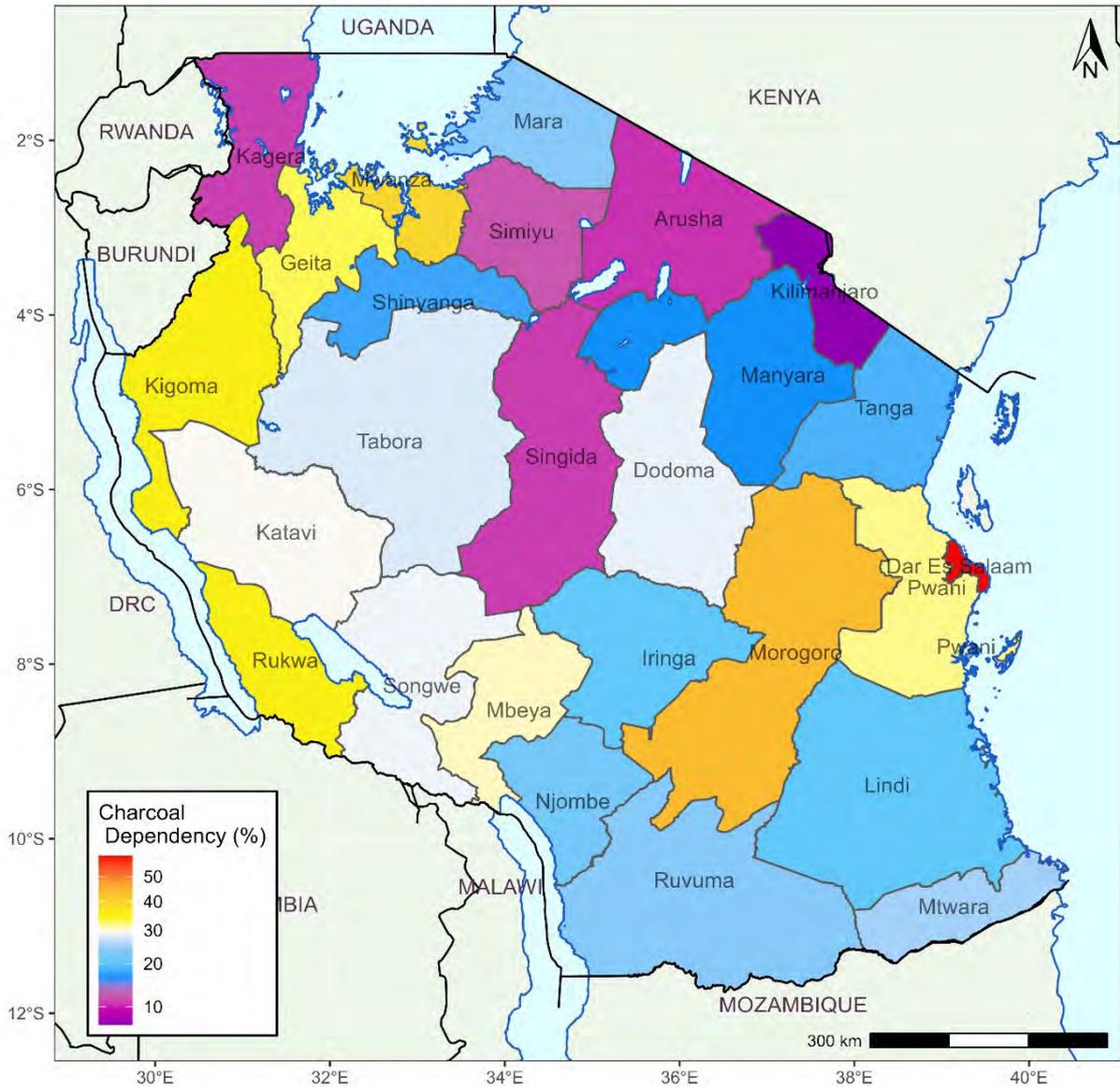


Figure 3-6: Map of Tanzania Showing Charcoal dependency percentage

Kagera Region (87.5%) has the largest percentage of households using firewood as a source of energy for cooking while Dar es Salaam (5.9%) has the smallest (Fig: 3-7).

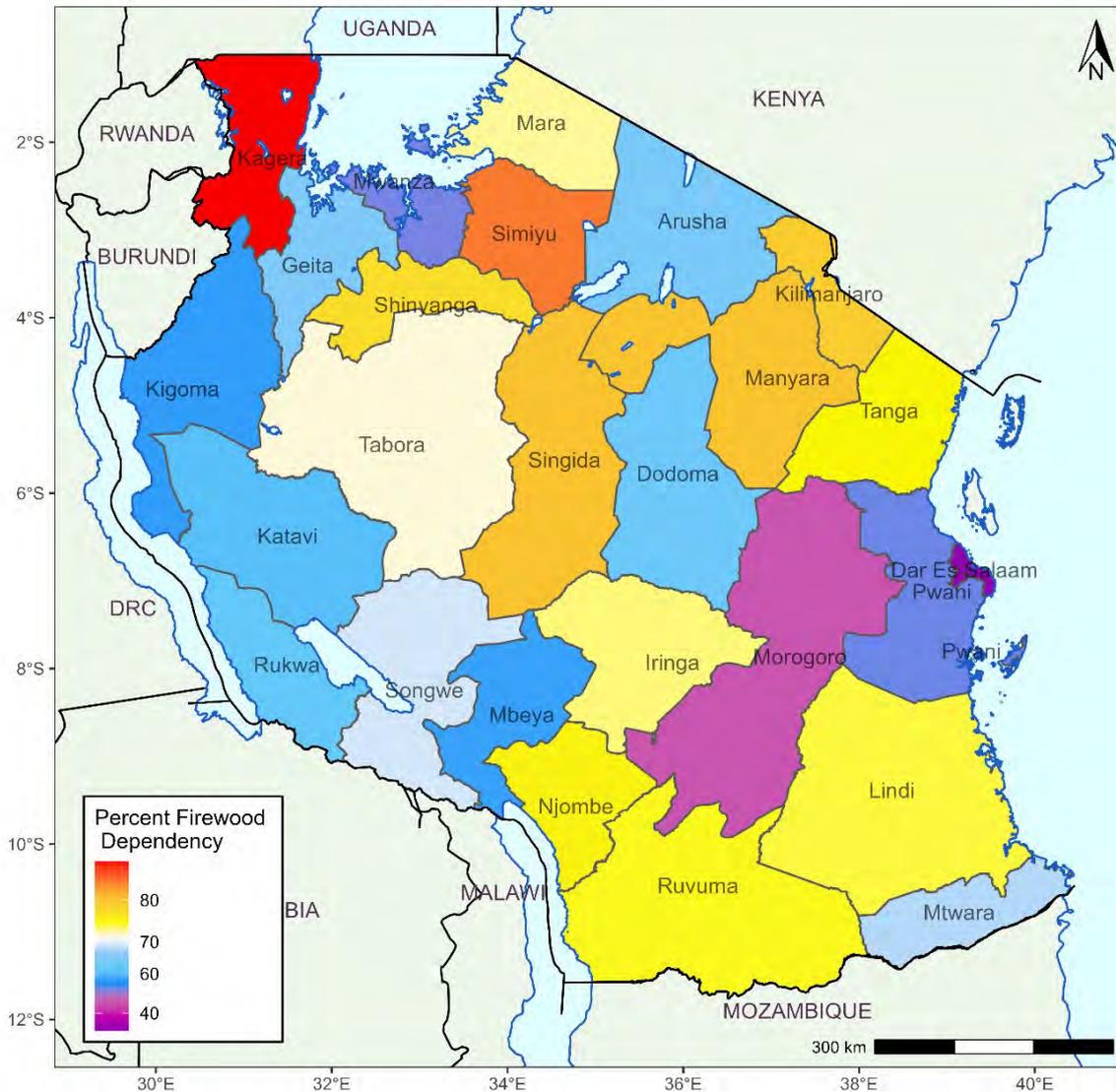


Figure 3-7: Map of Tanzania Showing Firewood Percentage dependency

3.2.5 Tobacco Curing

Tobacco is one of the cash crops produced by farmers in many parts of Tanzania. However, tobacco crop causes major detrimental effects to environment particularly forest resources from its growing to its production. In Tanzania tobacco is mainly grown in Tabora (Urambo, Tabora Municipal, Uyui, Nzega, Sikonge and Kaliua); Katavi (Tanganyika, Mlele and Mpanda); Shinyanga (Kahama); Geita (Chato, Geita, Mbogwe and Bukombe); Kagera (Biharamulo); Kigoma (Uvinza, Kasulu, Kakonko and Kibondo); Iringa (Iringa Municipality and Mufindi); Singida (Manyoni); Mbeya (Chunya); Ruvuma (Songea Rural, Namtumbo, Mbinga and Tundurur); Songwe (Songwe District); Mara (Serengeti, Tarime and Rorya) and Morogoro (Kilosa). The destruction and deforestation happen during farming preparation and at the time of curing of the tobacco leaves where massive trees are cut.



Plate. 3-1: Pile of logs to be used for tobacco curing in Tabora. Right tobacco farm in Titye village, Kasulu District

The most serious negative impact on forest caused in tobacco growing areas originates from the curing process. For example, smallholder farmers exclusively use wood as source of energy to cure the green leaves of tobacco in the process of doing that large quantities of wood are drawn from the natural forest every season not only for curing the crop, but also to construct curing burners.



Plate. 3-2: Pile of logs ready for transport to burner for tobacco curing in Tabora region

The WHO, 2017 report indicated major parts of Tanzania's Miombo ecosystem, which is about 11,000 ha of forests are lost annually and curing has been the leading cause of deforestation. Furthermore, tobacco farming is much more destructive on forest ecosystems than other agriculture uses such as maize farming or grazing. This has been observed in Urambo District, which is Tanzania's leading tobacco growing area, the combined annual deforestation rate due to tobacco curing is 3%. This rate is 10 times higher than the overall deforestation rate due to tobacco curing in Africa (0.64%), and globally 0.22%) during the first half of the 2000s.

As it has been pointed out earlier, tobacco farming accelerates deforestation through slash and burn, these actions are associated with the decline of biodiversity and loss of other forest ecosystem services, both wood and non-wood.



Plate. 3-3: Pile of logs and burner used for curing tobacco in Urambo District in Tabora region

3.3 Impacts of Deforestation

The deforestation's impacts include: land degradation; reduced land productivity due to loss of soil fertility; habitat loss; loss of biodiversity for both plants and animals; Increased human-wildlife conflicts due to proximity and overlaps in the use of space between wildlife; incidences of property damage by wildlife, livestock and humans; reduction or loss of tourism potentials due to destruction of principle resources including charismatic wildlife species and attractive sites; Loss of livelihood options among the communities who rely on forests for food, medicine, fuelwood, building poles and furniture; inadequate or unreliable rainfall patterns; and increase of climate change impacts.



Plate. 3-4: Left: Degraded Miombo Woodland at Doma Area – Morogoro for (Charcoal Production) Right: cleared natural forest land in mountains posing threat to soil erosion and land degradation.

3.4 Existing initiatives

Tanzania has put in place several measures to address deforestation. Nevertheless, these measures are either inadequate or are poorly implemented. In reversing the trend of deforestation, there is a need to strengthen these measures and adopt new ones to complement the existing measures. Some of the interventions which have been taken are described hereunder: -

3.4.1 Awareness Creation to Communities,

The strategy has been educating the public about the benefits of forests and adverse impacts that resulted from unsustainable behaviors and actions on forests, it has also been creating awareness on sustainable practices that promote the health of forests and alternative strategies for sustaining their livelihoods beyond those causing damage on forests. Tree planting campaigns have been part of the awareness in advocated communities whereby planting and conserving trees have been encouraged at national and local level. Large institutions have also been directed to establish their own woodlots for firewood/charcoal as source of energy for cooking.

3.4.2 Promotion of Alternative Sources of Energy for cooking

There have been some efforts of reducing overdependence on household biomass sources of energy by promoting alternative sources including electricity, liquefied petroleum gas, and natural gas. The effort includes the installation of 7.8-kilometer natural gas pipeline in Mikocheni Dar es Salaam with a capacity of 7.5 million cubic feet per day which aims to connect 10,000 domestic customers. By June 2020, 337 households and six institutions (Mtwara Teachers College, Mtwara Technical Teachers College, Mtwara Technical Secondary School and Lilungu Prison) located in Mtwara and two institutions (University of Dar es Salaam and Keko Prison) located in Dar es Salaam were connected to the pipeline networks in Mtwara and Dar es Salaam.

3.4.3 Promotion of innovation on alternative to charcoal for Small and Medium Entrepreneurs

The Vice President's Office in collaboration with Shell Exploration and Production Company Limited, organized and conducted a competition with purpose of promoting innovation and the use of alternative to charcoal sources of energy. The competition conducted from 2018 -2021 where three winners were awarded prizes with a total of TZS. 600 mil to promote appropriate technologies and innovation in many parts of the country. The three winners have recorded significant improvements in compliance, production, formal markets, community outreach and turnover of their products. This competition has contributed to increasing entrepreneurs' capacity of charcoal production from 1,396 tonnes in 2,018 to 4,588 tons in 2020 in Dar es Salaam, Tabora, Mafinga and Dodoma.

3.4.4 Village Land use plan

The importance of landuse planning for village land management has been emphasized in the Village Land Act Cap 114 such that it is now obligatory for every village to prepare a land use plan. A total of 2,556 Village land use plans have been undertaken across the country.

3.4.5 Tree Planting Programme

The Government is implementing Tree Planting programme by involving different stakeholders including Ministry of Natural Resources and Tourism (MNRT) through Tanzania Forest Services Agency (TFS). Under this programme, tree seedlings are given

free of charge in all TFS centers. The Strategy for Urgent Actions on Land Degradation and Water Catchments requires each District to plant not less than 1.5 million trees annually. The statistics shows that a total of 813,101,021 trees have been planted from 2016/2017 to 2019/2020 in Tanzania mainland.

3.5 Interventions for reversing deforestation

3.5.1 Goal

To enhance conservation of forest ecosystems and promote sustainable utilization of forestry resources.

3.5.2 Expected results

Deforested area reduced, overdependence on biomass reduced, management of forest resources improved, sustainable agricultural practices increased, increased awareness on the conservation and sustainable utilization of forest resources.

3.5.3 Priority areas

Priority areas for strategic interventions in Western zone account for 35 percent of the total deforested area in the country and which covers Tabora, Shinyanga, Kigoma and Katavi Regions.

3.5.4 Interventions and Targets

i. Restore deforested areas to ensure maximum ecosystem service provision

- a. Develop and implement conservation programmes and projects in 4 highly deforested regions by 2025;
- b. Strengthen and implement programmes for tree planting in regions with high deforestation rate by 2025; and
- c. Develop and implement programmes to access carbon credit market through awareness creation and capacity building by 2024.

ii. Build Institutional capacity for conservation and Management of forest resources

- a. Develop programme for strengthening of legislation that control and manage forest resources by 2025;
- b. Strengthen and implement programmes for forest fire management in forest areas by 2026.
- c. Build capacity of MDAs and LGAs to monitor implementation of the tree planting programme of 1.5 million trees per district per year by 2025.

iii. Reduce overdependence of biomass energy

- a. Develop and implement programmes to provide incentives to reduce initial investment cost in accessing LPG by 2026;

- b. Develop and implement awareness programme on targeted behavioral change towards use of charcoal and firewood by 2026;
 - c. Promote establishment of infrastructure to support supply and accessibility of Natural Gas for uses in Households and industries by 2032;
 - d. Cultivation of fast growing tree species suitable for charcoal and commercial firewood production promoted by 2025; and
 - e. Promote use of energy efficient technologies (cooking stoves and charcoal kiln) to at least 50% of the households and charcoal producers in highly deforested areas by 2024.
- iv. Engagement and participation of private sector and local communities in sustainable forestry management.**
- a. Develop and implement Programmes for collaboration between Government, private sector and local communities in forest conservation by 2025;
 - b. Capacitate communities to participate in Forest Management through Joint Forest Management (JFM) and Community Based Forest Management (CBFM) in all highly deforested areas by 2025;
 - c. Develop and implement awareness raising programmes on investment opportunities in forest resources by 2032.



DETERIORATION OF WATER SOURCES



4 DETERIORATION OF WATER SOURCES

Tanzania has relatively abundant water resources with several major rivers and lakes. The major lakes found in Tanzania are Lake Victoria, Tanganyika, Nyasa and Rukwa. There are also several inland lakes namely Lake Manyara, Eyasi, Natron, Singidani, Jipe, Chala and Babati. The main rivers found in the country include Pangani, Wami, Ruvu, Rufiji, Ruvuma, Mara, Kagera and Malagarasi (Figure 4-1). Lake Victoria, Tanganyika Chala, Jipe and Nyasa are transboundary lakes while Kagera, Mara, Pangani, Umba, Ruvuma and Songwe are transboundary Rivers.

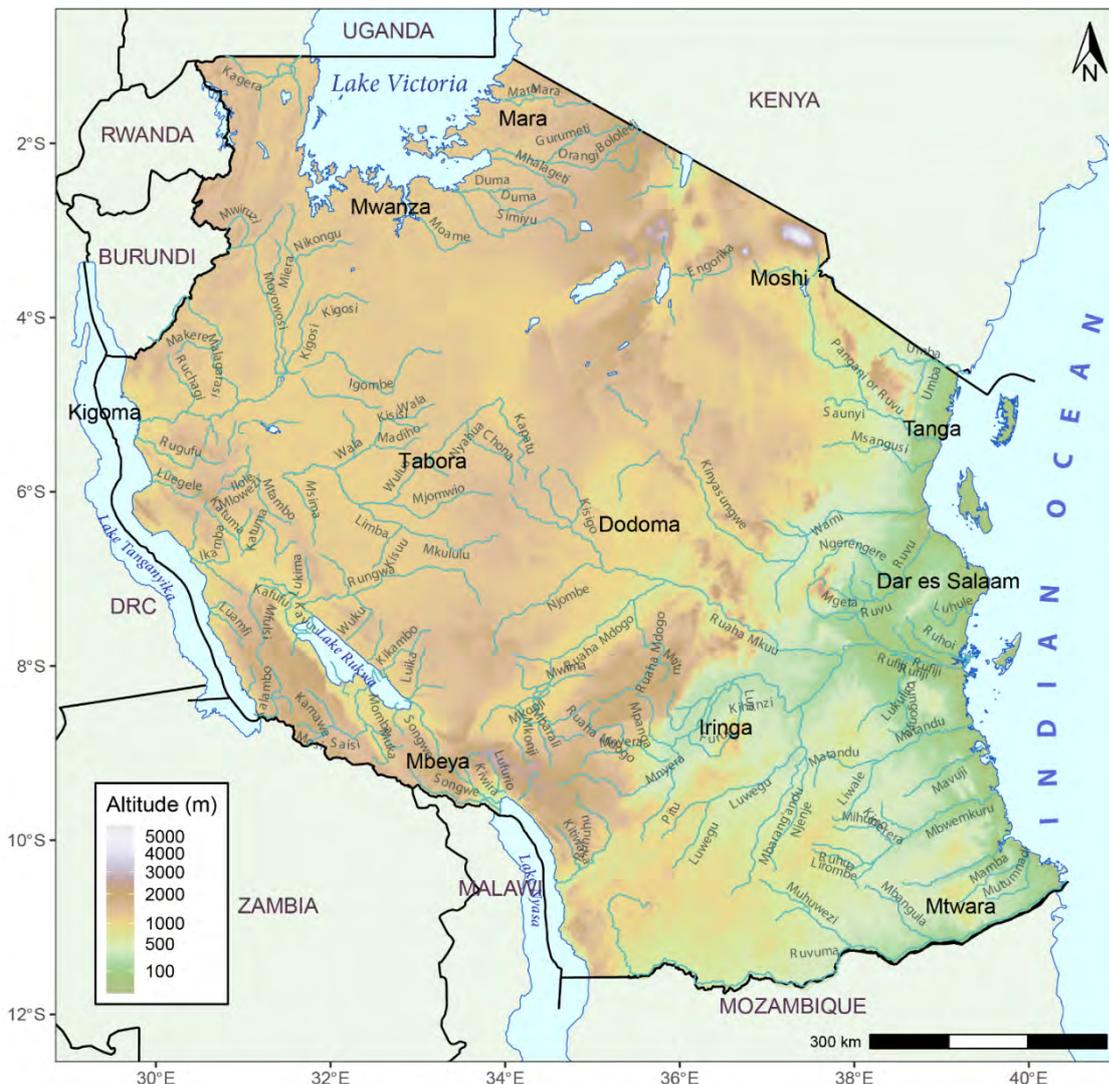


Figure 4-1: Major Lakes and Rivers network in Tanzania

Water sources are required to sustain the ecosystem and the valuable services they provide. They also provide water for domestic use, agriculture, power generation, shipping, fishing, recreational activities and tourism. Over the years, the demand for water in the country has increased as result of population growth combined with elevated temperature and increased frequency of drought events. This situation leads to increased demand for water utilization particularly for domestic, irrigation and livestock consumption thus altering the quantity and quality of water resources in water basins in the country.

4.1 Water Quantity in Water Sources

4.1.1 Status of Water Quantity in Lakes

Fluctuation in water levels in major lakes are high during the rainy season and low during the dry season. These fluctuations result from changes in the balance between water inputs (rainfall at lake level and inflows from lake tributaries) and water losses (evaporation at lake level and outflows from tributaries). Since 2010, the water level has changed dramatically in every major lake in the country. This is clearly shown in (Figure 4-2) where steady rising of water level between 2010 and 2021 was observed in Lake Rukwa, Tanganyika and Victoria, thus confirming the highest rising rate of 48.8 cm and 14.8 per year observed in Lake Rukwa and Tanganyika respectively, followed by Lake Victoria (Table 4-1). The sharp increase of water level in Lake Rukwa could be attributed to increased sediments load due to unsustainable human activities in the catchments areas. On the other hand the Lake Nyasa water level gradually decreased since 2010 and a slight increase after 2016.

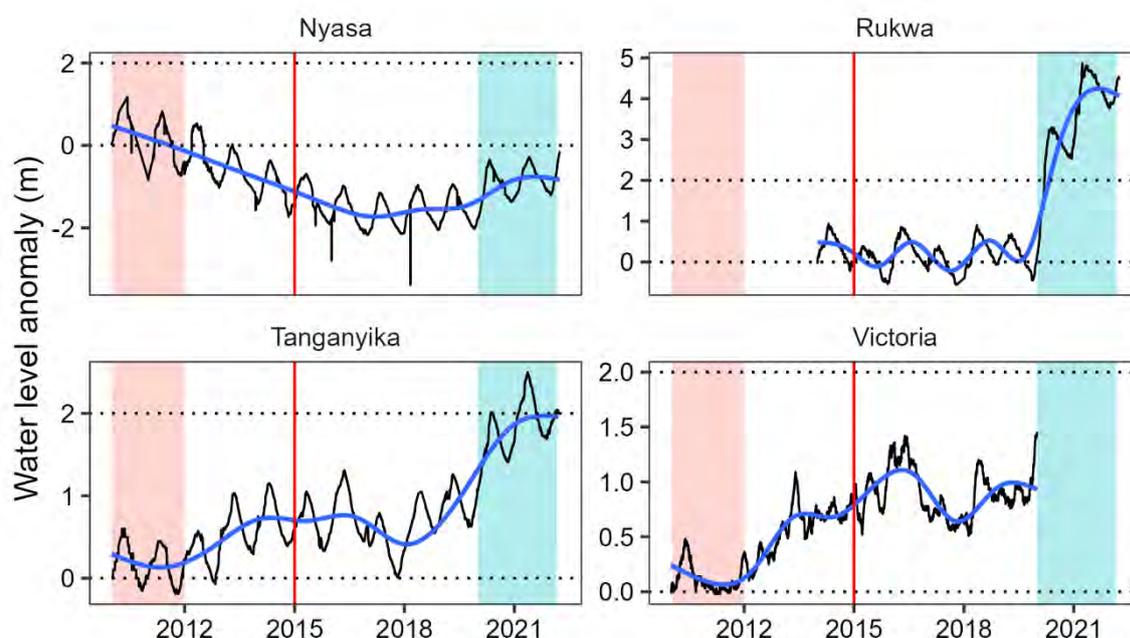


Figure 4-2 Trends of water level in major lakes of Tanzania. Black solid line denotes seasonal change in water level and solid red line indicates water level trends. The pale red fill color is the base year record, and the pale green color is the latest water level records.

Table 4-1: Water levels by year and annual trends for major lakes in Tanzania

| Lake | Trend (cm/year) |
|------------|-----------------|
| Victoria | 10.1 |
| Tanganyika | 14.5 |
| Rukwa | 48.8 |
| Nyasa | -10.9 |

4.1.2 Flow of water in Rivers

Across the country, river discharge in the nine water basins showed a fluctuation in water flow for a period between 2010 and 2021. On average river discharge in Lake Victoria, Ruvuma and Southern, Lake Nyasa, Rufiji, Lake Rukwa Basins were declining by more than 200,000 liters per day, while the River discharge in Internal drainage basin, Pangani, Wami-Ruvu, and Lake Tanganyika basins increased by 400,000 liters per day over the same period (Figure 4-3). Annual river discharge increased in Malagarasi, Ruhuhu, Songwe, Ruaha Mkuu, Ruvu and Pangani but decreased in Kagera, Mara, Momba, Lufurio, Mbarali, Ruaha Mdogo, Wami, and Ruvuma Rivers (Figure 4-4).

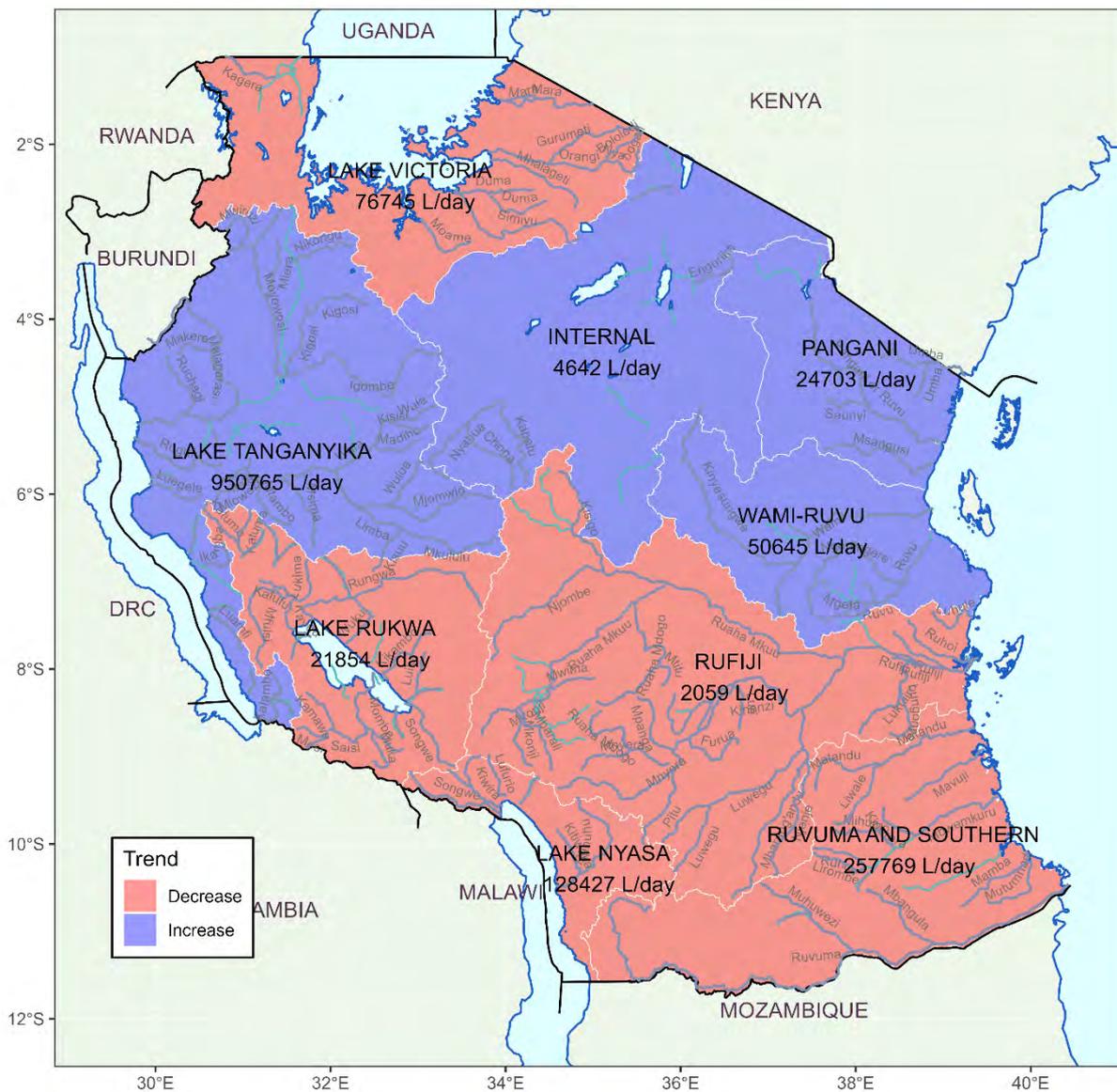


Figure 4-3: Trends of River Discharge in water basins

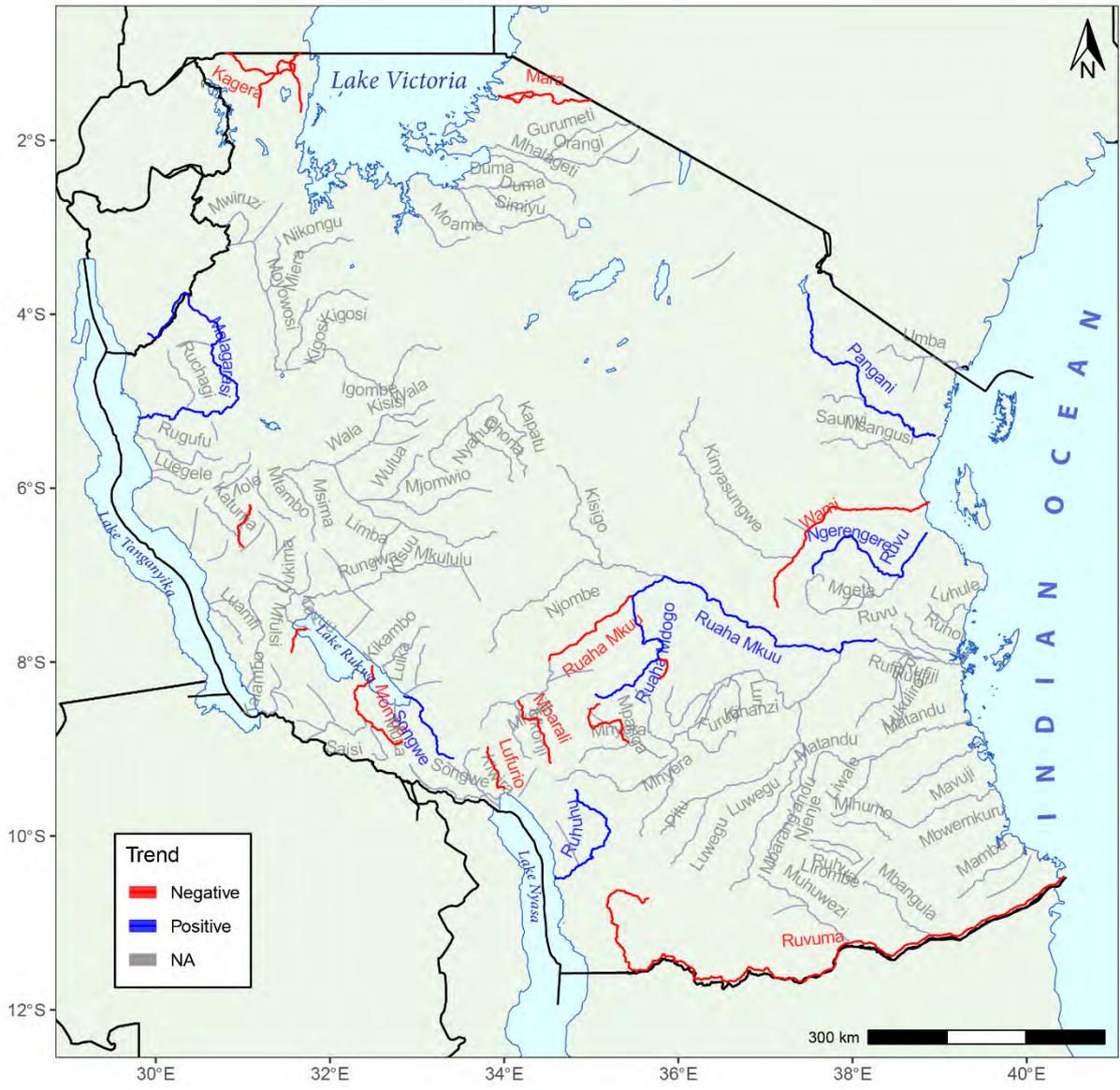


Figure 4-4: Major Rivers in Tanzania with annual discharge trends of rivers with gauging station. The blue color denotes rivers with increasing trends, red color denotes rivers with decreasing trends and grey color represent rivers without discharge information.

4.1.3 Cause of Change in Water Level

Deforestation, agricultural expansion, land degradation in the highlands and water catchment areas are the main cause of change in water level in lakes and water flow in rivers. Deforestation decreases soil infiltration of water and increases soil erosion leading to higher level of soil erosion that is washed during rainy season and carried into lakes with high sediment load. Increase in rainfall in recent years is also a major factor that contributes to the observed rising water levels in lakes in the country. For instance, the country has received rainfall above historical mean since 2016, and the heavy rainfall of 2019 was the country’s wettest year on record (Figure 4-5).

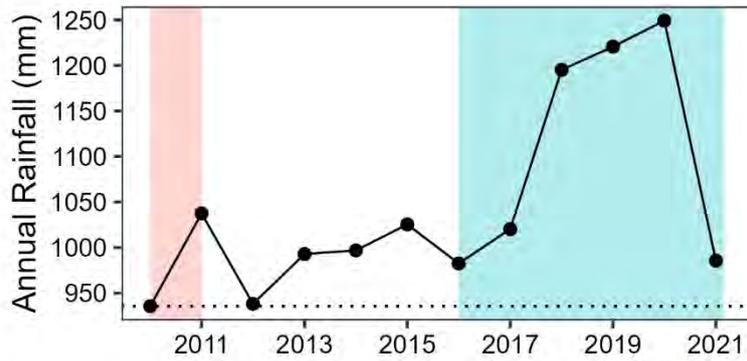


Figure 4-5: The annual trend of rainfall across Tanzania

4.1.4 Impact of Change in Water Level and water flow in Lakes and Rivers

The water level in major lakes of Tanzania has risen above 2 meters since 2010 with significant impact on ecosystem, social and economic activities of people depending on these lakes for their livelihood. Some of the impacts include surging waters causing flooding, soil erosion, lake shore erosion, and increased siltation in the lakes. The impacts results into flooded lakeshores; submerged homes, schools, and business premises resulting in displacement of people. In many locations along the Lake Victoria, Tanganyika, Nyasa and Rukwa lakeshore, flooding during rainy season is more frequent than it was in the past (Plate 4-1).

The increases and decreases in river water levels have an impact on livelihood and socio-economic activities. Flooding can result from high river discharge, whereas low river discharge impact on ecosystem-dependent species and, in extreme cases, develop into a hydrological drought, affecting public water supply, hydroelectric power generation, and commercial river transport. For example, the Rufiji River Basin, which has six major dams (Table 4-2), and generates more than 80 percent of hydropower in Tanzania has experienced a decreasing trend in river flow. This has been attributed to unsustainable human activities taking place in the basin and upstream areas as well as low rainfall levels in the summer season that created an increase of water demand. Improper allocation of water for upstream rice irrigation in the Usangu Plains and inefficiency of traditional smallholder irrigation contributes to decrease water flows in Little Ruaha and Mbarali Rivers (Figure 4-4) with adverse impact downstream hence threaten hydropower generation.

Table 4-2: Hydropower in Tanzania

| Basin | Dams in the basins | |
|---------------|--------------------|--|
| | Number | Name |
| Lake Nyasa | 3 | Masigira, Songwe, Rumakali |
| Lake Victoria | 2 | Kagera River, Rusumo Fall |
| Pangani | 4 | Pangani Fall, Hale, Manderu, Nyumba YaMungu |
| Rufiji | 6 | Mpanga, Mwl.Nyerere, Kidatu, Kihansi, Mtera, Ruhudji |



Plate 4-1: Submerged houses and trees in Lake Tanganyika caused by flooding and rising water level in 2020.

4.2 Water quality

4.2.1 State of water quality

Recent information on water quality monitoring obtained from Ministry of Water indicates that the average physical parameter on water quality are within acceptable limits with exception of Lake Victoria and Ruvuma and Southern which had higher turbidity and Pangani had higher pH levels above acceptable standard (Table 4-3). For the case of nutrients levels, nitrates and phosphates were also within acceptable level except for, Ngerengere and Mbezi River in Wami-Ruvu basin, and Great Ruaha in Rufiji basin which had higher nitrate levels (Table 4-4).

Table 4-3: Water quality parameters in the nine water basins

| Basin | Temperature | Colour | Turbidity | pH | EC | TSS | TDS | TH | Ecol |
|---------------|-------------|--------|-----------|---------|-------|-----|------|---------|------|
| Internal | 24.4 | 12.5 | - | 6.7 | 84.2 | - | 43.5 | 52.5 | - |
| Lake Rukwa | 25.5 | 65.2 | - | 6.9 | 205. | - | 101 | - | 46 |
| Lake | | | | | 4 | | 330. | | |
| Tanganyika | 24.7 | 6.3 | - | 6.3 | 670 | - | 5 | - | 10 |
| Lake Victoria | 25 | - | 411 | 7 | 170.4 | 160 | 94.5 | 65.2 | 81 |
| Pangani | 29 | 143 | 31 | 9.1 | 1182 | - | 591 | 76.8 | - |
| Rufiji | 29.4 | 93 | 22 | 7.4 | 111.2 | 7 | 46 | 19.1 | - |
| Ruvuma and | | | | | | | 258. | | |
| Southern | 29 | - | 352 | 6.8 | 444 | 316 | 5 | 119.2 | 10.5 |
| WAMI/RUVU | 25.3 | 27 | 21 | 7.8 | 122.9 | 0.1 | 61.4 | 45 | 4.5 |
| Standard | 20-35 | 300 | 300 | 6.5-8.5 | 2500 | | 1500 | 500-600 | |

Table 4-4: Water quality metals and nutrients in the nine water basins

| Basin | Cl | Fe | NA | SO4 | Ca | Mg | Alalinity | K | PO4 | NO3 | Fluoride |
|---------------|------|-----|------|------|--------|------|-----------|-----|-----|-----|----------|
| Internal | 20 | 0.9 | - | 5 | 16.7 | 3.6 | - | - | - | 8.5 | 0.1 |
| Lake Rukwa | 13.2 | 5.3 | 15.7 | - | - | 8.5 | - | 1.2 | - | 3 | - |
| Lake | 42.2 | 0.3 | 10.7 | 1.1 | - | 21 | - | - | - | - | - |
| Tanganyika | | | | | | | | | | | |
| Lake Victoria | 11.1 | 4.6 | - | 52.7 | 21.1 | 4.4 | 90 | - | - | - | - |
| Pangani | - | - | 62.9 | 0 | 23.5 | 43 | 4.4 | - | 0 | - | 1.3 |
| Rufiji | 5.1 | 0.3 | 7 | 2 | 8.2 | 3.2 | 46.9 | 2.8 | 1 | 0.6 | 0.5 |
| Ruvuma and | 75.4 | 0.5 | 46.9 | 51.8 | 31.8 | 14.1 | 77.8 | 4.7 | 0.5 | 1.6 | 0.1 |
| Southern | | | | | | | | | | | |
| WAMI/RUVU | 11.6 | 0.1 | 3.2 | 10 | 7.3 | 6.5 | 53.6 | 0.6 | 0.1 | 8 | 0.2 |
| Standard | 200 | 5 | 200 | 500 | 50-100 | 100 | NA | NA | | 20 | |

4.2.2 Causes of reduction in water quality

Reduction of water quality is caused by existence of organic pollutants in the water source. For the case of Lake Victoria, existence of Particulate Organic Carbon (POC) confirm the reduced quality of water in the lake. Furthermore, seasonal variation in rainfall have influence on the distribution patterns and concentration of POC with higher mean values of 2280 mg/m³ in the dry season (June to October) compared to a mean values of 1830 mg/m³ found during the rainy season in the month of February to May. The uneven distribution of POC was also observed where by high POC concentration is found in the western side of the lake (Figure 4-6).

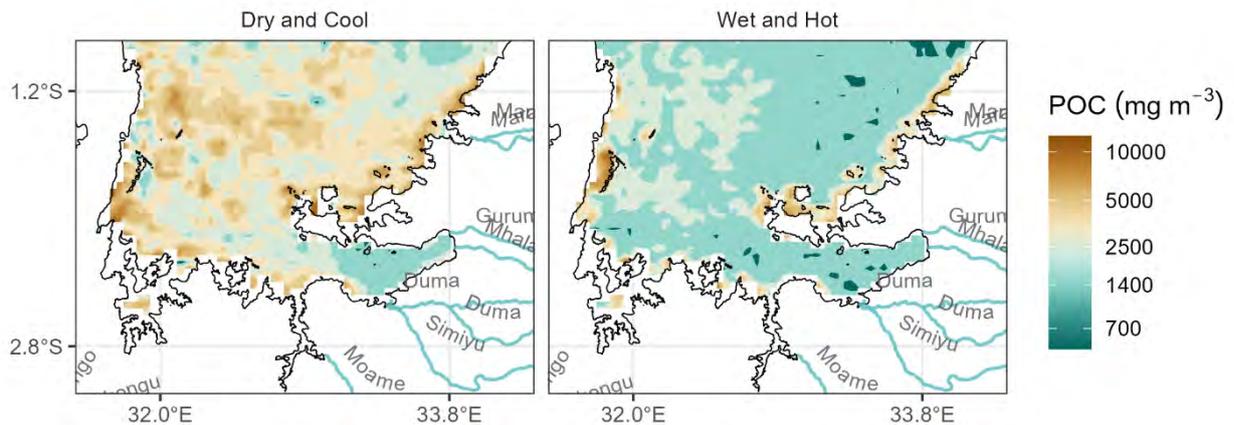


Figure 4-6: Spatial pattern of Particulate organic carbon (POC) during the dry (left) and wet (right) season in the Lake Victoria surface water

Furthermore, sediments and silt affect the water quality of Lake Victoria, which has impact on domestic use and the life of aquatic organisms. The high concentration of Particulate Inorganic Carbon (PIC) is observed in the southeastern side of the Lake Victoria (Figure 4-7). The high values of PIC is attributed to eroded soil upland that are discharged from major river of Mara, Gurumeti, Mhalageti, Duma and Simiyu from the eastern side of the Lake Victoria. The PIC value is higher during wet season, which occurs from early February to the end of May (Figure 4-7). Another threat that has changed the quality of water in the Lake Victoria is the growth of water hyacinth.

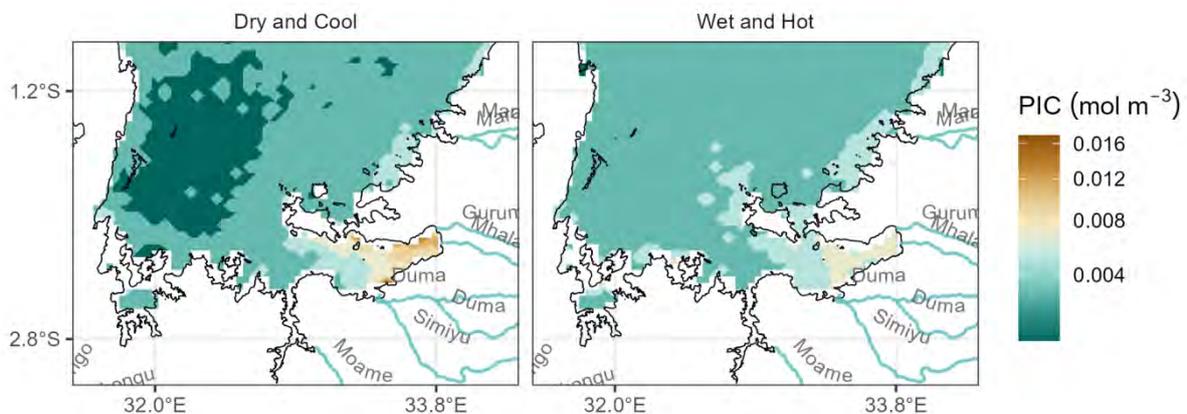


Figure 4-7: Spatial pattern of Particulate inorganic carbon (PIC) during the dry (left) and wet (right) season in the Lake Victoria surface water

4.2.3 Impact of reduced water quality

Poor water quality has its most direct impact on aquatic wildlife, particularly fish. The high POC concentration observed during the dry season coincides with death of fish usually occurring in Lake Victoria in the months of July and August which is linked to lowered dissolved oxygen levels. Excess nutrients, sediment load, and other contaminants has reduced the transparency of Lake Victoria and clarity of water flowing in Rufiji River which has an impact on domestic use and the life of aquatic organisms.

4.3 Existing initiatives

In recognition of the fact that many parts of the major lakes in the country can expect flooding due to continued water level rises exceeding the long-term mean average, several interventions are in place to curb or reduce the impacts of rising water. Some of these initiatives include: Establishment of Lake Tanganyika Water Management (LATAWAMA) project, which gathered data on rising water levels in Lake Tanganyika and shared the information to public. Capacity building to community on good practices in solid and liquid sanitation. On the other hand, the Lake Victoria Environmental Management Project (LVEMP) focuses on protecting the catchment of the Lake Victoria through reduction of pollutants entering the lakes and restore the ecosystem that supports the lake through sustainable land management practices and use of cleaner production technologies in major industries along the lake.

The Integrated Water Resources Management (IWRM) was developed as a tool for effective planning and management of water resources. Basin Water Boards established for the purpose of coordinating information management and assessment of water resources (e.g. hydrological, hydrogeological information, water and discharge permit registers, registers of water user associations etc). Basin Water boards and catchment and sub-catchment Committees are also involved to manage the environment of water basins in the country.

4.4 Interventions for addressing deterioration of water Sources

4.4.1 Goal

Water sources are conserved, protected and managed in a sustainable manner

4.4.2 Expected Result

Water catchments are conserved, water flow and quality in rivers and lakes are maintained, water in rivers and lakes are used efficiently, and the ecosystem services provided by rivers and lakes are sustained.

4.4.3 Priority Areas

To conserve water sources in Kagera, Mara, Ruaha Mkuu, Momba, Lufurio, Wami and Ruvuma rivers; to conserve water Basins in Lake Victoria, Lake Tanganyika, Lake Nyasa, Lake Rukwa and wetlands of Mara, Malagarasi and Malagarasi - Muyowosi Wetland.

4.4.4 Interventions and targets

- i. Enhance water catchments management to ensure a stable flow of water in river Kagera, Mara, Ruaha Mkuu, Momba, Lufurio, Wami and Ruvuma**
 - a. Develop and implement plans for restoration and management of land cover through tree planting and natural regeneration by 2028;

- b. Develop and implement program to promote sustainable livestock keeping including destocking, rangeland management and access to water for livestock by 2030;
 - c. Promote sustainable agriculture through the adoption of best agricultural practices, conservation agriculture and climate-smart agriculture by 2032; and
 - d. Establish and enhance of Water Users Associations by 2026.
- ii. Promote efficient water use by all water users in Kagera, Mara, Ruaha Mkuu, Momba, Lufurio, Wami and Ruvuma rivers**
- a. Promote the use of appropriate infrastructures to support efficient water use for irrigation and other uses by 2032;
 - b. Develop and implement plans for awareness to water users on the conservation and efficient use of water resources by 2025; and
 - c. Enhance enforcement through regular monitoring surveillance to control illegal abstraction of water by 2025.
- iii. Enhance water quality control in water sources.**
- a. Build capacity of institutions responsible for water management in adopting the best available technologies for monitoring water quality by 2025;
 - b. Enhance institutional coordination in the generation, availability and access to water quality data and information by 2024; and
 - c. Enhance NEMC capacity to continue monitoring water quality for pollution control by 2025.



WETLAND DEGRADATION



5 WETLAND DEGRADATION

A wetland is an ecosystem that is dominated by water and whose functional processes and characteristics are largely controlled by water. Wetlands occur where the water table is at or near the surface of the land, or where the land is covered by water. Wetlands are very important ecosystems as they support biological diversity, provide water and primary productivity, and thereby support the survival of a number of species of plants and animals.

Wetlands are very important ecosystem as they support flood control by spreading and slowing down floodwaters, regulate stream flow by absorbing water (wet periods), and release (dry periods) the water slowly into streams and rivers. In addition, they purify streams and rivers by trapping and retaining sediment, removing nutrient, provide habitat by supporting and maintaining rich biodiversity in the wetlands (aquatic and terrestrial). In doing so the wetlands provide economic goods and services and hence support the livelihood of the surrounding communities.

5.1 Status of wetlands

In Tanzania, about 10% of the land surface is covered by freshwater wetlands, of which thousands of people, especially local communities, depend on for livelihood. The Wetlands have different conservation status, whereby some are in forests and game reserves, national parks, and other protected areas, while others have no conservation status.

Wetlands of Malagarasi-Muyovosi, Kilombero Floodplain, Rufiji Mafia Kilwa (RUMAKI) and Lake Natron have been designated as wetlands of international importance under the Ramsar Convention on wetlands. These four wetlands are under intense pressure caused by encroachment and unsustainable human activities leading to a continuous decrease in their size due to expansion of other land uses emanating from increasing demand for arable land and settlement (Figure 5-1). Wetland ecosystems have also been experiencing loss of biodiversity due to habitat destruction and species loss.

5.2 Causes of wetland degradation

Wetland degradation is caused by unsustainable human activities in the wetland or watersheds upstream of the wetlands. These include: unsustainable agriculture, uncontrolled irrigation, overgrazing, uncontrolled construction of fishponds, illegal fishing, and overexploitation of other wetland resources. Recently, there has been drastic increase in irrigated land, livestock population in wetlands and clearing of wetlands for the construction of fish ponds (Plate 5-2).

5.2.1 Wetland encroachment for agriculture and livestock

Encroachment of wetlands for agricultural activities has been very common in most wetlands in the country. Agricultural expansion towards wetlands is linked to the establishment of vegetable crops, paddy production and other offseason cropping. Continuous degradation of terrestrial ecosystem has triggered movement of agricultural activities towards wetland. Agricultural expansion evidenced in Kilombero and Usangu

plain wetlands for rice production as shown in Figure 5-2. Other wetlands are under intense pressure for livestock grazing and aquaculture (Plate 5-1).

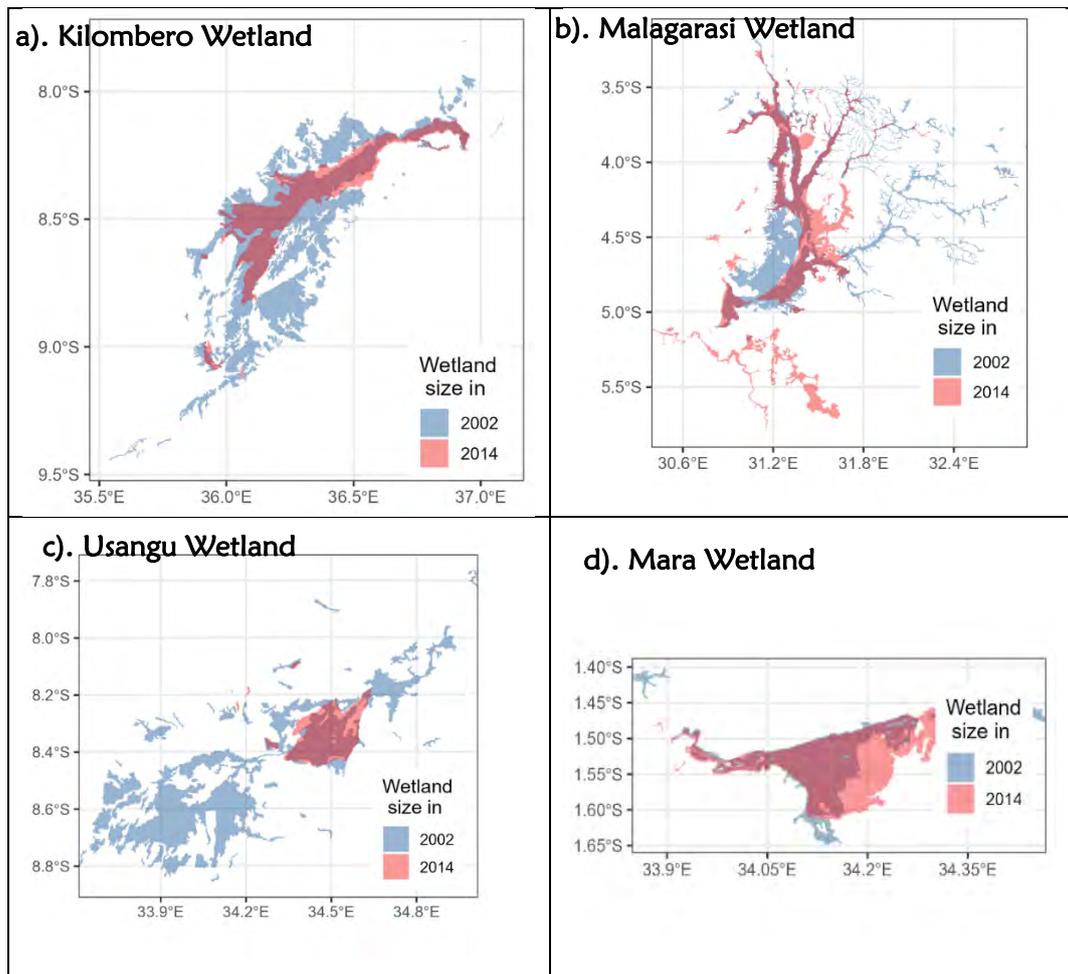


Figure 5-1: The size of Kilombero, Malagarasi, Usangu plain/Ihefu and Mara wetlands in 2014 has shrunk as compared to 2002.

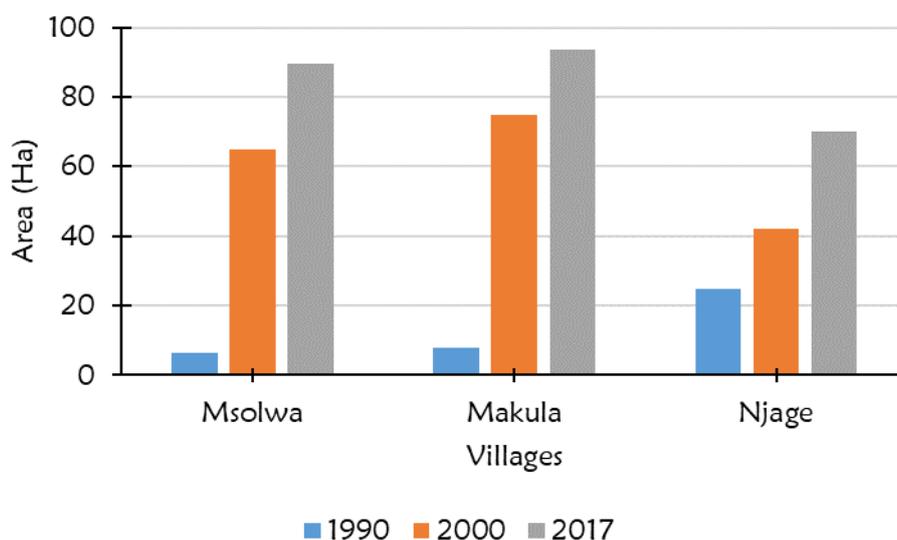


Figure 5-2: Expansion of agricultural activities in Kilombero flood plain wetland

5.2.2 Construction of fish ponds

There has been increasing investment in aquaculture recently whereby fish farming is on the rise. Though this is an income-generating activity, there have been incidences of invading and clearing wetlands for construction of fish ponds (Plate 5-1). The clearance of wetlands disturbs the ecosystem and the function performed by the wetland is lost. This challenge is seen in Lake Victoria wetlands in Misungwi Mwanza.

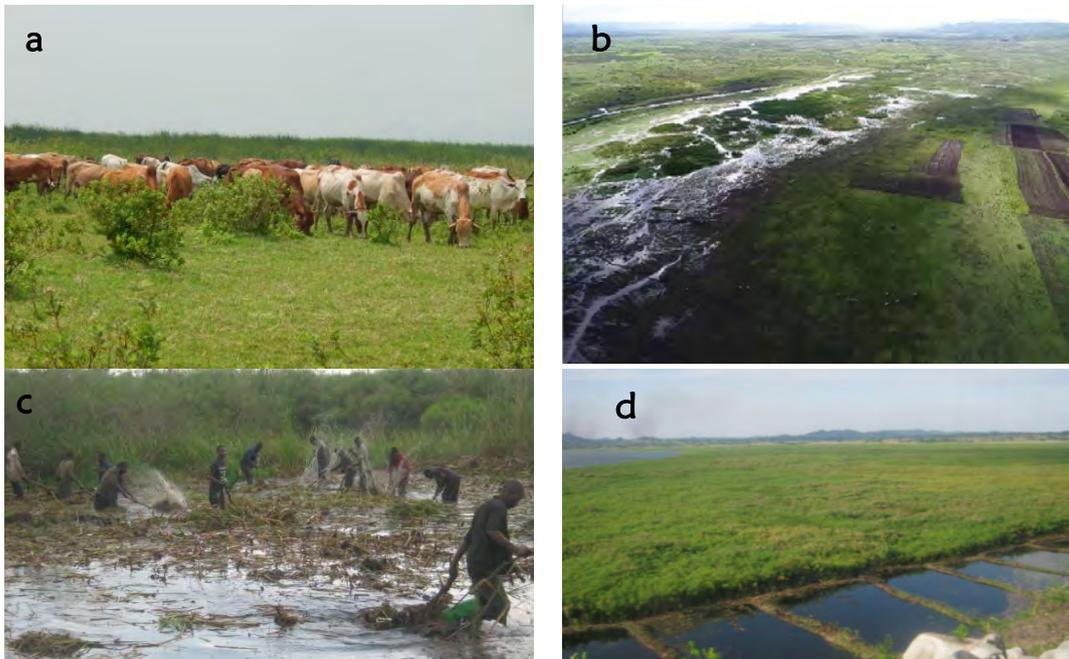


Plate 5-1: Grazing in the mara River wetlands (a), Cultivation in the wetland (b), constructed fish ponds in wetlands (c) in Misungwi and Clearing of wetlands for fishpond construction (d).

5.2.3 Degradation of catchment upstream

Unsustainable activities in catchment areas upstream causes reduced water flow and sedimentation in the wetland. Catchment degradation removes vegetation cover and hence the vegetation function of retaining water and maintaining steady water flow from river tributaries is compromised. These also causes nutrient enrichment in water bodies and proliferation of water weeds and other invasive plants as evidenced in Lake Babati and Lake Jipe.

5.3 Impacts of Wetland Degradation

Wetland degradation has caused loss of wildlife habitat and Biodiversity. The drying of the Ruaha River has disrupted the wildlife habitat causing loss of some species including freshwater oysters that have disappeared from the Ruaha River, along with clawless otters that lived off them. It as also threatened the White Crowned Plover (*Vanellus albiceps*) that build their nests on raised sand banks in the river protected from access by terrestrial predators; it has made the Crown Plover to become exposed to predators; it has caused a decline in Tiger Fish (*Hydrocynus sp*) which require oxygenated water is also experienced; it has also disrupted birds of prey and consequently put pressure on the African Fish Eagle (*Haliaetus vocifer*) resulting in an increasing scarcity of this magnificent bird in Ruaha river (Plate 5-2).

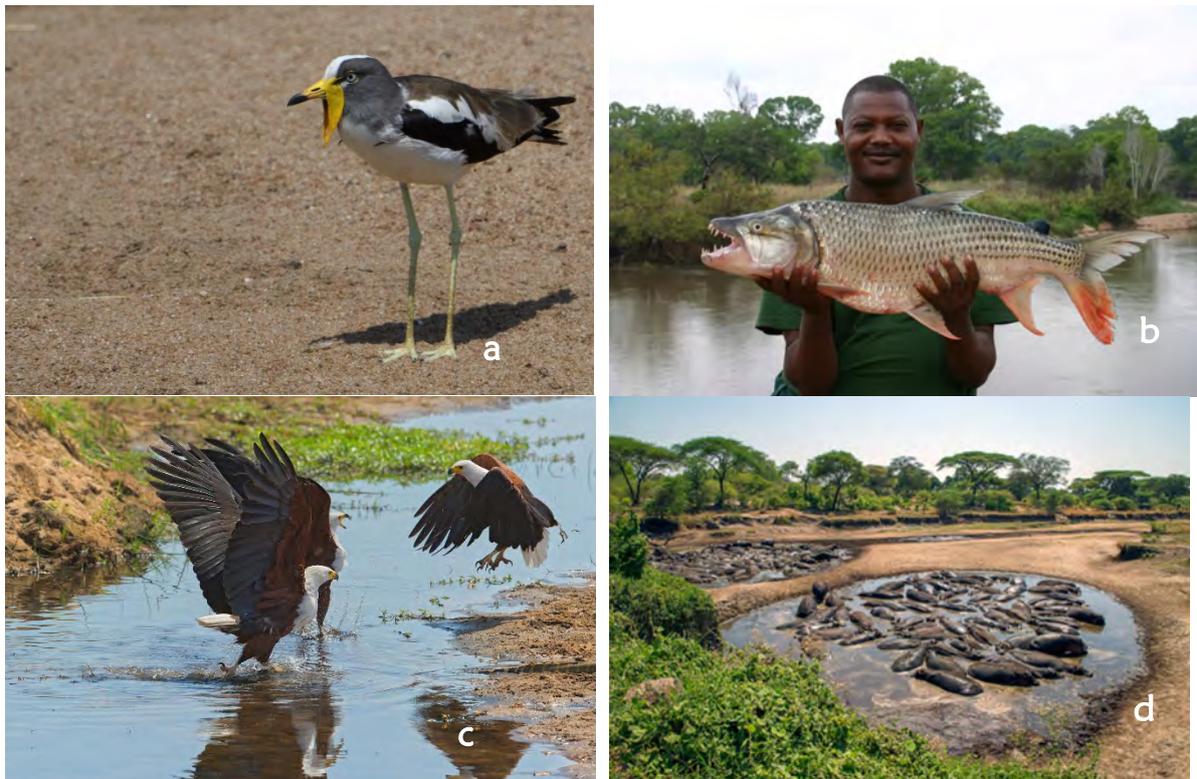


Plate 5-2: Some wild species which have declined as a result of reduced water flow in Ruaha river, Crowned Plover-*Vanellus albiceps* (a) Tiger Fish-*Hydrocynus sp* (b), African Fish Eagle-*Haliaetus vocifer* in Ruaha river (c) and Hippo in a pool in dried Katuma river (d)

5.4 Existing initiatives

5.4.1 Restriction on the use of wetlands

In response to increasing pressure in wetlands the Government banned unsustainable use of Ihefu wetland in 2006 to support its restoration process. As a result of the Government action, the land cover that had declined by 20% between 1995 and 2005, increased by more than 25% between 2005 and 2015. The size of the permanent swamp increased consistently, by more than 15% between 1995 and 2015. In order to address the challenge of diversion of water from the Katuma River for irrigation which caused water shortage in hippo pools downstream, the Government restricted unauthorized obstruction of water from the river.

5.4.2 Upgrading protection status of Usangu Game Reserve

In order to conserve the affected area of usangu plain, the Government upgraded the conservation status of the affected areas into protected areas. This was done by annexing Usangu Game Reserve, in which large part of the Ihefu lies, into Ruaha National Park. Kipengere Forest Reserve and Kitulo ranch were converted into game reserve and national park respectively. These two areas provide the catchment for several rivers that flow into the Usangu and the Ruaha River.

5.5 The Usangu Plain Wetland Case Study

The Usangu plain wetland is in the midst of the Great Ruaha River sub-basin of the Rufiji basin. The Ruaha River, which is the major tributary of the Rufiji River, has its catchment in Kipengere, Uporoto mountains and Chunya. The River tributeries drains through the wide Usangu plain, through Usangu wetlands to the great Great Ruaha river. The Usangu wetland (Ihefu) is a very important ecosystem due to its biodiversity and the regulation of downstream flows for the Great Ruaha River that go through the Ruaha National Park, to Mtera dam, Kidatu Hydroelectric Power plant and later joins kilombero river to form the main Rufiji River. Notwithstanding its importance in providing various ecosystem goods and services, the Usangu plain wetland has been seriously degraded due to intense anthropogenic activities including, unsustainable irrigation and livestock grazing in the wetland as well as degradation of catchment areas in Mbeya, and Njombe regions. These activities have led to reduced size of the wetland, serious reduction in river flow as well as loss of biodiversity.



Plate 5-3: Mismanagement of irrigation water in usangu plain (a and b), degraded catchment in Kipengere mountain and livestock invasion (d)

Unsustainable Irrigation is considered to be the major cause of the environmental impacts in the Usangu plain wetlands. There has been considerable increase in irrigated area, mainly for rice and to some extent vegetables and off-season maize. Unsustainable Livestock keeping is another activity that contributes to the degradation of the plains and wetlands. Since the grasslands of the wetland provide a good resource of pasture for semi-nomadic pastoralism, pastoralists invade the wetlands for grazing. Irrigation development and continuous expansion of the irrigated area started in 1975 and currently there are three large scale irrigation farms in the Usangu basin (Mbarali, Madibira and Kapunga rice farms).

There are also a number of smallholder irrigation farms for rice and vegetables that are scattered along the river basins. Though irrigation development contributes to food security and livelihood, unsustainable irrigation practices in the basin has negatively affected the ecosystem. Including uncontrolled obstruction of water for irrigation, inefficient irrigation water use and mismanagement of tailwater that contributes to significant water loss. The growing season has also been extended from one growing season (December – April) to two growing seasons (December – April) and (May – October). This has increased further the obstruction of water during the dry season which has further caused reduction in water flow and periodic drying of Ruaha River.

The periodic drying up of Great Ruaha river has resulted in adverse impacts on the Ihefu wetland ecosystem and the Ruaha National Park, disrupting the lives of many animals and causing changes in their behavior. The drying has consequential ecological impacts not only in the Usangu plain wetland and Ruaha river but also to the Ruaha National Park and another downstream ecosystem in the Rufiji basin including Mtera dam, Kidatu HEP and main Rufiji River.

Some initiatives have been taken to address the environmental challenges in Usangu plain wetlands which include development and implementation of the National Strategy for Urgent Actions on the Conservation and Management of Land and Water Sources and the National Plan for Conservation and Management of the Great Ruaha River Sub Basin.

5.6 Interventions to reverse wetland degradation

5.6.1 Goal

To enhance the sustainable management and wise use of wetlands.

5.6.2 Expected results

Degraded wetlands are restored, wetland encroachment halted, Loss of wetlands and unwise use of wetlands is halted, loss of wetland habitat reduced, loss of wetland goods and services provided by the ecosystem reduced, improved wetland water quality, loss of plant and animal biological diversity in the wetland halted, sedimentation reduced, natural filtration improved, recreational opportunities improved, aesthetic values improved, water flow and ground water recharge improved and available water for humans and livestock improved.

5.6.3 Priority areas

Severely degraded wetlands in great Ruaha and Kilombero sub-basin, Mara River wetlands, Malagarasi and dryland ecosystems.

5.6.4 Interventions and Targets

i. Promote restoration and conservation of wetlands for harnessing biodiversity and ecosystem services.

- a. Promote sustainable management of livestock to communities surrounding wetlands by 2025;
- b. Develop and implement wetland management plan for all wetlands outside protected areas under the jurisdiction of respective Local Government Authorities by 2030;
- c. Enhance management of at least 50% of the wetlands in protected areas by 2030;
- d. Promote agroforestry and soil conservation practices to address soil erosion and sedimentation by 2028; and
- e. Develop land use plans to at least 50% of villages in communities surrounding wetlands by 2026.

ii. Strengthen Management of Wetlands to foster conservation, integrity and ecosystem functioning.

- a. Assess the status of wetland resources for all wetlands by 2025;
- b. Develop programmes and projects to enhance institutional capacity responsible for wetland management to undertake research on wise use of wetland resources by 2027;
- c. Enhance coordination among institutions responsible for wetlands management by 2032;
- d. Promote and enhance cooperation on management of transboundary wetlands by 2032;
- e. Enhance research and build capacity to gather information and data for assessment of wetland status by 2028;
- f. Demarcate and buffer at least 50% of unprotected wetlands by 2032; and
- g. Build capacity for institution responsible for wetland management in conservation and management of wetland by 2024.

- iii. Enhance stewardship and build community consciousness on the important role of wetlands and their ecosystem functions.**
 - a. Establish Community Wetlands Management Committees (CWMC) to enhance community participation in wetland conservation by 2025; and
 - b. Develop and implement programmes and projects for Sensitization and awareness raising on wetland ecosystem stewardship in all wetlands by 2027.

- iv. Sustainable alternative livelihood Programme to strengthen local economic prospects and reduce pressure on wetland resources.**
 - a. Establish an inventory on community livelihoods that depend on wetland resources (direct and indirect) by 2025;
 - b. Promote alternative livelihood to communities surrounding all wetlands by 2025; and
 - c. Upscale the existing environmentally friendly practices to echo the wise use of wetland resources by 2024.

- v. Enhance community capacity for sustainable access of ecosystem services from the wetlands**
 - a. Develop and implement a Programme for enhancing access to water for domestic and livestock to communities surrounding wetlands through construction of cattle trough to at least 50% of the wetlands outside the protected areas by 2025; and
 - b. Develop and implement Programme for building capacity for accessing finance for wetland management for at least 50% of the major wetlands by 2024.

- vi. Promote sustainable irrigation and other water uses in the catchment areas for improving water use efficiency and allowing environmental flow downstream**
 - a. Assess water uses and water losses in all irrigation schemes for proper water allocation by 2025;
 - b. Improve irrigation efficiency and adopt best water conservation practices to reduce water stress by 2032; and
 - c. Promote and implement In situ rainwater harvesting technique by 2025.



INVASIVE SPECIES



6 INVASIVE SPECIES

Invasive species refer to species (alien and/or native) that are found to be widespread and abundant or localized but abundant; have high rate of spread and cause negative impacts to the economy, environment, or health. Currently, Tanzania has a total of 220 invasive and potentially invasive species. Out of the seventy-five (75) invasive species, 87% are aliens and 13% are native. The alien invasive species fall under various life forms: animals (15), plants (49), and fungi (1).

6.1 Status of invasive species

Currently, there are 12 priority invasive species in the country. The priority is based on impacts to the environment and economy depending on the rate of spread, abundance, and negative impacts to the economy, health or environment. The species include: Fall armyworm “Kanitangaze” -(*Spodoptera frugiperda*), Prosopis “Mrashia”-(*Prosopis juliflora*), Carrot weed (*Parthenium hysterophorus*), Kongwa weed (*Astripomoea hyscamoides*), Siam weed “Amachabongo” (*Chromolaena odorata*), *Gutenbergia cordifolia* (Gutenbergia), Indian house crow (*Corvus splendens*), Mauritius thorn (*Caesalpinia decapitala*), Water hyacinth (*Eichhornia crassipes*), and Tomato leaf miner (*Tuta absoluta*). These species are distributed in the different regions based on the nature of ecological and movement of livestock and wildlife, and human activities including crops and tourist movements.



Plate 6-1: Invasion of *Bidens (Bidens schimperi)* in Ngorongoro crater (left) Kongwa weed (*Astripomoea hyscamoides*) in Kongwa Ranch (right)

6.2 Causes of spread of invasive species

The spreading of alien species is caused by human activities especially transport, which involves the movement (intentional or non-intentional) of species from one region to another through ships, trains, aircrafts, automobiles, and vehicles. Likewise, moving animals, both domestic and wild into and outside protected areas including National Parks, can carry matured seeds from one area to another, hence causing spread of the species.

6.3 Impact of invasive species

Invasive species have negatively impacted the livestock sector by causing loss of grazing land in Kongwa ranch and other areas, wildlife and tourism sector through loss of grazing land in Ngorongoro and Serengeti, agricultural land and crop loss all over the country, and loss of biodiversity and fisheries, transport and nuisance caused by Indian house crow. Figure 6-1 the invasive species have colonized a large area of the crater replacing the other pasture species causing shortage of grazing land for wildlife. In 2016/17 for example the NCAA, spent 141million TZS for manual controlling of the invasive weed. In Kongwa, Kongwa weed is reported to have occupied more than 26,600 hectares (70%) of the entire Kongwa Ranch area which is 38,000 hectares, it is also reported that more than 57% of the total area of Kongwa District is occupied by the weed.

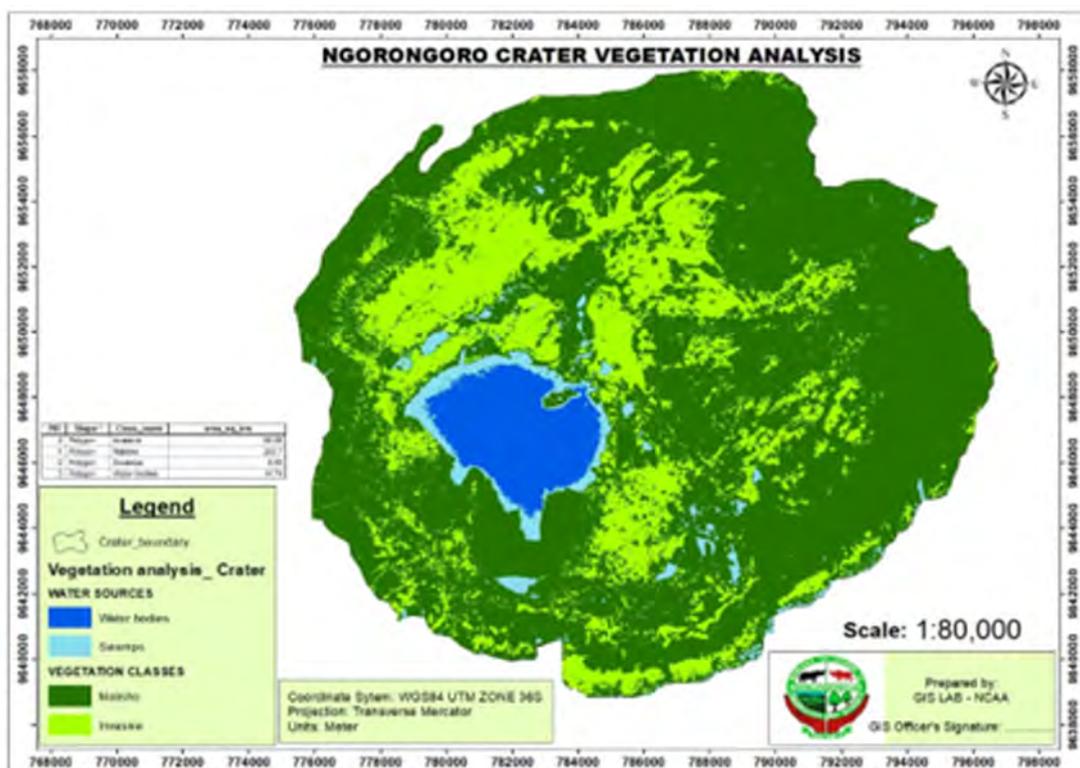


Figure 6-1: Spread of invasive species (yellow) as compared to other grass species in Ngorongoro crater.

6.4 Existing initiatives

In addressing invasive species some efforts have been taken at national level which include development of the National Invasive Species Strategy and Action Plan (NISSAP) and uprooting of the weeds in Ngorongoro and Kongwa ranch. Beneficial use of some invasive species has been used as a control measure as evidenced in Kondoa where *Lantana Camara* is used as a raw material for soap making in Kondoa.



Plate 6-2: Mechanical removal of *Bidens shimper* in Ngorongoro (left) and Mrashia”-(*Prosopis juliflora*) in Simanjiro.

6.5 Initiatives to address invasive species

6.5.1 Goal

To protect biodiversity, ecosystem services and livelihood assets from invasive species and their negative impacts.

6.5.2 Expected results

Stakeholders are aware of invasive species pathways and impacts, viable technologies for invasive species management researched and adopted, invasive species are effectively controlled and monitored, invaded areas are restored and, further invasion is prevented.

6.5.3 Priority areas

Severely infested areas in wildlife habitats and nature reserve (Ngorongoro, Serengeti, Amani nature reserve), agroecosystems (Kongwa, Arusha, Mara) and other Fall armyworm affected areas) ecosystems.

6.5.4 Intervention and Targets

i. Strengthen national capacity in research and management of invasive species

- a. Undertake assessment of the status of infestation (areas, locations, impact) of at least 50% of the priority invasive species by 2030;
- b. Enhance human, infrastructure and financial capacity of at least 50% of institutions responsible for management of invasive species by 2025; and
- c. Undertake research on management options for at least 50% of the priority invasive species by 2032.

ii. Enhance measures for effective control, monitoring and prevent introduction and spread of invasive species

- a. Strengthen implementation of National Invasive Species Strategy and Action Plan, by 2026;
 - b. Capacitate and support at least 90% of border posts to manage invasive species pathways by 2024;
 - c. Develop and implement plan to detect and eradicate at least 95% of new biological invasions before reaching a stable population by 2032;
 - d. Develop and implement plan to control at least 50% of National priority invasive species by 2032; and
 - e. Develop and implement plan to restore at least 50% of critical ecosystems impacted by invasive species by 2032.
- iii. Enhance stakeholders awareness and participation in invasive species management**
- a. Develop awareness programme on invasive Species by 2024;
 - b. Develop the business case for beneficial use of IS to enhance management by 2025; and
 - c. Strengthen implementation of awareness program for at least 50% of stakeholders on various invasive species management options by 2028;



LOSS OF WILDLIFE HABITAT AND BIODIVERSITY



7 LOSS OF WILDLIFE HABITAT AND BIODIVERSITY

Tanzania is one of the mega rich biodiversity hotspots in the world with 32,836 known important plant and mammal species recorded and confirmed according to Global Biodiversity Information Facility (GBIF). However, wildlife habitats and biodiversity have been threatened by various factors including: Conversion of natural lands to other land uses such as settlements, agriculture and grazing; habitat degradation due to wild-fires; unplanned land use and unmanaged natural resource extraction has resulted into serious habitat degradation and consequent loss of biodiversity.

Other serious threats to loss of wildlife habitats and biodiversity include charcoal burning, firewood collection, slash and burning for subsistence farming, mineral and aggregate mining, commercial logging, poaching, coral destruction, infrastructural development, proliferation of Invasive Species (IS), illegal global trade in plant and animal species, accidents in the roads crossing reserved areas and impacts of climate change.

7.1 Status of wildlife habitat and biodiversity

Out of the 32,836 species found in Tanzania, about 24,882 are categorized as not evaluated (NE) according to International Union for Conservation of Nature (IUCN) Red list which is about 76%, the remaining evaluated species category grouped as least concern (LC) are 5,847 (18%). The other groups that are threatened include vulnerable (VU) about 619 (2%), endangered (EN) 577 (2%), data deficiency (DD) 373 (1%), near threatened (NT) 288 (1%), and critical endangered (CR) 243 (1%) Figure 7-1.

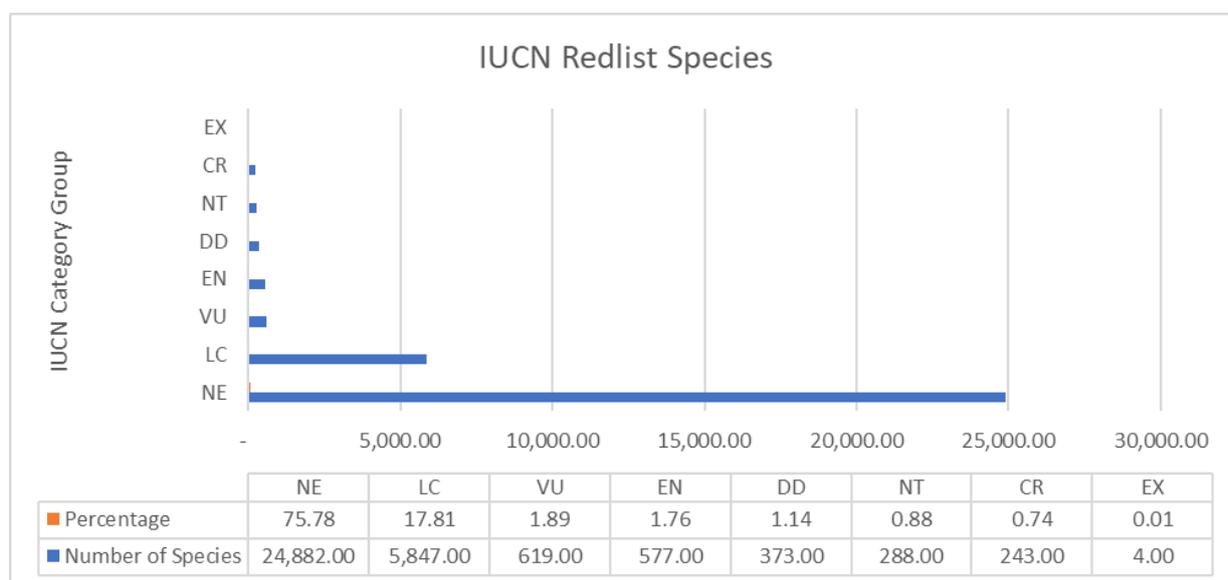


Figure 7-1: Number of Species on IUCN Redlist

Tanzania hosts 6 out of the 36 world renowned biodiversity hotspots with more than one-third of the total plant species in the continent and about 20% of the large mammal population. The biodiversity wealth contributes significantly to the socio-cultural, economic and environmental goods and services to the country and people's

livelihood. Figure 7-2 show the biodiversity hotspot distribution is spread all over the country and is very rich in the regions along the southern western zone toward eastern zone to northern-eastern, generally the biodiversity increases with increasing altitude. For instance, The Eastern Arc Mountains is one of the global biodiversity hotspots constituting an estimated 1,500 of different endemic species and providing significant ecosystem services that support the livelihood of many communities. In that regard, the areas with high terrains including mountains which normally have high biodiversity need to be conserved and protected.

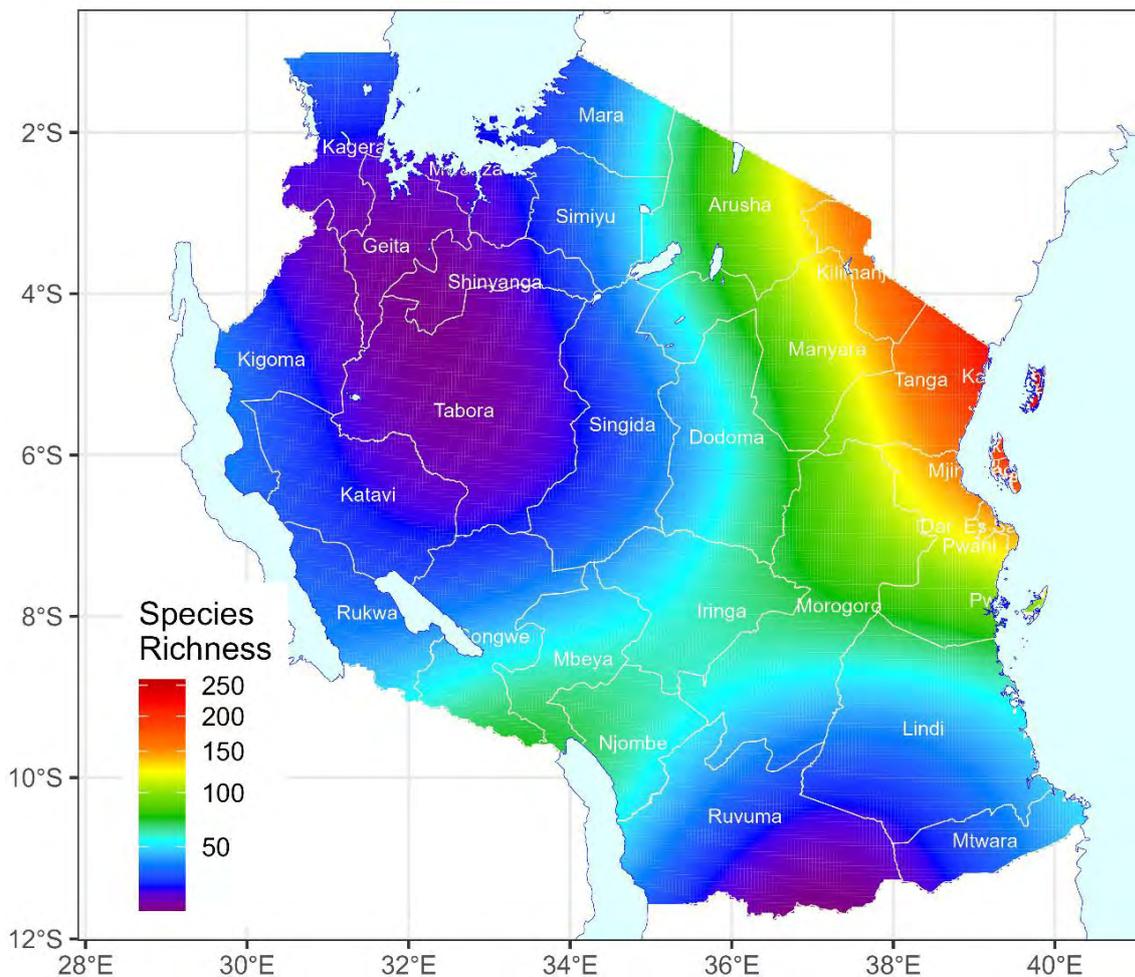


Figure 7-2: Biodiversity hotspots distribution in Tanzania

Endemic species:

Tanzania is endemic to more than 500 different group of species. These include major groups as follows: 44 mammals, 34 birds, 94 reptiles, 89 amphibians, 173 freshwater fish, 10 marine fish, 47 Swallowtail and nymphalid butterfly species, 22 vascular plants and 15 vertebrate genera.

Threaten/Endangered Species:

Tanzania is home to the 10th highest total number of IUCN Red Listed threatened species in the world. There are about 2,100 threatened species on which 895 are plants, 841 are non-plants and the remaining 364 are other small groups of species. The

proportional of threatened species includes Vulnerable (VU), Endangered (EN), Data deficiency (DD), Near threatened (NT) and Critical endangered (CR), (Figure 7-3).

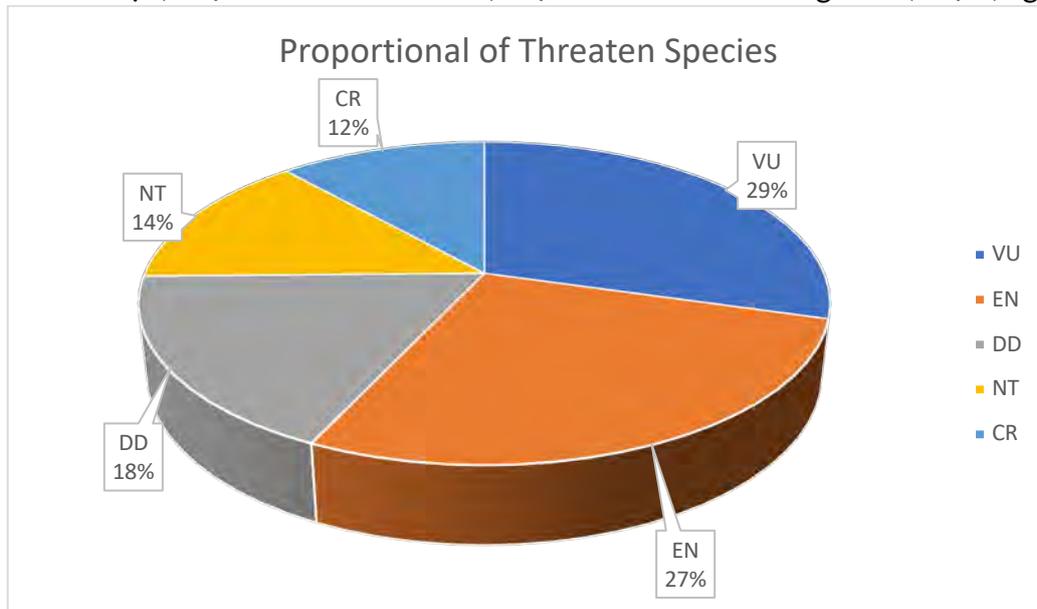


Figure 7-3:Proportional of threaten Species that have been evaluate.

For instance, *Gorilla beringei* is the eastern gorilla who is in the list of critically endangered species found in Mahale National Park in Kigoma region. Also, the southern Patas monkey (*Erythrocebus baumstarki*) is a critically endangered species of Old-World monkey found only in Tanzania, and formerly in Kenya. It may be the most endangered primate in Africa known to still be existing, with only 100 to 200 known wild individuals (Plate 7-1).



Plate 7-1: Chimpazee which is endangered in Kigoma. Right The southern patas monkey (*Erythrocebus baumstarki*) is a critically endangered species.

Pterocarpus Angolensis is placed in the least Concerned (LC) according to IUCN Redlist (plate 5-2) of plant species. However, in Tanzania the species is very rare in the forest and it is speculated could be endangered. *Milicia Excelsa* is another tree species on which IUCN has listed as Near threatened (NT) in many parts which it occurs, in Tanzania the tree has been harvested massively and is currently very scarcely seen.



Plate 7-2: *Pterocarpus angolensis* is found almost in many parts of the country and is categorized as Least concerned according to IUCN

7.2 Causes of the Loss of wildlife habitat and biodiversity

The main causes of declining of biodiversity include habitat loss and degradation, overexploitation of plant and animal species, pollution, introduction and proliferation of invasive species and climate change. Also, human activities such as conversion of natural lands to other land uses such as settlements, agriculture, and grazing; uncontrolled wildfires and unplanned land use. Other serious threats to habitats include overdependency on wood fuel and charcoal as source of energy, poaching, coral destruction and accidents on the roads crossing reserved areas.

7.2.1 Agricultural expansion

Opening new land for agriculture plays a significant role in habitat fragmentation and subsequent biodiversity loss in many areas within the country. The agriculture expansion is associated with shifting cultivation due to loss of land productivity as common methodology practised in many parts of the country.

7.2.2 Livestock keeping

In many parts of the country, there is an increasing demand for grazing land and feeds for the growing number of livestock. Unsustainable livestock keeping coupled with expansion of agricultural and grazing land has led to fragmentation of natural habitats thereby escalating pressures on biodiversity. Farmers and livestock encroach into protected areas creating serious pressure to wildlife resources. For instance, the study conducted in Serengeti National Park on 2020, shows that livestock, coupled with expanding agriculture, settlements, and human population growth are exerting pressure on natural resources around the protected ecosystem (figure 7-4).

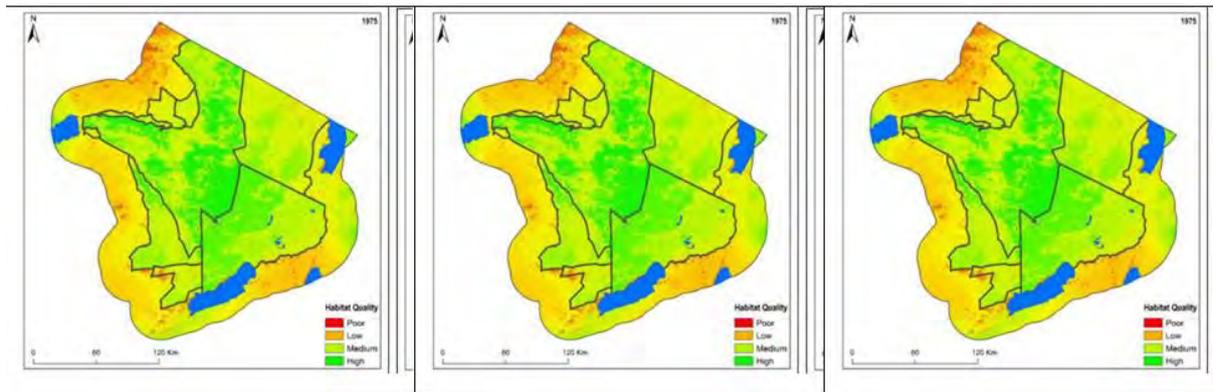


Figure 7-4 Spatial distribution of habitat quality classes in the Serengeti ecosystem and the surrounding buffer zone in 1975, 1995, and 2015 (Adapted from Kija et al., 2020).

7.2.3 Bush fire

Bush fire is a threat to forests and game areas in the country where most fires are caused by human activities particularly farm preparation. Driving forces include game hunting, honey collection, charcoal burning, and burning to simultaneously improve pasture quality.

7.2.4 Pollution

Most aquatic habitats suffer from excessive levels of nutrients mainly phosphates and nitrates that originate from domestic, industrial as well as agricultural activities. Herbicides and pesticides used in agriculture find their way into aquatic systems, and most of these are toxic to wildlife. Heavy metals such as lead, cadmium, iron and copper from industries and mining activities, and organic wastes from sewage, can accumulate in aquatic systems and affect water quality and species survival.

7.2.5 Invasive Species (IS)

Invasive Species are characteristically adaptable, aggressive and have a high reproductive capacity and hence can thrive well in areas beyond their range. The spread of invasive species is now acknowledged as one major threat to biodiversity in the country as they outgrow natural species over an area. For instance, In Tanzania over 220 species have been documented as invasive species.

7.2.6 Poaching

Tanzania's wildlife sector is faced with numerous challenges such as wildlife poaching ranking at the top, among others. Poaching is pursued to cater for subsistence and commercial needs. Household poverty and needs to meet the dietary requirements are the main drivers for subsistence poaching. Commercial poaching is mainly motivated by high market demand and, consequently, high economic returns which attract criminals. Both subsistence and commercial poaching are associated to a dramatic decline of population and local extinction of wildlife species in different parts of Tanzania.

In the last forty years, Tanzania had registered two major poaching episodes in her history. Various study shows that the first episode occurred between the 1970s and 1980s following global economic melt-down which weakened the law enforcement capacity. The populations of two keystone species, elephant, and rhino were reduced to less than 30 and 10%, respectively. In 1991, the elephant population was less than 58,000 compared to 203,000 in 1977, while rhino population dropped from 3,795 in 1981 to 275 in 1992.

The second major poaching episode was between 2009 and 2016. Though its span was shorter, it had massive impact on wildlife species, particularly elephants. In a period of 3 years, the country’s population dropped to 109,000 in 2009 from 143,000 in 2006. Further declines were noted in 2013 and 2015, when the numbers recorded were 50,500 and 43,500, respectively (plate 5-3).



Plate 7-3: Left: Elephant killed by poachers in Mikumi National Park, Right: the Elephant killed in Tarangire National Park.

However, according to recent reports by TANAPA issued in April 2022 the trend in poaching seems to be declining. For instance, in the period from 2018/2019 to 2020/2021, only 17 elephants were killed by poachers (Figure 7-5).

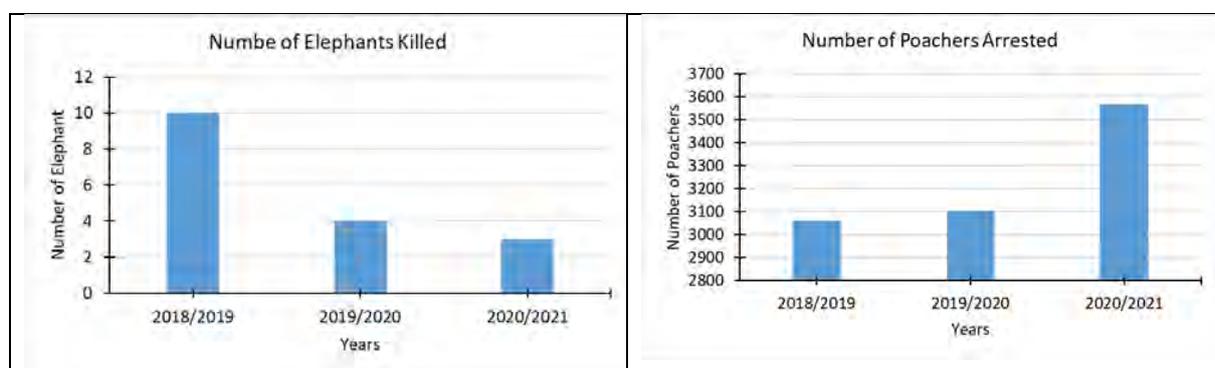


Figure 7-5: Declining number of elephants killed between 2018 – 2021 and number of poachers arrested between 2018 - 2021

7.2.7 Climate change

The frequency of occurrence of climate extreme events (droughts, heavy precipitations and associated floods) has been increasing in Tanzania in recent years and has exerted pressure on biodiversity and ecosystems at large. Severe and recurrent droughts as a consequence of climate change are pronounced in many parts of the country. For instance, semi-arid areas (Arusha, Dodoma, and parts of Iringa, Kilimanjaro, Manyara, Shinyanga, Singida, Mara, Tabora and Rukwa regions).

Frequent droughts in these areas have resulted in destruction of forests, leaving the land bare, making it susceptible to agents of soil erosion such as wind and water. Farmers and pastoralists in such areas are forced to migrate into virgin forests and other lands leading to further forest and land degradation in general. Severe and prolonged drought has also resulted into declines of water levels in satellite lakes and dams, shrinkage of receiving lakes such as Lake Rukwa and Lake Victoria, and drying of some water bodies.

In some areas, perennial rivers such as Katuma river in Katavi Region have changed to seasonal rivers, consequently leading to shrinkage or disappearance of subsequent wetlands, with severe effects on biodiversity. The impacts of climate change are evident with large mammals particularly their population and distribution patterns. During the dry seasons large mammals especially hippopotamus, crocodiles, buffalos and elephants crowd in few remaining water ponds and there are increased losses.

7.2.8 Wildlife accidents

Accidents on wildlife has been one of the major causes of the death of wildlife in many wildlife reserves where the roads passing in these reserves and hence reducing the number of animals in reserved areas. For instance, in the year 2020/21 it was reported that a total of 641 animals were killed in road accidents. The accidents took place almost in all 22 National Parks on which Mikumi National Parks topped the list in the frequency of accidents. The reports indicate increasing of road accidents from 106 in 2019/20 to 535 in 2020/21 (plate 7-4).



Plate 7-3: animal killed in road accidents at Mikumi National Park

7.3 Impacts of Loss of wildlife habitat and biodiversity

The loss of wildlife habitats and biodiversity has several impacts including, habitat destruction and over-exploitation of wildlife species that may lead to threat of extinction of some rare species in the country. Other impacts are Increased human-wildlife conflicts and obstructions of the wildlife corridors. For instance, some marine species such as sea turtles are under serious threat due to egg collection, killing of nesting female and turtles caught in gill nets (Plate 7-4).



Plate 7-4: Olive Ridley turtles caught in gillnets in Mtwara District

Logging of the most valuable timber species such as *Milicia excelsa* (Mvule), *Pterocarpus angolensis* (Mninga) and *Dalbergia melanoxylon* (Mpingo) has led to threatening of such species to the near extinction (Plate 7- 5). Apart from tree and marine species, wildlifes are also under tremendous pressure from unsustainable exploitation of the animal species and Human-wildlife conflicts. Impacted species include the larger carnivores such as lions (*Panthera leo*), leopards (*Panthera pardus*), cheetahs (*Acinonyx jubatus*), wild dogs (*Lycaon pictus*) and the herbivores group includes population of elephants (*Loxodonta africana*), Giraffe (*Giraffa camelopardalis*), zebra (*Equus burchelli*), buffalo (*Syncerus caffer*), antelopes, wildebeest (*Connochaetus taurinus*), and black rhinoceros (*Diceros bicornis*).



Plate 7-5: Tree species are nearly extinct (Left); *Milicia excelsa* (Mvule), Right *Dalbergia melanoxylon* (Mpingo) (Right).

due to human settlements, timber exploitation and charcoal burning. Wildlife moving between Sadani and Wami Mbiki, however, are forced to cross the Chalinze-Arusha highway. Given increasing human development, it is unlikely that this corridor can be sustained for very long.

On the other hand, wild animals move out of the protected areas and cause crop damage, livestock depredation and accidents to people. These scenarios occur in almost all protected areas in Tanzania and they jeopardize the integrity of the protected areas. For instance, report of 2020 by Wildlife Division indicates that for the period between 2012 and 2019 there were 1,069 human deaths, 642 temporary and permanent human injuries, 792 livestock death and 41,404 acres of crops damaged.

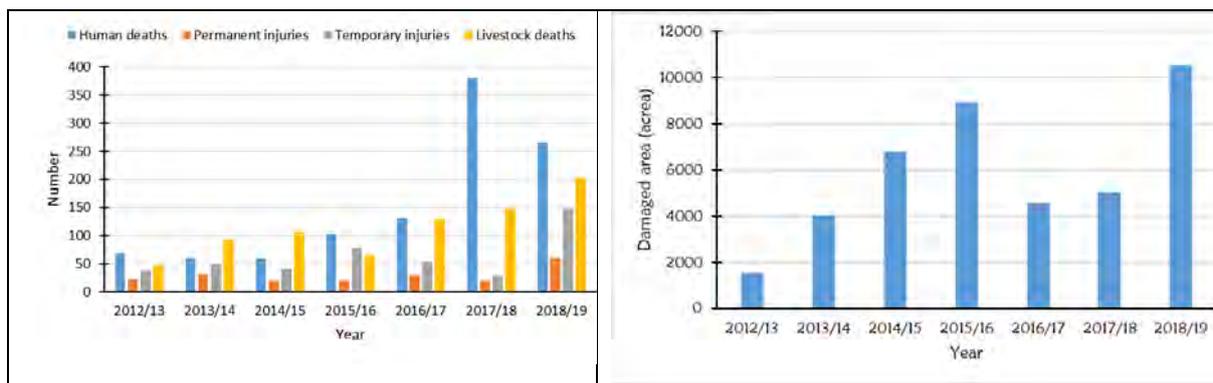


Plate 7-7: Number of human deaths, human injuries, livestock deaths and crop loss caused by wildlife between 2012/13 and 2018/19

7.3.2 Obstruction of corridors

Wildlife corridors play vital ecological roles in enhancing biodiversity and survival of a large number of species. However, many wildlife corridors, are under serious threat. There is human population pressure attributed to a number of factors in the rangeland that are incompatible with biodiversity conservation. For instance, Lake Manyara Basin is one of the areas, which have been experiencing an increasing population pressure.

The major population pull factors at this area include demand for agricultural land, construction of Minjingu Phosphate factory, establishment of fishing camps, small mining activities at Marang Forest Reserve, growth of tourism, and other economic opportunities. Population pushes factors from the areas with acute land shortage, such as Kilimanjaro Region, have also affected the lake Manyara basin. The major outcome of all the identified factors is an increased threat in the existing five wildlife corridors, which provide ecological links between Lake Manyara National Park and outside systems (See table 7-1).

The obstruction of wildlife corridors linking Lake Manyara National Park and other areas has led to some undesirable ecological impacts. The biggest impact is the reduced population and local extinction of some large mammal species, both within the park and along the corridors. However, the impact of other factors including poaching should not be underestimated. Also, at the Wildlife Corridor of Kwa Kuchinja Mbugwe

(KWC) indicated that there is a 72% decline of species diversity of large mammals along KWC.

For instance, seven species that were previously regarded as regular users of the KWC were locally extinct. These species include, cape eland (*Tragelaphus oryx*), hartebeest, (*Alcelaphus buselaphus*), buffalo (*Syncerus caffer*), oryx (*Oryx gazella*), lesser kudu (*Tragelaphus imberbis*), cheetah (*Acynonyx jubatus*), and leopard (*Panthera pardus*). Also, in the Lake Manyara National Park, the following nine species were reported to be locally extinct: African wild dog (*Lycaon pictus*), cape eland (*Tragelaphus oryx*), hartebeest, oribi (*Ourebia ourebi*), black rhinoceros (*Diceros bicornis*), lesser kudu, cheetah, mountain reedbuck (*Redunca fulvorufula*) and common reedbuck (*Redunca arundinum*).

Table 7-1 Threats facing five wildlife corridors linking Lake Manyara National Park and outside systems

| Corridor | Link Protected Area | Key Species | Human threats |
|---|---------------------------------|---------------------------|--|
| Kwakuchinja-Mbugwe Wildlife Corridor Park (KWC) | Tarangire National | Zebra and Wildebeest | Settlements and crop cultivation |
| Mayoka-Magara- Mwada-Vilima Vitatu | Tarangire National Park | Buffalo and Eland | Cotton field expansion in Mwada |
| Jangwani | Mto wa Mbu Game Controlled Area | Zebra and Wildebeest | Settlements, cultivation and camp sites |
| Upper Kitete-Lositete | Ngorongoro Conservation Area | Elephant, Buffalo, Hippos | Intensive crop cultivation mainly maize and wheat. |
| Laja | NCA and Marang Forest | Elephants | Livestock grazing, deforestation, mining |

7.4 Existing Initiatives

This environmental challenge is making human life and other species at risk. In that regard, Tanzania has put in place several measures to address this challenges which include implementation of the following projects Lake Victoria Environmental Management Programme (LVEMP), Lake Tanganyika Biodiversity Project, Kihansi Catchment Conservation and Management Project (KCCMP).

Other existing initiatives are, Establishment of Beach Management Units (BMUs), legally constituted organisations at local and community level responsible for managing the fisheries and the beaches over which they have jurisdiction, for their own benefits; and Adoption of community-based conservation approach, these were conducted in “operations”. Examples of these operations includes, Operation “Spider net”: Coordinated efforts of law enforcement and intelligence agencies, including National and Transnational Serious Crimes Investigation Unit (NTSCIU) and Tanzania National

Parks Authority (TANAPA), to combat ivory poaching and arms smuggling in Katavi which was conducted between 2014 – 2015.

7.5 Interventions for addressing loss of wildlife habitat and Biodiversity

7.5.1 Goal

To strengthen conservation and management of wildlife habitats and biodiversity both in protected and non- protected areas.

7.5.2 Expected results

Wildlife habitat and biodiversity are safeguarded to ensure provision of ecological goods and services; Conservation programs are to be maintained and expanded in both reserved and non-reserved areas, wildlife corridors connectivity are secured and maintained, and communities are involved in management of wildlife habitat.

7.5.3 Priority Areas

Priority areas for strategic interventions all protected and unprotected areas as well as threatened wildlife corridors in Wami Mbiki (Saadani, Mikumi and Selous National Parks), Kwakuchinja-mbugwe (Tarangire National Park), Mayoka-Magara-Mwada-Vilimavitatu (Tarangire National Park), Jangwani (Mto wa Mbu Game Controlled area) Upper Kitete - Lositete (Ngorongoro Conservation Area) and Laja (Ngorongoro Conservation Area and Marang Forest).

7.5.4 Interventions and Targets

i. Safeguard sustainable management of wildlife corridors

- a. Develop and implement Program for control encroachment of the wildlife corridor by 2032;
- b. Develop and implement Programmes for Strengthening conservation of protected areas, their surrounding corridors and buffer areas by 2032; and
- c. Develop and implement programs for managing transboundary wildlife corridors by 2032.

ii. Strengthen conservation of wildlife habitats and biodiversity

- a. Develop and implement programme for conservation of wildlife habitat outside protected areas by 2032;
- b. Strengthen surveillance system of road crossings in national parks and wildlife corridors to control animal motorvehicle accidents by 2032;
- c. Develop and implement plan for engagement of private sector and community participation in management of wildlife habitat and biodiversity by 2032; and
- d. Develop and implement Programmes and strategies for prevention, control and eradication of Invasive Species in wild life habitat by 2032.

iii. Enhance sustainable utilization of biodiversity.

- a. Develop and implement management plan of wildlife habitat and biodiversity by 2026;
- b. Develop and implement programmes to strengthen Integrated approaches for the sustainable utilization of biodiversity by 2032;
- c. Develop and Implement plan for involving local communities participation in sustainable management of wildlife habitat and Biodiversity utilization by 2032;
- d. Develop and implement plan for capacity building and provision of appropriate technology and equipment for wildlife habitat conservation and management by 2032;
- e. Develop and implement Collaborative Programmes to enhance research and development in wildlife habitat and biodiversity by 2032; and
- f. Develop and implement biodiversity conservation Strategy by 2032



COASTAL AND MARINE ECOSYSTEM



8 COASTAL AND MARINE ECOSYSTEM

Tanzania has a coastline of over 800 km stretching from its northern side in Tanga Region (latitude 4° 49'S) to its southern end in Mtwara region (latitude 10° 28'S) that is endowed with a significant diversity of coastal and marine ecosystems in both coastal and marine setups. Coastal and Marine ecosystems in the country are crucial for human well-being and sustainable development and their conservation safeguards the long-term productivity of economic and social activities such as fisheries, Mariculture, tourism, and coastal development.

Mangroves and coral reefs ecosystems provide core habitat for marine life and hence directly and indirectly provide a vast range of ecosystem services and hence support the livelihood of the coastal community and the economy as a whole. However, Mangroves and coral reef ecosystems are increasingly threatened, degraded and destroyed by marine and land-based human activities.

8.1 Mangroves

Mangroves are woody trees or shrubs adapted to live in a coastal saline or brackish environment where freshwater from rivers or streams flows to the ocean mixing with the salt water (areas referred to as estuaries). In Tanzania mangrove forest are located along many parts of the coastline, on gently sloping shores from Tanga to Mtwara around river estuaries, creeks, and bays and account for 0.3% of the total forest.

8.1.1 Status of mangrove ecosystems

Mangrove forests in the country are categorized into three major zones which are the Northern Zone comprising mangroves forest of Tanga Region; Central zone Comprising Mangrove Forest of Dar es Salaam and Coast region; and the Southern Zone Comprising Mangroves of Lindi and Mtwara Region. However, the largest stand of mangroves in Tanzania are found in the Rufiji delta accounting for 50% of all mangroves found in Tanzania and East Africa.

Based on the assessments, in 1991 and 2015 there has been substantial decreases in mangrove cover in the Northern zone and Southern zone from 11,159 (ha) to 1,701 (ha) and from 35,159 ha to 30,981(ha) in the year 1991 to 2015 respectively. An increase of mangrove cover from 68,390 (ha) in 1991 to 125,418 (ha) in 2015 was observed in central zone which covers Dar es Salaam and Coast Regions (Fig. 8-1). However, a study on mangrove cover change detection in Rufiji observed a loss of mangroves from 51,941 ha to 45,519 ha in the year 1991 and in 2015 respectively. The result has been contributed by continued destruction of mangroves due to rice farming and demand for timber and poles in Rufiji delta.

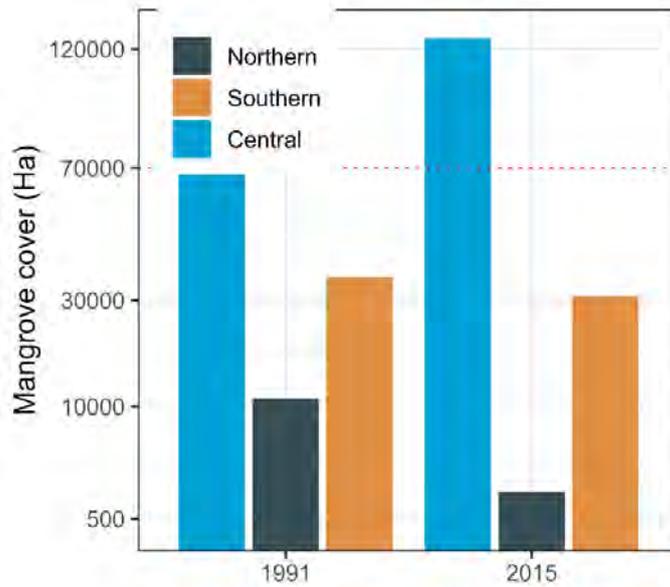


Figure 8 1: Mangrove cover (Ha) in selected mangrove blocks

8.1.2 Causes of mangrove degradation

Despite their economic and ecological value, the mangrove forests are under great pressure. The cause of mangrove degradation varies in different blocks depending on exploitation pressures that are mostly associated with their perceived and empirical uses and values. However, the major cause of mangrove degradation includes:- Overexploitation for poles and timber; Conversion of mangrove forest into agricultural land; Conversion of mangrove forest into salt production and Climate change.

8.1.2.1 Overexploitation for poles and timber

There has been an increased incidences of illegal mangrove harvesting for mangrove wood products especially, for timber and poles. This is common in Rufiji delta where a well-developed stand of mangroves is found (Plate 8-1a). The mangrove forests are also illegally harvested in Tanga and Rufiji for domestic uses such as house construction, making furniture, boat building and firewood. Moreover, harvesting for subsistence or for selling to obtain some income is also common in most of the mangrove covered areas



Plate 8-1: Clearing of mangrove for poles (a) and rice cultivation (b) in Rufiji Delta.

8.1.2.2 Conversion of mangrove forest into agricultural land

Mangroves are cleared for conversion to agriculture development mostly rice farming and irrigation schemes. This is evident in Rufiji where mangroves have been cleared for rice farming (Plate. 8-1b). Analysis of land cover change conducted in Rufiji delta has shown increase in area of cultivated land with corresponding decrease in mangrove area.

8.1.2.3 Conversion of mangrove forest into salt production

Mangroves are cleared for traditional salt making which is normally practiced by local communities in Rufiji delta as well as Lindi and Mtwara regions. Salt pans operated by major salt producers are done behind mangrove areas in the bare salt flats that did not have mangroves (Plate.8-2). However, many salt pan operators tend to violate the conditions given along with the licenses, often encroaching into non-licensed areas normally covered by mangroves to illegally clear the mangrove and expand production areas, a process resulting in degradation of mangrove forest. Major solar salt pans relative to mangrove areas are in Bagamoyo, Kilwa, Lindi, Mkinga, Mkuranga and Mtwara Regions.



Plate 8-2: Salt pans in Tanga

8.1.2.4 Climate change impact

Sea level rise is a major potential climate change threat to mangrove ecosystems, though information on mangrove degradation associated with this natural threat are very minimal in the country. Impact of sea level rise to mangrove ecosystem lies on its sensitivity to changes in inundation duration and frequency as well as salinity levels that exceed a species-specific physiological threshold of tolerance. The observed trend of sea level rise of 6mm/year in the coastal area of Tanzania confirm that mangrove ecosystems in the country are vulnerable to the impact of climate change. Sea level rise drives sea water on shore and push estuarine zone further upland, thus affecting the habitats and organisms intolerance to salinity.

8.1.3 Impact of Mangrove degradation

8.1.3.1 Habitat loss and decline in fish stock

Habitat loss has implications on species densities, biomass and diversity. Prawn fishing is alleged as the most impacted livelihood occupation due to its overdependence on

mangrove vegetation as nursery ground. Observed decreased in mangrove cover coincide with the decline in prawn fishery in the country (Fig.8-2), despite prawn fishery closure in 2008 to 2017 to allow recovery of the stock.

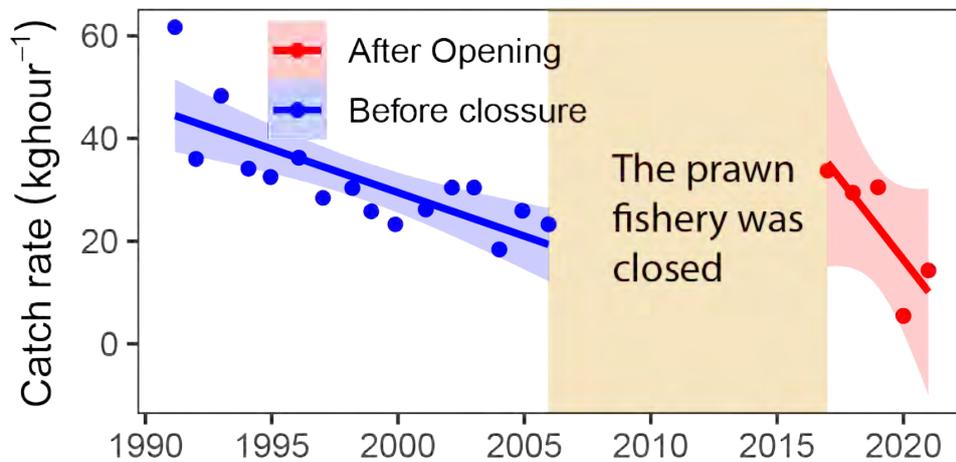


Figure 8 2: Annual mean catch rates of the prawn fishery in coastal waters of Tanzania between 1991 and 2021 showing a decreasing trend in catches over time.

8.1.3.2 Coastal erosion

Mangrove destruction also exposes coastal areas to erosion. This has been observed at Mikindani Bay in Mtwara Region where clear-cutting of mangroves has accelerated erosion hence loss of property, land and infrastructure (Plate 8-3).



Plate 8-3: Mikindani bay that has been exposed to erosion due to clear-cutting of mangroves (Photo credit: VPO coastal erosion Assessment team)

8.1.4 Existing Initiatives

- a. Enactment and implementation of natural resource management related acts such as Environmental Management Act Cap 191, Fisheries Act Cap 279 and Forest Act Cap 323. These acts provide a framework for the conservation of mangroves.

- b. Development and implementation of mangrove management plans. The management plans have been put in place as a way of managing and conserving mangroves. Management Plans for Rufiji delta and Kilwa have been developed and are in use. The management plans for other mangrove blocks are in different stages of development.
- c. Restoration of deforested areas: restoration initiatives supported by Government institutions, conservation NGOs and community-based organizations have been implemented in different places in order to rehabilitate the degraded land.

8.2 Corals

Corals are invertebrate animals with fascinating and colorful body. These animals extract abundant calcium from surrounding sea water and use this to create a hardened structure for protection and growth termed as coral reefs. In Tanzania coral reefs are found along the whole coastline and around all Islands including Mafia, Mbudya and Bongoyo. Corals reefs in the protected area are managed by Marine Parks and Reserve Unit (MPRU) and are divided as Tanga Coelacanth Marine Park (TACMP), Mafia Island Marine Park (MIMP), Dar es Salaam Marine Reserves (DMRS) and Mnazi bay-Ruvuma estuary Marine Park (MBREMP). Coral reefs in un protected areas are managed by Ministry responsible for Fisheries and respective Local Government Authorities

8.2.1 Status of Coral Reefs

Currently, the status of corals is provided in some localities, especially in Marine Protected Areas. There is scant data on the status of non-protected areas. An assessment conducted by Marine Parks and Reserve between 1999 and 2021, observed a gradual increase of coral cover in Mafia Island Marine Park (MIMP) and Tanga Coelacanth Marine Park (TACMP). On the other hand, a slight increase was observed in Dar es Salaam Marine Reserves (DMRS) Fig.8-3. Although the coral coverage data outside the protected areas could not be obtained, the observed trend in protected areas is contributed by the various conservation initiatives within the protected areas.

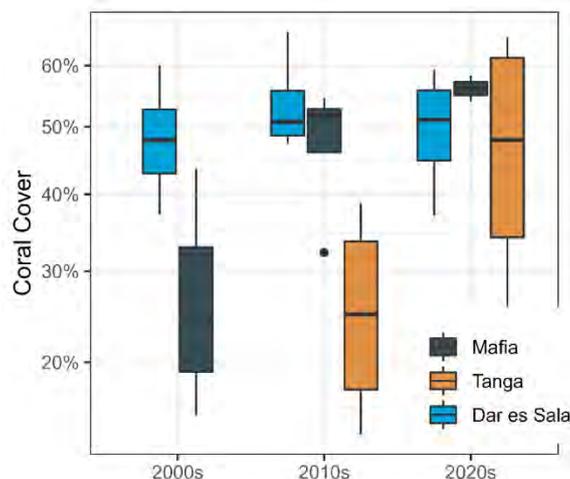


Figure 8 3: Coral cover in selected marine protected areas

8.2.2 Causes of coral degradation

8.2.2.1 Blast fishing

The explosion resulting from blast cause irreversible damage to coral reefs leads to damage to the reef, ecosystem and environment in general. The regions where blast fishing is common are Lindi, Mtwara, Tanga, Dar es Salaam, and Bagamoyo (Plate 8-4).



Plate 8-4: Illegal blast fishing (left) and degrades coral reefs due to blast fishing (right)

8.2.2.2 Climate Change

Coral bleaching resulting from elevated seawater temperature is another climate change related factor impacting coral reef ecosystems. Coral reefs are very sensitive and vulnerable to Sea Surface Temperature (SST) rise than their optimal maximum temperature (27°C). Coral bleaching was observed in the country in 1998 where 80% of corals in areas of Mafia, Kilwa (Songosongo), Rufiji, Zanzibar and Tanga were impacted. Since 1998, when the first bleaching event occurred, repeated bleaching has been occurring continuously in 2005, 2016 and 2020 (even though at smaller magnitudes). This has affected artisanal fish production, tourism industry, and coastal infrastructures.

8.2.3 Impacts of coral degradation

The impact of coral degradation include Loss of biodiversity and Loss of aesthetic value

8.2.3.1 Loss of biodiversity

Degradation of coral reefs due to blast fishing results into massive losses of biodiversity, weakened resilience and loss of habitat, which in turn lead to decline of fisheries resources. Comparison of catch rate over the period of 2000 to 2020 and trend in incidence of blast fishing along Tanzania coastal waters (Fig. 8-4), shows that decrease in catch rate in 2016 coincide with the increase in blast fishing incidence. Similarly, steadily rise in catch rate in 2018 to 2020 is the results of Governance interventions on blast fishing from Aug-Sept 2016 onwards, where blast incidence were successfully reduced by over 99% by December 2018. Further to this, implementation of South

West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish) which aimed at controlling destructive fishing contributes to the observed results.

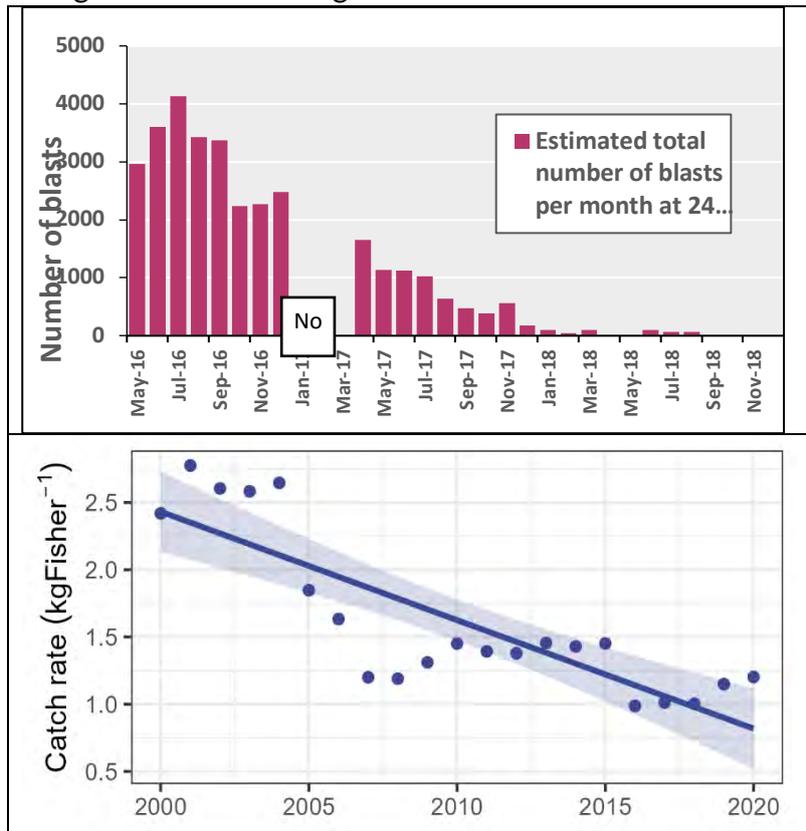


Figure 8-4: Trend in incidents of blast-fishing along Tanzania coast, May 2016 to December 2018 and Observed catch rate in Tanzania coastal waters

8.2.3.2 Loss of aesthetic value

Damaged corals can quickly lose many of the features that underpin the aesthetic appeal that is fundamental to reef tourism, likewise they can no longer buffer against increased frequency and magnitude of storm surge and wave, thus expose coastline to erosion (Plate 8-3).



Plate 8-3 Damaged corals due to bleaching

8.2.4 Existing Initiatives

- a. Establishment of the Marine Parks and Reserves Unit (MPRU) and Marine Park and Reserve Act Cap 279. This unit has taken a number of measures including conducting ecological monitoring of the reefs; conducting monitoring, control and surveillance and regular awareness on the role of coral reefs to the marine ecosystems.
- b. Establishment of the National coral Reefs Task Force. The task force acts as national facility to coordinate and provide technical expertise on issues around coral reef research, coral reef information sharing and coral reef management
- c. Establishment of community-based conservation organs such as Beach Management Units (BMUs).
- d. Implementation of projects aimed at controlling blast fishing
- e. Promotion of coral restoration in the degraded areas: about 3000m² area of degraded coral at Sinda and Mwakatumbe island marine reserves were restored in 2017. Survival rates of coral transplant were 58% and 64% in Makatumbe and Sinda respectively.

8.3 Interventions for conservation of marine and coastal environment

8.3.1 Goal

To ensure sustainable management and conservation of coastal and marine ecosystem

8.3.2 Expected results

Degraded mangroves and coral reefs restored, community participation in conservation of coastal and marine environment enhanced, conservation of mangrove and coral reefs adequately financed, destructive fishing activities minimized, illegal mangrove harvesting minimized, access to blue economy opportunities harnessed, marine spacial plans developed and implemented and ocean governance enhanced.

8.3.2.1 Priority areas

Mangrove areas of Northern zone (Mkinga District), Central Zone (Bagamoyo and Rufiji Delta) Southern Zone (Kilwa, Lindi and Mtwara).

Corals located in Marine Parks of Mafia, Mnazi Bay and Ruvuma Estuary, Tanga Coelacanth and Dar es Salaam and Corals reefs areas located out of the Marine parks in Bagamoyo, Songosongo, Kilwa and Mtwara.

8.3.2.2 Intervention and targets

i. Strengthen management and conservation of all mangrove ecosystem

- a. Establish a management working group and enhance its cross-sectoral coordination role in managing mangroves by 2025;

- b. Develop and implement management plan for all mangrove blocks by 2026;
 - c. Equip Institutions responsible for mangrove management with surveillance equipment to conduct regular monitoring by 2032; and
 - d. Develop and implement plan to enhance financial capacity for institutions responsible for mangrove management in managing the mangrove by 2032.
- ii. Promote the implementation of Joint Forest Management (JFM) in Rufiji**
- a. Conduct resources assessment to support the establishment of the JFM area by 2025;
 - b. Put in place and implement a Joint Management Agreement (JMA) by 2032; and
 - c. Develop monitoring plan for implementation of JFM by 2032.
- iii. Promotion of alternative livelihood activities in coastal communities.**
- a. Conduct assessment to determine the exploitation pressure on mangroves, empirical use and value and possible alternative livelihood options by 2025;
 - b. Develop appropriate infrastructure in Nyamisati and Kilwa masoko to promote eco-tourism as an alternative livelihood by 2025; and
 - c. Establish a plan for Integrated aquaculture (milkfish farming and mud crab fattening) in Pangani, Mtwara, Lindi and central and southern delta villages by June 2032;
- iv. Enhance mangrove restoration programs in Mkinga, Rufiji Delta, Mtwara and Lindi.**
- a. Conduct assessment to identify mangrove degraded areas by 2024;
 - b. Develop mangrove restoration guidelines by 2024; and
 - c. Develop and implement a restoration plan by 2032.
- v. Promote Marine Spatial plans (MSP);**
- a. Conduct an assessment of resource use, resource users, tenure and governance systems by 2025; and
 - b. Develop and implement localized Marine Spatial plans by 2032.

vi. Leverage additional financing for mangrove conservation

- a. Establish a baseline of mangrove resources for Blue Carbon financing by 2025;
- b. Enhance institutional and local community capacities to develop and manage Blue Carbon projects by 2027; and
- c. Develop and implement Blue Carbon projects to obtain sustainable financing and motivate mangrove conservation efforts by 2032

vii. Enhance conservation and management of coral reefs

- a. Conduct an assessment of the status and trend of corals reefs health located out of the protected areas in Songosongo, Kilwa, Mkinga, Bagamoyo and Mtwara by 2025;
- b. Develop and implement management plan for coral reefs located out of the protected areas in Songosongo, Kilwa, Mkinga, Bagamoyo and Mtwara by 2032;
- c. Establish a plan to extend the marine conservation area from the current size of 6.5% to at least 10% by 2032;
- d. Enhance the capacity of Marine Parks and Reserve Unit (MPRU) to manage coral reefs by 2032;
- e. Develop and implement monitoring programs that track trends in coral reef health in Marine Protected Areas by 2027; and
- f. Develop comprehensive digital maps and Climate Risk Atlas for all coral reefs by 2025.

viii. Reduce all forms of destructive fishing in a multifaceted approach

- a. Develop and implement environmental Awareness programs focusing on coral reefs conservation and sustainable fishing by 2032;
- b. Develop and implement a program for the involvement of the fishing community in coral reefs conservation by 2032;
- c. Equip fishermen with environmentally-friendly gear and vessels by 2032; and
- d. Build capacity of responsible institution on enforcement of legislation to enhance compliance in coral reefs management by 2032.



CLIMATE CHANGE IMPACTS



9 CLIMATE CHANGE IMPACTS

The scientific evidence for warming of the climate system is unequivocal, and the evidence for rapid climate change is compelling for both land and sea temperature rises. Tanzania is already experiencing changes in climate, evidenced by increasing temperature trends characterized by incidences of the highest ever recorded temperature mostly observed over the last decade. Over the last five years, the country has been warming by 0.6°C and above compared to the 1981 – 2010 baseline as shown in Figure 9-1.

The country also experiences uneven distribution of maximum and minimum temperatures. Observed changes reveal that in many parts of the country, temperature increases by 1°C has been observed since the 1960s. Both land and sea temperatures in the country have been increasing since 1980. Temperature trends show that the western regions (Kigoma, Katavi, Rukwa), Southern highlands (Mbeya, Songwe, Njombe, Iringa) and central part (Dodoma) will warm for more than 2°C by 2041, while most regions in the eastern zone will experience a temperature increase of 1°C (Lake Zone, Northern Zone, Coast and Southern Zone) by 2041. Figure 9-1 shows trend in both land and sea temperatures since 1980 in Tanzania.

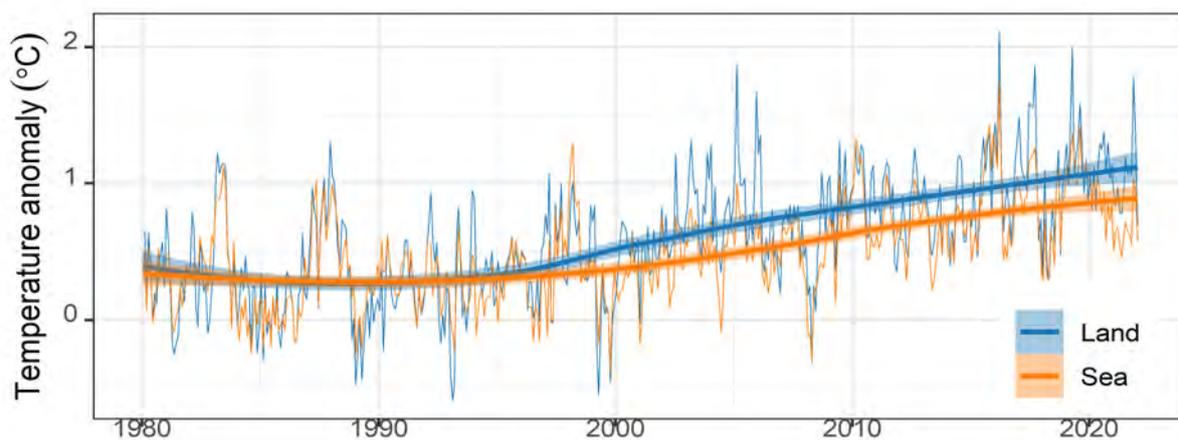


Figure 9 1: Trend in both land and sea temperature rise in Tanzania.

Climate change causes extreme precipitation and shifting in rainfall patterns. In Tanzania, rainfall shifts and changes is evidenced by increasing and decreasing trends and strong variability since 1970. Rainfall projections indicate that some parts of the country may experience an increase in mean annual rainfall of up to 18 to 28% by 2100, particularly over the Lake Victoria Basin and North-Eastern Highland. The South Western Highlands and Western Zones are projected to experience an increase in annual rainfall by up to 9.9% in 2050 and by up to 17.7% in 2100.

Change in temperature and rainfall patterns cause climate-induced water stress; spread of climate related diseases; extreme precipitation that led to flooding; spread of bush fires and invasive species; biome or ecosystem shifts; melting of glaciers leading to sea Level rise, loss of coral reefs and biodiversity, droughts, spread of vector-borne diseases like malaria and dengue fever.

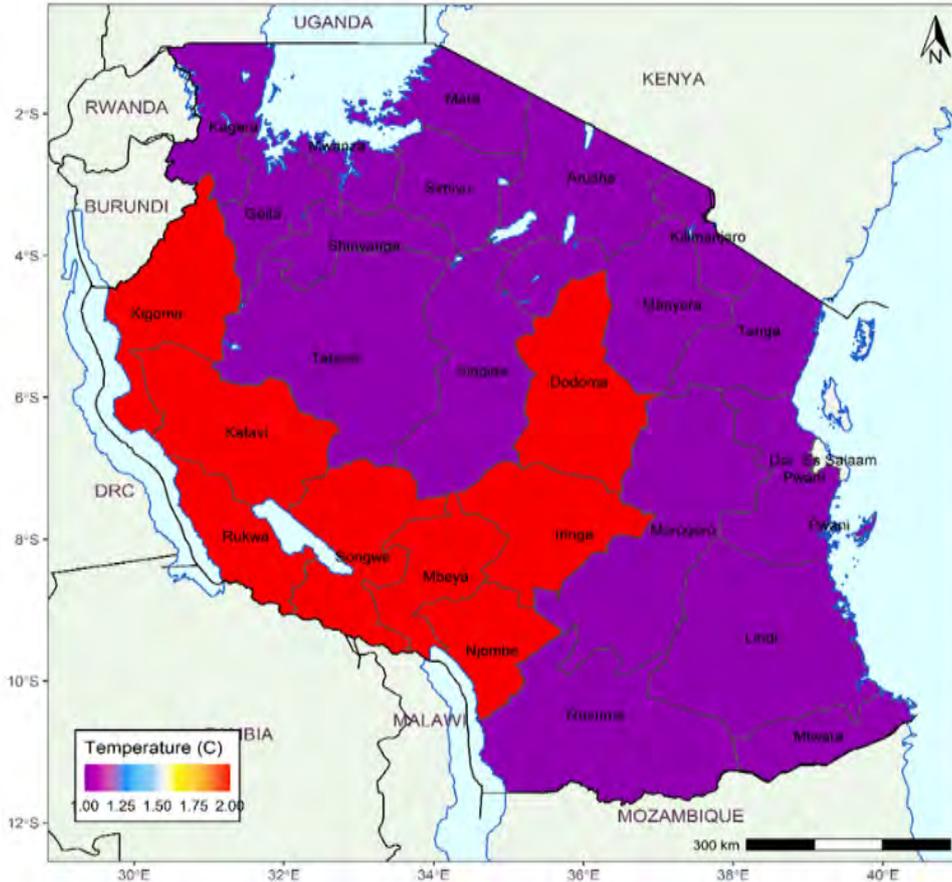


Figure 9 2: Spatial distribution of projected change in temperature in different regions in Tanzania

9.1 Status of climate change impacts

The adverse impacts of climate change impacts include: extreme precipitation that cause flooding; prolonged droughts; sea level rise leading to submerging of small Islands, coastal and low-lying areas, spread of bush fires and invasive species; ocean acidity and decreases in oxygen levels, which pose great risks to marine biodiversity, biome or ecosystem shifts or transformation.

9.1.1 Extreme rainfall and floods

Tanzania has been experiencing extreme weather conditions, including increased frequencies and intensities of heavy rainfall events (HRE) in different parts of the country. Extreme heavy rainfall events have led to floods and increased loss of life and properties for the past 35 years. The majority of the observed HREs are concentrated over the Lake Victoria basin with the highest number being to the western part of the Lake (Mwanza, Kagera, Kigoma) and over the northern coast (Unguja and Pwani). Heavy rain of 103.4 mm and 58.6 mm recorded at Dar es Salaam International Airport on 13th and 14th October, 2020, respectively, caused devastating flood that led to deaths of 12 people and severe infrastructural damages.

Representative Concentration Pathways (RCP) 4.5 scenario projection by 2041 and 2071 show that change in precipitation in Tanzania will be large in Morogoro and Manyara

regions, where a positive change or increase in precipitation will be experienced, while Kigoma region will have a negative or decrease in precipitation. This implies that areas with decrease in precipitation will be prone to drought while areas with high increase in precipitation will be prone to floods and increase in health water borne diseases. Figure 9-3 shows spatial change in precipitation in Tanzania.

Moreover, climate change has led to frequent droughts in many parts of the country affecting livelihood, development activities and environmental system. For example, the prolonged and persistence drought in the Northern part of the country has affected more than 10 semi-arid districts in Manyara, Arusha, Kilimanjaro and Tanga regions. In these regions, livelihoods of more than 2 million people have been impacted. Recurrent and persistent drought in many parts of the country affects crop yield, has affected crop growth, reduced the availability of water and pasture for livestock.

Furthermore, floods have increased in recent years and reported to be the costliest hazard at the national level. From 1990 to 2014 about 62% natural disasters were caused by floods accounting to 17 to 122 deaths from 2017 to 2020. Also, the highest rate of floods among natural disasters was reported in 2017 (77%) and 2020, (91%). Number of the displaced population from floods is estimated to increase from 182 and 22,680 in the year 2016 and 2020, respectively. Since 1964 about 876 deaths; 1,073 injuries; 21,406 houses destroyed; 107,060 houses damaged; 415,879 people directly affected; 1,224,142 people indirectly affected; 6599 relocated; 3,864 evacuated; economic loses; education center affected (257); hospitals affected (35); damage in crops and lost cattle (101,252). Most of these incidences occurred between 2010-2021.

The increased flood events are also associated with development of human settlements in flood prone areas in location that include Mwanza and Tabora. The effects of flood in human settlement areas and road infrastructures is shown in Plate 9-1.



Plate 9 -1 (a): Effect of floods on public transport in Dar es Salaam (Left), and residential settlement areas affected by flood in Lindi Region, January, 2020 (right)

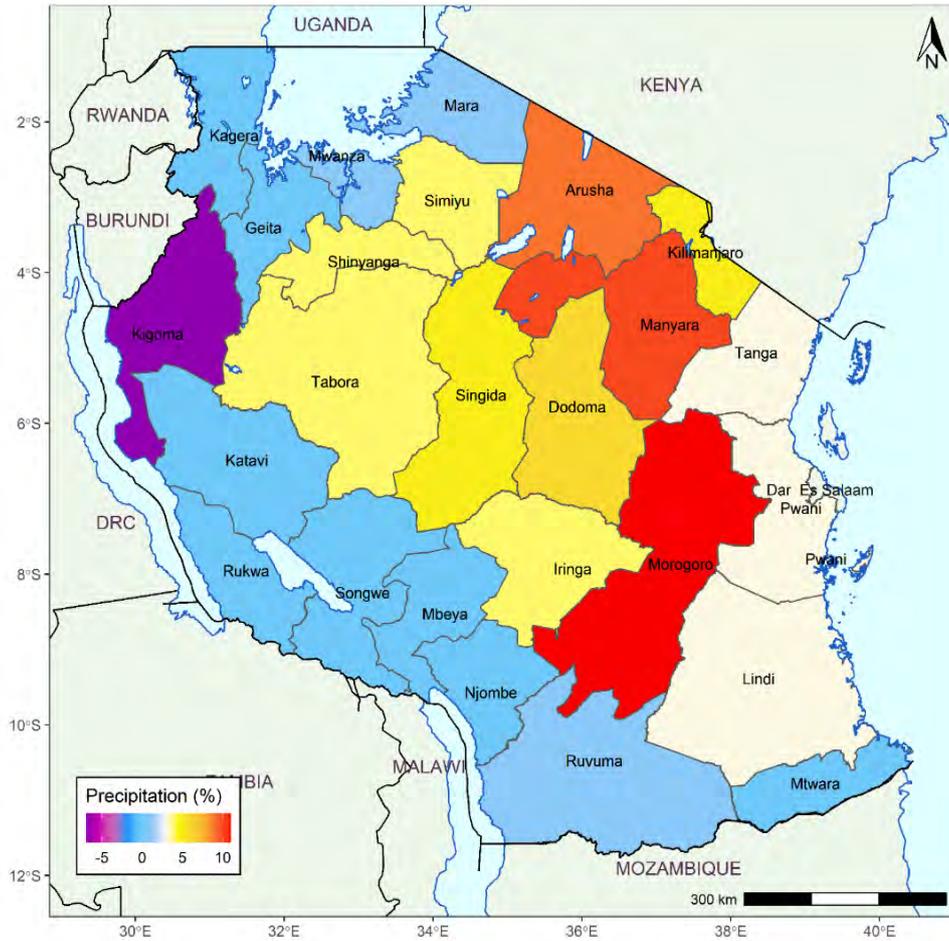


Figure 9 3: Trends in projected spatial distribution of change in precipitation (%) in Tanzania



Plate 9- 2: (b): Impacts of flood in different roads and transport infrastructures

9.1.2 Drought

Droughts have continued to increase in different locations of the country, affecting livelihood, development activities and environmental system. Some of the affected activities include decrease in water flow (e.g., Rufiji basin); migration Livestock and farmers (Shinyanga, Mwanza, Simiyu regions); livestock mortality (Manyara, Simanjiro regions) (Figure 9-4 shows livestock loss due drought reported in different regions in Tanzania. Moreover, drought affects rain fed crop yield and may lead to poor yield, reduce the availability of safe drinking water, compromise sanitation and increase the incidences of water borne diseases. Plate 9-3: Effects of drought on maize crop in Busega Simiyu.

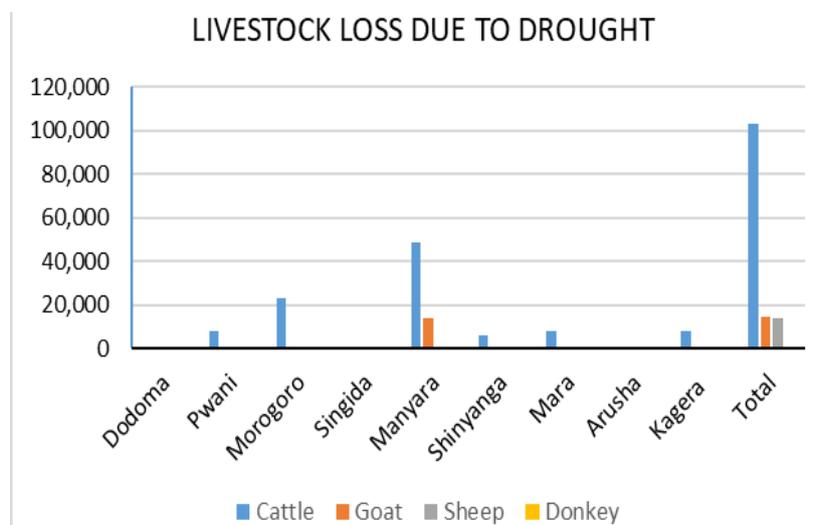


Figure 9-4: Livestock loss due drought reported in different regions of Tanzania in 2016/17



Plate 9-3: Effects of drought on maize crop in Busega Simiyu (Source URT, 2021)

9.1.3 Rising sea level

The impact of climate change includes sea level rise and erratic precipitation and saline intrusion to groundwater along the coastal areas of Tanzania. In Dar es Salaam, for example Sea level rises at a rate of 0.492, equivalent to 6mm per annum from 2002 to

2018 as indicated in Figure 9-5. The increase in sea level for Tanzania mainland has led to beach erosion and destruction of coastal infrastructure (e.g. Mbweni JKT in Kinondoni Municipality and Mikadi Beach in Kigamboni Municipality); intrusion of salty water into settlement and agricultural land (Bagamoyo, Rufiji), inundation of low-lying islands such as Maziwe (Tanga); Fungu la Nyani (Rufiji); salinization of fresh water well. Figure 9-5 shows impacts of sea level rise (beach erosion) along coast of Dar es Salaam.

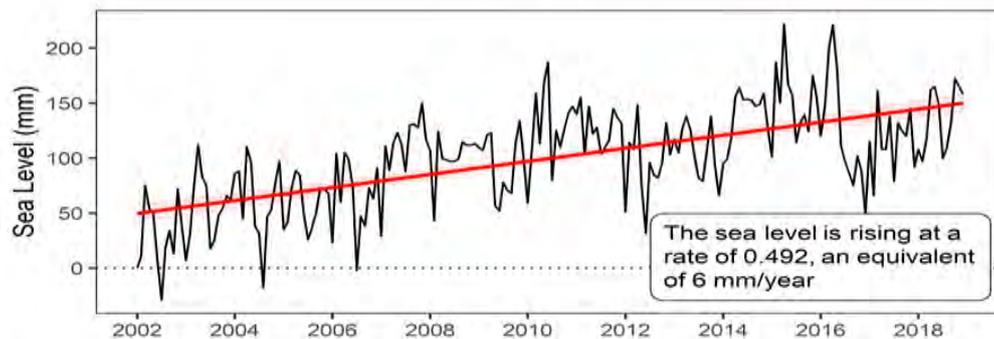


Figure 9-5: Sea level rise trend in rise in Dar es Salaam coastline since 2002.

9.1.4 Lake water levels rise

In recent years, water levels in many lakes, including Lake Nyasa, Tanganyika, Rukwa, and Victoria experienced rising water levels that have caused significant flooding impacts on Lake shoreline and downstream communities. Lake Tanganyika recorded highest water levels by almost 3 metres (from 772.85 m in 2006 to 776.04 m in June, 2020) and 3.62 metres (772.85 m in 2006 to 776.47 m in May 2021); Lake Victoria by 0.53 m (from 1134.27 m in 1965 to 1134.8 m in June, 2020).

The effect of lake water levels rise include intrusion and submerging of agricultural land and infrastructures located in low lying areas as shown on Plate 9 – 4 below.



Plate 9-4: Effect of water level rise on the Kasanga landing site, Lake Tanganyika, Kalambo, Kigoma

9.1.5 Dam water level rise

Heavy rains experienced between 2017 and 2020 in many parts of the country threatened the existence of dam infrastructures and human life due to water levels rises

reaching unprecedented maximum levels. Mtera hydropower dam recorded an outflow of 3300m³/s in 2020, which is the highest water inflow ever recorded since 1954. Figure 9-6 shows trend in water level of Mtera Dam from 2018 to 2020. The rise in dam water levels poses both environmental and economic challenges. Other challenges facing the dams sediment deposit due to erosion in the catchment areas.

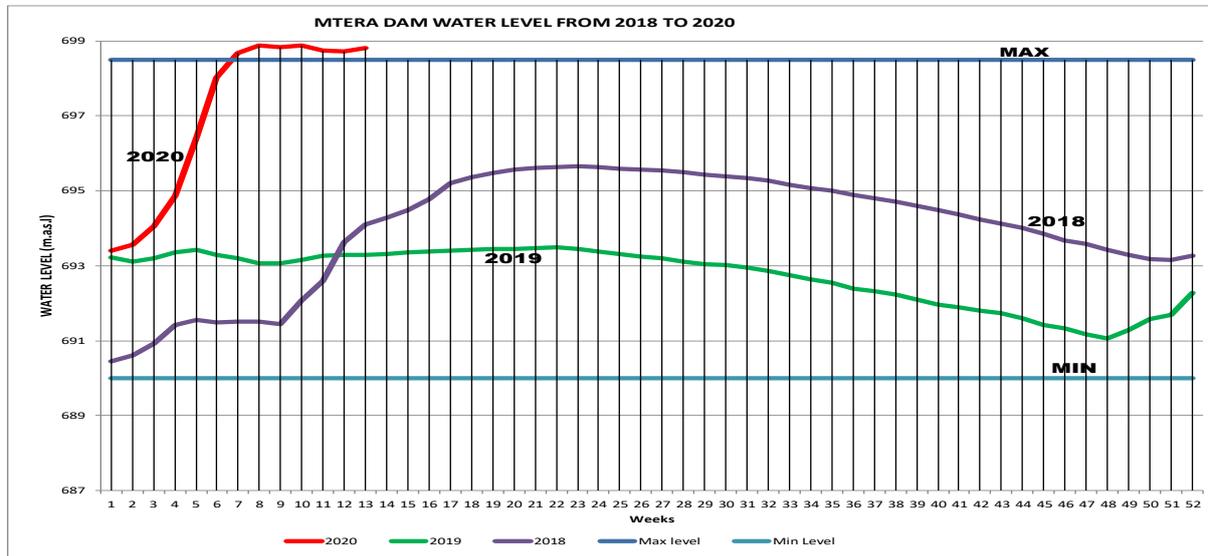


Figure 9-6: Trends in water levels at Mtera Dam from 2018 to 2020.

9.1.6 Migration and social conflicts

Climate change challenges have triggered migration of people and livestock within the country and other regions in the western and southern parts of Tanzania. This has led to social conflict in areas of destination. For example, in Kigoma and Katavi Regions, social conflicts have increased due to resource competition between migrant livestock keepers and local communities. It is reported that currently about 75 per cent of all land-related conflicts reported in Kigoma were related to migrants, including pastoralists. The main type of conflicts is farmer-pastoralist.

9.1.7 Ecosystems shift and biodiversity loss

Climate change has accelerated loss of biodiversity and shift ecosystems caused by increasing or decreasing precipitation that result into habitat loss and degradation of ecosystems and proliferation of invasive species. The trends of rising temperatures of both sea and land has affected both marine and fresh water ecosystems.

9.2 Existing initiatives

In order to address aforementioned climate change adverse impacts and challenges, the government of Tanzania has put in place several measures. These measures include: construction of hard structures such as seawalls; gooneys; drainage systems; drilling of bore holes; planting of mangroves and coral reefs. Other initiatives include: Construction of major and micro hydropower projects, intensification of electrification through Nationwide Rural Energy Agency (REA) programme; use of solar power in street and home lighting; establishment of Tanzania Geothermal Development

Company Limited (TGDC) and National Carbon Monitoring Center (NCCM) and National Renewable Energy Center and National Renewable Energy Center; connecting natural gas pipeline to households and industries in Dar es Salaam; construction and improving transport infrastructures; adoption of policies that reduce or promote emission reduction and enhance awareness and National Tree Planting Campaign. In addition, Nationally Determined Contribution (NDC); National REDD+ strategy and its implementation plan (2013); National Climate Change Response Strategy (2021-2026) and National Environmental Policy (2021) are in place.

9.3 Interventions for addressing Climate Change impacts

9.3.1 Goal

To reduce climate vulnerability and enhance resilience to climate change impacts.

9.3.2 Expected results

Enhance climate resilience of people, ecosystems and productive sectors by reducing adverse impacts of climate change and build capacity for harnessing of climate change mitigation opportunities.

9.3.3 Priorities areas

Flood prone (urban and rural) areas of Dar es Salaam, Kilwa (Lindi) and Rufiji (Pwani), Kyela (Mbeya), Kilosa (Morogoro); coastline areas subject to sea water erosion, intrusion and inundation Mbweni and Mikadi Beach (Dar es Salaam); Bagamoyo (Pwani), degraded terrestrial and marine ecosystems (Tanga, Pwani, Dar es Salaam), Low lying shores along coastlines (Dar es Salaam, Lindi, Mtwara, and Tanga) and low lying shores of Lake Tanganyika, Nyasa and Victoria; and drought-stricken in Manyara, Singida, Dodoma, Shinyanga, Mwanza, Kilimanjaro, Mara and Simiyu. Deforested and forested areas (western, southern, central, eastern zone, northern and Lake Zones) and national and village forest reserves.

9.3.4 Interventions and targets

i. Comprehensive and Holistic Flood Control programme in flood prone areas.

- a. Develop and implement long-term plans for flood control in at least 50% in flood prone areas by 2032.
- b. Construction of drainage systems in at least 10% of new and existing roads in flood prone areas by 2032.
- c. Implementation of storm water management plans enforced by 2032.
- d. Develop and implement disaster communication guidelines for community based early warning and disaster management system by 2032.

- ii. **Build institutional capacity for sustainable management of water bodies (lakes and dams) and catchments to reduce flood risks, intrusion and inundation**
 - a. Construct flood control infrastructure in at least 50% of water basins by 2032;
 - b. Develop and implement integrated water resources management (IWRM) plan in all 9 basins by 2032; and
 - c. Identify and demarcate at least 30% of water intrusion/inundation prone areas to reduce climate change vulnerability by 2032.
- iii. **Provide access to water to enhance community resilience to climate change induced drought**
 - a. Capacitate at least 10% of communities in drought-stricken areas to adopt and use rainwater harvesting technologies by 2032; and
 - b. Develop and implement plans for climate change resilient traditional and modern knowledge on sustainable pasture and range management systems in drought prone areas by 2032.
- iv. **Build capacity to to enhance monitoring and early warning system for coastal and marine environment**
 - a. Conduct assessment to identify coastal areas threatened by inundation from sea water level rise by 2025;
 - b. Construct climate proof infrastructure such as seawalls, gabions and groins to at least 30% of the areas under threat from sea water level rise by 2032;
 - c. Construct alternative water sources such as boreholes to at least 30% of communities in the coastline affected by saltwater inundation by 2032; and
 - d. Develop and implement plan for promotion of nature-based solutions in coastal LGAs communities under threat from sea water level rise by 2032.
- v. **Build capacity enhance monitoring of fresh water bodies and early warning systems**
 - a. Conduct assessment to identify areas threatened by lake water rise by 2032;
 - b. Develop and implement programmes and project to address lake water rise in affected areas by 2032; and
 - c. Develop and implement plan for promotion of nature based solution in fresh water bodies under threat by 2032
- vi. **Tapping opportunities arising from carbon trade**
 - a. Develop and operationalise National Carbon Trading Guidelines and Regulations by 2023;
 - b. Conduct assessment on potential ecosystems and sectors for attracting carbon credits trade by 2024;

- c. Develop and implement a program on gender empowerment for carbon credit by 2025.
 - d. Develop and implement awareness raising and capacity building programmes on procedures, accessibility and potential buyers of carbon credits by 2025;
 - e. Develop plans in at least 20% of village forest reserves participating in voluntary carbon markets and REDD+ regimes by 2026;
 - f. Develop and implement programme/projects on voluntary carbon markets and REDD+ regimes in least 20% of village forest reserves by 2026;
 - g. Develop and implement at least 5 of agro-processing industries projects geared to generate energy and carbon credit by 2032; and
- vii. **Promote investment in clean technologies for diverse renewable energy sources and mass transport systems**
- a. Develop and implement at least 10 Carbon projects on renewable energy and power generation by 2032;
 - b. Construct at least 20% of public buildings that adhere to energy efficient systems by 2030;
 - c. Adopt and install at least 10% of mass transit with technologies that enhance fuel efficiency and clean technologies such as natural gas, electricity, and ethanol by 2032; and
 - d. Capacitate at least three of cities to have mass transit infrastructure by 2032; and
 - e. Support implementation of at least 10 programs on multilateral obligations and requirements by 2032.
- viii. **Up-scale implementation of participatory forest management programmes and ecosystem restoration service schemes**
- a. Develop and implement at least 10 community forest management; programmes under carbon market schemes by 2032;
 - b. Promote and voluntary carbon markets and REDD+ schemes in least 20% of village forest reserves by 2032; and
 - c. Restore at least 3 million ha of degraded forest land by 2032;



ENVIRONMENTAL POLLUTION



10 ENVIRONMENT POLLUTION

Tanzania is experiencing rapid economic growth with urbanization and industrialization leading to significant challenges in pollution management from wastewater, air pollution, noise and vibration, chemical waste and land pollution. The growing volumes of solid, liquid and hazardous wastes are major threats to the environment and the sustainable development of economic activities. Pollution reduces the quality of air, water, and land, hence contributing to the loss of biodiversity. This has the effect of lowering the value of ecological services while affecting public health and contributing to environmental degradation. The exceedance of pollution levels emanate from industries, agricultural activities, and mining, which threaten to undermine the quality and health of vulnerable ecosystems on which communities depend.

10.1 Pollution status

The forms of pollution experienced countrywide include air quality; noise and vibration; surface water pollution; land and soil pollution; marine and coastal pollution; chemical pollution; and waste pollution. The magnitude of pollution varies from location to location depending on the development level and economic activities taking place. Among the environmental public complaints received by the NEMC from 2019 to 2022 (Figure 10.1), indicate the major public complaints on environmental pollution are noise, mostly experienced in cities, municipalities, and urban areas of Dar es Salaam, Dodoma, Mwanza, Mbeya and Tanga. This is followed by air pollution and wastewater discharges in all cities, with the exception of Dodoma, which lacks surface water bodies crossing the city. Lastly, is the inadequate disposal of solid waste in urban areas.

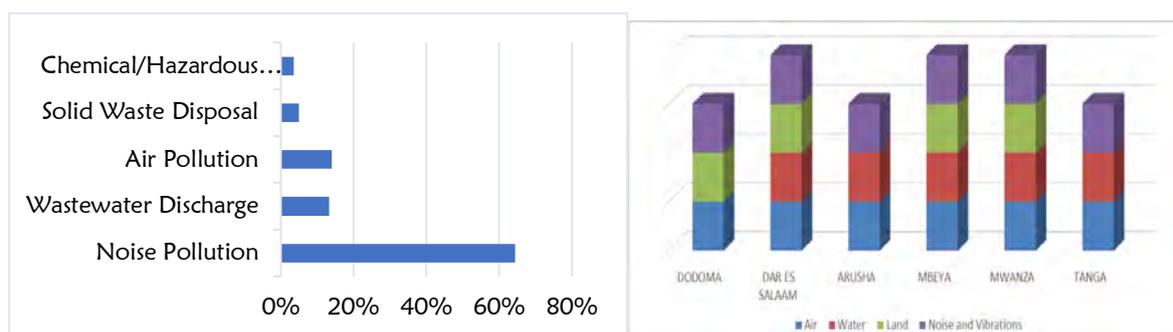


Figure 10-1: Environmental Pollution Complaints filed to NEMC from 2019 to 2022

In major cities and across Tanzania, air quality is not frequently monitored. Emissions particularly Sox and NOx, as well as particulate matter (PM2.5) concentrations are increasing in cities and urban areas but are not actively monitored. According to statistics collected from the public on environmental pollution complaints from 2019 to 2022, Dar es Salaam accounts for 88 percent of air pollution incidents, while Dodoma, Mwanza, Arusha, and Mbeya account for 2 to 4%. (Figure 10.2a). Furthermore, noise pollution is a challenge in urban areas, especially in major cities as seen in Figure 10.2b.

Dar es Salaam's complains regarding noise and air pollution are highest due to urbanisation, industrialisation, and the proximity of polluting facilities to population settlements.

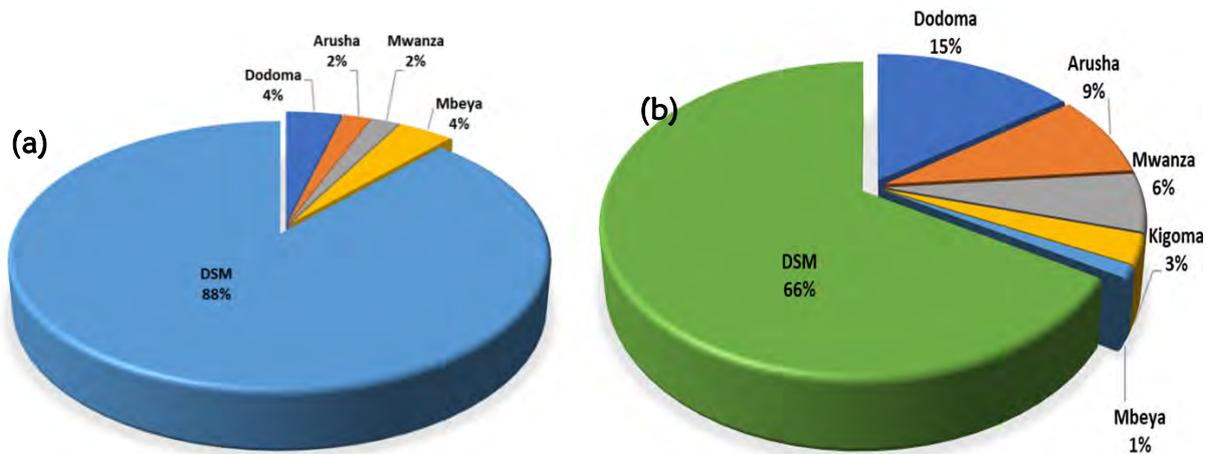


Figure 10-2: Public Complains on (a) Air Pollution and (b) noise pollution affecting nearby communities (Source: NEMC 2019 to 2022)

The other sources of pollution are associated with the hazardous disposal of chemicals on land and water resources. The chemical pollution in water is due to agricultural, industrial and mining activities. The surface water monitoring in rivers traversing through urban areas and high intensity agricultural land have increasing levels of nitrate in exceeding the acceptable level of 20mg/l as indicated in Figure 10.3. Nitrate and phosphorus levels have been found to rise over time in various water sources, such as the Ngerengere River in Morogoro, the Great Ruaha River in Iringa, and the Mbezi River in Dar es salaam where the levels are seen to increase above a prescribed threshold. This necessitates continuous monitoring of the water catchments characterized by extensive agricultural operations to control eutrophication of water sources.

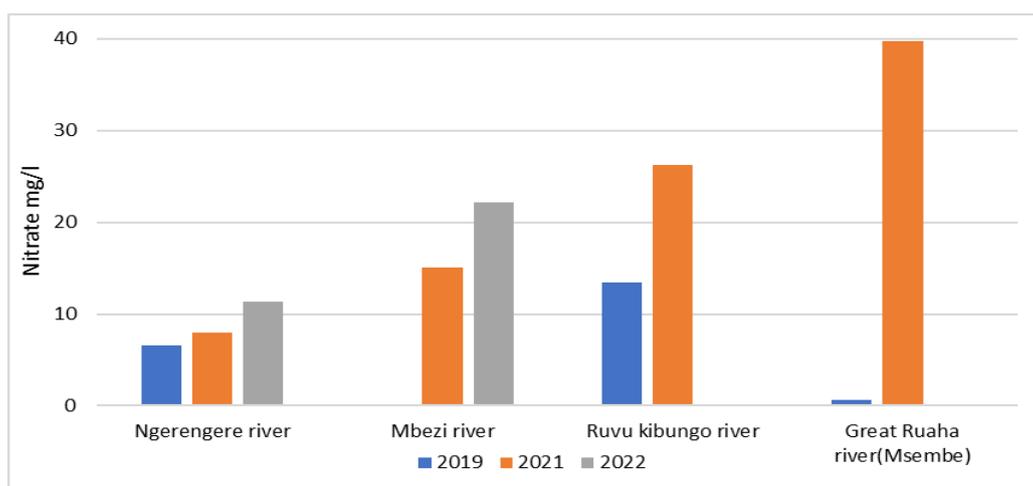


Figure 10-3: Pollution in water sources from Nitrates in rivers

Further, inadequate waste management has been among the major causes of water pollution. This is attributed to the inadequate availability of waste water treatment facilities whereby, more than 80% the of LGAs lack waste treatment facilities. Consequently, untreated sewage disposed into the open environment and water bodies such as rivers and the ocean. Moreover, the effluents from the domestic wastewater treatment plant have elevated levels of biodegradable oxygen demand (BOD), total suspended solids (TSS) and Ph. This could result in oxygen depletion and eutrophication in the aquatic ecosystem, as well as an increase in the risk of water-borne diseases.

In mining areas, existence of heavy metals are common in water bodies around the mines. Copper and arsenic are detected in lower than permissible levels in water sources. However, in some areas lead (Pb) are detected above permissible levels. For example, in 2021 measurements of surface waters, groundwater, and mine facilities in Geita gold mines, indicated that lead (Pb) levels in eight different locations were higher than permissible levels of 0.1 mg/l. The observed levels that are above threshold poses risk to human health and and the environment (Figure 10.4).

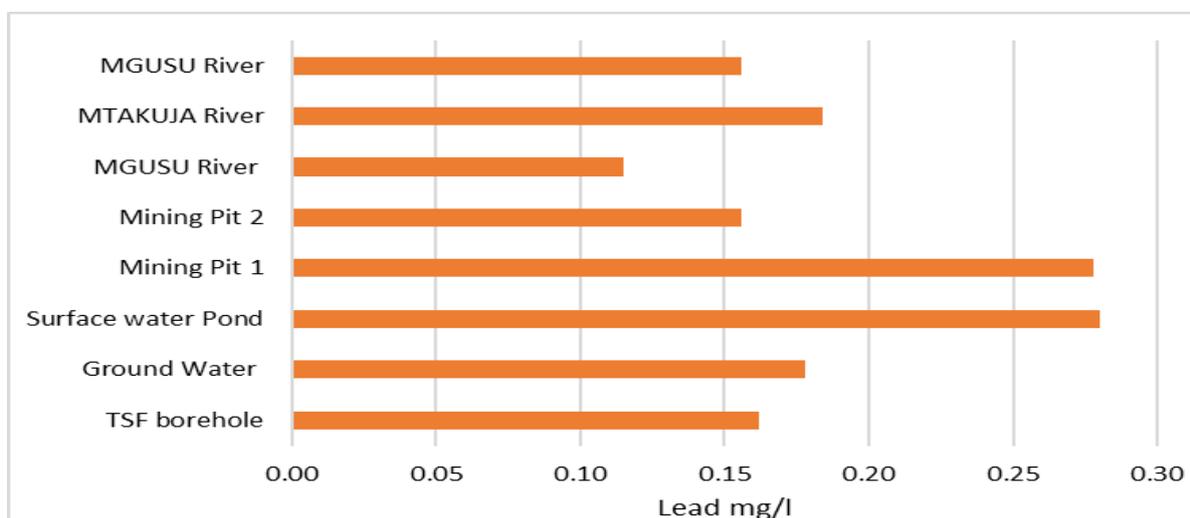


Figure 10-4: Lead (Pb) pollution in water sources in mining areas of Geita

The most significant source of pollution to marine include hydrocarbon oil spills from shipping refuse on the ports and plastic wastes from land-based sources as well as excess nutrients from wastewater disposal in the ocean. The coast of the Indian Ocean in Dar es Salaam, Lindi, Tanga, Mtwara and Pwani Regions has continued to experience large amount of waste and pollutants including plastic debris, excess nutrients and chemical waste. Coastal and Marine environment is also highly affected by litter emanating from land based sources and activities. Over 70% of the waste littered in the Indian Ocean in the coast of Dar es salaam is composed of plastic (Plate 10.1). Furthermore, oil spill has continued to pollute the coastal and marine environment in the country. For the period 2019 to 2022, five incidents of significant oil spills have been reported on the coast of the Indian ocean.



Plate 10-1: Marine littering Dar es Salaam on the coast of the Indian Ocean (Source: Tanzania Sustainable Development Initiative (TSDI) December 2021 and February 2022)

10.2 Underlying Causes of Pollution

Environmental pollution in Tanzania emanates from numerous causes ranging from human activities and natural sources. Human activities are the leading major causes of pollution and they include inadequate waste management, industrial effluents, mining operations and socio-economic activities that include agriculture, fishing, grazing as well as religious and entertainment activities as indicated in figure 10.5. The natural sources of pollution include the biodegradable organic matter in water sources.

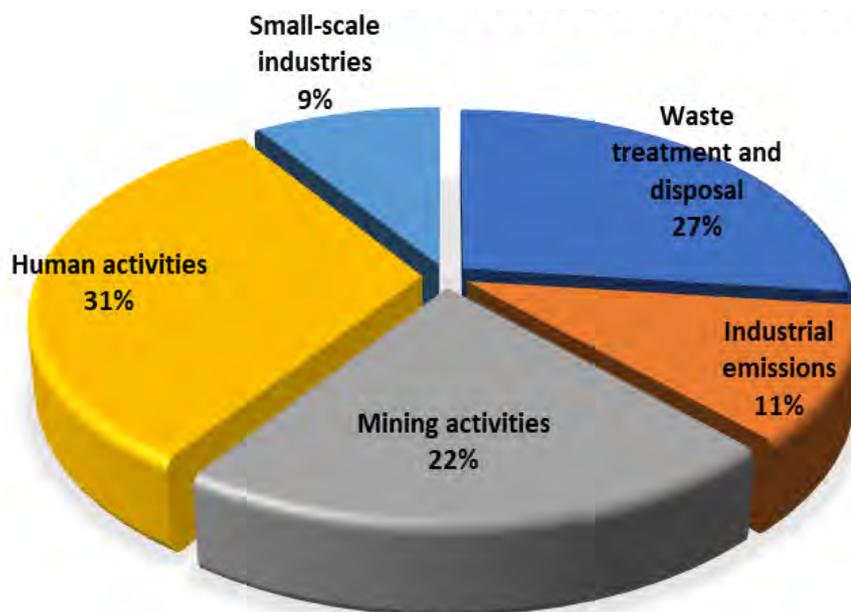


Figure 10.5: Sources of Pollution

10.2.1 Inadequate Waste Management

Inadequate waste management is a major cause of air, soil and water pollution in urban areas. In most cases lack of the capacity to collect generated solid wastes, and inadequate solid waste treatment are the routes causes of pollution. It is estimated that

over 90% of solid waste generated in urban areas are not properly disposed and hence contribute to pollution of the water sources both underground and surface water.

10.2.2 Wastewater discharges

Industrial activities are regarded as the major point source of water pollution in urban areas. 80% of industries are located in urban areas of Dar es Salaam, Mwanza, Arusha, Tanga, Morogoro and Mbeya. Many of these industries have inefficient water management practices and inadequate wastewater treatment facilities. As a result, they generate and discharge large quantities of wastewater which do not meet the quality limits set in the national standards, leading to pollution of the receiving water bodies and the environment as a whole.

10.2.3 Industrial Air Pollutants

Emissions from industries affect 66% of major cities including Dar es Salaam, Mwanza, Arusha and Mbeya. It extends further to 40% of municipalities including Iringa, Singida, Temeke, Morogoro, Musoma, Ilemela, Kigoma and Kigamboni.

The common industries that generate air pollutants include coal and oil-fired thermal plants, cement production industries generating particulate matter, waste recycling and recovery industries generating emissions but also heavy metal air pollutants depending on the raw waste processed. The major challenge of industrial pollution is lack of the efficient air pollution control equipment in the industries and their locations in close proximity to urban populations (plate 10-2).



Plate 10-2 Fumes from industries which are located close to residential areas

10.2.4 Mining Activities

Tanzania's mining sector is currently contributing 5.2% of the country's Gross Domestic Product (GDP) with most ore deposits such as gold, building materials, gemstones, diamonds, coal, Tanzanite and other minerals. Environmental pollution is mostly observed in gold mining sectors that can be categorised as Large Scale Mining (LSM) and Small-Scale Mining (ASM) including artisanal. The large scale mining sectors have

the potential to the generation of massive pollution if appropriate technologies and infrastructures are not in place. The ASM sector is scattered in more than 17 regions of Tanzania and is dominated by local miners using basic methods to extract near-surface deposits. Uncontrolled pollution is seen in the small scale mining activities whereby to current there are approximate 12,282 active gold Primary Mining Licenses countrywide.

Mining operations not only lead to water pollution but also attribute to land/soil and noise and vibrations pollutions. Mining operations pollute water and land due to Acid Rock Drainage (ARD) and chemicals especially mercury (for small scale mining) and cyanide (for medium and large scale mining). On the other hand, blasting activities also contribute to noise and vibrations. Pollution of water due to mining activities are more pronounced in the Lake Victoria Basin (LVB) and parts of the Katavi and Mbeya regions which are well endowed with mineral deposits of gold.

The ASGM processing involves the use of mercury and the generation of tailing contaminated mercury which is toxic to the environment. Later the tailing is reprocessed using chemical cyanide and thereafter is abandoned pilling up in ASGM locations (Plate 10-3).



Plate 10-3: Small scale Gold mining activities in Misungwi and chemical spillage (Cyanide Chemicals) in one of the Vat processing plants in Chunya DC

10.2.5 Socio-economic activities

Social activities that include religious places, transport facilities and entertainment areas like nightclubs and bars are repeatedly been reported to be pertinent causes of noise pollution in the urban areas. The location of these facilities near the residential may lead to exposure to excessive noise above standard. The challenge of noise pollution is highly experienced in cities including Dar es Salaam, Dodoma, Arusha, Mwanza and Mbeya.

10.2.6 Small Scale Industries

Small Scale Industries attribute to noise pollution, wastewater and solid wastes. These small-scale industries including the welding industries which have been generating noise pollution and are present all over the country. The oil processing industries such as palm in the Kigoma region, and sunflower in the central regions of Tanzania are potential sources of solid waste from biomass, and hydrocarbon contaminating the land water sources (Plate 10-4).



Plate 10.4: Small scale industry located on the Malagarasi river bank

10.2.7 Agricultural Activities

Unsustainable agricultural activities that involve the improper use of agrochemicals (pesticides and inorganic fertilizers) and poor farming methods, contribute to water and soil pollution as they are responsible for soil erosion and consequently sedimentation of water bodies. The improper use of agrochemicals (pesticides and inorganic fertilizers) contaminates the soil leading to the occurrence of land/soil pollution.

Agricultural involves the use of chemical pesticides resulting in the generation of waste chemical containers and the use of agrochemicals and inorganic fertilizers near watercourses has also affected the water bodies around contributing to water and soil/land pollution. Obsolete pesticide stockpiles in most cases are improperly managed including locations in the vicinity of urban or rural populations and environmentally sensitive locations including water sources, imposing risks to human and livestock health, ground and surface waters, productive land use, and broader environmental conditions. Regions which use massive of pesticides in agricultural activities are potential to land pollution including Iringa (Kilolo), Arusha, Mbeya, Morogoro and Shinyanga.

10.2.8 Transportation Activities

Transportation activities generate emissions that affected the population located near the congested roads. The emissions generated from transportation have constantly been

ignored to the role of transportation in the economic development of the country, however, it affects the environmental quality of the urban population.

10.3 Impact of pollution

10.3.1 Air Pollutants

Exposure to air pollutants leads to human health that include breathing disorders, cardiovascular diseases, cancer, health and lung diseases. Furthermore, it leads to impairment of the neurological and immune system development. Air emissions and particulate matters have the potential to affect the ecological system that including acidification for areas where pollutants are sulphides in nature. This is more experienced in major cities that contain industries where sulphides are emitted or areas where the particulate matters are of a sulphide nature.

Air pollution also leads to eutrophication of water and soil due to atmospheric deposition of the air pollutant. This can be seen in Lake Victoria, which is affected not only by effluent eutrophication but also by atmospheric depositions from industries within the lake catchment. Particulate matters in particular present throughout the country especially in the area where the soil is bare have the potential to reduce visibility and impair plant photosynthesis which in turn affects plants' growth.

10.3.2 Deterioration of water source quality

When water bodies are polluted, the quality of water in the respective sources is often compromised. The polluted water inhibits water supply to communities, thus leading to the abandonment of the source. Likewise, water pollution has been partly responsible for increasing operational costs due to the increased use of chemicals for water treatment for the removal of pollutants such as turbidity and pathogenic microorganisms.

Water contamination due to a higher load of biodegradable materials leads to low oxygen content, high turbidity, toxic algae and the release of toxic gases from the sediments such as hydrogen sulphide. These changes favour the most robust algal and animal species whilst the more sensitive ones may disappear, and the changes interfere with various beneficial uses of water leading to the death of flora and fauna.

10.3.3 Water Quality Deterioration from Nutrients

Nutrients caused by the over-application of fertilizer to agricultural activities lead to pollution of nearby water bodies and cause eutrophication, which in turn leads to the oxygen depletion and affects aquatic species that reduce the ecological services generated from water bodies. Eutrophication threatens food security, the fishing industry and people's livelihoods as well as pose a significant threat to biodiversity and ecosystem services globally. Furthermore, excess nutrient loads in the coastal area affect marine life including coral reefs which later affect ecosystem service generated including fishing and the productivity of fish stocks.

10.3.4 Exposure to heavy metals

Heavy metal pollution from waste and small-scale mining activities is a public health risk as heavy metals can become highly concentrated in soils and carried accumulate to higher trophic levels. Exposure to high toxic levels of heavy metals such as mercury, lead and arsenic has persistent toxicity because they do not break down in the environment. They settle to the bottom and persist in the stream for long periods of time, providing a long-term source of contamination to the aquatic insects that live there, and the fish that feed on them and are finally carried into the food chain. Furthermore, the impact of exposure to heavy metals such as arsenic, cadmium, chromium, copper, lead, mercury, nickel, uranium, thorium and zinc in human health includes cases of diseases such as peripheral vascular diseases, restlessness, anxiety, numbness in the hands and feet, various types of cancer, haemolysis, kidney stones, liver damage, various systems disorders, DNA damage, haemolytic anaemia, nausea, loss of IQ, Low sperm count, loss of hearing, asthma, tremor and may cause death.

10.3.5 Marine Plastic Litter

Marine litter can cause physical harm to marine life in various ways. This include: fish trapping through abonded nets commonly known as “ghost fishing”, entanglement, and ingestion. Also, marine litter can act as a carrier for toxic substances, and transport invasive species across the ocean.

10.3.6 Chemical Pesticides

Chemical pesticides including persistent organic pollutants (POPs) can pose serious long-term threats to human health and the environment because of their mobility, toxicity, bioaccumulation potential, and persistence. Chemical pesticide contamination of soil and water bodies exposed populations to POPs via surface water runoff, groundwater leaching, food crop uptake, and domestic animal exposure.

10.4 Interventions for Pollution Management

10.4.1 Goal

Reduce pollution to enhance public health and the environment

10.4.2 Expected results

Air, water and soil pollution are reduced to acceptable levels that are no longer considered harmful to health and the environment. Maintained toxic-free environment should for the integrity of the ecosystems and sustainable development of inter and intra-generations.

10.4.3 Priority areas

The priority areas include point sources, urban areas and sensitive environmental areas.

10.4.4 Interventions and targets

- i. Reduce health and environmental impacts arising from poor air quality in urban areas.**
 - a. Develop and implement monitoring mechanism of air quality parameters related to health and environmental pollution in at least 90% of major cities of

Arusha, Mwanza, Dar es Salaam, Mbeya, and Tanga to facilitate proactive and responsible environmental management by 2027;

- b. Develop a database on air quality information accessible to 75% of the public through the Air Quality Health Index (AQHI) for major cities by 2027; and
- c. Control air quality in at least 90% of urban communities for public health and environmental wellbeing by 2027.

ii. Reduce the health impact arising from noise exposures in urban areas

- a. Enforce legislation to ensure at least 75% of noise sources in entertainment and worship areas adopt noise-reduction infrastructure, technology, and architecture to reduce the impacts of noise pollution on humans and the ecosystem by 2027;
- b. Develop and implement information sharing system to ensure at least 50% of urban communities are participating in noise pollution management and monitoring by 2027; and
- c. Develop a plan to ensure at least 90% of noise complaints and incidents are resolved through a coordinated noise response, enforcement and information-sharing network by 2027.

iii. Enhancement and promotion of the environmentally sound management of plastic wastes to achieve the prevention and minimization of the generation of plastic wastes and the associated impacts on Land, Indian ocean, Lakes and Rivers

- a. Develop and implement plan to reduce at least 50% of plastic litter and microplastics released into the water bodies in Dar es Salaam, Mtwara, Pwani, Lindi, Tanga, Mwanza, Kigoma, Mara, Kagera, Rukwa, Ruvuma, na Mbeya by 2032;
- b. Capacitate LGAs and institutional to facilitate to control marine plastic pollution in 75% of coastal areas By 2032;
- c. Develop and implement a plan to engage and mobilise business actors to support effective management and reduction of plastic pollution in urban areas by 2027; and
- d. Develop and implement plan of transboundary cooperation to address plastics pollution in Indian ocean, Lakes, and Rivers by 2027.

iv. Enhance capacity of institution for pollution management and control

- a. Build capacity for institutions in planning, implementation, monitoring, and evaluation of health risk related to environmental pollution by 2032;

- b. Build capacity of at least 50% of the Village/Mtaa and ward level environmental committees to manage pollution issues in respective areas by 2032;
 - c. Enhance capacity to develop and implement plans for controlling pollution in at least 50% of Village/Mtaa and ward level environmental committee to manage pollution issues in respective areas by 2032;
 - d. Build capacity to small and medium scale enterprises on adoption of cleaner production interventions by 2032; and
 - e. Build capacity to institutions in implementation of Multilateral and Regional Agreements related to chemicals and waste management by 2032.
- v. **Develop pollution management intervention targeting control of pollution in mining activities**
- a. Rehabilitate abandoned ASM in at least 50% mine sites of by 2032; and
 - b. Introduce and adopt at least 2-mercury alternative technologies in small-scale mining areas by 2032.
- vi. **Development and piloting of a sustainable system to identify, collect and dispose of obsolete pesticides and associated chemical waste.**
- a. Develop and implement program to control at least 30% of nutrients in water bodies from agricultural nonpoint source by 2032;
 - b. Conduct inventory of hazardous chemical waste, containers and obsolete pesticides in 70% of the country by 2027; and
 - c. Assess and clean up at least 90% of the chemical contamination sites such as Vikuge kibaha, tengeru Arusha, NHC Morogoro by 2032.



WASTE MANAGEMENT



11 WASTE MANAGEMENT

11.1 Solid Waste Management

Solid Waste Management (SWM) is among the most serious environmental and public health issues confronting most of the urban areas in the country. Rapid urbanization, economic growth and changes in lifestyles and consumption patterns have resulted in a remarkable increase of waste volume and diversity mostly in cities, municipalities and town councils. While generation has been on the rise, collection and disposal practices continue to be a problem.

11.1.1 Solid waste generation

The country generates nearly 7 million tons of solid waste annually. The quantity of waste generation is more severe in urban authorities compared to district councils which are predominantly rural. For example, cities which make only 3.2% of the total Local Government Authorities, they are accounting for 15.3% of the total generated waste; Municipalities which account for 10.86% of the total Local Government Authorities account for 30.9% of the generated waste; and Town councils which makes 11.4% of the local Government authorities account for 10.0% of the total generated waste (Table 11-1).

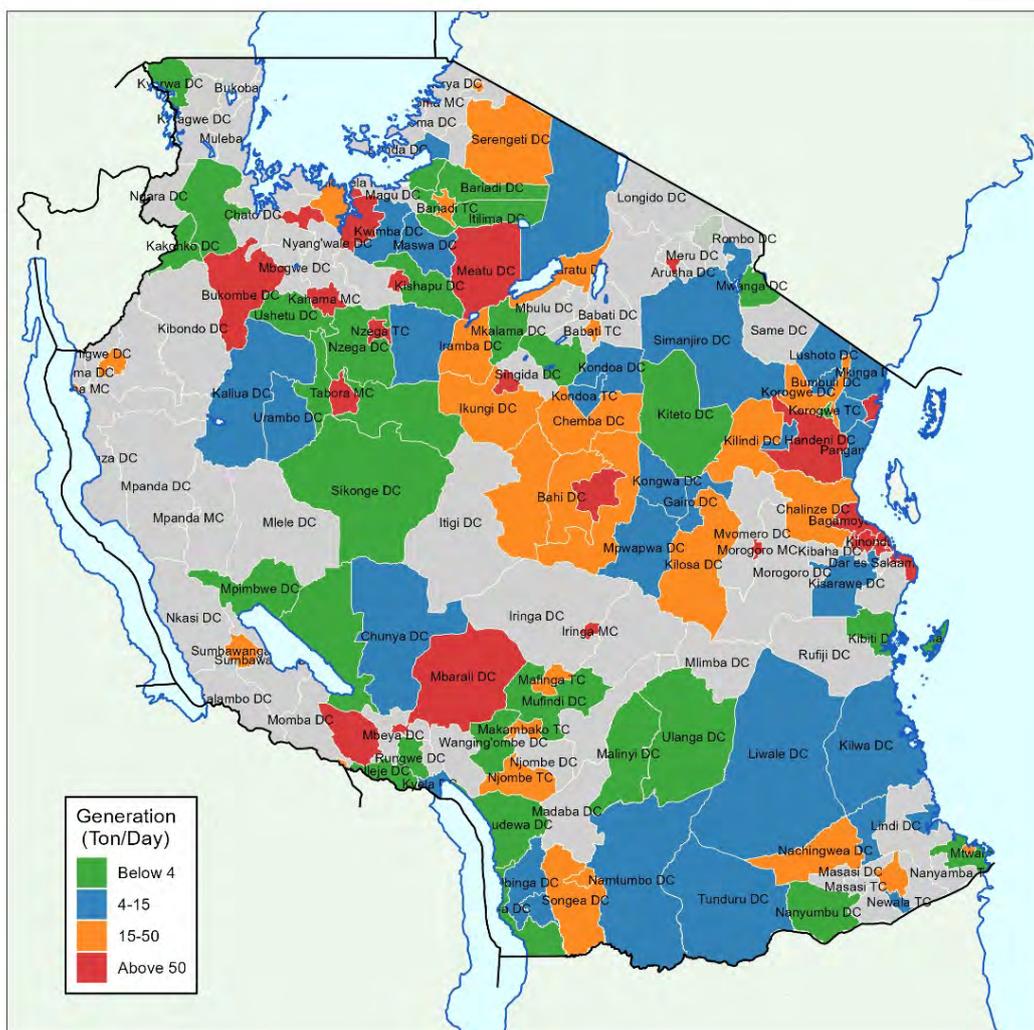


Figure 11-1: Spatial distribution of solid waste generation in Tanzania

However, district councils which makes 74.4% of the local Government authorities in the country account for only 43.7% of the total generated waste. Dar es Salaam city account for nearly 26.67% of the generated waste in the country. Figure 11-1 shows spatial distribution of disposal practices in the country.

Table 11-1: Summary of waste generation

| LGA set up | Annual generated waste in tons | Percentage of total generation |
|-------------------------|--------------------------------|--------------------------------|
| Cities (6) | 1,013,349 | 15.3 |
| Municipalities (20) | 2,043,698 | 30.9 |
| Town councils (21) | 663,124 | 10.0 |
| District Councils (137) | 2,892,453 | 43.7 |
| Total | 6,612,626 | |

11.1.2 Solid waste collection

Despite generating nearly 7 million tons annually, it is only 32.72% of the generated waste is collected countrywide. Cities are leading with highest collection rate while district councils exhibiting less collection rate as shown in Figure 11-2.

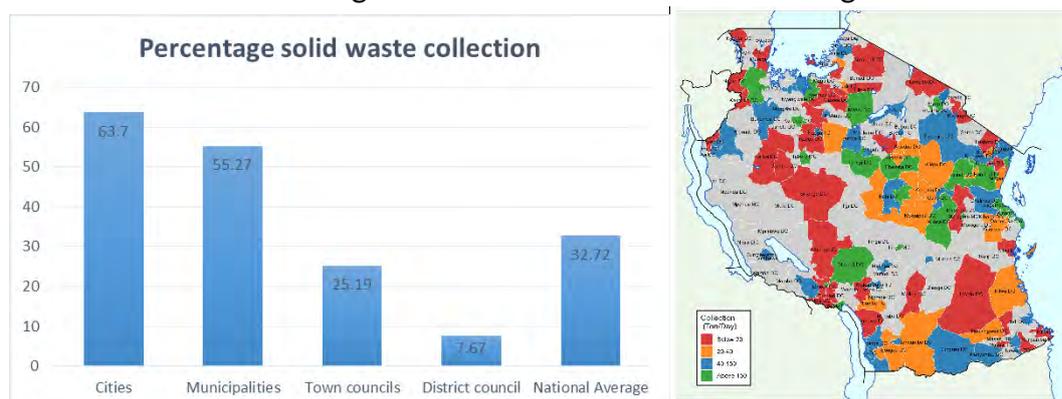


Figure 11-2: Percentage of solid waste collection by administrative set up (left) and Spatial distribution of collection (Right)

11.1.3 Solid waste disposal

Waste disposal is a challenge in both rural and urban areas in the country. Assessment conducted in all LGAs in 2022 indicates that, more than 90% of the generated waste is not properly disposed. Current waste disposal practices include controlled, uncontrolled and illegal dumping as shown in (Figure 11-3) which contribute to poor waste disposal practices. District councils and town councils are leading with poor waste disposal practice in the country whereas, nearly 100% of the generated waste is disposed improperly (Figure 11-5). On the contrary, Cities are leading with proper disposal practice whereby, 83% of the cities use sanitary landfill as their waste disposal option. Although Dar es Salaam city accounts for nearly 30% of the generated waste in the country, the city uses controlled dumping plate 11-1.

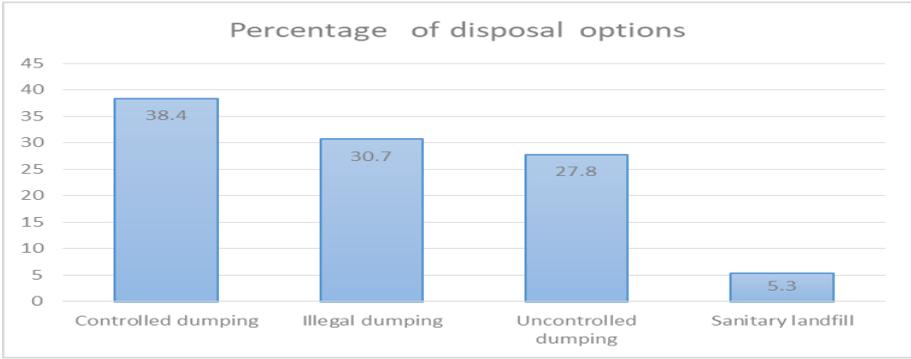


Figure 11 -3: Percentage distribution of disposal option practices



Plate 11-1: Controlled Pugu Kinyamwezi dump site in Dar es Salam city (left) Illegal dumping practice in in Dar es Salaam City (Right)

For the case of municipalities, the disposal practice is more diverse whereas, controlled dumping, uncontrolled dumping, sanitary landfill and illegal disposal account for 50%, 25%, 20% and 5% respectively as shown in Figure 11-4. Nationally, the spatial distribution of the solid waste disposal option is as indicated in Figure 11.6.

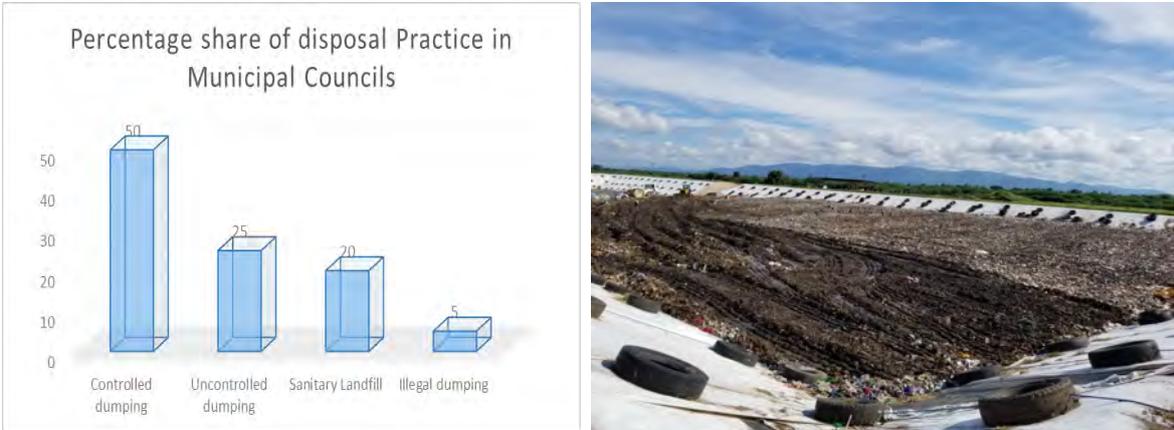


Figure 11-4: Distribution of disposal practice in Municipalities , Plate 11-1: Sanitary landfill in Moshi Municipality (Right)



Figure 11 5: Percentage distribution of disposal practice in Town councils (Left), Percentage distribution of disposal practice in District Councils (Right)

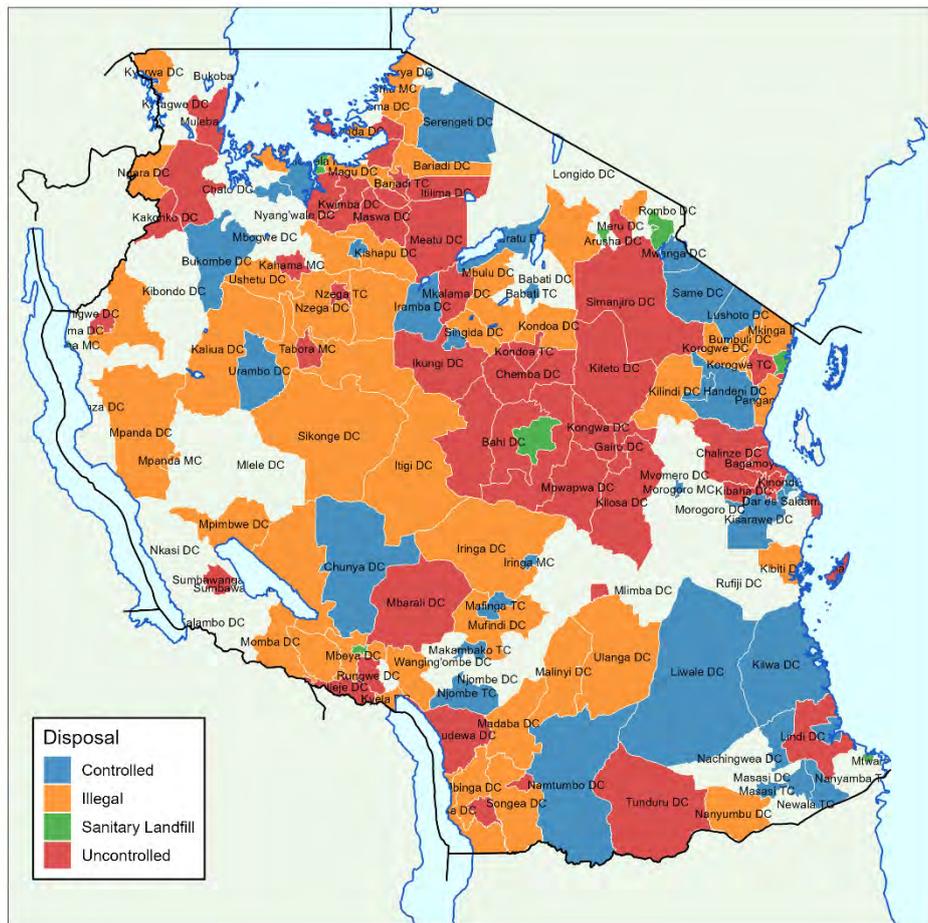


Figure 11 6: Spatial distribution of solid waste disposal practice in the country

11.2 Causes of improper solid waste management

The improper solid waste practice has been associated with several factors including: inadequate solid waste minimization initiatives; inadequate financing; ineffective collection of waste collection charges; delays in payment of the collected waste charges to service providers; inadequate contract duration period; and Sharing of waste collection charges.

11.2.1 Inadequate solid waste minimization initiatives

One of the most effective approach in waste minimization is the waste Reduce, Reuse, and Recycling (3Rs) Practices. However, nearly all LGAs in the country lack 3Rs initiatives which consequently increases the waste management cost by increasing the amount of waste to be transported to the disposal sites. It is only, Arusha and Mbeya cities, as well as Moshi, Kinondoni and Iringa Municipalities where there are few cases of waste Reduce, Reuse and Recycling initiatives. Arusha and Mbeya cities and Kinondoni and Moshi municipalities have established composting plants to reduce the amount of organic waste to be sent to disposal sites.



Plate 11-2: Unsorting solid waste practices Ubungu (Left) and Kinondoni (Right) Municipalities

11.2.2 Inadequate Contract Management

There has been inadequate contract management in the management of solid waste in LGAs. This include; delays in the compensation of service providers, inadequate contract duration and sharing of waste collection charges. For example, in the compensation of service providers, there has been payment delays where majority of the LGAs take at least 30 days to pay a service provider as shown in Figure 11-7. The delays have been affecting the effectiveness and efficiency of the service providers and consequently, contributed to inadequate waste management services.



Figure 11 7: Disbursement time in days for the service providers from collected waste charges

For the case of contract duration, the range has been less than 6 months to 3 years as shown in figure 11.8 and 11.9 . Inadequate contract duration affects the investment

capacity of the service providers and consequently, impair the quality of waste management services.

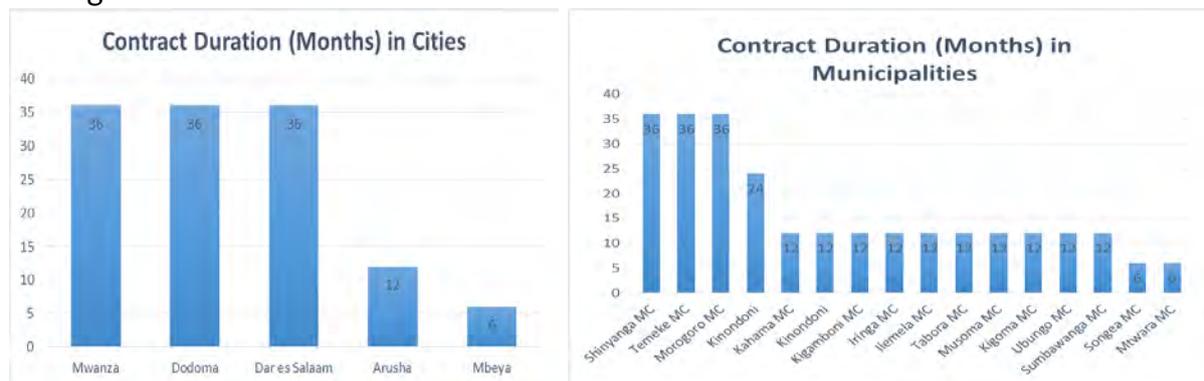


Figure 11-8: Service providers' Contract duration in cities (Left), Service providers' Contract duration in Municipalities (Right)

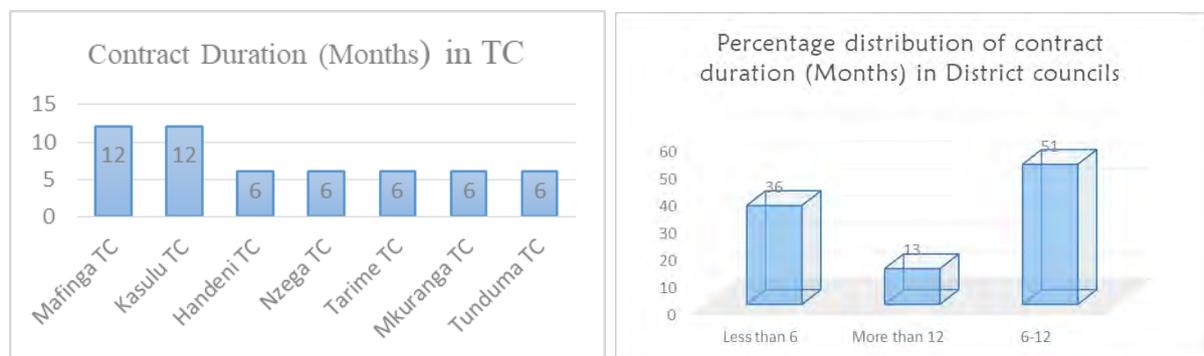


Figure 11-9: Service providers' contract duration in Town councils (Left), Service providers' contract duration in district councils (Right)

For the case of sharing the collected waste collection charges, service providers have been receiving a share in the range of 50-100% as shown in Figure 11-10. However, effective service provision requires adequate share to the service providers for effective and efficient service provision.

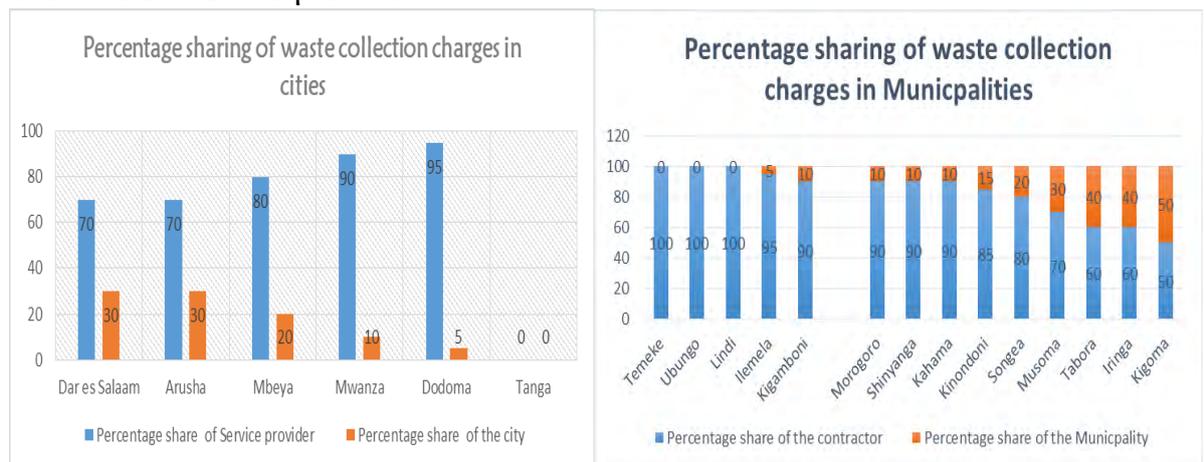


Figure 11-10: Sharing percentages of Waste Collection Charges by Cities (Left), Sharing Percentage of Waste Collection charges by Municipalities (Right)

11.2.3 Inadequate Financing

Effective management of 1 tonne of solid waste in developing countries requires at least Tshs. 80,000. However, inadequate resources in LGAs has been affecting solid waste management financing. Consequently, effective collection of waste charges become the most viable waste management financing option. There has been ineffective collection of waste charges which is attributed to ineffective customer registrations which denies LGAs reliable customer database; ineffective billing system which affects timely payment for service recipients and inconvenient payment systems which affect customers' willingness to pay.

11.3 Impacts of inadequate solid waste management

Improper waste disposal practice through controlled, uncontrolled and illegal dumping account for over 90% of disposal practice to all local Government authorities in the country. However, such practices causes significant economic, social and environmental impacts including blockage of drainage systems and hence aggravates floods incidents and leakage of waste into the environment which resulted into land, air and water pollution with subsequent impact to human health.

11.3.2 Emission of poisonous chemicals

Inadequate waste management lead to waste open burning practice which causes significant air pollution that impacts human health through emission of extremely poisonous “dioxins” and “furans”. The “furans” and “dioxins” are unintended Persistent Organic pollutants (uPOPs) with some peculiar characteristics such as ability to remain in the environment for a long time, ability to travel long distances through air and water, bioaccumulation in the fatty tissue of animals and hence potential for causing cancer.



Plate 11- 3: Open burning practice with potential health impact in Kigamboni Municipality (Left), Bagamoyo District council (Right)

11.3.3 Health impact

In urban authorities especially cities and municipalities, the indiscriminate dumping of waste creates risks of diseases. Research has shown a correlation between proximity to

open dumpsites and incidence of disease, including increased risk of cholera, malaria, typhoid fever, dengue fever and Zika

Also, exposure to chemicals such “Furans” and dioxins from open waste burning practice can be associated with a wide range of adverse health effects including endocrine disruption, reproductive and immune dysfunction, neurobehavioral disorders, cancer, organ damage and death.

Further, smoke from open waste burning can cause other adverse health effects such as respiratory irritation of the airways, coughing or difficulty breathing, decreased lung function and aggravated chronic bronchitis.

11.3.4 Occurrence of flooding incidences

Indiscriminate disposal of generated waste cause waste to be transported by flood waters downstream, where it gets trapped in bridge and culvert openings. This waste accumulates together with sediments, leading to reduced flow capacity and flooding upstream of the roads and bridges and other manmade infrastructure barriers. Consequently, it causes severe floods and economic loss including destruction of infrastructure as shown in plate 11-4.



Plate 11-4: waste trapped in bridges and flooding impact at Jangwani area in Dar es Salaam City Source: World Bank (2022)

11.3.4 Deterioration of beaches quality

Improper waste management has also been associated with littering at water bodies and thus, contributing to the death of aquatic organisms and deterioration of beach qualities as shown in Plate 11-5.



Plate 11-5: Improper solid waste disposal practices in ocean in Dar es Salaam City (Left), Death of marine species from improper solid waste disposal practice in the ocean (Right)

11.4 Liquid Waste Management

Liquid waste is the end water form material produced from household level or industrial level or health center and disposed of, sometimes are called unwanted water for use for the domestic purposes. Depending on the source of generation the generated waste water can be categorized into sanitary sewage, industrial liquid waste, storm sewage and mixed sewage.

Sanitary sewage, is the liquid waste produced from homes that containing human wastes and wash water. This is mostly generated from homes, public buildings or commercial and industrial site. Sometimes is referred as domestic waste water meant waste from kitchen, barn, bathroom, laundry, and others that do not contain human sewage; **Industrial liquid waste**, this is category of liquid waste generated from the industrial activities during manufacturing of different products depending on the nature of production and nature of industry. This liquid waste from industry is always contained various chemical compound which are mostly harmful to human being.

Storm Sewage, this is a surface run off caused by rainfall, it carries organics, suspended and dissolved solids, and other substances picked up as it travels over the ground. This is usually depends on rainfall season and the liquid waste generated during rainfall can be harmful if the surroundings are not clean but when the surroundings are clean it's usually contains normal waste that cannot be a problem to the peoples' environment and **Mixed Sewage**, which is the result of all classifications of liquid waste when get combined or mixed up over the surface and it becomes most dangerous compared to other classifications of liquid waste.

Therefore, management of wastewater is crucial in protecting public health by preventing diseases as well as environmental pollution from sewage contaminants. However, a large volume of untreated wastewater has been dumped directly into the water streams threatening human health and ecosystem biodiversity resources.

11.4.1 Sewage management

The amount of sewage collected and transported to treatment plants in the country is still very low. In average, less than 30 percent of the generated sewage were collected and transported by truck and sewer networks in the country. Table 11-2 shows estimates of the generated and collected sewage annually in some selected Local Government Authorities those who are not connected to sewer network (off-site) and those relying on on-site services.

Table 11-2 Proportion of the amount of sewage generated and collected in selected urban areas for 2016/17

| Name of the Urban Area | Sewerage generated | Percentage collected |
|------------------------|--------------------|----------------------|
| Mwanza City | 23,600 | 29 |
| Tanga City | 8,180 | 9 |
| Mbeya City | 430 | 3 |
| Dodoma Municipality | 11,290 | 7 |
| Dar es Salaam City | 98,960 | 5 |
| Songea Municipality | 2,340 | 23 |
| Kigoma Municipality | 2,050 | 0.1 |
| Mbinga Town council | 400 | 0.03 |
| Sengerema Town council | 400 | 0.04 |
| Kasulu Town council | 480 | 0.03 |

Source: Data extracted from Annual Report 2012 - 2017 from Urban Water and Sanitation Authorities and EWURA (2018)



Plate 11-6: Waste water discharged at waste stabilization ponds in Dodoma and Dar es Salaam Cities

11.4.2 Industrial sewage management

In Tanzania, most industries fall in the category of small and medium scale. These include textiles, metals, pharmaceuticals, mining, tanneries, printing, painting, automobiles, breweries, food industries, construction industry (such as cement), paper industry and small scale industries e.g. milling, small garage, carpentry, metal works, jewellery and masonry. Most industries are located in urban areas and in large towns mainly in Dar es Salaam, Arusha, Morogoro, Moshi and Mwanza. However, many of these were established without ample environmental consideration, and as a result they have been working without liquid waste pre-treatment facilities. Most of industries have put in place liquid waste disposal facilities although are inappropriate and ineffective. Some industries have been reported to pollute water bodies including rivers Msimbazi, Kizinga and Mzinga in Dar es Salaam; Thembi in Arusha; Ngerengere in Morogoro; Karanga in Kilimanjaro; Mirongo and Lake Victoria in Mwanza.

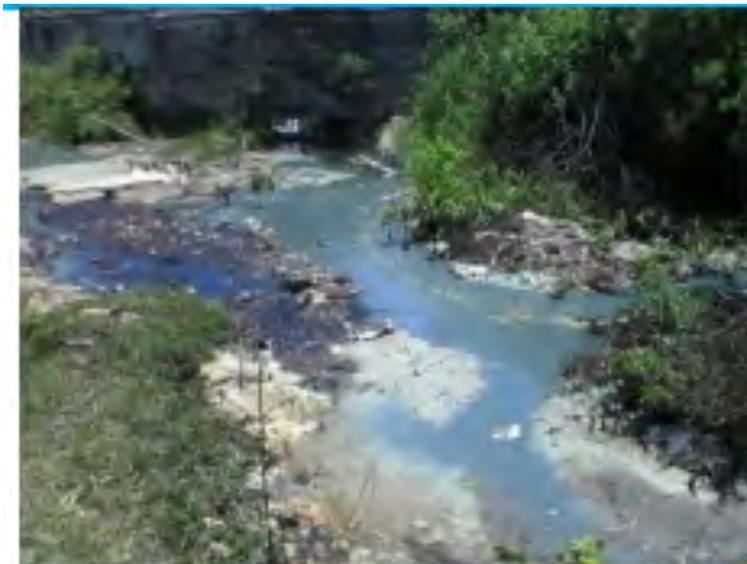


Plate 11 7: Untreated Industrial waste water flowing into the River in Mikocheni area Dar es salaam City

11.4.3 Sewer network coverage

According to the Waste Management Investment Guide (2020), only 10 out of more than 100 urban centres, in the country have sewerage systems which serve less than 20% of the total urban population. The access to the sewerage services by population residing in urban settlements continues to be low without significant improvement over the time. Only 7.5% of the population living in urban areas connected to the sewer network. More than 70 percent could not access the sewer networks in their respective urban centres as shown in Figure 11-13.

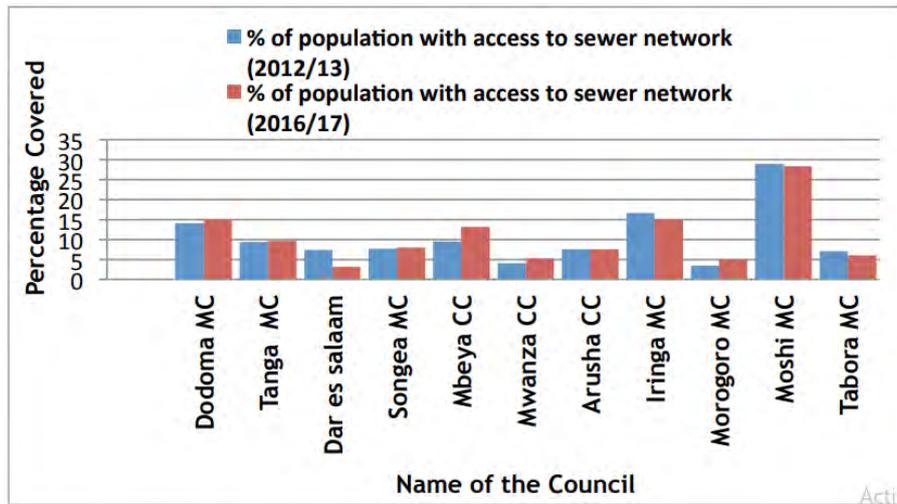


Figure 11-11: Percentage of population in urban areas served with Sewer Network for the period from 2012 to 2016/17 Source: CAG Performance Audit Report (2018)

Also, many of the existing sewerage systems are old and broken-down, and require further upgrading, repair or replacement to effectively continue to provide the intended function. Consequently, about 93 percent of municipal residents in the country rely on pit latrines of various types.



Plate 11-8: Latrines condition in informal settlements in Dar es Salaam city

11.4.4 Sanitary sewage management

This is the liquid waste produced from homes that containing human wastes and wash water. This is mostly generated from homes, public buildings or commercial and industrial site. Sometimes is referred as domestic waste water meant waste from kitchen, barn, bathroom, laundry, and others that do not contain human sewage. Most of the households in the country especially in informal settlements where there is inadequate waste water infrastructure households are directly discharging liquid waste into the environment through drainage line, from overflowing, seeping pit, latrines, septic tanks, public toilets, open ground excreta defecation and gray water from kitchens and bathrooms that connect to rivers and open spaces without any treatment. Plate 11-11 shows waste water flow from households in informal settlement in Dar es Salaam.



Plate 11-9: Sewage discharge in informal settlements

11.4.5 Sewage treatment

Wastewater treatment and management is the overall process that involves the improvement of the quality of wastewater between points of production and points of discharge. This process is aimed at improving the physical, biological and chemical properties of wastewater to eliminate both the known and emerging contaminants from the wastewater eventually available for release into the environment.

Most of the existing centralized sewerage system utilize Waste Stabilization Ponds (WSP) as wastewater treatment option. For example, some areas of Dar es Salaam have waste stabilisation ponds to treat sewage from 2000 - 6000 people. However majority are not functioning well and had become stagnant sites for mosquito breeding. Most of the existing waste stabilization ponds are not designed correctly for the specific conditions, not properly maintained, lack of sludge removal, lack maintenance and lack of trained operators.

Additionally, in some cities including Tanga there is a sea outfall for discharging untreated municipal wastewater. The case is the same in Dar es Salaam where there is minimal treatment of sewage with direct discharge via short ocean outfall into the Indian Ocean. The city is also experiencing large discharges of sewage into the Msimbazi River with coliform bacterial counts once it reaches the Indian Ocean of $2.5 - 4.0 \times 10^5$ cfu/100 mL. Also, many of the smaller urban settlements in the country have inadequate or no sewage treatment. The practice in the country has been for the treated and untreated wastewater to be discharged into water bodies while storm water remains untreated at all.



Plate 11-10: Water stabilization ponds in Dar es Salaam Source: Wawa (2020).

11.5 Underlying Causes of Inadequate Liquid Waste Management

Liquid waste management is increasingly becoming among the socio-economic and environmental challenges in the country. This is a result of rapid growth of population; urbanization; rural development; growing population; climate change; agriculture and increased demand from industry and limited resources to cater for the growing volume and pollutants of liquid waste. Inadequate financing, inadequate capacity and perception on the expensiveness of the sewer connection services.

11.5.1 Inadequate financing

Effective liquid waste management requires adequate financing. However, inadequate resources in actors responsible for management of liquid waste have led to inadequate financing of liquid waste management services. Consequently, there has been limited expansion of sewer infrastructure and thus, only less than 20% of the population are connected to the central sewer services.

11.5.2 Perception of high cost of sewer connection

The performance audit report of the Control and Auditor General (2018) has highlighted that most domestic users prefer to use on-site sanitation like septic tanks, Ventilated Improved Pit (VIP) latrines as opposed to connecting to sewer system which is considered expensive by the majority of customers. Consequently, over 56% of the population with access to sewer connection in Dodoma, Mbeya, Mwanza, Songea and Tanga have not been connected as shown in Table 11-3.

Table 11-3 Percentage of population with Access to Sewer Against the population connected to Sewer Network for the period from 2012/13 up to 2016/17

| Urban Authority | Population with access to sewer services | Population connected to Sewer services | % of Population not connected to sewer services |
|-----------------|--|--|---|
| Dodoma City | 42,000 | 27,350 | 35 |
| Mbeya City | 15,142 | 2,166 | 86 |
| Mwanza City | 337,384 | 196,000 | 42 |
| Songea City | 25,200 | 16,344 | 35 |
| Tanga City | 34,545 | 12,737 | 63 |
| Total | 454,271 | 254,591 | 56 |

Source: CAG, Performance Audit Report, (2018)

11.5.3 Inadequate capacity

Effective management of the liquid waste requires enough capacity for both Urban, Water and Sanitation authorities and Local Government authorities. This include human resources, technical expertise, equipment and appropriate technologies. However, there are inadequate staffs with required expertise in both local Government authorities and Urban, Water and Sanitation authorities in the country; limited expertise in the management of the existing dilapidated liquid waste management infrastructure, and limited adoption of the proper technology in the management of liquid waste. Consequently, there has been continues pollution especially, in water bodies.

11.5.4 Unavailability of faecal sludge treatment facilities within short distances from the points of generation

The distance to the faecal sludge treatment facilities in many urban areas is quite far from point of generation. The faecal sludge treatment facilities are located on average 10- 30 kilometers from the points of generation. For example in Dar es Salaam, ponds are located in Vingunguti, which is approximately 30 kilometers away from collection point at Tegeta and Kimara. The situation prompted improper disposal of the generated liquid waste.

11.5.5 Dilapidation of the existing sewer networks

Most of the existing sewer network in the country have been constructed since colonial period. For example, the public sewerage system in Dar es Salaam was constructed between 1948 and 1950. The Mikocheni sewer system is the only one that was constructed after the independence in 1976. The Mikocheni public sewer is also dilapidated due to poor construction. Generally the public sewer in Dar es Salaam is more than 48 years old. These sewers provide services to less than 5% of the Dar es Salaam residents.

11.5.6 Inadequate faecal sludge emptying trucks

Over 90% of the LGAs in the country have no faecal sludge emptying trucks. The service is commonly offered by private sector especially in urban areas. Consequently, the price

of the emptying service has been so high which force residents to resort in improper management including channeling waste water into storm water drains and water bodies.

11.5.7 High level of informal settlement

As discussed in other chapters, nationally the level of informal development in the country has reached over 65% whereas, some cities like Tanga, Arusha, and Mbeya cities the level of informal development is over 70%. The Informal settlements development affect the ease of extending sewer network to those areas and in some cases the emptying trucks cannot easily access areas requiring the emptying services. Consequently, only 30% of households with on-site sanitation facilities empty their facility through contractors or cess pit-emptier. Many households simply shift the facility to another place as long as space is available. Often people refrain from using emptying services, because of the high cost for those services.

11.5.8 Inadequate compliance to the effluence standards

Reviews of the EWURA Regional Water Annual Performance Reports for the period from 2012/13 to 2016/17 in the performance audit report of Control and Auditor General (2018) revealed that the effluent discharged to the environment in Mbeya, Mwanza, Dar es Salaam, Songea, Tanga and Dodoma Urban Water and Sanitation Authorities did not meet the national effluent quality standards set by Tanzania Bureau of Standards (TZS 789:2008). The downstream water in those areas found to have high levels of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and pH. This is an indicator that the effluents discharged from most Urban Water and Sanitation Authorities pollute the environment.

11.6 Impact of Inadequate waste management

11.6.1 Economic loss

In Tanzania it has been estimated that inadequate sanitation costs 301 billion Tanzanian Shillings (TZS) each year (US\$ 206 million). This is equivalent to 1 % of Tanzanian gross domestic product (GDP) and US\$ 5 per person (ibid). The economic losses are directly related to loss of time for people having to find places to defecate, premature death, productivity losses whilst sick and money spent on health care.

11.6.2 Spread of diseases

The poor liquid waste management practice has led to the health degradation, particularly among low income residents living in unplanned settlements. Some studies have linked lack of access to improved sanitation in informal settlements with a higher instances of cholera. In Dar es Salaam city, there has been frequency occurrences of cholera in informal settlements which could also be linked with inadequate hygiene. Inadequate waste water management and sanitation has also caused prevalence of diarrhoea cases in the country. According to the World Health Organisation, about 9 %

of all mortality in children under five years and 6 % mortality in adult population are linked to diarrhoea.

A study on 278 households in the Kilombero valley have revealed that instances of diarrhoea in children under 5 years were significantly reduced when hands were washed before cooking, if the children were washed regularly and if the opening to the pit latrine was covered. Pit latrines have also been identified as a breeding ground for malaria and filariasis carrying mosquitoes. Some studies found that if larvaeide and polystyrene beads were used to cover the surface of the pit latrines then the density of mosquitoes dropped by 98% in households and the detection of microfilarias in peoples blood reduced from 49% to 10%.

11.6.3 Degrading the soil quality

Liquid waste affected the soil quality for farming. Soil pollution results in a disturbance in the balance of flora and fauna inhabiting in the soil, decrease in soil fertility and hence decreases in the soil yield. Normally crops cannot grow and do well in a polluted land, although some crops manage to grow, then these crops might have absorbed and bio-accumulated the toxic chemicals in the soil and might cause serious problems to primary consumers.

Topsoil is an important part of the land, when liquid waste from the textile industry flow on it, it increases soil pH as well as the salt contents left after the water has evaporated. Consequently, affect growth of plants as plants may wilt due to increase in salt concentration. Also the soil loses some of its nutrients that are needed by plants. This is because the toxicity of industrial liquid waste limits the ability of decomposers to break down waste in soil and thus, reduce the productivity of land quality.

11.7 Hazardous Waste Mngement

Environmental Management act (EMA Cap 191) define "hazardous waste" as any solid, liquid, gaseous or sludge waste which by reason of its chemical reactivity, environmental or human hazardousness, its infectiousness, toxicity, explosiveness and corrosiveness is harmful to human health, life or environment. Based on that, the hazard waste in the country includes e-waste, scrap metal, obsolete pesticide containers, used oil, used batteries etc. However, unlike municipal solid waste, management of hazardous is under the custodian of Vice President Office-Division of Environment and National Environmental Management Council (NEMC).

11.7.1 Status

The country is estimated to generate annually 25,000 Metric tons of e-waste, 25 million Litres of used oil and 10,000 Metric tons of used lead acid batteries and 150,000 Metric tons of Plastic waste. The quantity of other types of hazardous waste generated have not yet established. However, scrap metal is the mostly managed hazardous waste type in the country.



Plate 11-11: Private sector involvement in Scrap metal collection

Additionally, for the period of 2019 to March 2022 a total of 7,820 tons of scrap Metal have been collected in the country as shown in Figure 11-12.

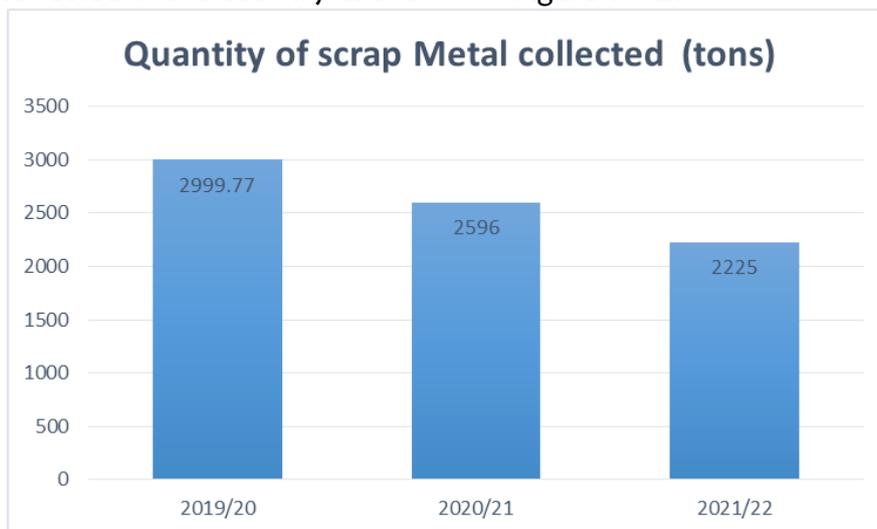


Figure 11-12 : Scrap metal collected from 2019/20-2021/22

Due to its market value, scrap metal has also attracted the involvement of private sector. It accounted for 59% of the issued hazardous waste management permits for the period of 2019-2022 as shown in Figure 11-13.

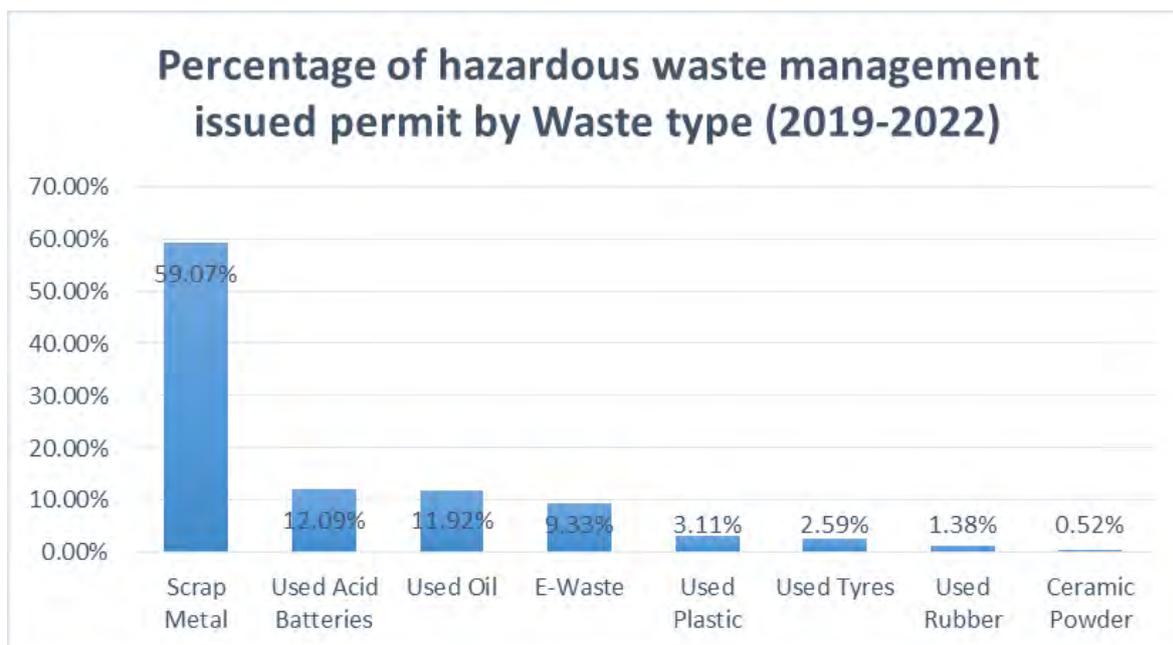


Figure 11-13: Percentage Distribution of hazardous waste permits

E-waste despite being among the great hazardous waste generated in the country it is inadequately managed. Only 9.33% of the issued waste management permit for the period of 2019-2022 comprises of e-waste management permits. Consequently, only 1-3% the generated e-waste is recycled as shown in the Table 11-4.

Table 11-4 :Hazardous waste recycling rate in Tanzania

| Waste type | Plastic (HDEP and PET) | E-waste | Used oil | Used Batteries | Lead Acid |
|----------------|------------------------|---------|----------|----------------|-----------|
| Recycling rate | 20-30% | 1-3% | 2-5% | 20-30% | |

Source: URT (2020)

Inadequate hazardous waste management has been associated with several factors including; inadequate recycling and disposal facilities, inadequate hazardous waste management technologies, Inability to distinguish imported Used Electric and Electronic Equipment from E-waste, Importation of sub-standard electric and electronic equipment and Lack of standards on imported Used Electric and Electronic Equipment. Consequently, improper management of hazardous waste have contributed to several impacts including: the surface and underground water pollution especially, through heavy metal resulted from improper disposal practices; Air pollution and subsequent global warming effect resulting from emission of ozone depleting chemicals from mishandling of hazardous waste; explosion that resulted from poor management of explosive related hazardous waste such as unrinsed pesticide containers, pesticides waste, cleaning solvents, petroleum products, used oils and other inflammable waste ; and emission of persistent organic pollutants from burning of hazardous which are among the mostly known carcinogenic substances and thus, create a greater risks to human health.

11.8 Interventions

11.8.1 Goal

To enhance waste management services to ensure protection of environment and human health

11.8.2 Expected results

Minimized solid, liquid and hazardous waste generation, increase recycling, improved collection, treatment and disposal.

11.8.3 Priority areas

All urban areas with emphasis to Cities

11.8.4 Interventions and targets

- i. Enhancement of solid waste management infrastructure**
 - a. Establish Material Recovery Facilities to at least 20% of all cities, municipalities and town councils by 2032;
 - b. Construct at least 10 Sanitary landfills (one in Dar es Salaam city and 9 in 9 municipalities) with high waste generation rate by 2032;
 - c. Establish of E-waste recycling infrastructure by 2032; and
 - d. Establish of hazardous waste takeback centres in 6 cities and 20 municipalities by 2032.
- ii. Promotion and adoption of waste minimization approaches**
 - a. Develop and implement plan for public awareness and participation on source reduction and recycling initiatives to at least 50% of households in 6 cities, 50% in municipalities and 20% in town councils by 2024;
 - b. Promote implementation of Reduce, Reuse, and recycling (3Rs) approach in at least 50% of the households, industries, institutions and commercial areas in 6 cities and 20 municipalities by 2026; and
 - c. Establish at least one source reduction and reuse programs in 6 cities and 20 municipalities by 2032.
- iii. Formalization of Informal Solid waste collection service providers**
 - a. Develop and implement plan on awareness to 20% of householders and waste collectors in cities and municipalities on health and environmental impact of improper hazardous waste management by 2024.
 - b. Conduct assessment and mapping informal waste collectors in 6 cities and 20 municipalities by 2025; and

- c. Establish legal framework recognising informal waste collection service and waste picking as formal livelihoods by 2027;
- iv. **Establishment of harmonized appropriate waste management governance systems**
 - a. Conduct assessment on appropriate solid waste management governance system by 2024;
 - b. Harmonized solid waste management governance guidelines developed and implemented by 2024; and
 - c. Establishment of Pilot Solid Waste Management Authority in Dar es Salaam and Dodoma City by 2027.
- v. **Establishment of waste management information system**
 - a. To build capacity for collection, analysis and access of solid waste management data and statistics for at least 50% of LGAs by 2024;
 - b. Conduct an inventory of hazardous waste generation by 2024; and
 - c. To establish a central information waste management systems for solid and hazardous waste at NEMC by 2025.
- vi. **Enhancement of Solid Waste Management Financing**
 - a. Conduct an assessment of the existing financing and waste collection charges systems in 6 cities, 20 municipalities and 21 Town councils by 2024; and
 - b. Adopt and implement best option waste management financing systems by 2032
- vii. **Improve management of liquid waste to Prevent and control of environmental pollution**
 - a. Develop and implement plan to control at least 75% of the wastewater generated is treated in environmentally sound technologies (EST) for reuse purposes in 6 cities and 20 municipalities by 2032;
 - b. Develop and implement plan to ensure at least 50% of all cities, municipalities, and towns councils, urban wastewater management infrastructure by 2032;
 - c. Develop and implement programmes and projects to increase coverage of sewerage network by 20% in cities and municipalities by 2032;
 - d. Conduct awareness to at least 30% of households in 6 cities and 20 municipalities on health and environment impact of improper management of liquid waste by 2032; and
 - e. Construct decentralised wastewater treatment systems in 30% of informal settlements in 6 cities and 20 municipalities by 2022.

12 ENVIRONMENTAL CHALLENGES IN URBAN AND CITIES

Urban and cities environment is characterized by high population densities, high concentration of enterprises, transport infrastructures, motor vehicles and industries among others. The high densities and concentrations of businesses in cities bring a variety of advantages for meeting human needs and livelihood as a whole. However, such concentrations if not guided properly may also lead to negative impacts to human health, environment and the economy. The mentioned characteristic of urban and cities environment makes the environment to become unique that needs a different management approach as compared to other natural ecosystems. In Tanzania there are forty seven (47) Urban authorities which include six Cities (6), twenty (20) Municipalities and twenty one (21) town councils. The cities include Dar es Salaam, Tanga, Arusha, Mwanza, Dodoma, and Mbeya.

12.1 Status of Environmental Challenges in Cities and Urban areas

12.1.1 Solid waste management

Solid waste generated in cities accounts for nearly, 10 per cent of the total generated waste in the country. However, most cities do not have enough capacity to effectively collect the generated waste. Consequently, the amount of waste generated in Cities is higher than the amount of waste collected and properly disposed. The unproportionally between the waste generation and collection leads to increasing illegal waste dumping and water related impacts.



Plate 12-1: Dumped waste in Dodoma city

12.1.2 Degradation of urban forests

Urban forests provide valuable ecosystem services, such as air pollution reduction, carbon storage, oxygen production, and runoff prevention. Degradation of urban forests is an environmental challenge facing cities and urban areas in the Country. The situation is accelerated by urbanization that leads to depletion of natural vegetation in

cities such as forestry, natural Vegetation and mangroves in Tanga and Dar es salaam Cities and Kinondoni, Kigamboni, Mtwara, Lindi Municipalities. Currently, the Land uses for settlement development has elevated from 0.3% in the year 1960 to 0.6% in 2020.

Urban forests are in intense pressure due to urban land use changes and encroachments of Urban Forest. Encroachment and urban land use change is evidenced in Mbeya Range urban forestry where part of the forest has been changed to residential land uses from forestry as shown in Plate 12-2. Other urban forests which are under pressure include Pugu kazimzumbi and Pande forests in Dar Es salaam.



Plate 12-2: Clearing of part of part of Mbeya range forest for settlement (left), beacon for residential plot planted in the Mbeya range forest.

12.1.3 Urban green landscapes and recreational parks

Urban green space refers to open spaces that is accessible to the public which includes parks, community gardens, vegetated walkways that are partly or completely covered with trees, grass, shrubs, flowers or other vegetation. Green space is important in urban areas as they contribute in reduction of air pollution, provide cool environment, offsets carbon emissions in the local area, soaks up rainwater that could otherwise create flooding, creates a habitat for local wildlife, supports physical and mental health, improve beauty and environmental quality of neighborhoods. Most cities in Tanzania have inadequate green spaces and this denies the city dwellers the opportunity of having recreational area, enjoy fresh air and space for open air physical exercise. Most of the designated area for green space have been changed their use to built areas. In Dodoma for example, the coverage of Urban ecological space such as forestry and vegetation have decreased from 34,168(81.6%) Coverage in 1998 to 16,210(38.7%) in 2018. In such circumstances the coverage of bare land increased from 17.1% in 1998 to 54.6% in 2018. In the same regard built- up land increased from 572 Ha (1.4%)in 1998 to 2,793 Ha (6.7%) in 2018 as shown in Figure 12-1.

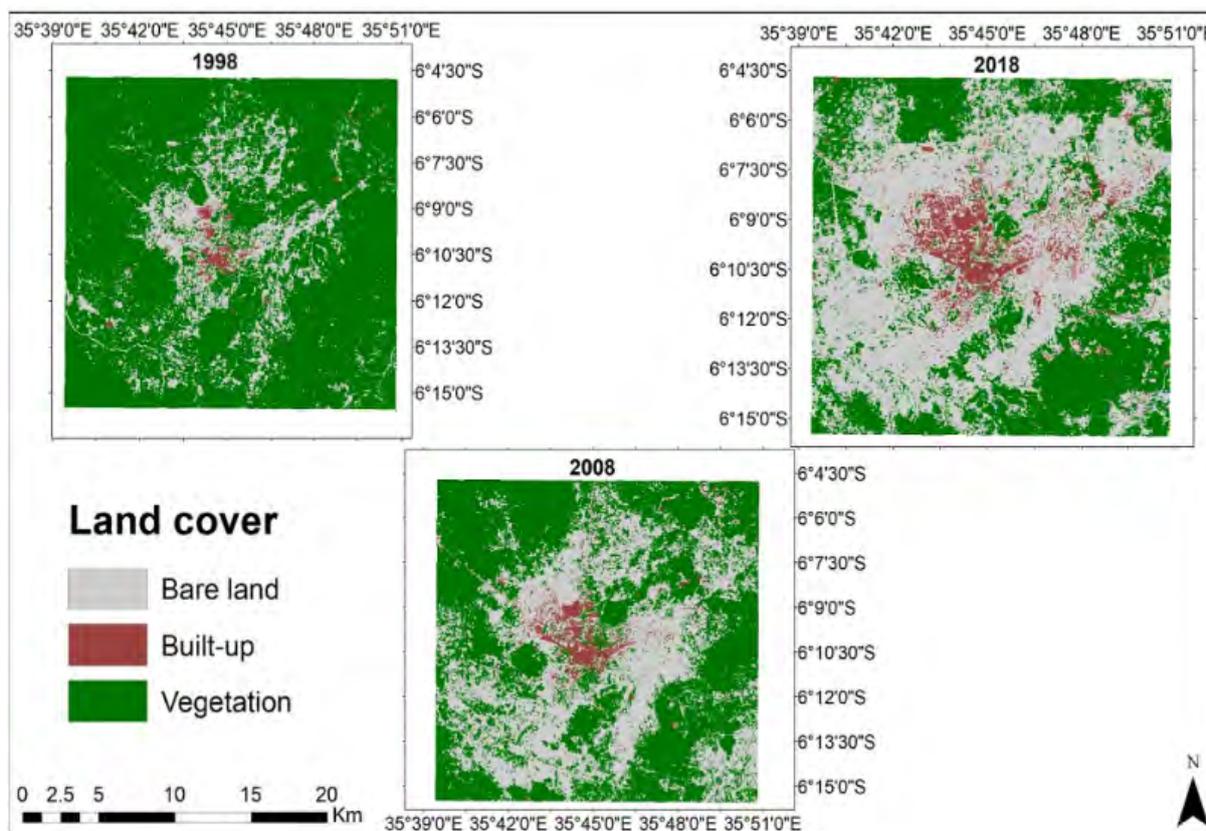


Figure 12-1: Land cover in Dodoma city.

12.1.4 Storm Water Management

Storm water management is among the challenges facing cities and municipalities in the country. Coverage of storm water drainage system in cities is approximated to 40% while Municipalities' is only 24%. However, most of the drainages are deposited with waste and sedimentation which contributed to floods during the rainy season. The situation has been evidenced in Dodoma city, Dar es salaam, Mbeya, and Mwanza. Likewise, in Lindi, Mtwara, Kigoma, Musoma have experienced sedimentation of storm water drainage.

Furthermore, inadequate storm water management is aggravated by inadequate water harvesting. Consequently, much of the rainwater ends up in the streets causing floods in various places in an urban environment.

12.1.5 Environmental Pollution

Air, water, land and noise pollution are the four major forms of environmental pollution facing cities and urban authorities in the country. Emission emanated from industrial activities and noise pollution are the main challenges which have been reported by the general public to the Council and Local Government Authorities. The challenges are evidently observed in all six (6) cities and 20 Municipalities in the country .

12.2 Underlying Causes for environmental Challenges in Cities

The major causes for the deterioration of urban ecological features are: inadequate implementation of the land use plans, inadequate capacity for solid waste management, dilapidated sewerage systems, inadequate industrial environmentally friendly technologies and, inadequate storm water drainage systems.

12.2.1 Inadequate Implementation of Land use Plan

The outward growth of all cities in Tanzania has been extended beyond their legal administrative boundaries and hence contribute to diminishing of neighboring rural villages. Under such circumstances, for instance in Dar es Salaam, the spatial development has been extended up to **40** Km from its centroid and Mwanza has been extended up to, 20 Km, Tanga, 20Km, Mbeya, 12 Km, Arusha 12 Km, and 48Km in Dodoma Cities. Consequently, this has increased the cost of infrastructure provision such as solid and liquid waste infrastructure. This has attributed to environmental pollution associated with improper disposal of both solid and liquid waste.

12.2.2 Informal settlement

Cities are among the leading administrative hierarchy with high rate of informal settlements. For example, Arusha and Tanga are leading with highest rate of informal settlements with 80% and 79% respectively. This has caused enormous environmental challenges including; inadequate garbage collection, improper storm water management, traffic congestion, and other environmental degradation problems.

12.2.3 Increasing of air pollution from transportation sector

The development pattern in cities requires commuting in longer distances. This include access to working places and service centres. In cities like Dar es Salaam some residents have to commute to a distance of over 80km round trip. Consequently, this prompted increasing of vehicles which mostly use fossil fuel with potential increase of Green House Gas emission. This is attributed by ineffective public transport system in many urban areas which encourage the use of private vehicles.

12.3 Impacts resulting from environmental Challenges in Cities

12.3.1 Occurrence of flood incidences

Inadequate, poorly managed and construction along water passages has fueled occurrence of flood incidences in cities. For example, in Dar es Salam city the floods incidence of the year 2021 has claimed the lives approximately, 15 people died; 11 severe injuries; about 2,151 households displaced, 42 houses and 21 latrines completely collapsed and 342 houses were severely damaged. Further, the floods has also lead to destruction of infrastructure including bridges which negatively impacted the economic activities. For example, the damaged caused by 2021 floods have been estimated to reach TZS 10 billion.

12.3.2 Increasing of air and noise pollution related diseases

The concentration of economic activities in cities mostly accompanied with Increasing of industries and use of vehicles. Consequently, this has accelerated the Green House

Gas from transportation sector and emission from industries. This has been attributed to the spread of air borne diseases such as headache, pressures and cardio vascular diseases. Additionally, this has also been accompanied with the increase of noise pollution in many cities.

12.3.3 Increasing water borne related diseases

Increasing population in cities increases demand for habitation. Consequently, cities residents resort to informal settlements. However, most of the informal settlements in the cities are characterized with inadequate clean and safe water supply and liquid waste infrastructure. Consequently, most of the informal settlement in cities have become prone to water borne diseases including cholera, typhoid, dysentery etc. In Dar es Salaam city most affected areas include Mburahati, Mwananyamala, Manzese, Tandale, Vingunguti and Buguruni.

12.4 Existing Initiatives for controlling environmental Challenges in Cities

The existing initiatives include: Construction of Sanitary landfills in Dodoma, Mbeya, Tanga, Mwanza and Arusha Cities, Construction of Mass transits infrastructure (Bus Rapid Transit) in Dar es Salaam city, Construction of Storm water drainage systems at Buguruni wards in Dar es salaam city, Development of Master Plans in 6 Cities and 20 Municipalities.

12.5 Intervention for addressing environmental challenges in Cities

12.5.1 Priority areas

Six (6) Cities (Dar es Salaam, Dodoma, Tanga, Mbeya, Arusha, and Mwanza) and 10 Municipalities (Temeke, Kinondoni, Kigamboni, Ilemela, Kigoma, Shinyanga, Tabora, Iringa, Musoma, and Mtwara).

12.5.2 Goal

Enhance sustainable environment and utilization for urban and cities resources to community well being

12.5.3 Expected results

Environmental resilient cities and urban centres with effective implementation of land use plans and management, waste minimization through the approach of reduce, reuse and recycling, low industrial emission, adequate storm water drainage systems and beautiful landscape including recreational parks and open spaces.

12.5.4 Interventions and targets

- i. Build capacity of cities and Municipalities to implement Urban Land Use Plans and Management**
 - a. Build capacity of least 70% of the 6 Cities and 10 municipalities to implement their Master Plans, 2027;

- b. Promote adoption of Environmental sound technologies in industrial production in 6 Cities and 10 municipalities by 2032; and
 - c. Build capacity of City councils and Municipalities to enforce Urban Planning Act, 2007 by 2032.
- ii. Enhance Management of storm water drainage**
- a. Rehabilitate existing storm water infrastructure in Dare es Salaam and Dodoma by 2032;
 - b. Construct new storm water drainage systems in three cities of Dar es salaam, Dodoma and Tanga and 5 municipalities Kinondoni, Temeke, Ubungo, Mtwara, and Kigoma by 2032; and
 - c. Promote rain water harvesting at households and institutional level in 6 Cities and 20 Municipalities by 2032.
- iii. Promote Waste Minimization in cities and urban Areas**
- a. Conduct Awareness raising programs on waste minimization through reduce, reuse and recycling the approach in 6 cities and 20 municipalities by 2032
 - b. Construct waste minimization transfer stations in 6 cities and 10 Municipalities by 2032
 - c. Develop and implement programmes to enhance involvement of Private sector, NGOs, and FBOs in waste management in 6 Cities and 20 Municipalities by 2032; and
 - d. Capacitate 6 cities and 10 Municipalities with waste management equipment by 2032
- iv. Enhance green urban landscape and beautification in 6 Cities and 20 Municipalities**
- a. Establish Botanical gardens in 6 cities and 20 Municipalities by 2032;
 - b. Strengthen implementation of tree planting program in 5 Cities and 20 Municipalities by 2032;
 - c. Promote the Implementation of walkway and walkable designing in 6 cities and 20 municipalities by 2032; and
 - d. Promote investment on green building by 2032.

12.6 DODOMA CAPITAL CITY

Dodoma Capital City lies inland very close to the centre of Dodoma Region. Geographically, the City is located south of the Equator at latitudes 6° 10' and Longitude 35° 44' east of Greenwich. The City is bordered by the Bahi District to the West, Chamwino District to the North, South, and South east. Much of the City is a plateau rising gradually from 1,200 metres above sea level and has a total land area of 2,769 square kilometres. Population is estimated to be 510,038 of whom 247, 584 are male and 262,454 female. Administratively, the City has 4 Divisions and 41 Wards.

Dodoma City is mostly semi-arid due to low and erratic rainfall. The city has a single rainy season between November/December and April/May. Generally, these rains fall in heavy storms resulting in flash floods. Total rainfall ranges from 500mm to 800mm per annum with high geographical, seasonal and annual variation.

Shifting of Government to Dodoma accelerated urbanization that has created many opportunities in various sectors of construction, industry and transportation and has stimulated and allowed upgrading of existing infrastructures including road networks, airport facilities, water supply, communication, and electricity networks. However, the opportunities for various economic activities are associated with some environmental challenges including pollution, land degradation, waste management, and deforestation.

12.6.1 Environmental challenges in Dodoma

Environmental challenges in Dodoma include land degradation; Deforestation and Forest Degradation; Inadequate Urban green landscapes and recreational parks; Invasive Species; Air Pollution (Odour and Dust/Particulate Matter) and Noise Pollution.

12.6.1.1 Land Degradation

12.6.1.1.1 Status

Land degradation is one of the major environmental challenges in Dodoma City. This challenge is more pronounced in the following wards: Mtumba, Chang'ombe, Nala, Zuzu, Nzuguni, Ntyuka, Ihumwa, Makutopora, Kikombo, Chihanga, Ipala, and Chahwa. Further, Mpunguzi, Mbabala, chigongwe, Mbalawala, HomboloMkuu, HomboloBwawani, Ngh'onghonah and Matumbulu Wards have comparatively low land degradation (Figure 12-2).

12.6.1.1.2 Causes

Major causes of land degradation include overgrazing, shifting agriculture and small-scale mining activities. The overstocking of livestock relative to the carrying capacity within peripherals of Dodoma City has led to the development of dispersed gullies in Ntyuka, Mkonze, Mpunguzi, Kikombo and Chihanga Wards.

Mbalawala, Hombolo Mkuu, Hombolo Bwawani, Ngh'onghonah and Matumbulu Wards.

12.6.1.2 Deforestation and Forest Degradation

Forests in Dodoma city play an important role in ecology of human habitats in many ways; namely: they filter air, water, and sunlight, provide shelter and recreational for people. There are also economic benefits associated with urban trees such as increased land, property, and rental value. Furthermore, greening the city helps to store and sequester carbon, increase sense of local identity, encourage outdoor activities and also help to reconnect people with nature.

12.6.1.2.1 Status

Dodoma Capital City had large urban forests within her area of jurisdiction. However, these forests are disappearing rapidly due to landuse change arising from urbanization, infrastructure development and low level of public awareness on the importance of urban greening. For instance, between 2006 and 2016 forest area within the City jurisdiction decreased by 12.34% from 1,103.37 km² to 781.20 km².

Consequently, 52 percent of Dodoma City landscape is bareland and grassland with an estimated deforestation rate of 4,288 ha/year (1.5%/year). Furthermore, for the past 20 years; between the year 2000 to 2020, there has been a total loss of 85,771.5 ha of forest (Forest, Bushland and Woodland) equivalent to 30.6% of the total area. This is a precarious situation that needs immediate attention.

12.6.1.2.2 Causes

The contributing factors to deforestation and landscape degradation in the City include over-dependence on fuelwood and charcoal as energy sources for cooking; encroachment in the nature reserves, parks and open areas; free-range livestock grazing; concentration of socio-economic activities in all Wards of the City including urban farming and small-scale extraction of construction materials; severe and recurrent drought as a result of climate change and inadequate engagement of stakeholders in greening initiatives.

12.6.1.2.3 Impacts

Deforestation has impacts in socio-economic settings due to loss agricultural, loss soil fertility, deterioration of water sources, and loss of biodiversity.

12.6.1.2.4 Existing initiatives

Some of the existing initiatives include adoption of traditional forest management practices such as *milaga*; participation of local communities in forest management through Joint Forest Management (JFM) and Community Based Forest Management (CBFM); promoting alternative sources of energy for cooking such as LPG; afforestation programs including greening Dodoma in which trees were planted in iseni park, medeli and iyumbu open spaces; expansion of protected areas like Kiboriani forest; and community awareness raising programs.

12.6.1.2.5 Priority areas

Priority areas include conservation, nature reserves, water bodies and Mzakwe Catchment in makutupora wards, recreational areas in Dodoma Makulu, Tambukareli, Ipagala, and Iyumbu ward, scattered settlements and farming in Hombolo, Zuzu, Chihanga, Ihumwa, Chigongwe, Mpunguzi, and Government City in Mtumba Wards, industrial areas in Kizota and Nala wards, public spaces, transport routes, and new development areas in all wards.

12.6.1.3 Inadequate Urban green landscapes and recreational parks

Like in other Cities, green spaces and recreational parks are very important for Dodoma City. These areas benefit the city through air pollution reduction, provision of cool environment, control rainwater and flooding, creating habitat for local wildlife and supporting physical and mental health. The Dodoma city has a number of potentials areas for development of green and recreational parks. These include the hills and landforms surrounding the city, open spaces, retention ponds, seasonal swamps, road reserves and household pavements that can form green landscapes. Other potential areas are hills located in Imagi, Mlimwa, Itega, Isanga, Chimwaga Hills and Iseni, Kikombo, Matumbulu, and Hombolo Ridges. These hills are challenged with various human activities.

12.6.1.3.1 Status

Though the Dodoma city has vast potential for green space and recreational parks there are limited functional green and recreational parks in the city. However, there are some designated areas for green space that have not been developed. These include Chimwaga, Mtumba, Kisasa, Nanenane, Ilazo, Imagi and Itega hillside. Currently the trend shows that a lot of other human activities are taking place in these areas including agriculture, livestock keeping, sand mining and human settlement. The areas are experiencing informal land use change and encroachment, especially southern part of Imagi hillside and also the area around Itega Hill are parts of the land reserved for parks but currently they are used for farming activities, Northern part of Imagi Hill is encroached by Informal settlements developments and at the foot of its eastern part there is a 300-acre plot belonging to Dodoma Christian Medical Centre.

12.6.1.3.2 Causes

Inadequate control of human activities functioning in reserved hills and recreational areas leads to land degradation, inadequate awareness rising to the community to understand the significance of conserving the existing landscapes and lack buffer zones that separate the recreational parks and human settlement.

12.6.1.3.3 Impacts

Existence of human activities such as agriculture and human settlement in reserved and recreational area contribute to loss of urban biodiversity and reduces urban landscapes aesthetic functions.

12.6.1.3.4 Existing Initiatives

There are some existing initiatives in enhancing the urban forest in the city, these include: forest and recreational areas planted with a total of 580,130 trees in Mtumba urban forest, Medeli and Lyumbu open spaces, Bus stand and road reserves (Lyumbu road), Iseni recreational area and Mlimwa C Hill Park which constitutes about 18,670 hectares, establishment of Chinangali recreational parks in area A and tree nursery at Chinangali.

12.6.1.4 Invasive Species

12.6.1.4.1 Status

There is scanty documentation of invasive species both for plants, animals that exist in Dodoma City. A total of three (3) invasive species have been reported in Dodoma City, which pose substantial threats to agriculture, livestock, biodiversity and delivery of ecosystem services. The identified invasive species include: Kongwa weed (*Astripomoea hyscamoides*) is now spread in Nzuguni, Mtumba, and Ihumwa Wards; Fall armyworm (*Spodoptera frugiperda*) found in all wards; and *Bidens schimperi* found in Mtumba, Chamwino, Ihumwa, Buigiri and Masanga Wards (Plate 12-3). Currently, Nzuguni, Mtumba, Buigiri, Ihumwa and Chamwino Ikulu Wards have been dominated with all three varieties of invasive species.



Plate 12-3: *Bidens schimperi* in Buigiri ward (left), Kongwa weed in Mtumba ward (right)

12.6.1.4.2 Causes

The spread of invasive species is caused by movement of animals (wildlife and livestock), wind, road construction, water sources mostly through transboundary resources, Botanical garden/zoo/aquaria, transportation of goods and plant nurseries.

12.6.1.4.3 Impacts

Reduced yield production, increased farming costs and livelihood insecurity, suppressing the growth of native species thus affecting local ecology and biodiversity.

12.6.1.4.4 Existing initiatives

Existing initiatives include existence of several legal instruments that partly address the control and prevention of invasive species including Seeds Regulations (2007), and the

Environmental Impact Assessment and Audit Regulations (2005). Further, Sokoine University of Agriculture (SUA) is coordinating on-going research work on agro-ecological technologies to be used to manage the Kongwa Weed through integrated approaches.

12.6.1.4.5 Priority areas

The priority areas for strategic intervention are all Wards of the Dodoma City with particular focus on Nzuguni, Mtumba, Buigiri, Ihumwa and Chamwino Ikulu Wards.

12.6.1.5 Air Pollution (Odour and Dust/Particulate Matter)

12.6.1.5.1 Status

Currently, notable air pollution challenges in Dodoma City is rather localized and related to odour and dust (particulate matter). Odour emissions are generally composed by complex mixtures of different volatile chemical compounds. Odour nuisance sources include industrial establishments and haphazard disposal of solid waste and untreated wastewater. Odour nuisance has been observed mostly in Kizota Ward and to a lesser extent in Kikuyu Ward. In contrast, dust (particulate matter) is associated with industrial establishments, commercial areas, construction activities, unpaved roads, and vehicles. Areas of major concern with dust (particulate matter) is mainly Kizota Ward and Majengo Ward mainly attributed by industrial activities.

12.6.1.5.2 Causes

Some of the contributing factors to odour and dust pollution include inadequate urban implementation of Urban Master Plans; and inadequate enforcement of relevant legislation and by-laws for the control and prevention of environmental pollution in general.

12.6.1.5.3 Impact

Impacts associated with odour and dust pollution include respiratory diseases, lung cancer and headache.

12.6.1.5.4 Priority Areas

The priority areas for strategic interventions include all 41 Wards of Dodoma City with particular emphasis on Kizota, Kikuyu and Majengo Wards.

12.6.1.6 Noise Pollution

12.6.1.6.1 Status

Noise pollution is one of environmental pollution that is widespread in community centres of the Dodoma Capital City. These areas have appreciable concentrations of industries, ongoing physical development which involve construction and increasing traffic as well as other social events including commercial promotions, worship, brick making and entertainment activities. Most notable areas associated with noise nuisance have been observed to be Ipagala, Mlimwa, Nkuhungu, Kizota and Kikuyu Wards (Figure 12-3). A report obtained from NEMC shows that for the year 2021/2022, a total of 30 complaints were raised in relation to noise pollution from entertainment sources and 7 complaints against other social and economic activities (equivalent to 61.7% of total environmental complaints received by Authorities).

12.6.1.6.2 Causes

Uncontrolled rapid urban development and industrial expansion including informal small-scale industries (SSIs) has resulted in the intensification of noise particularly in densely populated areas. Further to this, increasing number of vehicles, particularly in major urban roads and booming of construction activities have contributed to rise in noise and vibration pollution.

12.6.1.6.3 Impacts

Some of the impacts of noise pollution include social conflicts and health problems such as hearing impairment, sleep disturbance, mental health and cardiovascular diseases.

12.6.1.6.4 Initiatives

One of the initiatives undertaken to address noise pollution is the formulation of Noise and Vibrations (Standards and Control) Regulations, 2015; Guidelines in the control of noise and vibration 2021; awareness campaign on noise pollution; and institutional cooperation in noise pollution management.

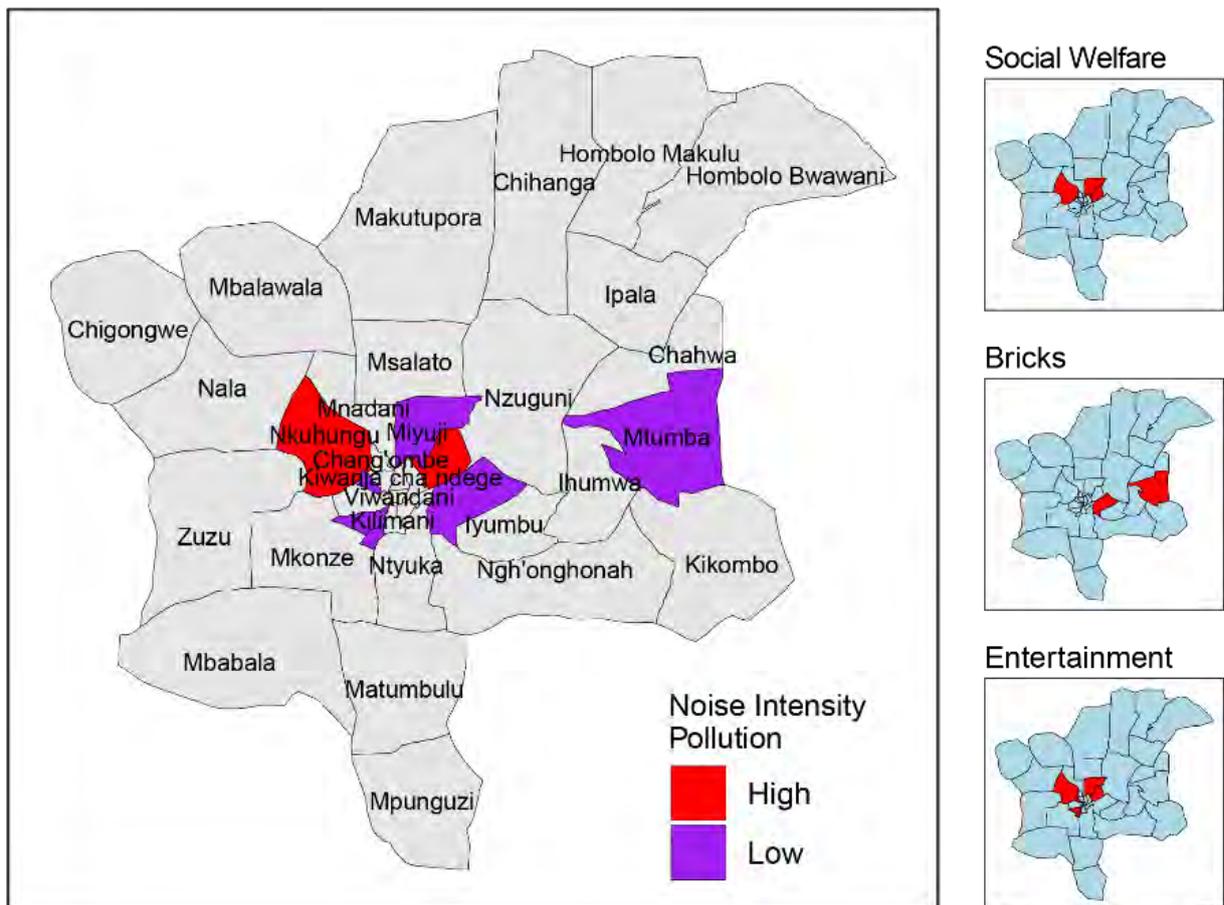


Figure 12-3: Noise pollution intensity in Dodoma Capital Cit

12.6.1.6.5 Priority areas:

Priority areas for strategic intervention is all 41 Wards of Dodoma City in view of the rapid urbanization and population growth with particular focus on Ipagala, Mlimwa, Nkukungu, Kizota and Kikuyu Wards.

12.6.1.7 Solid Waste Management

12.6.1.7.1 Status

Dodoma City is estimated to generate a total of 391 tonnes of solid waste daily from domestic, commercial, industrial and institutional sources. Out of these, only 200 tons are disposed at Chidaya Sanitary Landfill. This amount accounts for only 51.1 percent of all the waste generated in the City. The area covered by the solid waste management collection services is 24 out of 41 wards (Figure 12-4). The remaining 17 wards dispose wastes improperly and this situation may lead to health risks such as malaria, bacillary dysentery and cholera. Notably, domestic and commercial solid waste consists of a significant amounts of organic waste (more than 70 percent) which can be utilized to produce compost and thus reduce the amount of solid waste ending in the landfill.

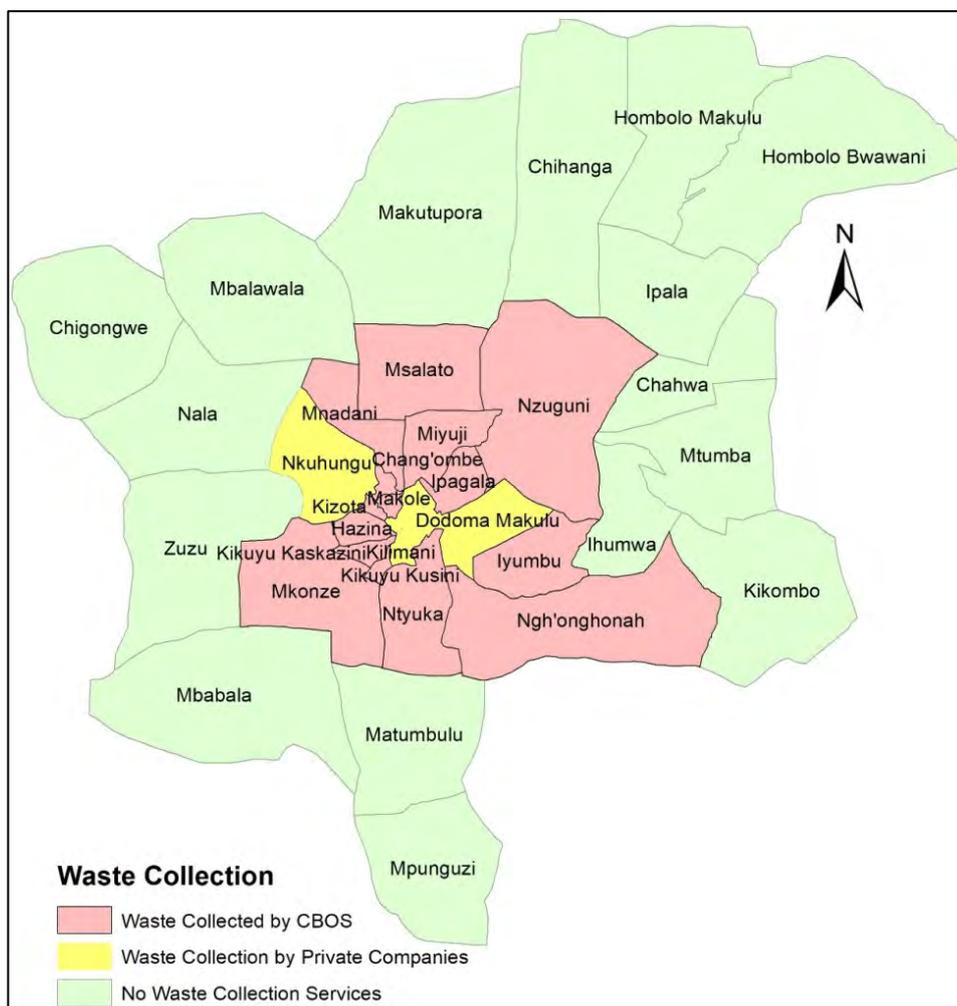


Figure 12-4: Status of Waste Collection Services in Dodoma Capital City

12.6.1.7.2 Causes

Inadequate equipment, infrastructure and finance to manage waste; appropriate technologies for waste sorting, collection, recycling, and disposal accelerates waste generation and hence contribute to inadequate soili waste management in the city.

12.6.1.7.3 Impact

Some of the impacts of improper solid waste management include: increase of waste

disposal in storm water drainage and storm water retention ponds in Pombe, Kikuyu and Sabasaba storm water drainage and Swaswa water retention ponds. This situation contribute to floods thus affecting infrastructure and properties and increased incidences of disease.

12.6.1.7.4 Existing initiatives

Existing initiatives include ongoing cleaning campaign conducted every saturday in a month; promotion of awareness-raising to the community on sustainable solid waste management focusing on segregation, collection and transportation.

12.6.1.7.5 Priority areas

The priority areas for strategic intervention are all 41 Wards of Dodoma City with particular emphasis on urban and peri-urban areas such as Hombolo and Impala Wards.

12.6.1.8 Waste water Management

12.6.1.8.1 Status

Dodoma City uses a combination of on-site and off-site sanitation systems for wastewater management. The on-site sanitation is a predominant method of waste water disposal. The major sources of wastewater are residential settlements, commercial areas, institutions and industrial facilities.

On-site sanitation system: It comprises of septic tanks with their associated soak away pit. Septic tanks systems are commonly used in areas with water supply connections, while most of households without water connection use pit latrines as means of liquid waste disposal. The on-site sanitation facilities serve 80 percent of the total population. wastewater from the septic tanks is emptied using cesspit emptier disposed at Swaswa Waste Stabilization Ponds.

Off-site sanitation system: It comprises of sewerage systems which collect wastes and transport them by gravity to the waste stabilization ponds which are located at Swaswa area. The sewerage system serves mainly the Central Business District (CBD) and planned areas of Area A, B, C and D and western industrial area. The sewerage network extends to further to Kilimani and Mirembe areas. The current sewerage system serves only 20 percent entire population of Dodoma City. Furthermore, University of Dodoma have decentralized sewerage systems. However, the existing waste stabilization ponds at Swaswa are not functioning properly because they do not meet the increased population of Dodoma and effluent liquid do not meet the required standards for various reasons.

12.6.1.8.2 Causes

The design was meant to serve a small population whereas the current population is well beyond the design population.

12.6.1.8.3 Impacts

Overflow of waste stabilization ponds leading to flooding to Swaswa and the surrounding areas

12.6.1.8.4 Priority Areas

Ipagala, Dodoma Makulu, Nzuguni, Kizota, Nkuhungu and Msalato wards.

12.6.1.9 Storm water Management

Dodoma Capital City is facing a challenge of stormwater management despite the fact that it is considered to be semi-arid. This is because the City experiences short rain of high intensity leading to large volume of surface runoff. Effective management of stormwater is crucial to maintain urban resilience to flooding risk.

12.6.1.9.1 Status

Dodoma City's stormwater drainage system coverage is about 29 kilometers from the city centre to Zuzu and Hombolo water retention ponds. The existing drainages are overloaded due to increase of water runoff caused by rapid urbanization in the City. In outlying neighborhoods and un-built up areas, water runs along natural ravines, but these are not able to evacuate all surface runoff during heavy rain. Furthermore, some of the planned areas such as Nzuguni and Ilazo are flood prone areas due inadequate stormwater management infrastructures.

12.6.1.9.2 Causes

Some of the underlying causes of existing inadequate stormwater drainage system are deposition of sediments in the existing drainage, and waste dumping in drainage system.

12.6.1.9.3 Impact

Occurrence of floods during the rainy season leads to destruction of infrastructure like road in Masalato and Ipagala ward, loss of properties and soil erosion in Tambukareli wards. Furthermore, accumulation of sediments create breeding sites for vectors hence causes diseases to the community.

12.6.1.9.4 Priority Areas

Priority areas for strategic intervention is all 41 Wards of Dodoma City with particular focus to expand stormwater system in new planned areas and upgrading existing stormwater drainages including Ilazo, Mkalama, Kikuyu, Sabasaba, Mwangaza, Kizota, Nkuhungu, Ipagala, Pombe, Image and Kisasa stormwater drainage.

12.6.1.10 Inadequate non-motorized infrastructure

Growing cities face increasing challenges including inadequate infrastructure for mass transport. Infrastructure accelerates use of personalized transport including vehicles that lead to increased traffic jams hence accelerate air pollution. Moreover, increased commuters or vehicles contribute to emission of greenhouse gases. Dodoma city is growing quickly accompanied with increased demand for commuter services and subsequent traffic jams and air pollution. Addressing this challenge may include promotion on the use of non-motorized transport such as cycling lanes and pedestrian walkways. Currently, there is inadequate infrastructure to facilitate non-motorized transports. Addressing this challenge, would need the use of non-motorized transport such as cycling lanes, and pedestrian walkways. Currently, there are inadequate infrastructure to facilitate non-motorized transport.

12.6.1.10.1 Status

Most of the existing road networks are characterized with exclusion of non-motorized infrastructure. Dodoma City has a total of 133.27 km of tarmac road network. Approximately, 82.07 km of tarmac roads have not included pedestrian and cycling infrastructures and only 51.2 km of tarmac road integrate the non-motorized infrastructure.

12.6.1.10.2 Causes

Inadequate implementation of infrastructure plans.

12.6.1.10.3 Impact

The impacts increase in the use of vehicles leads to emission of Carbon dioxide and Carbon monoxide (CO₂) which contribute to climate change.

12.6.2 Interventions for addressing Environmental challenges in Dodoma City

12.6.2.1 Goal

Enhance sustainable environmental management and socio-economic well-being in Dodoma City.

12.6.2.2 Expected results

A sustainable management of environmental and natural resources of Dodoma City with restored degraded land, green landscape, recreational areas, sustainable solid waste management, high quality of non-motorized and stormwater drainage infrastructure systems.

12.6.2.3 Priority areas

Priority areas are along major urban roads of Dar es Salaam, Arusha and Singida Roads.

12.6.2.4 Interventions and Targets

- i. Restore and rehabilitate highly degraded landscapes**
 - a. Upscale and implement Greening Dodoma Programme by planting 6 million trees in 300,000 hectares of degraded land in all wards by 2032 and
 - b. Promote and implement best practices for sustainable land management (such as agro-forestry, pit and trench farming, traditional forest management (milaga) in Mpunguzi, Mbabala, Zuzu, Makutupora, Chihanga and Hombolo Wards by 2032.
- ii. Promote greening and beautification of the City landscape by planting trees**
 - a. Develop and implement an enrichment planting programme in nature reserves (85,411.0 ha) of Hombolo and Zuzu wards, and Mzakwe Water Catchment in Makutupora Ward, recreational areas of Medeli and Iseni in Tambukareli, Iyumbu open space in Iyumbu Wards by 2032;

- b. Intensify tree planting in designated areas for urban forests in Chimwaga and Mtumba by 2025;
 - c. Establish 100 ha botanical garden including library, herbarium , greenhouse and arboretum by 2029; and
 - d. Establish and/or strengthen Ward Environmental Committees in all wards by 2032.
- iii. **Promote beneficial use of existing seasonal swamps and water retention Ponds into recreational area**
- a. Conduct feasibility study to assess the values and costs of potential water retention ponds and their functional design to improve City greening initiatives by 2025; and
 - b. Establish recreational buffer zones and infrastructure to support recreational and greenery views, particularly around Mkalama, Swaswa, and Nkuhungu ponds by 2030.
- iv. **Enhance actions to control and monitor the identified invasive species in Dodoma City**
- a. Develop and implement a programme on public awareness and participation in invasive species management in Dodoma City by 2025;
 - b. Develop and implement a plan to control and restore areas affected by invasive species in Nzuguni, mtumba, and ihumwa by 2031; and
 - c. Develop and implement a programme to support and utilize applied research in the control, prevention and eradication of invasive species of concern to Dodoma Capital City by 2032.
- v. **Promote actions to control and manage air pollutants in Dodoma City**
- a. Enforce relevant laws and regulations to address air pollution in all wards particularly in Kizota, Kikuyu Kaskazini and Kikuyu Kusini Wards by 2032; and
 - b. Adopte and make use of Cleaner production technologies in industrial related activities in Kizota, Nala and Majengo wards by 2032.
- vi. **Strengthen enforcement of relevant laws and regulations to address noise pollution in Dodoma City**
- a. Enforce Noise and Vibration Regulations (2015) in all Wards of Dodoma Capital City with particular emphasis on Nkuhungu, Mtumba, Ipagala, Kikuyu Kaskazini and Kikuyu Kusini Wards by 2032;

- b. Develop and implement initiatives to conduct regular strategic mapping of noise pollution sources in all Dodoma City wards by 2032; and
 - c. Develop and implement awareness program focusing on the management and control of noise pollution in Dodoma City by 2032.
- vii. Strengthen effective and sustainable solid waste management in the Dodoma City**
- a. Establish material recovery facilities to enhance sorting, collecting and handling of solid waste in Ipagala, Nzuguni, Hombolo and Ipala Wards wards by 2032;
 - b. Develop and implement a capacity building programme to enhance Council capacity through provision of equipment to facilitate collection of solid waste by 2032;
 - c. Establish and implement a system to promote participation of private sector in recycling initiatives by 2032;
 - d. Establish and implement programme for promotion of waste reduction at source y 2032;
 - e. Develop and oversee the implementation of establishment of takeback centers for recyclable materials in all Wards by 2032;
 - f. Develop and implement public awareness programme for promotion of Reduce, Reuse, and Recycling (3R) practices by 2032;
 - g. Build City council capacity in collection of solid waste fees by 2032.
- viii. Control and Manage wastewater generated in Dodoma Capital City**
- a. Upgrading the existing sewerage system by 2025
 - b. Expand coverage of the sewerage network to 30% from the current 20% by 2032
 - c. Construct two (2) new wastewater treatment plants at Buigiri and Nzuguni by 2032.
 - d. Develop and implement a plan to promote wastewater reuse by 2032.
- ix. Control and manage stormwater**
- a. Upgrade the existing Stormwater drainage system upgraded in Pombe, Kikuyu, Sabasaba, Mwangaza and Nkuhungu Wards by 2032;

- b. Construction of new storm drainages of 20% from existing 29.46 kilometers stormwater drainage system by 2032; and
 - c. Develop and implement a rainwater harvesting and permeable pavement awareness program for at least 50% of households by 2032.
- x. **Promote non-motorized infrastructure systems in Dodoma city**
- a. Improve and construct a non-motorized infrastructure including pedestrian walkways and cycling lanes, street trees, and adequate street lighting along new and existing streets in Ihumwa, Nzuguni, Ipagala, Mkonze, Iyumbu, Msalato, Kizota, Dodoma makulu, Ntyuka and Miyuji wards by 2032;
 - b. Develop and implement a capacity building plan to enhance the city's capacity to increase the imposition of non-motorized infrastructure by 2032.

13 ENVIRONMENTAL GOVERNANCE

Environmental governance in Tanzania is guided by broad national frameworks mainly the Tanzania Vision 2025 and the National Five-Year Development Plan III (2020/21–2025/26). In addition, it is governed by the National Environmental Policy (2021), EMA Cap,191 and complemented by relevant sectoral policies and legislation. Also, for effective conservation and management of environment a number of institutions have been established including The Ministry responsible for Environment, The National Environment Management Council, Environment sections to some ministries and LGAs.

The policy, legal and institutional frameworks for environment governance in the country have yielded some positive results and lessened the impacts of environment degradation to the livelihoods of people, and the economy at large. However, environment governance is still not effectively executed, resulting into continuing of environment degradation. This situation is exacerbated by a number of factors including; Inadequate institutional capacity, Inadequate enforcement of EMA Cap,191 and inadequate human resource.

13.1 Inadequate institutional capacity

Effectively environment governance in the country is currently hampered by inadequate institutional capacity. This situation is attributed by the following challenges: ineffective coordination among actors, inadequate monitoring and evaluation systems, inadequate availability and access of environmental statistics, data and research. This state of affairs continues to pose a challenge in conservation and management of the environment in the country. The details of each challenge and interventions to address these challenges are described in the following subsection.

13.1.1 Ineffective coordination among actors

The set-up of coordination of environment actors is stipulated in EMA Cap, 191 in which roles and responsibilities of all key actors have been prescribed and the overall coordination mandate is entrusted to the Ministry Responsible for Environment. However, there have been observed coordination challenges among actors such as Sector Ministries, LGAs and other stakeholders engaging in environment conservation and management in the country. At sectoral ministries level and LGA, the major challenges include limited coordination, communication and information sharing between Ministry responsible for environment, LGAs and sector ministries and across sector ministries. Although the EMA Cap, 191, clearly stipulated the set-up of coordination between these actors, no formal communication, information sharing and feedback systems have been established resulting into actors working in silos and hence affecting efficiency and effectiveness of coordination of environmental matters.

Another coordination challenge hinges on coordination of various stakeholders including individuals, NGOs, and Private sector. This is attributed by some of these

operating in informal sector and lack of a centralized database that maps all environment stakeholders, due to the existence of multiple Government institutions responsible in registering these stakeholders. These institutions do not have a formal mechanisms of sharing information which hinder the establishment environment database. The environment database is an essential tool for mapping and coordinating these stakeholders.

Also with regards to cross-coordination and inter-government collaboration, the implementation of EMA Cap, 191 requires the support and proactiveness of all levels of government. To date, limited awareness of the sector ministries, LGAs, and the public of their role and responsibility in implementing EMA Cap, 191 is a challenge that needs to be overcome. A comprehensive capacity awareness-raising campaign targeting sector ministries, LGAs, and government institutions on their roles and responsibilities is paramount.

13.1.2 Inadequate monitoring and evaluation systems

The Government in collaboration with stakeholders, devises and implements various initiatives including formulation of annual action plans, projects and programmes for environment protection and management. However, monitoring and evaluation systems are fragmented within the sectors and LGAs. This situation leads to duplication of efforts and resources. Effective monitoring and evaluation calls for a robust national environment monitoring and evaluation system, which will need to be capacitated with competent human resources with extensive knowledge and skills in monitoring and evaluations, accorded with necessary equipment and tools and adequate budgetary allocation for effective tracking of progress and impacts attained after implementation of these endeavors.

13.1.3 Inadequate availability and access of environmental statistics, data and research

Quality environment decision, policy and programme, calls for quality environment data, statistics and research. However, there have been observable challenges of access of environmental statistics and research, exacerbated by limited information sharing options among key actors, attributed to absence of Central Environmental Information System. Consequently, environmental statistics and data remaining fragmented within the sector ministries Department, Agencies and Research institutions.

This situation is attributed by inadequate financing in data and statistics generation, inadequate expertise, high costs of data collection, storage and dissemination; Inadequate networking and coordination mechanisms between data producers and users; few statisticians; limited use and application of information and communication technologies (systems and software of data collection, dissemination of data and

statistics and data digitization). low funding of research activities, limited dissemination of research findings; and inadequate cooperation and collaboration with bilateral, regional and international environmental research bodies. All these factors resulting into limited environmental data, statistics and research, hence impair sound decision making and robust formulation and implementation of environmental policies and programmes.

13.1.4 Human resource shortage in conserving and managing the environment

Adequate human resources are critical factor in conservation and managing the environment in the country. In this regard, The Government have taken some considerable initiatives including continuing hiring environmental officers who are serving in various government institutions, Despite the taken initiatives, there have been observable staff shortage at all levels, from line ministries, local government authorities and other government institutions responsible for conservation and protection of the environment.

13.1.5 Inadequate enforcement of EMA Cap, 191

For effective conservation and management of the environment, The Government enacted EMA Cap, 191 and several environment regulations. In addition, a number of projects have been designed and executed to facilitate the implementation of EMA Cap, 191, including a project for Enhancing National Capacity for Implementation of the Environmental Management Act which is currently being implemented.

Despite these initiatives, EMA Cap, 191 has not been fully enforced and implemented. This situation is attributed to inadequate capacity. Consequently, a number of issues have not been implemented as envisioned by this Act.

Delay in establishment of environment sections and appointments of sector coordinators by some ministries; Operationalization of National Environment Trust Fund and The Environment Appeal Tribunal; designation of environment management officers at administrative areas such as Mtaa and village of the Township and Hamlets due to various constraints including human resources and budgetary factors, and given the existing number of administrative areas.

Other challenges involve low public awareness and compliance with EMA Cap, 191 by Government actors in discharging their mandated functions and the low public awareness on EMA Cap, 191.

13.2 Interventions

13.2.1 Goal

Enhance institutional capacity for improving environmental governance.

13.2.2 Expected Results

Effective communication and coordination among actors, monitoring and evaluation systems improved, enforcement of legislations strengthened and human resources, as well as capacity in environmental research, enhanced.

13.2.3 Interventions and targets

- i. Enhance communication, coordination and information sharing systems between the Ministry responsible for Environment and Sector ministries and Local Government Authorities;**
 - a. Develop and implement information sharing and accessibility strategy by 2027;
 - b. Develop and implement guidelines for information sharing and accessibility for effective coordination of environment issues across sectors and LGAs by 2023;
 - c. Create cross-ministerial forums for information sharing by 2024;
 - d. Establish a database that will map all environment stakeholders operating in the Country by 2023; and
 - e. Develop and implement integrated monitoring and evaluation strategy by 2032;
- ii. Enhance availability of accessible and reliable environmental data and information**
 - a. Prepare and implement plan for capacity needs assessment for environmental research by 2025;
 - b. Develop and implement programme for capacity building by 2027;
 - c. Establish a Central Environmental Information System at NEMC by 2028;
 - d. Prepare and implement plan for environmental research cooperation and collaboration with bilateral, regional and international environmental research bodies by 2032; and
 - e. Develop and implement building capacity for project preparation and research by 2032.
- iii. Enhance institutional human resource**
 - a. Recruit staff to institutions with a high shortage by 2032;

- b. Encourage the use of interns in LGAs and other government institutions with high staff shortages by 2032.
- iv. Strengthening enforcement of EMA Cap, 191**
- a. Develop and implement a sensitization program on EMA Cap, 191 to Government ministries, LGAs and agencies by 2032;
 - b. Develop and implement a public awareness strategy on EMA Cap, 191 by 2032;
 - c. Prepare and enforce environmental regulations by 2032
- v. Review EMA Cap, 191, to accommodate National Environmental Policy (2021)**
- a. Conduct consultative meetings for soliciting stakeholders' views on the proposed amendments on EMA Cap, 191 by 2023;
 - b. Table the Bill for amending EMA Cap, 191 the National Assembly by 2023;and
 - c. Establish the office of the Registrar of the Environmental Appeal Tribunal by 2025.

14 IMPLEMENTATION ARRANGEMENTS, ACTION PLANNING, MONITORING, EVALUATION AND REPORTING

14.1 Institutional Arrangement

A wide spectrum of actors shall be responsible for implementation of the of NEMPSI. Being cross cutting in nature , NEMPSI the will be implemented through sectoral Ministries and LGA's , by mainstreaming strategic interventions and subsequent targets in their respective sectoral policies and strategies, In addition, succesfull implementation of NEMPSI will require an improved coordination arrangements among actors, to meet this end , EMA Caps 191 need to be reviewed to ensure appropriate coordination mechanism is in place.

Furthermore, cooperation among stakeholders at national, regional as well as international levels will be of paramount importance. The key actors include the Ministry responsible for environment, Sector Ministries, Regional Secretariats, Local Government Authorities, National Environment Management Council (NEMC) Environmental Appeals Tribunal and the National Environmental Advisory Committee (NEAC). Other players include Development Partners, Academic and Research Institutions, Private Sector, Civil Society Organizations, Media, Local Communities and the Public at large.

14.2 Action Planning

Action Planning to simplify the planning process, ensure efficient resource allocation and effective implementation of the activities, annual and quarterly work plans will be formulated by the sector ministries and LGAs based on NEMPSI 2022 and submitted to the Permanent Secretary of the Ministry responsible for Environment. The Ministry responsible for Environment will conduct technical meetings to syntheses and validate the work plans. The participants will be technical directors and officers from sector ministries and LGAs. The work plans shall be approved by the Permanent Secretaries from sector ministries. For the sake of consistency, this process shall be streamlined in the government planning and budgeting cycles, to avoid parallel processes and any unnecessary inconsistencies that may arise.

14.3 Monitoring and Evaluation

The NEMPSI 2022 has strategic interventions to deliver on expected outputs, outcomes and impact. To attain such objectives a robust monitoring and evaluation system is of paramount importance. Therefore, this section demonstrates a need for having a well-functioning monitoring and evaluation system which is an essential cornerstone of the performance management.

Monitoring and Evaluation (M&E) for NEMPSI 2022 is a tool that will track the performance on the implementation of Plan. The main goal of M&E Framework is to guide implementation of the Plan with the view to maximize effectiveness and efficiency of the interventions. Specifically, the M&E framework intends to:

- i) Establish benchmark of indicators for policy and programme assessment;

- ii) Guide actors participation in implementation and monitoring activities; and
- iii) Control use of resources during implementation.

14.3.1 Monitoring, Review and Evaluation Plan

This section provides the Monitoring Plan, Planned Reviews and Evaluation Plan for the period of ten (10) year of implementation of covering the period from Fiscal year 2022/23 – 2031/32. Furthermore, the section provides information on periodic reviews, assessment and evaluation of the effectiveness, efficiency, impact and sustainability.

14.3.2 Monitoring Plan

Monitoring will involve continuous and systematic data collection, analysis, indicator and reporting frequencies, interpreting and reporting on the implementation of EMPSI 2022. This will provide information to the ministry responsible for environment and stakeholders on ongoing interventions, for the purpose of assessing the extent of progress and achievements made over the objectives and the use of allocated funds.

For effective conducting monitoring activities, the Ministry responsible for Environment in collaboration with Sector ministries and LGA's will prepare a joint comprehensive annual monitoring plan, to meet this end each sector ministry and LGAs shall be required to prepare and submit Plan to the Permanent Secretary of the Ministry responsible for Environment.

The Ministry responsible for Environment shall synthetizes the plans and prepare a joint Comprehensive Annual Monitoring Plan. The Ministry responsible for Environment will conduct one technical meeting for validation of the plan. The participants will be technical directors and officers from sector ministries, departments and agencies, and LGAs. For the sake of transparency and common understanding, the plan will be approved by the Permanent Secretaries from sector ministries and LGAs implementing the NEMPSI 2022.

For effective implementation of a joint monitoring plan, the VPO's Permanent Secretary in consultation with Sector Permanet Secretaries will compose a team of officers from the Ministry responsible for Environment, Sectoral ministries, LGAs, Department and Agencies. The team will be responsible for monitoring the plan, the team will deploy various approaches in monitoring including field visits and desk review of submitted progressive reports. The team shall be required to prepare and submit a monitoring report, to the Permanent Secretary of the Ministry responsible for Environment who shall share such report to the Permanent Secretaries of the Sector ministries though various channel including formal writing and during the quarterly progressive meetings.

14.3.3 Planned Reviews

The planned reviews will be conducted by the Ministry responsible for environment in collaboration with Sectoral ministries, LGAs, Department and Agencies.. This will consist of review meetings, milestones and rapid appraisals including their frequencies. This will

help to improve management decision making, encouraging internal and external transparency and accountability.

14.3.4 Performance Review Meetings

Performance review meetings will be conducted by the Ministry responsible for Environment in collaboration with sector ministries, LGA's, Department and Agencies to track the progress on milestones developed and targets. The following table describes how review meetings will be conducted.

Table 14-1: Review Meetings

| No. | Type of Meeting | Frequency of the Meetings | Chairperson | Participants |
|-----|-----------------------------|---------------------------|-------------------------|---|
| 1. | Quarterly sectoral Meetings | Quarterly | Director of Environment | Directors in sectoral ministries, Executive Directors of Departments and Agencies |
| 2. | Mid-Year sectoral Meetings | Twice per Year | Permanent Secretary-VPO | Permanent Secretaries from Sectoral Ministries |
| 3. | Annual sectoral Meetings | Once per Year | Minister of Environment | Ministers from sectoral ministries |

Apart from this arrangement, Ministry responsible for environment and the sector ministries may convene meetings for deliberations on contentious issues that need urgent attention. The specific guidelines prescribing modalities of conducting review meeting will be prepared.

14.3.5 Planned Milestones Reviews

Milestone reviewing will focus on determining whether the planned activities are being implemented towards achieving the annual targets and will find out whether the implementation is on track, off track, or at risks. The findings obtained from the milestone reviews will be used to adjust the implementation strategies and targets accordingly.

14.3.6 Performance Evaluation Plan

Performance evaluation will be a periodic assessment to identify the effectiveness and efficiency of performance of the objectives. The evaluation process will concentrate on outcomes. During the ten years of implementation, four evaluations will be conducted quarterly (2.5 years), mid (5 years), third quarter (7.5 years) and final evaluation (10 years). These evaluations will assess progress towards attainment of NEMPSI specific goals and targets. Challenges encountered during the implementation will be identified and measures to address them will be developed accordingly. The final evaluation will be conducted to obtain evidence as to whether the interventions and outputs have led to the achievement of the outcomes as envisioned in the NEMPSI.

14.3.7 Performance Reporting Plan

This will involve reporting on the performance in compliance to the progress towards attainment of NEMPSI 2022. Goals and Targets or implementation of targets against expenditures focusing on the impacts to stakeholders and community at large. The Sector Ministries and Local Government Authorities shall be required to prepare quarterly progressive report on the performance of the NEMPSI 2022 implemented on their areas of jurisdictions. The reports shall be submitted to the Permanent Secretary of the Ministry Responsible for Environment. For the case of LGAs the report shall be submitted through their appropriate authority i.e. Minister responsible LGA's.

Appendix

THE TEAM INVOLVED IN THE PREPARATION OF THE NATIONAL ENVIRONMENT MASTER PLAN

| No. | NAME | INSTITUTION | TITLE |
|-----|----------------------------|---|--------------|
| 1. | Ms.Mary N. Maganga | Vice President Office | Chair person |
| 2. | Dr. Switbert Zakaria Mkama | Vice President Office | Member |
| 3. | Dr Andrew Komba | Vice President's Office | Member |
| 4. | Ms.Kemiilembe Mutasa | Vice President Office | Member |
| 5. | Dr.Thomas Bwana | Vice President's Office | Member |
| 6. | Dr. Hussein Mohamed Omar | Vice President's Office | Member |
| 7. | Dr.Kanizio Manyika | Vice President's Office | Member |
| 8. | Dr, Befrina Igulu | National Environment Management Council | Member |
| 9. | Dr. Paul Deogratus | Vice President's Office | Member |
| 10 | Eng. Julius Enock | Vice President's Office | Member |
| 11. | Mr. Kalokola Rwabizi | Vice President's Office | Member |
| 12 | Mr. Masumbuko Semba | Nelson Mandela Institution of Science and Technology | Member |
| 13 | Ms. Emelda Teikwa Adam | Vice President's Office | Member |
| 14 | Mr. George Joseph Miringay | President's Office-Regional Administration & Local Government Authority | Member |
| 15 | Mr. Enock Sanga | Vice President's Office | Member |
| 16 | Mr. Msifuni Mmasa | Vice President's Office | Member |
| 17 | Ms.Sophia Kivina | Vice President's Office | Member |



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