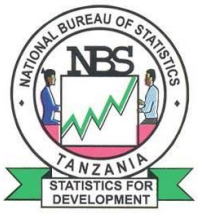
The United Republic of Tanzania

National Environment Statistics Report (NESR, 2017) - Tanzania Mainland

June, 2018

The United Republic of Tanzania

National Environment Statistics Report, 2017
Tanzania Mainland



The National Environment Statistics Report, 2017 (NESR, 2017) was compiled by the National Bureau of Statistics (NBS) in collaboration with National Technical Working Group on Environment Statistics. The compilation work of this report took place between December, 2016 to March, 2018. Funding for compilation and report writing was provided by the Government of Tanzania and the World Bank (WB) through the Tanzania Statistical Master Plan (TSMP) Basket Fund. Technical support was provided by the United Nations Statistics Division (UNSD) and the East African Community (EAC) Secretariat.

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3Rs	-	Reduce, Re- use and Recycle
AASS	-	Agricultural Annual Sample survey
BAU	-	Business as Usual
BDAS	-	Basic Data of Agricultural Sector
BEST	-	Biomass Energy Strategy in Tanzania
CAN	-	Calcium Ammonium Nitrate
CBM/ M3	-	Cubic Metres
CE	-	Chief Executive
CFCs	-	Chlorofluorocarbons
CGL	-	Comprehensive guideline
CO_2	-	Carbon-Dioxide
COWSOs	-	Community-Owned Water Supply Organizations
DANIDA	-	Danish International Development Agency
DAP	-	Di Ammonium Phosphate
DAWASA	-	Dar es Salaam Water Supply Authority
DAWASCO	-	Dar es Salaam Water and Sewerage Corporation
DBSS	-	Director of Business Support and Services
DCC	-	Dar es Salaam City Council
DLAs	-	Dar es Salaam Local Authorities
DPRU	-	Director of Planning and Resources Utilization
DRM	-	Director of Resources Management
EBM	-	Ecosystem Based Management
EEZ	-	Exclusive Economic Zone
EIA	-	Environmental Impact Assessment
EIS	-	Electric Industry Supply
EMA	-	Environment Management Act, 2004
ERC	-	Environment Resources Management
EWURA	-	Energy and Water Utilities Regulatory Authority
FAO	-	Food and Agriculture Organization of the United Nations
FBD	-	Forest and Beekeeping Division
FDI	-	Foreign Direct Investment
FNR	-	Forest Nature Reserves
FYDP	-	Five Year Development Plan
GCA's	-	Game Controlled Areas

GDP	-	Gross Domestic Product
GHGs	-	Greenhouse Gases
GIIP	-	Gas Initial in place
GN	-	Government Notice
GO	-	Gas Oil
GoT	-	Government of Tanzania
GWh	-	Gigawatt-hour
ha	-	Hectares
HCFCs	-	Hydrochlorofluorocarbons
HFCs	-	Hydrofluorocarbons
HFO	-	Heavy Fuel Oil
ICZM	-	Integrated Coastal Zone Management
IDF	-	Irrigation Development Fund
IEA	-	International Energy Agency
IPPs	-	Independent Power Producers
ISO	-	International Organization for Standardization
ITCZ	-	Intertropical Convergence Zone
IUCN	-	International Union for Conservation of Nature
IWMI	-	International Water Management Institute
IWRMD	-	Integrated Water Resources Management and Development
JESR	-	Joint Energy Sector Review
JICA	-	Japan International Cooperation Agency
JNIA	-	Julius Nyerere International Airport
JPCC	-	Joint Permanent Commission of Cooperation
KGS	-	Kilograms
KIA	-	Kilimanjaro International Airport
Km^2	-	Kilometers Squares
Ktoe	-	Kilotons of Oil Equivalent
kWh	-	Kilowatt-hour
LGA	-	Local Government Authority
LPG	-	Liquefied Petroleum Gas
LTM	-	Long term mean
LVEMP	-	Lake Victoria Environment Management Project
MEAs	-	Multi-lateral Environment Agreements
MEM	-	Ministry of Energy and Minerals
MLF	-	Multilateral Fund

MMCFT	-	Million Cubic Feet
MNRT	-	Ministry of Natural Resources and Tourism
MoA	-	Ministry of Agriculture
MOP	-	Muriate of Potash
MoWI	-	Ministry of Water and Irrigation
MRP	-	Minjingu Rock Phosphate
MSW	-	Municipal Solid Waste
MW	-	Megawatt
NAFORMA	-	National Forest Resources Monitoring and Assessment
NAIVs	-	National Agricultural Inputs Voucher System
NAP	-	National Agricultural Policy
NEMC	-	National Environment Management Council
NEP	-	National Energy Policy
NEP	-	National Environment Policy
NGUMP	-	Natural Gas Utilization Master Plan
NIP	-	National Irrigation Policy
NIRC	-	National Irrigation Commission
NOU	-	National Ozone Unit
NPK	-	Sodium, Phosphorus and Potassium
NRW	-	Non-Revenue Water
NTWG	-	National Technical Working Group
ODS	-	Ozone Depleting Substances
PDA	-	Personal Digital Assistant
PET	-	Polyethylene Terephthalate
PFCs	-	Perfluorocarbons
PIC	-	Prior Informed Consent
PSMP	-	Power System Master Plan
REA	-	Rural Energy Agency
S/A	-	Sulphate of Ammonia
SADC	-	Southern Africa Development Community
SAN	-	Sustainable Agricultural Network
SAP	-	Subsidiary Action Programme
SDG	-	Sustainable Development Goals
SDGs	-	Sustainable Development Goals
SOP	-	Sulphate of Potash
SP	-	Strategic Plan

SVP	-	Shared Vision Programme
TAFIRI	-	Tanzania Fisheries Research Institute
TAFORI	-	Tanzania Forest Research Institute
TANAPA	-	Tanzania National Parks
TANESCO	-	Tanzania Electric Supply Company
TAWA	-	Tanzania Wildlife Management Authority
TCF	-	Trillion Cubic Feet
TCMP	-	Tanzania Coastal Management Partnership
TFS	-	Tanzania Forest Services
TMA	-	Tanzania Meteorological Agency
TON	-	Tonnes
TPA	-	Tanzania Ports Authority
TPDC	-	Tanzania Petroleum Development Corporation
TRA	-	Tanzania Revenue Authority
TSP	-	Triple Super Phosphate
TZS	-	Tanzania Shillings
UNCLOS	-	United Nation Convention on the Law of the Sea
UNESCO	-	United Nations Education, Science and Cultural Organization
URT	-	United Republic of Tanzania
URT	-	United Republic of Tanzania
USAID	-	United States Agency for International Development
USD	-	United States Dollars
UWSS	-	Urbanl Water Supply and Sanitation
VPO	-	Vice President's Office
WMO	-	World Meteorological Organization
WQMPCS	-	Water Quality Management and Pollution Control Strategy
WRMA	-	Water Resources Management Act
WSSAs	-	Water Supply and Sanitation Authorities
WSSR	-	Water Sector Status Report
WUA	-	Water Users Associations
ZAMCOM	-	Zambezi Basin Watercourse Commission

PREFACE

The National Environment Statistics Report, 2017 (NESR, 2017) is the first ever national comprehensive report on environment statistics in Tanzania. Publication of this report has shifted the paradigm of production of environment statistics in the country, from the conventional practice of researching on a single environment phenomenon to a multi and inter disciplinary approach encompassing various aspects of the environment. This transition was made possible upon National Bureau of Statistics (NBS) request for technical support from United Nations Statistics Division (UNSD) to enhance the production of environment statistics within the National Statistical System (NSS) which meet international standards. As a follow up to this request, the UNSD advised on the use of Framework for the Development of Environment Statistics (FDES 2013), which was endorsed by the United Nations Statistical Commission (UNSC) as a guideline for production of environment statistics. FDES 2013 classifies environment statistics into six components namely, Environmental Conditions and Quality; Environmental Resources and their Use; Residuals; Extreme Events and Disasters; Human Settlements and Environmental Health; and Environmental Protection, Management and Engagement.

Environment statistics is a relatively new field in statistics development when compared with other branches of statistics such as economic or social statistics. This is understood, since issues of environment became more prominent after the 1992 Rio Summit. However, in spite of this perceived infancy, the demand for environment statistics is increasing in tandem with the ongoing environmental challenges faced by societies. These challenges emanate from use of technology, population pressure, energy issues, sustainable development and climate change. The realization that human wellbeing and development depend on the environment has led to an increasing emphasis on the environment and sustainability concerns on which decisions and actions need to be taken. For instance, environment is among the three pillars of sustainable development to ensure environment sustainability is achieved in parallel with social and economic development of the society. Of paramount importance to these actions is the regular production of environment statistics of the highest quality to monitor the performance of national, regional and international development plans, policies and programmes for sustainable development.

NESR, 2017 provides a comprehensive picture of the environment situation of the country and it is an important instrument for policy integration and informed decision making. The NESR, 2017 covers a wide range of environment topics to facilitate one stop access and use of environment statistics for evidence-based decision making. It provides statistics for monitoring of national, regional and global development frameworks such as Tanzania Vision, 2025; the National Five - Year Development Plans; the East Africa Community Vision 2050; the Africa Development Agenda, 2063; the Sendai Framework for Disaster Risk Reduction 2015 – 2030, the Paris Climate Agreement 2015 and the UN Sustainable Development Goals, 2030 (SDGs, 2030). These development frameworks articulate environment management milestones to be attained over the course of time. In this regard, data and information in this report help quantify the stress that is put on environment and informs the strategies that seek to minimize harm to the environment and mitigate climate change.

Most of the statistics presented in this report have been gathered from administrative sources from various institutions and thus, some of the data may already be available in other publications. NBS as a coordinator for production and dissemination of official statistics within the NSS appreciates the contributions of all the experts and stakeholders who provided data for this report. The report provides series of statistics from 2012 to 2016 and whenever possible, 2017 statistics are also presented.

Notwithstanding the foregoing, there are still data gaps that would need to be addressed to comprehensively meet the high and growing demand for environment data and statistics. NBS in collaboration with the National Technical Working Group for Environment Statistics (NTWG) will put more efforts to fill the identified data gaps and update this publication every two years. NBS will also be producing environment statistics booklets, in between the years of production of the NESR, which will include frequently produced data to meet data needs.

Production of this report would not have been successful without collaboration of various participants who contributed valuable inputs throughout the process. In this regard, I wish to extend my sincere gratitude to the development partners, particularly the World Bank (WB) for the financial support through the Tanzania Statistical Master Plan (TSMP), the United Nations Statistics Division (UNSD) and the East African Community (EAC) Secretariat for their technical support. I appreciate the substantial technical contribution made by Ms. Reena Shah, the Chief of the Environment Statistics Section at UNSD and the coordinator of Module A of the UN Development Account project (DA) “Supporting member states in developing and strengthening environment statistics and integrated environmental-economic accounting for improved monitoring sustainable development”, of which Module A focused on strengthening environment statistics in the EAC Secretariat and its member states.

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I also wish to extend special thanks to the heads of Ministries, Departments and Agencies (MDAs) from which members of the NTWG on environment statistics were appointed. Appreciations are particularly extended to Irenius Ruyobya, Director for Statistical Operations Directorate and Ruth Minja, Environment Statistics and Further Analysis department Manager at NBS for managing the compilation of this report. I acknowledge the immense technical and coordination support provided by Jafari Chobo from Tanzania Metorological Agency (TMA), in his capacity as Chairperson of the NTWG and of other members of the NTWG indicated below: Mandalo Salum (Tanzania Forest Service Agency); Ndalu Youbert Amos (National Environment Management Council); Faraja Ngerageza (Vice President's Office); Jane Alfred (Prime Minister's Office); Julius Edward (Planning Commission); Ansbert S. Rwamahe (Ministry of Natural Resources and Tourism); Simon Mwansasu (University of Dar es Salaam); Diana Kimbute (Ministry of Water and Irrigation); Sarah Novaty Kayunze and Obeth Mwakalindile (Ministry of Agriculture); Lait A. Simukanga (National Irrigation Commission); Thobias M. Sonda (Tanzania Ports Authority); M.J. Gwambaye (Tanzania People's Defence Forces); Jackson Birore and Aziza Swedi (Ministry of Mineral); John Francis Kitonga (Ministry of Energy); Brigita Sylvester (Tanzania Electric Supply Company Ltd); Abel Mhehe Anthony (Ministry of Livestock and Fisheries); Milka Jane Sangiwa (Tanzania Forest Research Institute); Annes Mahembe (Ardhi University); Deogratius Malamsha, Pius Kaskana, Opiyo Mamu and Hashim Njowele (NBS) and the NBS editorial team.

NBS welcomes comments and suggestions regarding this report and for improving quality of future reports. All comments and suggestions should be addressed to the Director General, National Bureau of Statistics, P.O. Box 796, Dar es Salaam, e-mail dg@nbs.go.tz.

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EXECUTIVE SUMMARY

The National Environment Statistics Report, 2017 follows the structure proposed by the Framework for the Development of Environment Statistics, 2013 (FDES 2013), for collection and compilation of environment statistics at the national level. The report brings together data and information from various subject areas and sources covering issues and aspects of the environment that are relevant for measuring, monitoring and decision making for various environmental phenomena.

Chapter one of the report on Environmental Conditions and Quality, presents statistics about the physical, biological and chemical characteristics of the environment. In this report, statistics on meteorology; hydrography; geography; soil characteristics; land cover; ecosystems and biodiversity; forests; and freshwater quality are presented.

Regarding the climate, the report notes that, most part of Tanzania is characterized by two main rain seasons, long rains (*Masika*) from March to May, and the short rains (*Vuli*) from October to December. The mean maximum temperatures are observed in September to March, ranging from 26.6°C in southern western to 33.1°C in northern Eastern. The mean minimum temperatures occur in July, ranging from 5.3°C in southern western regions of the country to 18.3°C in coastal areas. The report findings also show that, for the period of 2012 - 2016, the observed annual mean maximum temperature was 28.5 °C while the annual mean minimum temperature was 18.0°C.

The results further indicate an increasing trend of monthly mean maximum temperatures with an average of 30.0°C for the period of 2012 to 2016 compared to 29.4°C for the long-term period from 1981to2010. For the period of 2012 to 2016, there hasn't been significant variability on annual total rainfall. The minimum amount of annual rainfall was 411.8 mm and maximum 2,280.0 mm.

Regarding hydrographical characteristics, the report underscores the country's great endowment of surface water resources, including - rivers; lakes; springs and dams. All lakes and swamps constitute about 5.8 % of the country's surface area. Management of these water resources is

based on hydrological boundaries in the form of basins, rather than administrative boundaries. The report notes that, Rufiji (182,708.10 Km^2) and Lake Nyasa (34,266.09 Km^2) are the largest and smallest basins respectively out of the nine water basins in Tanzania. In addition, seven out of the nine basins are transboundary in nature.

The report also presents some statistics regarding soil characteristics and land cover; the findings reveal that, the dominant soil groups in Tanzania are Cambisols (37 %), followed by Luvisols (7.6 %), Lixisols (6.7 %) and Ferrosols (5.7 %). For the land cover, woodlands and cultivated lands are the major contributors to the total land cover with 53.6 % and 20.6 %, respectively. Other types of land cover, like forests, bush land, grass land, open land, water and others, account for less than 10.0 % of the total land cover each.

With respect to the country'secosystems, the report reveals three dominant types of natural ecosystems in Tanzania, namely: - terrestrial ecosystems, inland water ecosystems (lakes, rivers, dams and wetlands), and coastal and marine ecosystems. For the terrestrial ecosystems, the forest ecosystem occupies 55 % of total land area while the agricultural ecosystem occupies 45 % of total land area under terrestrial ecosystems. The report also informs about several species of flora and fauna native to Tanzania. There are six known flora species that are endemic to Tanzania, namely: - *Saintpaulia goetzeana; Saintpaulia shumensis; Allanblackia stulhmanii; Allanblackia uluguruensis; Ocotea usambarensis; and Afrocarpus usambarensis.* The invasive flora species are: - *Maesopsis emini; Leucaena spp; Lantana camara; and Cedrela Mexicana*. The invasive species are among the drivers of environmental changes and important causes of loss of biodiversity.

Chapter two of the report - Environmental Resources and their Use, presents information about quantities of environmental resources and their changes, along with statistics on activities related to their use and management. The report presents statistics on various topics under various subcomponents of the FDES 2013, particularly on mineral resources; energy resources; land; and biological resources.

For the mineral resources, the report pictures Tanzania as one of the major mining countries in Africa, the 4th major gold producer in Africa, and also endowed with other industrial mineral

reserves, including iron ore (219 million tonnes); titanium (175,000 tonnes); uranium (156 million pounds) and other metals in various quantities. On the production and trade of minerals, Tanzania is the sole producer of the precious Tanzanite gemstone worldwide. The report indicates that, for the period of 2013 to 2016, there has been an increase in production of important minerals such as gold by 1.5 percentage points, diamond by 6.8 percentage points, coal by 22.1 percentage points, silver by 11.8 percentage points, and copper by 6.2 percentage points. The increase in mineral production was attributed by the increase in industrial demand. On the other hand, statistics indicate a decline in production of some mineral resources such as: Tanzanite by 17.1 percentage points; and tin by 27.5 percentage points. On importation of minerals, the report findings reveal that, coal and clinker are the two major imported minerals in Tanzania. The imports for these minerals in 2015 amounted to 244,400 and 50,000 metric tonnes respectively and, were largely contributed by an increase in demand for cement production. On the export side, statistics indicate that gold has been the most important exported mineral, contributing more than 80 % of the country's exports earnings from minerals for the period 2013 – 2016.

The available statistics demonstrate that there have been some positive results from the Government strategies to develop the energy sector to ensure reliability, availability, affordability and access to modern energy services in the country. There has been a palpable increase in production of natural gas from about 21,000 cubic feet in 2013 to 51,000 cubic feet in 2017. As a result of this increase, use of gas in electricity production accounts for a larger proportion (51 %), compared to the use of hydro, 35 %; diesel, 13 %. Electricity generation has also grown considerably, rising from about 5,000 GWh in 2011 to 7,000 GWh in 2017. It also depicts the commitment of the Government to enhance electricity generation by increasing installed capacity from 1,583.0 MW 2014 to 10,000MW by 2025 and increasing connection levels from 32 % in 2016 to 75 % by 2033.

Chapter three - Residuals, presents statistics on the amount and characteristics of remnants generated by human production and consumption processes, their management and their final discharge to the environment. The report presents information for subcomponent emissions to air, particularly on consumption of Ozone Depleting Substances (ODS); and Generation and Management of Wastewater.

With respect to emissions to air, Tanzania is a low volume consuming country of the ODS. However, despite the minimal consumption, there has been a steady consumption of ODS alternatives for the period of 2012 to 2015, while consumption of Hydro chlorofluorocarbons (HCFCs), in particular has been on the decline. It is revealed that, Hydrochloro (HC 600a) is one of the most common ODS alternatives used in Tanzania, which increased from 232.6 MT in 2012 to 636.4 MT in 2015. In order to regulate trade and consumption of ODS, the Government has put in place licensing regulations for ODS. These regulations oblige people intending to import or export a controlled substances or products to lodge an application to the Director of Environment at the Vice President's Office. On Generation and Management of wastewater, statistics reveal a general increase in wastewater generation from about 74 million cubic metres per year in 2013 to 100 million cubic metres per year in 2015. The volume of wastewater collection and treatment has however, nearly remained nearly stagnant at about 16 million cubic metres per year during this period. At the same time, there has beena steady increase in volume of wastewater that is discharged to the environment without treatment from about 57.5 million M^3 to 83.7 million M^3, during this period.

Chapter four of the report- Extreme Events and Disasters presents statistics on the occurrence of extreme events and disasters and their impacts on humans and on infrastructure. The report indicates floods, droughts, heavy rainfall and earth quakes being common natural events and disasters, and notes their occurrence in various parts of the country at various times. The latest natural disaster was an earthquake which hit Kagera region in 2016. The reported casualties associated with this disaster were 17 deaths and 440 injuries. The damage to infrastructure included total demolition of 2,072 private houses, 2,191 partial damages to public buildings and 14,595 private houses. The report also notes fire and motor or marine accidents being the frequent technological or man-made disasters.

Chapter five of the report presents statistics on the environment in which humans live and work, particularly with regard to living conditions and environmental health. This information is covered under various sub-components of the FDES 2013. The NESR, 2017 specifically, presents statistics on population, access to some basic amenities and housing conditions.

With regard to population, the Tanzania population distribution is suchthat there are more people living in rural than in urban areas. The rural-urban population ratio is estimated at 70:30 (2012 Census). With respect to access to some basic services, the statistics showthat nearly six-tenths of the population (58.6 %) use improved drinking water sources and 67.5 % have access to electricity. Under one-fifth of the population (19.0 %) use improved toilet facilities.

On housing conditions, the report notes that as of 2012, about 39.4 % of households had their house floors made of cement or tiles, and 58.6 % of households had their house floors made of earth. The report also indicates baked or burnt bricks and iron sheets are common building materials for walls and roofs. About 27.3 % of households had their house walls made of burnt bricks, while 66.3 % had their house roofs maded of iron sheets.

Chapter six of the report- Environmental Protection, Management and Engagement, presents statistics and information regarding the country's engagement in protection and management of the environment and the resources it dedicates to that task. In particular, it presents information on Government environmental protection and resource management expenditure; institutional strength of the environmental management authority; environmental regulations and instruments; and participation in Multilateral Environmental Agreements (MEAs) and environmental conventions.

With respect to Government environmental protection and resource management expenditure and institutional strength of the environmental management authority, the report underlines the National Environment Management Council (NEMC) as the authoritative office for environmental management in Tanzania. The NEMC had staffing strength of about 160 employees and budgetary allocation of about TZS 13.1 billion per year as of 2016.

The report also underlines the country's environmental initiatives towards regional, continental and global communities. Tanzania as a member of the global community has joined in the global efforts by taking part in addressing various global environmental challenges through ratification of several MEAs. Some important MEAs which have been ratified include: - United Nations Convention to Combat Desertification; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; United Nations Framework Convention on

Climate Change (UNFCCC); Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Kyoto Protocol to the United Nations Framework Convention on Climate Change; and Vienna Convention for the Protection of the Ozone.

Summary Table of Key Latest Available Environment Statistics, 2013-2017

S/N	INDICATOR	VALUE
1.	**TEMPERATURE, 2012 – 2016**	
	Range of Mean minimum temperature (°C)	5.3°C to 18.3°C
	Range of Mean maximum temperature (°C)	26.6°C to 33.1°C
2.	**RAINFALL, 2012 – 2016**	
	Ranges of Annual Rainfall	550 mm to 2500 mm
	Minimum Rainfall	411.8 mm
	Maximum Rainfall	2,280.0 mm
4.	**HYDROLOGICAL CHARACTERISTICS**	**VALUE**
	Largest water basin (Rufiji basin)	182,708 Km^2
	Smallest water basin (Nyasa basin)	34,266.09 Km^2
	Lakes and swamps country area coverage	5.4 million hectares
	Annual average available renewable water resources per capita - 2015/2016	1,952 M^3/Year
	External renewable water resources - 2016	12.27 million M^3
	Estimated surface water leaving the country - 2016	15,640 million M^3/year
	Number of dams - 2009	633
	Total capacity of large dams - 2009	104,200 million M^3
5.	**WATER USE**	
	Total water withdrawn in year 2012	5,142 million M^3
	Proportions of Dominant Sectors in Use of The Withdrawn Water Resources	
	Agricultural sector	90 %
	Municipal sector - 2002	10 %
	Rural population in Tanzania mainland (2012)	31,623,999
	Cumulative water points constructed (from 2007 to 2016)	95,733
	Cumulative number of rural population served with water (from 2007 to 2016)	22,792,322
	URBAN WATER SUPPLY & SANITATION	
	Groundwater withdrawal - 2012	462 million M^3
	Urban population served with clean and safe water (23 regional headquarters) - 2016	86 %
	Number of people with access to water supply - 2016	4,260,820
	Domestic connections - 2016	375,757
	Kiosks - 2016	2,013
6.	**DOMINANT SOIL TYPES IN TANZANIA**	
	Cambisols - soils characterized by slight or	37 %

	moderate weathering of parent material and by absence of appreciable quantities of illuviated clay, organic matter, aluminium and/or iron compounds.	
	i. Luvisols - are fertile soils and suitable for a wide range of agricultural uses	7.6 %
	ii. Lixisols – Suitable for perennial crops	6.7 %
	iii. Ferrasols - less susceptible to erosion and easy to work	5.7 %
7.	**Land Cover - 2015**	
	Forest/woodland/bush land cover	60 %
	Cultivated land (Around)	20 %
8.	**Total number of game reserves**	28
	Game Reserves Coverage Area	114,782.97 Km^2
9. EXPORTATION OF SELECTED MINERALS (000), 2016		
	Gold - 45.15 Kg	USD 1,824.81
	Diamond 239.89 Carats	USD 90.39
	Tanzanite 13.94 Kg	USD 29.05
10. NATURAL GAS PRODUCTION (MCFT), 2013 – 2017		
	2013	20,633.43
	2014	33,845.69
	2015	37,182.41
	2016	48,247.21
	2017	51,041.21
11. ELECTRICITY GENERATION (GWh) BY TYPE OF FUELS, 2011 - 2017		
	Gas	21,817.4
	Hydro	14,972.9
	Diesel/HFO/GO	5,649.4
	Biomass	116.9
12.	**GENERATION OF WASTE WATER IN DAR ES SALAAM CITY, 2017**	
	Volume of wastewater generated	100,078,972 M^3
	Volume of wastewater collected	16,329,545 M^3
	Total volume of wastewater discharged to the environment after treatment	16,329,545 M^3
	Total volume of wastewater discharged to the environment without treatment	83,749,428
13.	**GENERATION OF SOLID WASTE (TONNES) PER ANNUM IN DAR ES SALAAM CITY, 2013 - 2016**	
	Residential Sources	594,000
	Industrial Sources	46,000
	Non Industrial Sources	1,476,000
14.	**RECENT NATURAL DISASTERS AND CASUALTIES**	

	Earthquake occurred on 10th September,2016 in Kagera Region	17 people died and 440 people were injured
15.	**RECENT TECHNOLOGICAL DISASTERS AND CASUALTIES**	
	Collapse of a Building in Dar es salaam on 29/03/2013	39 People died

BACKGROUND, METHODOLOGY, AND CONCEPTS AND DEFINITIONS

Background

Historically, compilation of environment statistics dates back to 1994 when the National Bureau of Statistics in collaboration with the Statistics Sweden compiled the first pamphlet on Environment Statistics. Due to lack of resources, NBS could not manage to maintain periodicity of environment statistics reports. The next publication was compiled in 2012, followed by 2014. This publication marks the first comprehensive National Environment Statistics Report in Tanzania Mainland which is compliant with the International Framework for the Development of Environment Statistics, FDES 2013. NBS is planning to update this publication every two years and also produce environment statistics booklet on annual basis to inform the public on the status of environment for selected high frequency environment statistics such as climate change.

Objectives of Environment Statistics Report

The Environment Statistics Report provides statistical data on various environmental aspects. It helps in monitoring state of environment of the country over time and provides data for evidence based decisions on different development programmes. The specific objectives of the Environment Statistics Report include the following:

i. Measure goods and services provided by the environment to economy and the impact of the economic activities and development on the environment;
ii. Increase community awareness on the importance of preserving the environment and support efforts to protect the environment;
iii. Provide data on available and stocked natural resources and the extraction of those resources;
iv. Provide data on environment pollutants and the extent of its impact on the environment;
v. Combine planning tools with environment statistical indicators;
vi. Monitor the value of the State’s contributions and assistance to preserve the environment; and
vii. Provide information about the actions taken to protect the environment in the country.

Methodology

The environment statistics include a wide range of information which is multidisciplinary in nature. Data sources are spread over different organizations and data producers, and numerous methods are applied for their compilation. The data used for production of the National Environment Statistics Report, 2017 were compiled using a variety of data collection techniques such as statistical surveys, administrative records, remote sensing (for satellite imaging of land use, water bodies or forest cover); monitoring systems (field-monitoring stations for water quality, air pollution and climate); and scientific research and special projects undertaken to fulfil National and International demand.

In order to produce high quality environment statistics, specific statistical and environmental expertise, knowledge, institutional development and adequate resources are necessary. This includes presence and application of an appropriate framework to guide the development, coordination and organization of efforts for statistics production at all levels. To facilitate this, NBS has started to apply the United Nations Framework for the Development of Environment Statistics (FDES) 2013 to guide National Efforts in the production of Environment Statistics.

Adoption of the UN Framework for the Development of Environment Statistics (FDES 2013)

In strengthening production and dissemination of environment statistics, the NBS has been working in close collaboration with the United Nations Statistics Division (UNSD) for technical support. This synergy was realized through the UNSD Development Account Project named, *"Supporting Member States in developing and strengthening environment statistics and integrated environmental-economic accounting for improved monitoring of sustainable development" of which Module A focuses on strengthening environment statistics in the East African Community (EAC) Secretariat and its member states.*

In Tanzania, the UNSD support for production of Environment Statistics has focused on activities including:

i. Introduction of Framework for Development of Environment Statistics (FDES 2013) and Environment Statistics Self-Assessment Tool (ESSAT);
ii. Capacity building to enhance knowledge of the environment experts within the NSS;
iii. Improved data quality assurance procedures when comparing the recommended methodology in the FDES 2013 with the quality dimensions used to compile the available statistics;
iv. Support on environment statistics' prioritization using tier classification;
v. Participation in the development of regional EAC Environment Statistics Compendium; and
vi. Promoting of inter-institutional platforms such as the establishment of the National Technical Working Group (NTWG) on environment statistics. This is a technical forum in which issues related to production of environment statistics are discussed and has representation from Ministries, Department and Agencies (MDAs) responsible for production of environment statistics in the country.

The introduction of ESSAT enabled Tanzaniato conduct a data gaps assessment to identify available environment statistics, identify data sources, existing gaps and reasons for non-availability. Furthermore, adoption of the tools facilitated designing of data capture questionnaire according to FDES 2013, development of National Environment Statistics Action Plan (NESAP, 2017/18) and development of metadata guidelines to be used by data producers for quality assurance, to increase transparency in data production and to facilitate data comparison.

The FDES 2013 organizes environment statistics into three tiers based on the level of relevance, availability and methodological development of the statistics, Using this approach, it has been possible to identify among others, the Basic Set of Environment Statistics in the country and the associated methodologies to identify and reclassify the environmental concerns highlighted in the National Environmental Policy (NEP, 1997) according to the FDES 2013 and identify environmentally-related SDG indicators which can be monitored using the existing national environmental frameworks. In effect, this has helped to improve coverage of environment

indicators for monitoring and implementation of national, regional and global development programmes.

Main Challenges faced during the implementation of FDES 2013 and ESSAT

This exercise was, however, not without challenges. Among the main challenges faced during the implementation of the FDES 2013 and ESSAT include:-

i. Lack or incomplete metadata for some indicators from Ministries, Departments and Agencies (MDAs)
ii. Inexistence of coordinated Information Management Systems in MDAs

Concepts and Definitions for Environment Statistics

Climatology

This refers to Climate and its phenomenon, sometimes understood as the "average weather," and is defined as the measurement of the mean and variability of relevant quantities of certain variables (such as temperature, precipitation or wind) over a period of time, ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO).

Long term Mean

Refers to climatological standard normal which is defined as averages of climatological data computed for successive 30-year periods (WMO).

Variability

The term is often used to denote deviations of climatic statistics over a given period of time (e.g. a month, season or year) from the long-term statistics relating to the corresponding calendar period.

Bimodal Areas

Refers to areas having two rainfall regimes per year.

Unimodal Areas

Refers to areas having a single rainfall regime per year.

Precipitation (Rainfall)

The total amount of rainfall reaching the ground during a stated period is expressed as the depth to which it would cover a horizontal projection of the Earth's surface. The rainfall averages/totals are based on the daily rainfall measurements. Daily rainfall is defined as the 24-hour accumulated amount of rain from 8:00 AM on a given day until 8:00 AM the following day.

Temperature

Air temperature is a measure of how hot or cold the air is. It is the most commonly measured weather parameter. More specifically, temperature describes the kinetic energy, or energy of motion, of the gases that make up air. As gas molecules move more quickly, air temperature increases. Air temperature is measured in a shaded enclosure (most often a Stevenson Screen) at a height of approximately 1.2 metres above the ground. Maximum and minimum temperatures for the previous 24 hours are nominally recorded at 9 am local clock time. Minimum temperature is recorded against the day of observation, and the maximum temperature against the previous day.

Forest

A continuous stand of trees many of which may attain a height of 50 metres. Species composition is quite different from that of the woodland. Normally has three canopy layers; emergents, middle and lower canopy with a regenerative canopy beneath. Forests are further characterized by the presence of lianas, climbers and creepers, and also epiphytes including ferns and, occasionally, orchids.

Woodland

The canopy coverage in woodland typically ranges between 20–80 % (Closed if crown cover>40 % and Open if crown cover <40), and height between 5–20 metres although occasionally being taller. Wet woodland is dominated by Brachystegia/Julbernadia sp. (Miombo woodland). Dry woodland is usually dominated by Acacia. Trees possess recognizable stems, normally single, that may be measured for both diameter and height. Woodland is characterized by only two main

strata - the main canopy itself and a shrub / herb-layer beneath, which often contains regenerating saplings of the species comprising the main canopy.

Bushland

Bushland differs from Woodland in two principal ways. Stature is less, rarely exceeding 5 m and normally between 1–3 metres in height. Single-stemmed plants are almost nonexistent. The exception is when there are occasional trees termed as emergents. Bushland is fundamentally defined as being predominantly comprised of plants that are multi-stemmed from a single root base.

Grassland

Predominantly grasses though may contain ground cover of trees or bushes below 10 % of total.

Cultivated Land

The physiognomy varies widely in accordance with the significance of the tree and crop component associated with each sub-class. The agro forestry systems contain permanent tree crops (timber and fruit) which are mixed with permanent and annual agricultural crops (yam, beans, banana, coffee, etc. The tree crops (Gravillea, Albizia, Cordia, Citrus, Acrocarpus, etc.) which form the upper canopy act as shade to the lower canopy crops (banana, coffee, beans). Cultivation with herbaceous crops (e.g. cotton, vegetables, sisal, tobacco, flowers etc) where the tree component may be reduced to the occasional fruit tree or trees retained to demarcate field boundaries. Cultivation with grain crops is a sub-class that approaches open grassland where the role of trees is often diminished. Cultivation with pure woody crops of cashew, tea, coffee, mango, citrus, jackfruit and coconut are common and identifiable as a subclass where the physiognomy approaches a closed woodland, or woodland with scattered cropland.

Open Land

The common feature is that vegetation cover is almost or entirely absent in each case, although many rock outcrops often bear small pockets of xerophytes that are botanically very interesting. These units are not represented extensively upon the maps. Bare soil type may be more widely represented, but is generally confined to the larger lake shores and disturbed areas.

Inorganic Fertilizer

Inorganic fertilizers are natural compounds formed through chemical processes (composed of natural chemicals and minerals) or are fertilizers mined from mineral deposits or manufactured from synthetic compounds.

Known Flora and Fauna Species

Endemic species are flora and fauna species which occur in only one geographical region. The total number of endemic species (i.e. flora and fauna) in Tanzania is not well known but it's estimated to range between 400-3000 species. Most of the endemic species are likely to be found within the Eastern Arc Mountains as they are famously known to harbour a diverse number of flora and fauna.

Invasive species are the species that are non-native to the ecosystem whose introduction cause economic and environmental harm. They are among the significant drivers of environmental change worldwide and important causes of biodiversity loss.

Research to obtain data on known flora and fauna species takes long time to be completed; it requires professionalism and large investment to capture these data, thus obtaining such data may seem impossible although through external help some areas have been researched on.

Protected Areas and Species

Protected areas are the sites which are set aside to conserve the wildlife present in that specific area. In Tanzania, protected areas include 16 national parks that comprise a total area of 57,365 Km^2, 28 Game Reserves covering a total area of 114,782.97 Km^2, and 42 Game Controlled Areas covering a total area of 55,565.02 Km^2.

In national parks only nonconsumptive wildlife utilization is allowed while in game reserves and GCAs both consumptive and non-consumptive wildlife utilization is allowed after permits are obtained.

Ruaha National Park is the largest covering a total area of 20,300 Km^2 while Saanane Island National park is the smallest, covering an area of 50 Km^2.

Most protected areas are affected by encroachment by local communities living near the areas and illegal hunting activities that affect the management efforts.

Forest Reserves

Forest nature reserves (FNRs) are area that are protected and managed in order to preserve particular types of habitat and their flora and fauna which are often rare or endangered. No extraction of woody or animal species is allowed in these FNRs and activities are generally restricted to research, education and nature-based tourism.

To date Tanzania has a total of 12 forest nature reserves which are managed by Tanzania Forest Service Agency (TFS).

Minerals

Mineral is any substance, whether in solid, liquid or gaseous form, occurring naturally in or on the earth, or in or under the seabed formed by or subject to a geological process, but does not include petroleum or surface water.

Exploration

Exploration is the search for minerals by drilling, trenching, excavation, blasting, disturbance of the ground by mechanical means, or prescribed geophysical equipment.

Mineral Reserves

Reserve are quantities of mineral resources anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions.

Mineral Production

Mineral production is defined in physical terms as the amount of the mineral extracted from the deposit within the national territory in a given period of time, usually a year.

Mining

Mining is the extraction of ore from the ground.

Surface Mining

Surface mining involves the removal of overburden and waste rock, drilling of the ore, blasting, loading and transporting the materials for storage or beneficiation.

Underground Mining

Underground mining involves excavating of either, a vertical shaft, a horizontal adit or an inclined passageway. It involves ore extraction from the ground, which is then transported, refined and processed (ore dressing).

Ores dressing

Ores dressing is themilling and separation of ore minerals from gangues.

Refining or Purification

Refining or Purification is the removal of impurities from substance; it depends on the nature of the metals and impurities.

Smelting

Smelting is the process of recovering metals from mineral concentrates.

Mineral Imports

Mineral imports are defined in physical terms as the amount (in mass or volume) of the minerals that is produced or extracted by non-residents outside the national territory and that is bought by the residents of the national territory in a given period of time, usually a year.

Export of Minerals

Exports are defined in physical terms as the amount (in mass or volume) of the minerals that is produced by the residents of the national territory and sold to non-residents in other territories in a given period of time, usually a year.

Natural Gas

Natural gas is a fossil fuel naturally occurring as a gaseous mixture of light hydrocarbons in sedimentary rocks. Main constituents of natural gas are methane, ethane, propane, butane and pentane with other non-hydrocarbons compounds including carbon dioxide, hydrogen, sulphide, nitrogen and rare gases found in small quantities.

Natural Gas Reserves

Natural Gas Reserves are quantities of gaseous energy resources anticipated to be commercially recoverable by application of development projects to known accumulations from a given date forward under defined conditions.

Natural Gas Production Field

Production field is an oil and gas producing area which has been given a specific name by regulatory bodies.

Energy Production

Production of energy is defined as the capture, extraction or manufacture of fuels or other energy products in forms which are ready for general consumption.

Renewable and Non-renewable Energy

Renewable energy: are energy resources which are naturally replenished on a human timescale while Non-renewable energy sources are finite in nature and do not get replenished.

Primary Energy Production

Primary energy products are extracted or captured directly from natural resources such as crude oil, coal, firewood and natural gas. Or primary energy is energy from sources that involve only extraction or capture with or without separation from contiguous materials, cleaning or grading before the energy embodied in that source can be converted into heat or mechanical work.

Import of Energy

Import of energy is energy such as petroleum, electricity, coal, LPG, JetA1 and etc that is imported or brought into the domestic territory from other territories or countries.

Total Energy Supply

Total energy supply is the total energy supply which includes primary energy and secondary energy supply.

Final Energy Consumption

Final energy consumption is the energy consumption by final user i.e. energy which is not being used for transformation into other forms of energy.

Electricity Generation

Electricity generation is the production of electric energy and power from any primary source of energy.

Fuel

Fuel is a material which can be burnt or processed to produce heat or power. Fuel types/sources include water (hydro), gas, oil (diesel oil, heavy fuel oil/HFO, gas oil/GO), biomass, coal, and others.

Electricity Consumption

Electricity consumption is the use of electric energy.

Electricity Consumption Groups:

Domestic Use (D1): This represents usage tariff for domestic customers who on average consume less than 75kWh per month, and the power is supplied at low voltage levels.

General Use (T1): Represents general usage tariff for customers such as residential, small commercial and light industries, public lighting and billboards, where power is supplied at low voltage levels.

Low Voltage Supply (T2): Represents a usage tariff for general use customers with an average consumption of more than 7500kWr and demand not exceeding 500kVA per reading metre reading period.

High Voltage Supply (T3): Represents tariff for customers connected to medium voltage. Zanzibar (T5): Represents tariff for customers connected to high voltage. These include Zanzibar Electric Company (bulk power to Zanzibar Electric Company-ZECO) and Twiga cement. Kahama Gold Mine (T8): represents a power usage tariff for Kahama mining company (Bulyanhulu mine)

High voltage supply (T3) refers to the supply of ac or dc voltage of the amount equal or above to sixty six thousand plus or minus ten percent (66,000-10 % kW).

Low voltage supply (T2) refers to the supply of ac or dc voltage less or equal to four hundred plus or minus five percent (400-5 % kW).

Electricity Supply is defined as sale of electricity to consumers.

Electricity access is defined as the proportion or percentage of the population living within 600 **metre**s from a transformer.

Connection level is the proportion or percentage of population/households with **metre**ed electricity.

Irrigation

Irrigation is the application of a specific amount of water at a particular location in order to meet the requirements of a crop growing at that location in amounts that are appropriate to the crop's stage of growth. It can also mean the application of water in amounts necessary to bring soil to the desired moisture level prior to crop planting.

Irrigation Potential

Irrigation potential is the total area which is technically feasible, economically and financially profitable, socially viable and environmentally acceptable that has been brought under irrigation, plus that which can be planned for irrigation on the basis of water availability, land availability and suitability.

Developed Irrigation Scheme

Developed irrigation scheme is an irrigation scheme that is provided with technically constructed or installed irrigation infrastructure and facilities.

Irrigation Scheme

Irrigation scheme is the area where crops are grown under irrigation through any method including flood recession; gravity or pump fed canal systems supplying either surface or groundwater; water harvesting and pressurised systems such as drip and sprinkler. Irrigation schemes include traditional schemes, rehabilitated or upgraded schemes, new smallholder investment and purely private commercial investment.

Traditional Irrigation Scheme

Traditional irrigation scheme is an irrigation scheme with irrigation system comprising of temporary infrastructure and/or facilities that are not technically constructed/installed

Ozone Depleting Substances (ODS) Alternatives

Ozone depleting substances (ODS) alternatives are those substances which deplete the ozone layer and are widely used in refrigerators, air conditioners, fire extinguishers, in dry cleaning, as solvents for cleaning, electronic equipment and as agricultural fumigants. They include: Chlorofluorocarbons (CFCs), Halon, Carbon tetrachloride (CCl_4), Methyl chloroform (CH_3CCl_3), Hydrobromofluorocarbons (HBFCs), Hydrochlorofluorocarbons (HCFCs), Methyl bromide (CH_3Br), and Bromochloromethane (CH_2BrCl).

The ODS are controlled by the Montreal Protocol, an internationally legally binding instrument which came into force in January 1989.

Ozone is a gas that occurs naturally in the atmosphere. Each ozone molecule contains three atoms of oxygen and is denoted chemically as O_3. Ozone has a pungent odour that allows it to be detected even at very low amounts.

Ozone Layer is a band of Ozone-rich air located at an altitude ranging from 10-50 Km in the upper part of Earth's atmosphere called the "stratosphere". The Ozone layer has the function of filtering biologically harmful ultraviolet solar radiation.

Servicing: Means any act of repair, maintenance, testing and trouble shooting of parts, including mechanical and electrical components of an existing refrigeration and air conditioning equipment.

Chlorofluorocarbon: a family of chemicals containing chlorine, fluorine and carbon.

Hydrochlorofluorocarbon: a family of chemicals containing hydrogen, chlorine, fluorine, and carbon.

Hydrofluorocarbons: a family of chemicals containing hydrogen, fluorine and carbon.

Hydrofluoroolefin: a family of chemicals containing hydrogen, fluorine and carbon, with a double bond in the molecule.

Roadways

This refers to the total distance in Kilometers of paved and unpaved roads in the country.

Marine Transport

Sea and Inland water ways transport services; it covers the number of passengers or tonnage of cargo transported by water ways in the country

Waste

Means any matter whether liquid, solid, gaseous or radioactive, which is discharged, emitted or deposited in the environment in such volume, composition or manner likely to cause an alteration of the environment, and includes such waste as may be prescribed under the (Environmental Management, Act No. 20 of 2004).

Waste Management

Waste Management is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of waste materials in a way that best addresses the range of public health, conservation, economics, aesthetic, engineering and other environmental considerations.

Hazardous wastes

Hazardous wastes imply toxic, flammable, corrosive or radioactive waste. These include motor oil, diesel, fuel, gasoline (petrol), paint, solvents, dry cell and batteries, pesticides and infectious or medical wastes from hospitals and clinics. They also include metallic and/or oily sludge or solvents from commercial and industrial establishments, asbestos materials, pesticides, radioactive wastes, and the like.

Recycling

Is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use.

CHAPTER ONE

ENVIRONMENTAL CONDITIONS AND QUALITY

1.1: Physical Conditions

1.1.1: Atmosphere, Climate and Weather

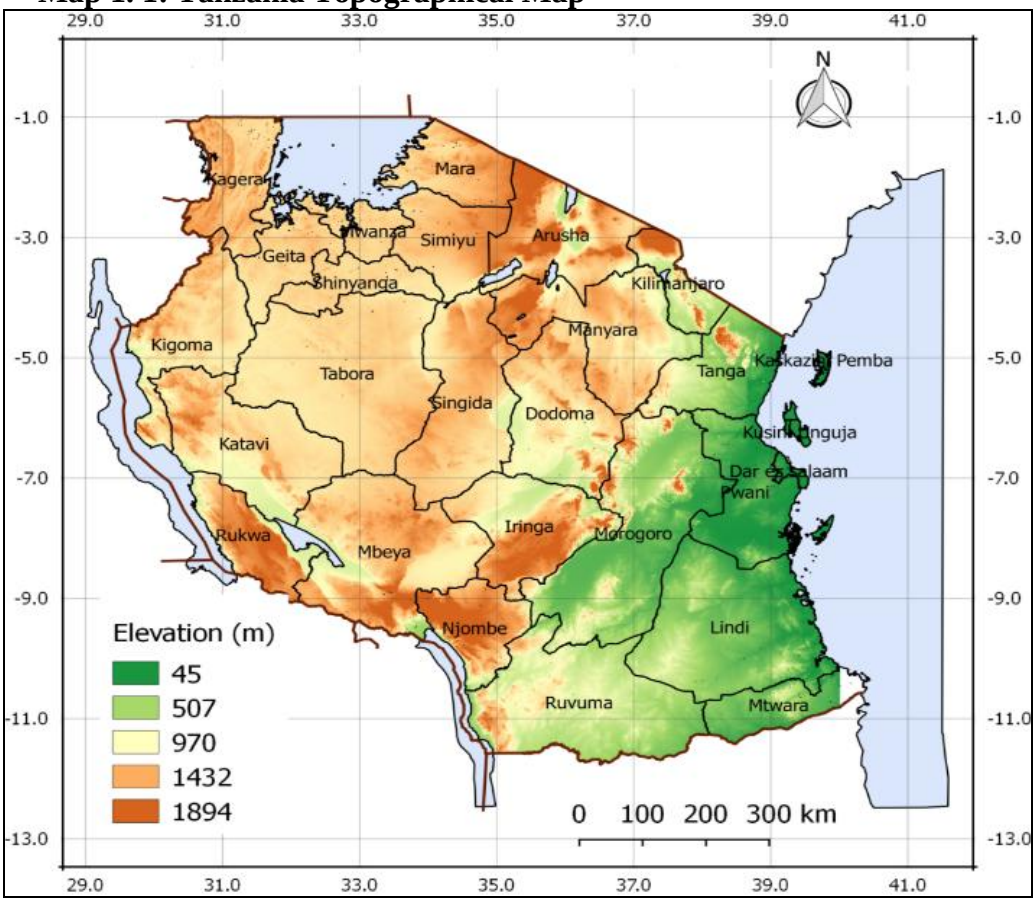
1.1.1.1: Background

This topic provides information on atmosphere, climate and weather compiled and managed by Tanzania Meteorological Agency (TMA). TMA is a Government Agency established by the Government Executive Agency Act No.30 of 1997 and officially launched on 3rd December 1999. The Agency is responsible for provision of meteorological services; weather forecasts, climate services and warnings and advisories information for the country. TMA is operating as an agency under the Ministry of Works, Transport and Communications. Among the roles of TMA are to monitor and predict the state and behaviour of the atmosphere, climate change and variability; and their impacts to communities. In fulfilling this role, TMA issues statement on the status of Tanzania climate annually. The statements provide detailed information on temperature and rainfall distribution, extreme weather events and their socio-economic impacts in the country.

1.1.1.2: Physical Features

Tanzania has complex topographical features extending from coastal belt of the western Indian Ocean with sand beaches to an extensive plateau with altitude ranging from 1,000 to 2,000 metres above mean sea level. The plateau is fringed by narrow belts of highlands, including Mount Kilimanjaro (5,895m), the highest mountain in Africa and other mountain ranges such as Livingstone, Kipengere, Udzungwa, Uluguru, Nguu, Usambara and Pare mountains. Tanzania has several freshwater bodies, including Lake Victoria, the largest in Africa; Lake Tanganyika, the longest and deepest in Africa; and Lake Nyasa. Tanzania has many large rivers including River Kagera, Mara, Ruaha, Rufiji, Pangani, Ruvuma and Malagarasi.

Map 1. 1: Tanzania Topographical Map



Source: Tanzania Meteorological Agency (TMA)

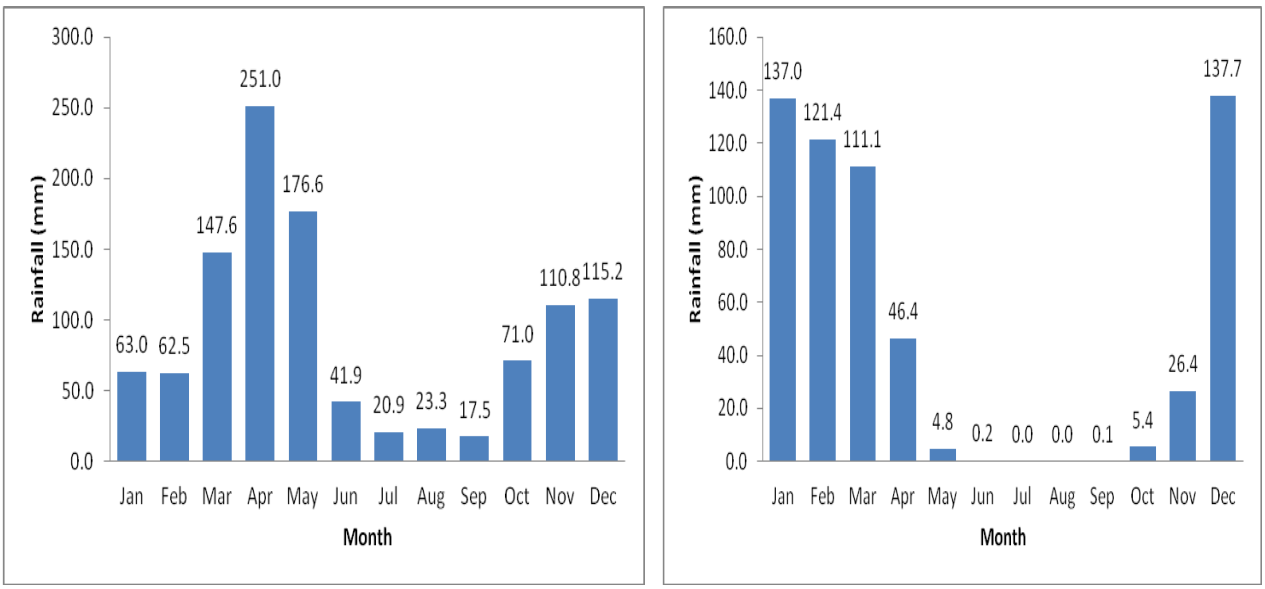
1.1.1.3: Climatology of Tanzania

The climate of Tanzania is characterized by bimodal and unimodal rainfall regimes. The northern part of the country including areas around Lake Victoria Basin (Mwanza, Kagera, Mara, Shinyanga, Geita and Simiyu), North-Eastern Highlands (Kilimanjaro, Arusha and Manyara) and the Northern Coast (Dar es Salaam, Tanga and Northern Morogoro) experience two main rain seasons (bimodal) namely, long rains (Masika) which normally begins in mid March and end at the ends of May and short rains (Vuli), which begins in mid October and continues to early December (Figure 1.1a). The Central part of the country (Dodoma and Singida), the Southern part (Ruvuma, Lindi and Mtwara), the Western areas (Kigoma, Tabora, Katavi and Rukwa) and South-western Highlands (Mbeya, Njombe, Iringa and Southern Morogoro) have a prolonged unimodal rainfall regime that start in November and continues to the end of April (Figure 1.1b). These rain seasons are associated with the southwards and northwards movement of the Intertropical Convergence Zone (ITCZ). Annual rainfall amount varies from 550 mm in the

central parts of the country to 2500 mm in some parts of surrounding Lake Victoria as indicated in Map 1.2.

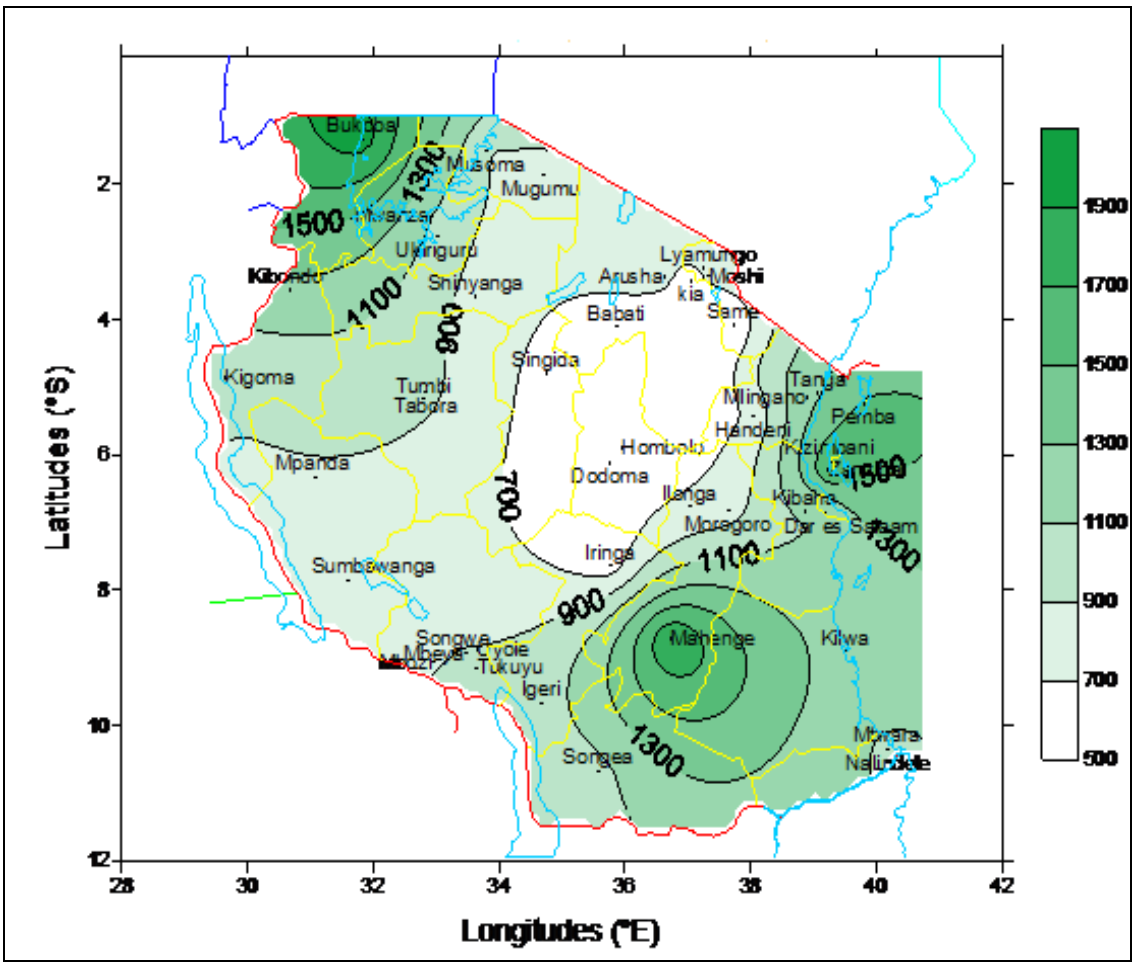
Figure 1. 1: Annual Cycle of Rainfall for 2 Selected Stations, Bimodal (a) Dar es Salaam and Unimodal (b) Dodoma

(a) Dar es Salaam (b) Dodoma



Source - Tanzania Meteorological Agency

Map 1. 2: Tanzania Annual Mean Total Rainfall Distribution for 30 Years, 1981-2010



Source: Tanzania Meteorological Agency (TMA)

Temperatures are generally are evenly distributed whereby mean maximum temperature is normally experienced in February and ranges from 26.6°C in Southern Western Highlands to 33.1°C in Northern Eastern Highlands. Mean minimum temperatures normally occur in July from 5.3°C in Southern Western Highlands to 18.3°C in coastal areas.

1.1.1.4: Annual Mean Maximum Temperature Records from Meteorological Stations

Table 1.1 presents annual mean maximum temperature for Tanzania for the period of 2012 to 2016 with overall mean maximum temperature of 28.5°C. The results further indicate that, the highest mean maximum temperature observed was 32.2°C recorded at Julius Nyerere International Airport (JNIA) meteorological station in Dar es Salaam in 2012. The lowest mean maximum temperature was 23.7°C recorded at Mbeya meteorological station in 2014. Available

statistics show that, annual mean maximum temperature variations from station to station are small.

Table 1. 1: Annual Mean Maximum Temperature (°C), 2012 - 2016

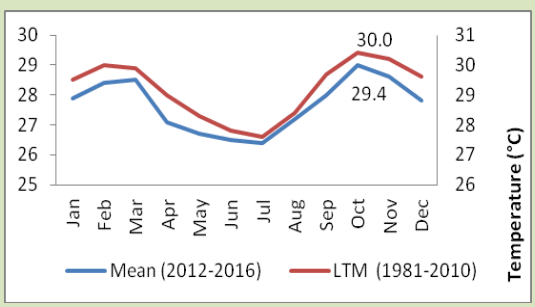
Station	2012	2013	2014	2015	2016	Mean
Bukoba	26.5	26.5	26.4	27.3	26.2	26.6
Mwanza	28.6	27.3	28.3	28.6	28.9	28.6
Musoma	28.7	28.9	28.2	29.7	28.6	28.8
Kigoma	29.5	29.2	28.1	29.9	30.0	29.3
Tabora	30.3	30.2	29.5	30.3	30.5	30.1
Dodoma	29.2	29.6	29.1	29.6	29.4	29.4
Iringa	27.8	27.4	26.4	27.4	27.2	27.0
Arusha	26.2	25.7	25.8	26.5	26.6	26.3
Kilimanjaro (KIA)	30.8	30.3	29.7	30.4	30.1	30.1
Dar es Salaam (JNIA)	32.2	32.1	32.0	32.0	31.3	31.8
Mtwara	30.6	31.0	30.7	31.1	30.9	30.9
Songea	26.7	27.3	26.7	27.7	28.0	27.5
Mbeya	25.1	24.6	23.7	26.2	24.0	24.6
Mean	**28.6**	**28.5**	**28.0**	**29.0**	**28.6**	**28.5**

Source: Tanzania Meteorological Agency (TMA)

1.1.1.5: Monthly Mean Maximum Temperature

Key Message

The monthly mean maximum temperatures are showing a rising trend with an average of 30.0°C for the period from 2012 to 2016 compared to 29.4°C for the long-term period from 1981-2010, both observed in October.



Monthly mean maximum temperature refers to average maximum temperature for a period of one month and Long Term Mean (LTM) maximum temperature is the mean value of monthly average maximum temperature over the period of 30 years (1981 – 2010). For this report the mean maximum temperature presented in Table 1.2 are averages of monthly maximum temperature of all meteorological stations presented in Table 1.1. Overall, long term mean monthly maximum temperature was 28.2°C while, for the shorter period of 2012 to 2016, mean monthly maximum temperature observed was 28.7°C. The hottest mean monthly maximum temperature for both

long term and shorter period (2012 - 2016) was observed in October with temperature of 29.4°C and 30.0°C respectively.

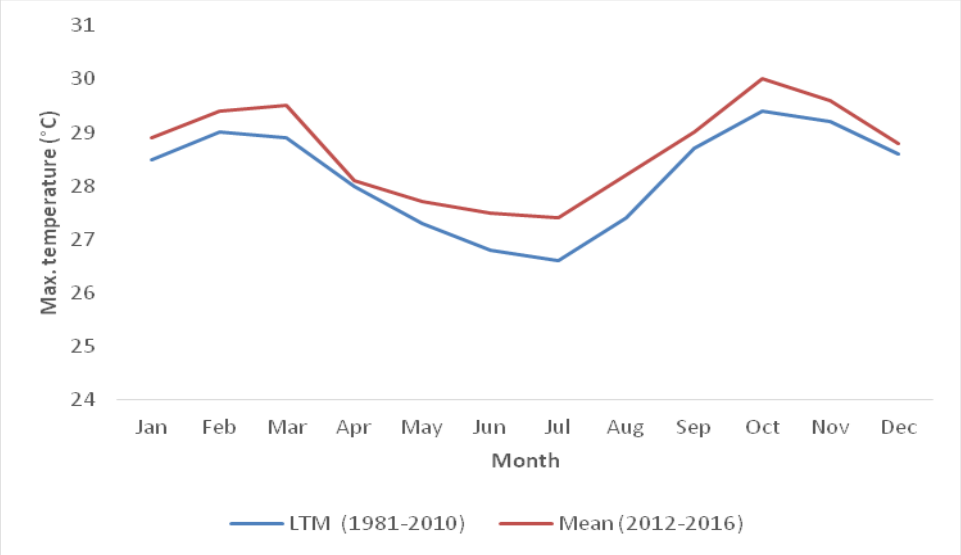
The comparison of temperature between the shorter period (2012 - 2016) and long term mean temperature indicates that, the temperature for the period (2012 - 2016) are higher than long term means for all months as indicated in Figure 1.2.

Table 1. 2: Monthly Mean Maximum Temperature (°C), 2012 - 2016 and Long Term Mean Maximum Temperature (1981 – 2010)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2012	29.3	29.9	29.5	28.1	27.5	27.4	27.5	28.2	29.2	30.3	29.5	28.9	28.8
2013	29.3	29.9	29.3	28.2	27.7	27.3	27.5	27.9	29.3	30.0	30.0	28.8	28.8
2014	29.0	28.4	28.9	28.2	27.4	27.8	27.4	28.4	28.4	29.8	29.7	29.0	28.5
2015	28.6	30.0	29.8	28.0	27.8	27.7	27.9	28.6	29.6	29.9	29.0	28.7	28.8
2016	28.4	28.9	29.8	27.9	27.9	27.3	26.8	28.1	28.5	29.9	29.6	28.5	28.5
Mean (2012-2016)	**28.9**	**29.4**	**29.5**	**28.1**	**27.7**	**27.5**	**27.4**	**28.2**	**29.0**	**30.0**	**29.6**	**28.8**	28.7
LTM (1981-2010)	**28.5**	**29.0**	**28.9**	**28.0**	**27.3**	**26.8**	**26.6**	**27.4**	**28.7**	**29.4**	**29.2**	**28.6**	**28.2**

Source: Tanzania Meteorological Agency (TMA)

Figure 1. 2: Monthly Mean Maximum Temperature from 2012 - 2016 compared with Long Term Mean 1981-2010



Source: Tanzania Meteorological Agency (TMA)

1.1.1.6: Annual Mean Minimum Temperature Records for Meteorological Stations from 2012 to 2016

Table 1.3 shows that, the annual mean minimum temperature was 18.0°C from 2012 to 2016. In addition, the highest mean minimum temperature was 23.2°C observed at JNIA meteorological station in Dar es Salaam in 2016 while, the lowest minimum temperature was about 11.7°C observed at Mbeya meteorological station in 2012.

Table 1. 3: Annual Mean Minimum Temperature (°C) for Stations, 2012 - 2016

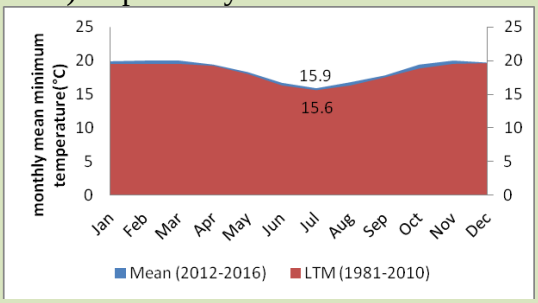
Station	2012	2013	2014	2015	2016	Mean
Bukoba	17.9	18.1	18.4	18.6	18.9	18.6
Mwanza	17.9	17.5	18.6	18.9	18.6	18.7
Musoma	18.2	18.7	17.9	18.3	17.7	18.0
Kigoma	19.2	19.4	19.9	19.7	19.8	19.8
Tabora	17.7	17.6	16.9	16.9	15.9	16.6
Dodoma	17.7	17.8	17.9	17.7	17.7	17.8
Iringa	15.3	14.7	15.5	15.3	15.2	15.3
Arusha	15.1	14.6	15.3	15.5	15.3	15.4
Kilimanjaro	18.0	17.6	17.1	17.6	18.6	17.8
Dar es Salaam	22.4	22.3	22.5	23.1	23.2	22.9
Mtwara	21.5	20.9	21.2	21.5	21.4	21.4
Songea	14.9	14.2	15.7	12.2	15.6	14.5
Mbeya	11.7	20.9	14.1	12.0	14.4	13.5
Mean	**17.8**	**18.2**	**17.9**	**17.8**	**18.1**	**18.0**

Source: Tanzania Meteorological Agency(TMA)

1.1.1.7: Monthly Mean Minimum Temperature

Key Message

The lowest monthly mean minimum temperature was observed in July (15.9°C and 15.6°C for the period of 2012 - 2016 and long term mean (1981 - 2010) respectively.



Monthly mean minimum temperature refers to average minimum temperature for a period of one month and Long term mean (LTM) minimum temperature is the mean value of monthly average minimum temperature over the period of 1981to2010. The minimum temperature averages presented in Table 1.4 are averages of all meteorological stations presented in Table 1.3. It is indicated that, the long term mean minimum temperature was 18.3°C compared to 18.1°C for the period of 2012 to 2016.

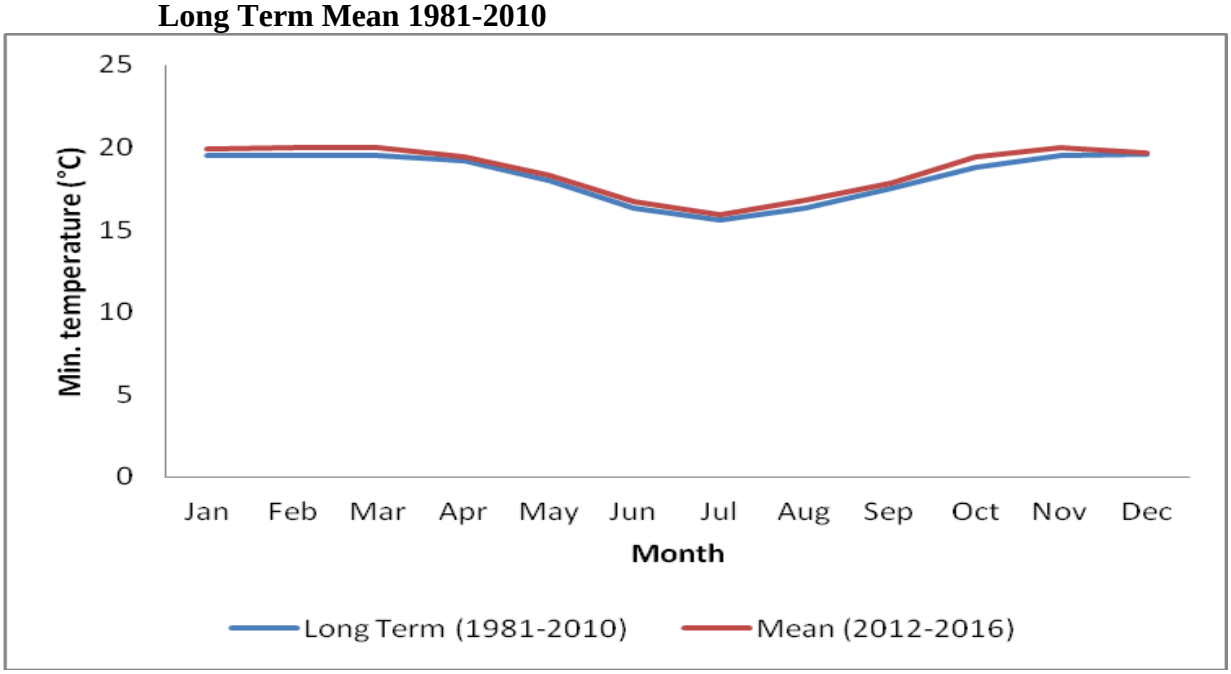
The results indicate that the lowest mean minimum temperature was observed in July for both long term and shorter period of 2012 to 2016 with 15.6°C and 15.9°C respectively. Likewise, when compared to the long term mean (1981 – 2010) with five years' period from 2012 to 2016, monthly mean minimum temperature shows no significant changes in temperature trends (Figure 1.3). Although the monthly mean minimum temperature for shorter period (2012 - 2016) was slightly higher than the long term mean for the whole period.

Table 1. 4: Monthly Mean Minimum Temperature (°C), 2012 – 2016 and Long Term Mean Minimum Temperature (1981 -2010)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2012	19.8	20.4	19.9	19.4	18.2	16.6	15.8	16.9	18.1	19.6	19.9	20.2	18.7
2013	20.3	20.1	20.5	19.7	18.2	15.9	15.6	16.7	18.1	19.5	20.5	20.1	18.8
2014	19.9	19.9	19.8	19.4	18.3	17.9	16.4	18.1	17.9	19.7	19.7	19.8	18.9
2015	19.9	20.0	19.6	18.6	18.6	16.9	16.4	16.9	18.0	20.1	20.2	20.1	18.8
2016	19.9	20.2	20.9	20.0	18.3	16.7	15.8	15.6	17.3	18.7	20.0	18.1	18.5
Mean (2012-2016)	19.9	20.0	20.0	19.4	18.3	16.7	15.9	16.8	17.8	19.4	20.0	19.7	18.1
LTM (1981-2010)	**19.5**	**19.5**	**19.5**	**19.2**	**18.0**	**16.3**	**15.6**	**16.3**	**17.5**	**18.8**	**19.5**	**19.6**	**18.3**

Source: Tanzania Meteorological Agency (TMA)

Figure 1. 3: Monthly Mean Minimum Temperature from 2012 to 2016 Compared With Long Term Mean 1981-2010



Source: Tanzania Meteorological Agency (TMA)

1.1.1.8: Annual Rainfall Records for Meteorological Stations (2012 – 2016)

Key Message

Based on TMA observations for the period of 2012 to 2016, the annual total rainfall variability is not significantly pronounced because of the nature of rainfall patterns with minimum being 411.8mm and maximum 2,280.0mm.

Annual rainfall refers to total amount of rainfall over a period of one year for the location (station). Table 1.5 indicates that on average, for the period of 2012 to 2016, Tanzania received annual rainfall of 893.9 mm recorded from different meteorological stations. It is also observed that, the amount of rainfall recorded in bimodal areas ranged from 411.8 mm (recorded at Kilimanjaro International Airport (KIA) station in Kilimanjaro) to 2,280 mm at Bukoba meteorological station. On the other hand, recorded rainfall in unimodal areas ranged from 452.2 mm recorded at Dodoma meteorological station to 1,332.9 mm (recorded at Mtwara meteorological station). The available rainfall statistics show that the annual rainfall variability is not significantly pronounced because of the nature of rainfall patterns. However, inter-seasonal and inter-annual variability and shift in rainfall patterns are very common.

Table 1. 5: Annual Rainfall (mm), by Stations, 2012 - 2016

Rainfall Regime	Station	2012	2013	2014	2015	2016	Mean
	Bukoba	2,280.0	1,863.3	2,227.2	1,755.1	1,452.9	1,915.7
	Dar es Salaam	702.6	1,004.4	1,278.9	1,038.9	782.9	961.5
	Mwanza	1,307.5	1,125.6	971.4	1,530.7	1,039.3	1,194.9
	Musoma	646.3	766.2	720.9	1,038.0	627.2	759.7
	Kilimanjaro (KIA)	429.2	411.8	501.7	482.8	492.5	463.6
Bimodal Areas	Morogoro	646.7	551.8	993.8	587.6	587.6	673.5
	Mtwara	646.3	1,157.1	1,023.9	1,072.0	1,332.9	1,046.4
	Songea	896.0	1,072.7	1,010.8	852.3	846.7	935.7
	Tabora	810.8	939.8	826.5	957.4	911.6	889.2
	Kigoma	735.3	999.9	832.7	951.6	913.5	886.6
	Mbeya	508.1	1,028.3	1,220.3	876.0	952.6	917.1
	Iringa	545.3	859.1	885.5	555.4	757.6	720.6
Unimodal Areas	Dodoma	620.9	487.4	489.7	452.2	545.2	519.1
	Annual Mean	**828.8**	**872.7**	**968.8**	**934.6**	**864.8**	**893.9**

Source: Tanzania Meteorological Agency (TMA)

1.1.1.9: Monthly Total Rainfall

Key Message

For the period of five years from (2012 - 2016) monthly mean rainfall decreased by 4.5 mm which is about 5 % as compared to the long term mean (1981-2010). This gives an indication that monthly rainfalls are declining in most parts of the country.

Monthly total rainfall refers to total amount of rainfall accumulated over a period of one month and Long term mean (LTM) rainfall is the mean value of monthly total rainfall over the period of 30 years (1981 – 2010). Monthly rainfall averages in Table 1.6 below are averages of all stations presented in Table 1.2 above. For the period of 30 years (1981 - 2010) the highest mean monthly total rainfall was 160.9 mm, which was recorded in March and the overall period mean was 83.3 mm. On the other hand, the period of five years from 2012 to 2016 Tanzania received, on average of 78.8 mm rainfall per month with the maximum observed in April, which accumulated to 172.9 mm. Generally, it is observed that, monthly mean rainfall decreased by 4.5 mm during this five year period, which is about 5 % when compared to long term mean. This gives an indication that rainfall has been declining in most parts of the country in recent years.

Table 1. 6: Monthly Total Rainfall, 2012 – 2016 and Monthly Long Term Mean Rainfall (mm), 1981 – 2010

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2012	86.2	95.4	93	151.5	93.8	24.1	2.6	17.9	14.9	63.9	92.6	138.4	72.9
2013	144.2	63.2	196	147.8	62.8	0.4	9	13.1	33	23.2	95.2	142.7	77.6
2014	108.7	140.9	185.3	180.7	60.2	15.4	4.5	20.6	42.8	61.9	105.3	117.9	87.0
2015	123	57.7	122.8	171	100.3	9.2	5.1	9.4	11	63.3	164.3	132.2	80.8
2016	191.8	131.2	140	213.6	41.1	9.2	2.2	8.3	14.1	27.8	64.6	66.6	75.9
Mean (2012-2016)	**130.8**	**97.7**	**147.4**	**172.9**	**71.6**	**11.7**	**4.7**	**13.9**	**23.2**	**48**	**104.4**	**119.6**	**78.8**
LTM (1981-2010)	**133.9**	**113.4**	**160.9**	**155.6**	**82.5**	**16.7**	**9.3**	**13.3**	**18.7**	**53**	**99.8**	**142.3**	**83.3**

Source: Tanzania Meteorological Agency (TMA)

1.1.2 - Hydrographical Characteristics

Tanzania adopted Basin Management Approach for water resource management in the 1980s when the country was divided into nine basins through Act No.10 of 1981, which was an amendment of the Principal Act No. 42 of 1974. Since then, there have been several initiatives on formal water management institutions. In 1991, the first National Water Policy was launched to augment the changes in the water sector. In 1993, the Rufiji Basin Water Board was launched and the Rufiji Basin Water Office started operating in the same year. Later, in 1997, the Principal Act for water management, i.e. the Water Utilization (Control and Regulation) Act No. 42 of 1974 was amended to accommodate further changes.

Early in 1995 a comprehensive review of Tanzania's water resources policies and institutions was carried out by the Government of Tanzania, World Bank and DANIDA (DANIDA & World Bank, 1995). The nine Basin Water Boards are fully responsible for regulating and planning water resources and uses within the basin borders.

Table 1. 7: Water Basins in Tanzania, 1991 - 2004

S/N	Basin	Catchment Area (Km^2)	Drainage Basin	Year of Establishment
I	Pangani	55,176.82	Indian Ocean	1991
II	Wami / Ruvu	66,867.18	Indian Ocean	2000
III	Rufiji	182,708.10	Indian Ocean	1993
IV	Ruvuma	102,743.38	Indian Ocean	2004
V	Lake Nyasa	34,266.09	Indian Ocean	2001
VI	Lake Rukwa	77,808.92	Endorheic basin	2001
VII	Lake Tanganyika	167,732.23	Atlantic Ocean	2004
VIII	Lake Victoria	114,508.14	Mediterranean Sea	2001
IX	Internal Drainage	143,697.76	Endorheic basin	2004
Total (Km2)		**945,508.62**		

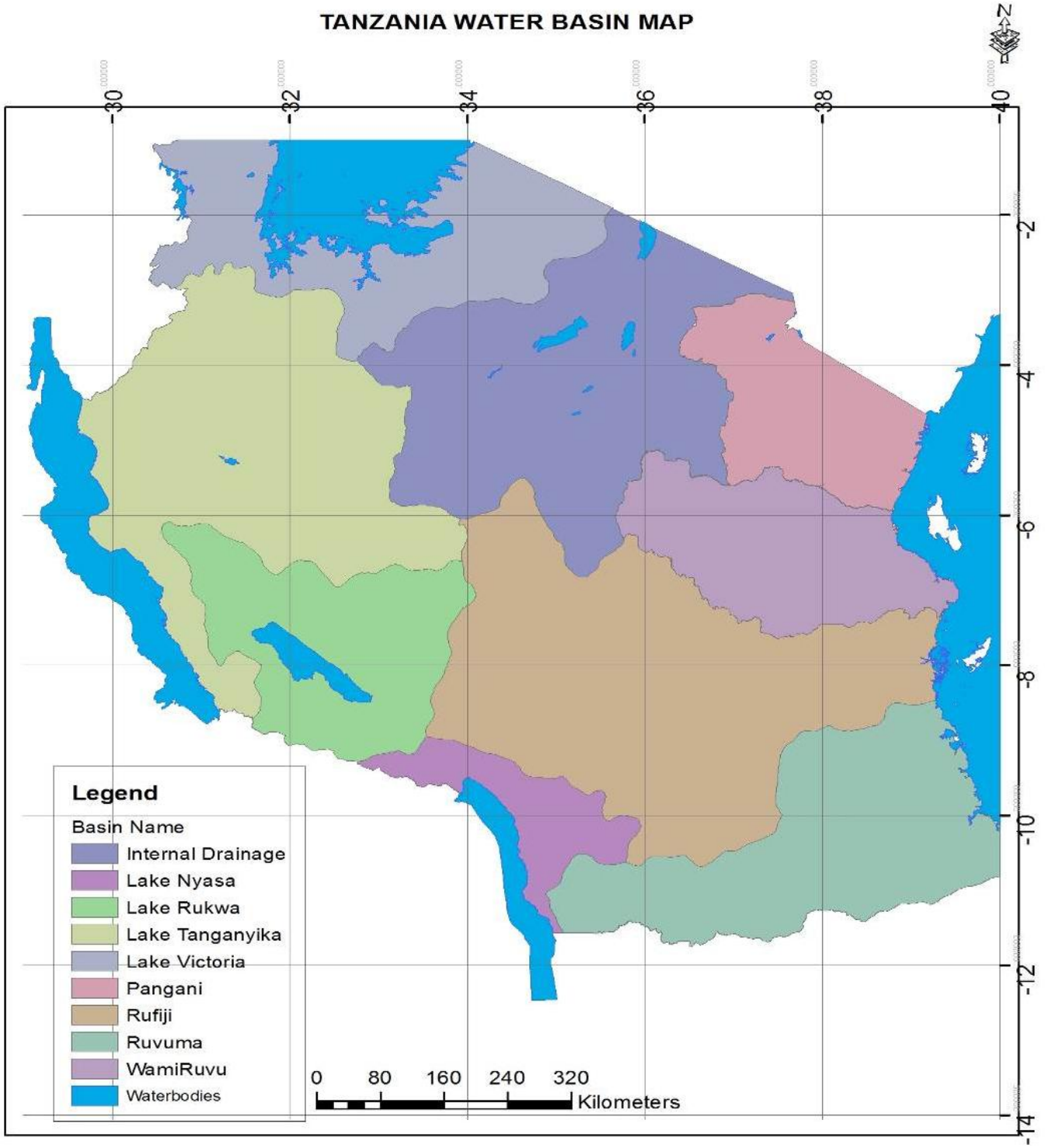
Source: MoWI, WSSR, 2016

Key Message

Water resources management is based on hydrological boundaries and not administrative boundaries. The largest basins is Rufiji (182,708 Km^2), about 20% of Tanzania Surface Area.

The Rufiji Basin is the largest basin covering an area of 182,708 square kilometers (about 20 % of Tanzania). The river drains into the Indian Ocean. The land use in the basin includes agriculture, mining, forestry, livestock keeping, fishing, wild life, navigation and human settlements. The Rufiji Basin comprises four major rivers namely: - The Great Ruaha River, Kilombero River; Luwegu River and Rufiji (lower part of main river). The climate in the basin differs from the coast to the highlands in the upper parts of the catchments. The Average rainfall varies from 400 mm in the drier areas to 2000 mm in wetter parts.

Map 1. 3: Tanzania Water Basin Map



Source: Ministry of Water and Irrigation

1.1.2.1: Water Resources Availability

Key Message

In the hydrological year 2015/2016 annual average available renewable water resources per capita recorded 1,952 M^3 which is above the lowest annual average of 1,700 M^3 acceptable internationally.

Tanzania is endowed with numerous and diverse water resources in the form of rivers, lakes, groundwater aquifers, ponds, reservoirs, and wetlands. The country is riparian to some of Africa's largest trans-boundary freshwater lakes (URT, 2006). Each of these water bodies exhibits unique characteristics and a complex range of water resources management development issues as well as challenges. With its numerous water bodies, the country is perceived to have abundant surface and groundwater resources for meeting its present consumptive and non-consumptive needs.

River discharge and lake levels start rising in November-December and generally reach their maximum in March-April with a recession period from May to October/November. Many of the larger rivers have flood plains, which extend far inland with grassy marshes, flooded forests and ox-bow lakes.

The lakes and swamps cover 5.4 million hectares and comprise 5.8 percent of the country (SEI, 2007). The major ones include: - Lake Victoria, Lake Tanganyika and Lake Nyasa, which also form the border to neighbouring countries. Other lakes are Lake Rukwa, Lake Eyasi, Lake Manyara and Lake Natron.

The available annual renewable water resources in Tanzania is about 89 Km^3 as of 2015/2016 hydrological year with possibility of decreasing with time, hence reducing the annual average available renewable water resources per capita. This decline could be attributed to different reasons including climate change effects, inadequacy in planning and water security infrastructures, population increase, increase of social economic activities, catchment degradation as well as water user conflicts. However, in the hydrological year 2015/2016 annual average available renewable water resources per capita has been recorded as 1,952 M^3 which is above the lowest annual average of 1,700 M^3 acceptable internationally. However, if efforts are

not taken, such amount is expected to be depleted to an average annual per capita of 883 M^3 in 2035 (WSSR, 2016).

1.1.2.2: International Water Issues

Key Message

Tanzania shares more international water resources (6 lakes, 5 rivers and 7 aquifers), than any other country in Africa.

Tanzania shares six international lakes and five international rivers including three of the largest African river basins - Nile, Congo and Zambezi, and seven international aquifers. This is more than any other nation in Africa in comparison. A larger part of the country's international borders are water bodies. The Ruvuma River forms a boarder with Mozambique, Lake Tanganyika with the Democratic Republic of the Congo, Zambia and Burundi, Lake Nyasa and the Songwe River with Malawi, the Kagera River with Rwanda and Uganda and Lake Victoria with Uganda and Kenya. As a result, the United Republic of Tanzania is part of numerous transboundary institutions and agreements for the management of these shared water resources.

Some important international agreements on the use of water resources are: - the SADC's Shared Water Course Systems Protocol, Lake Tanganyika Authority (LTA), the Joint Water Commission Agreement between Tanzania and Mozambique in 2007, the Lake Victoria Tripartite Agreement, Cooperative Framework Agreement for the River Nile Basin ratified in 2015.

Table 1. 8: Transboundary Lakes

Lake	Lake area (Km2)	Basin	International Management
Victoria	68,800	Nile	Lake Victoria Basin Commission, Nile Cooperative Framework Agreement
Tanganyika	32,900	Congo	Lake Tanganyika Authority
Nyasa	30,800	Zambezi	Zambezi Basin Watercourse Commission (ZAMCOM)
Natron	1,040	Internal drainage Basin	
Jipe	16.4	Pangani Basin	MoU between Tanzania and Kenya on Transboundary Management of Lakes Chala and Jipe; and Umba River Ecosystems
Chala	3.15	Pangani Basin	MoU between Tanzania and Kenya on Transboundary Management of Lakes Chala and Jipe; and Umba River Ecosystems

ource: Ministry of Water and Irrigation

Table 1. 9: Transboundary Rivers

River	Total basin area (Km^2)	Riparian countries	International management
Kagera	59,800	Burundi, Rwanda, United Republic of Tanzania, Uganda	Nile Equatorial Lakes Subsidiary Action Programme (NELSAP)
Mara	13,504	Kenya and United Republic of Tanzania	Lake Victoria Basin commission and NELSAP MoU between Tanzania and Kenya on Transboundary Management of the river
Ruvuma	152,200	Mozambique United Republic of Tanzania	Ruvuma River Joint Water Commission
Songwe	4,200	Malawi and United republic of Tanzania	Convention of a Joint Songwe River Basin Commission
Umba	4,3650	Kenya United republic of Tanzania	MoU between Tanzania and Kenya on Transboundary Management of Lakes Chala and Jipe; and Umba River Ecosystems.
Malagarasi	67,710	Burundi and United republic of Tanzania	
Mwiruzi		Burundi and United Republic of Tanzania	

Source: Ministry of Water and Irrigation

1.1.2.3: Water Use

Total water withdrawal in Tanzania was estimated for the year 2002 to be 5,142 million M^3. Agriculture was the largest water withdrawal sector with almost 90 % of total, and in particular irrigation (86 %) which is only one percentage point higher than the 2002 National Water Policy and the 2009 Water Resources Management Act targets. In addition, the municipal sector used 10 % and industry less than one percent.

1.1.2.4: Rural Water Supply

In the course of implementation of the Water Sector Development Programme (WSDP I) (July 2007 to June 2016), a total number of water points constructed is 50,995 benefiting 11,607,822 people. The total cumulative achievement is 95,733 water points, serving 22,792,322 people in rural areas of Tanzania Mainland, equivalent to 72 % of the 31,623,999 people of rural population, according to 2012 Population and Housing Census (WSSR 2016).

1.1.2.5: Urban Water Supply and Sanitation

There are 130 Regional and Districts Urban Water Supply and Sanitation Authorities (WSSAs) regulated and licensed by the Energy and Water Utilities Regulated Authority (EWURA). These are classified into categories A, B and C according to financial capability. As of 2017, there are 15 registered WSSAs in category "A", which are Dar es Salaam Water Supply Authority (DAWASA), 13 regional WSSAs and Kahama District Utility. Four water supply and sanitation authorities, namely, Singida, Kigoma, Sumbawanga and Bukoba are registered as category B, Swhile 6 Regional WSSAs, 8 National projects and 97 District WSSAs are registered as category C, (WSSR 2016).

In Dar es Salaam City, there are interventions which have been commissioned by the Government to provide reliable water services to the growing population in the DAWASA/ Dar es Salaam Water & Sewerage Corporation Dar es Salaam Water & Sewerage Corporation (DAWASCO) service area. These interventions include construction of transmission main and rehabilitation and expansion of systems. The programme planned to increase water production

capacity from 300 million litres per day to 756 million litres per day; current demand in Dar es Salaam City is 510 million litres per day.

The construction, rehabilitation and expansion efforts have resulted in 1,383,610 additional people who are making a total of 2,201,625 people served with safe and clean water. There are currently 143,495 water supply domestic connections and 246 kiosks in suburban areas of Dar es Salaam. Despite these achievements, DAWASA is faced with problem of non revenue water (NRW) which is currently recorded at 53 % against the internationally recommended target value of 20 %. Studies and remedial actions are being taken to reduce physical and commercial losses (WSSR 2016).

In Regional WSSAs there are also interventions underway to increase water supply services and reduce water losses; 4,260,820 people have access to water supply through 375,757 domestic connections and 2,013 kiosks in the 23 regional headquarters equivalent to 86 % of urban population served with clean and safe water. NRW in almost all regional WSSAs is still higher than the recommended target value of 20 %. By June 2016, the average NRW in all regional urban utilities was 35 %.

1.1.2.6: Water Management

Water resources in the United Republic of Tanzania are managed according to the 2009 Water Resources Management Act (WRMA) at five levels, from national to local: i) national water board, ii) the nine basin water boards, iii) catchment water committees, iv) district councils and v) water users associations (WUA). The latter are organized in water catchments and are responsible for managing allocation of water resources at local level, managing equitable allocation of resources during drought, and mediating local disputes (Medmu, Magayane, 2005).

The nine basin water boards are responsible for preparation of Ingrated Water Resources Managemenat and Development (IWRMD) Plans, (MoWI, 2017). Regarding water supply and sanitation services, Community-Owned Water Supply Organizations (COWSOs) are in charge in rural areas, and Water Supply and Sanitation Authorities (WSSA) in urban areas.

1.1.2.7: Groundwater Resources

It is unquestionable that groundwater is an important resource for human life and ecosystem sustenance. Groundwater availability is mainly controlled by geology and climate, and is unevenly distributed across the country. The groundwater has huge potential for complementing the surface water sources, it accounts for over 97 % of the accessible global freshwater resource. In many countries, Tanzania included groundwater is often the main source for domestic water supply apart from widely being used for irrigated agriculture and industry. (JICA, 2002 coordinated by the Ministry of Water and Irrigation).

1.1.2.8: Groundwater Governance

The principal instruments that regulate water resources in Tanzania are the Water Resources Management Act, (WRMA) No. 11 of 2009 and the Water Supply and Sanitation Act, No. 12 of 2009. These legislations regulating water resources management and water delivery respectively built on the 2002 National Water Policy.

In order to properly guide and control drilling activities, the Government in 2013 published the Groundwater (Exploration and Drilling) Licensing Regulations in Government Notice No.219. Groundwater licensing is a legal requirement to comply with the Water Resources Management Act No. 11 of 2009 Section 62. Licensing of all water well exploration consultants and drilling contractors ensures better relations with (and information flow to) the water resources administration, higher standards of well construction, improved reports on the hydrogeological conditions encountered, and reduced likelihood of illegal well construction.

As of 2017, there are 65 registered groundwater drilling companies and 13 registered groundwater exploration companies (MoWI, Jan 2018). The main persistent challenge, which contineus to be ahindrance to groundwater utilization and development, is paucity of data. More efforts are needed in order to get relevant information on available and minable groundwater resources.

1.1.3 - Geological and Geographical Information

1.1.3.1: Geographical Location, Boundaries and Area

1.1.3.2: Location

Tanzania is located in Eastern Africa between longitudes 29^0 and 41^0 East and latitudes 1^0 and 12^0 South. The most Northerly point is Mutukula (1^0 01' S and 31^0 25' E), most Southerly point-Mtalika (11^0 32' S and 37^0 05' E. The most Westerly and Easterly points are Kigoma (4^0 52' S and 29^0 38' E) and Msimbati (10^0 21' S and 40^0 26' E).

1.1.3.3: Boundaries

Tanzania Mainland is bordered on the north by Kenya and Uganda; on the west by Rwanda, Burundi and Democratic Republic of the Congo; on its south sestern side by Zambia and Malawi; in the south by Mozambique and in the east by the Indian Ocean.

Map 1. 4: Tanzania Administrative Regional Boundaries, International Boundaries, and Number of Islands

Source: Tanzania in Figures, 2016

1.1.3.4: Major Islands in Tanzania Mainland

The two major islands of Ukerewe (in Lake Victoria) and Mafia (in the Indian Ocean) have a total area of 1,165 Km^2 which is about 0.12 % of the total country area. There are also several other small Islands.

Table 1. 10: Area of Major Islands in Tanzania Mainland (Km^2)

Major Islands in Tanzania Mainland	Area (Km^2)	Percent
Ukerewe	647	0.07
Mafia	518	0.05
Total Island	1,165	0.12
Total Area of Tanzania Mainland	**945,508.62**	**100.00**

Source: Tanzania in Figures, 2016

1.1.3.5: Description about Coastal Area

Key Message

Protection of Coastal and Marine resources is a national policy priority which needs to be implemented based on an integrated multistakeholder approach led by coastal communities.

Tanzania Mainland's coastline is both ecologically and economically important to the nation. The coastline is approximately 800 km long, extending from the Kenyan border in the north (4^o 7'S) to the Mozambican border in the south (10^o 5'S), (TPA & TAFIRI, 2007). The coastline is somewhat straight and is bounded by sandy, open beaches and some cliff out croppings in the south and with extensive mangrove forests in the riverine estuaries and deltas. It encompasses five coastal regions which are Mtwara, Lindi, Pwani, Dar es Salaam and Tanga. About 10 rivers drain into the Indian Ocean, of which Pangani in the north, Rufiji in the middle and Ruvuma in the south are the main ones. The smaller rivers include Zigi, Wami, Ruvu, Matandu, Mavuji, Mbwemkuru and Lukuledi.

The continental shelf is characterised by seagrass, fringing coral reef and island habitats. The shelf is generally narrow, dropping sharply after the depth of 60 M. The 200 m depth is about 2 Km from the coast at the narrowest point and 80 Km at the widest point. The widest points are the Zanzibar and Mafia Channels and off the Rufiji Delta. With the exception of the narrow coastal belt, most of the country lies on the Great African Plateau with altitudes ranging between 1,000 and 2,000 M above the mean sea level, (TCMP 2001). It also has three large islands of Mafia, Unguja and Pemba.

The coastal Districts cover about 15 % of the Nations total land area and they support 25 % of the population or 11.2 million people (Census 2012), it is projected that the coastal population will increase to 20 million by 2025 (Akwilapo, 2007).

1.1.3.6: International Legal Frameworks for Coastal and Marine Resources Governance

The URT government has signaled its intent and commitments to protect coastal and marine areas in the country by adopting numerous international and regional conventions that are concerned with the sustainable use and conservation of these areas. The country has implemented these instruments at the national level using a wide variety of tools including the establishment of MPAs, implementation of SDGs 14 through FYDP II and other policies relevant for marine environment conservation, protection, and sustainable use. These international legal frameworks include:-

(i) United Nations Convention on the Law of the Sea (UNCLOS) 1982

(ii) UNCLOS provides that some ocean areas are under national jurisdiction while others are beyond the jurisdiction of any single state, i.e. open to all states, whether coastal or landlocked. Beyond the limits of national Exclusive Economic Zones (EEZs) or in the high sea, UNCLOS recognizes high seas freedoms of navigation, over flight, cable laying, fishing, and scientific research, etc. The URT enacted this convention by the parliament as Territorial Sea and Exclusive Economic Zone Act 1989, stated that the EEZ shall not extend beyond 200 nautical miles from the baseline from which the breadth of the territorial sea is measured.

(ii) The Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention)

The Nairobi Convention was adopted in 1985 and came into force in 1996. The principle objective of the Nairobi Convention is to establish close cooperation to protect and improve the state of wild fauna and flora and natural habitats in the East African region through the establishment of specially protected areas in the marine and coastal environment. Article 10 of the Nairobi Convention requires all Parties to the convention to take appropriate measures to protect and preserve rare or fragile ecosystems as well as rare, depleted, threatened or endangered species and their habitats.

1.1.3.13: Environment Legislation

(i) National Environment Policy (NEP, 1997)

The National Environmental Policy (NEP) of 1997 is an overarching national environment policy, which focuses on the conservation of the environment and the effective use of natural resources. The policy identifies six major environmental problems to be addressed, namely: - loss of wildlife habitats and biodiversity; deforestation; land degradation; deterioration of aquatic systems; lack of accessible good quality water; and environment pollution.

The government admits in this policy that, the country needs to adopt environmentally sustainable natural resource management practices in order to ensure that long-term sustainable economic growth is achieved. It can therefore be concluded that, the policy recognizes that the country's long-term economic growth is dependent, among other factors, upon its coherent natural resource management. The Policy thus provides the framework for mainstreaming environment consideration in decision making processes.

(ii) Environment Management Act (EMA, 2004)

The EMA is the main legal framework for the management of the environment in Tanzania. It was enacted by the Parliament of the URT in 2004 and came into force in 2005. Prior to its enactment, environment management issues were governed and regulated by sectorial laws. Thus, EMA establishes an administrative and institutional

arrangement to facilitate administration of environment matters across the different government institutions, from the local to national level. The Act provides a legal and institutional framework for the sustainable management of the environment. It outlines principles of environment management, environment impact and risk assessment, prevention and control of pollution, waste management, environment quality standards, public participation in environment decision making and planning; environment compliance and enforcement; implementation of international instruments on environment; and implementation of the NEP (Daffa J, 2011).

In Cap 191 the Act emphasizes the protection of Coastal environment zones, conservation of biological diversity and protection of atmosphere. It also empowers the NEMC to cooperate with Local Government Authorities (LGAs) to formulate strategies to deal with coastal and marine management.

1.1.3.14: Economic Importance of Coastal Area

About 80 % of industries in Tanzania are located in Dar es Salaam. These include: - food, beverage and animal feed processing; chemical and cosmetic production; metal product manufacture; paper product, printing and publishing industries; wood products manufacture and construction materials production; electrical appliance and battery industries; motor vehicle servicing; glass product manufacture; ginnery and tobacco processing; and mining. In addition, tourism and the hospitality industry are centred around the city's beaches. The marine environment off Dar es Salaam receives pollutants from these sources through streams, sewer and storm water outflows. Some of the streams also drain the densely-populated areas of the city. Even though the level of industrialization is still low, untreated municipal and industrial wastewater discharges cause significant localized pollution (Machiwa, 2010).

The other major economic activities in the coastal areas of Tanzania include mariculture development and natural gas exploration. There is also a substantial potential for agriculture, offshore fisheries, shipping activities, urban development, small scale mining and manufacturing.

1.1.3.15: Coastal Resources Degradation

The main causes of coastal degradation include:-

a. Population growth which causes excessive exploitation and uncontrolled use of coastal and marine resources e.g. mangrove cutting.
b. Increasing pressure from tourism,
c. Major developments associated with industrial growth,
d. Coral mining which is increasing to supply building material for construction activities.
e. Lack of non-resources dependant jobs in rural coastal area.

1.1.3.16: Coastal Area Management

Ecosystem-Based Management (EBM) approach recognizes that maintaining the structure and function of ecosystems is vital and that human uses and ecosystem health are interdependent. Tanzania's ocean ecosystems and its marine biological diversity are core national assets. If their use is well managed, they can meet a broad range of economic, social and cultural aspirations. Marine planning under various policies uses entire ecosystems as the basic planning unit. As a result, marine plans seek to integrate across jurisdictions and sectors to ensure that all impacts on the ecosystem are considered concurrently.

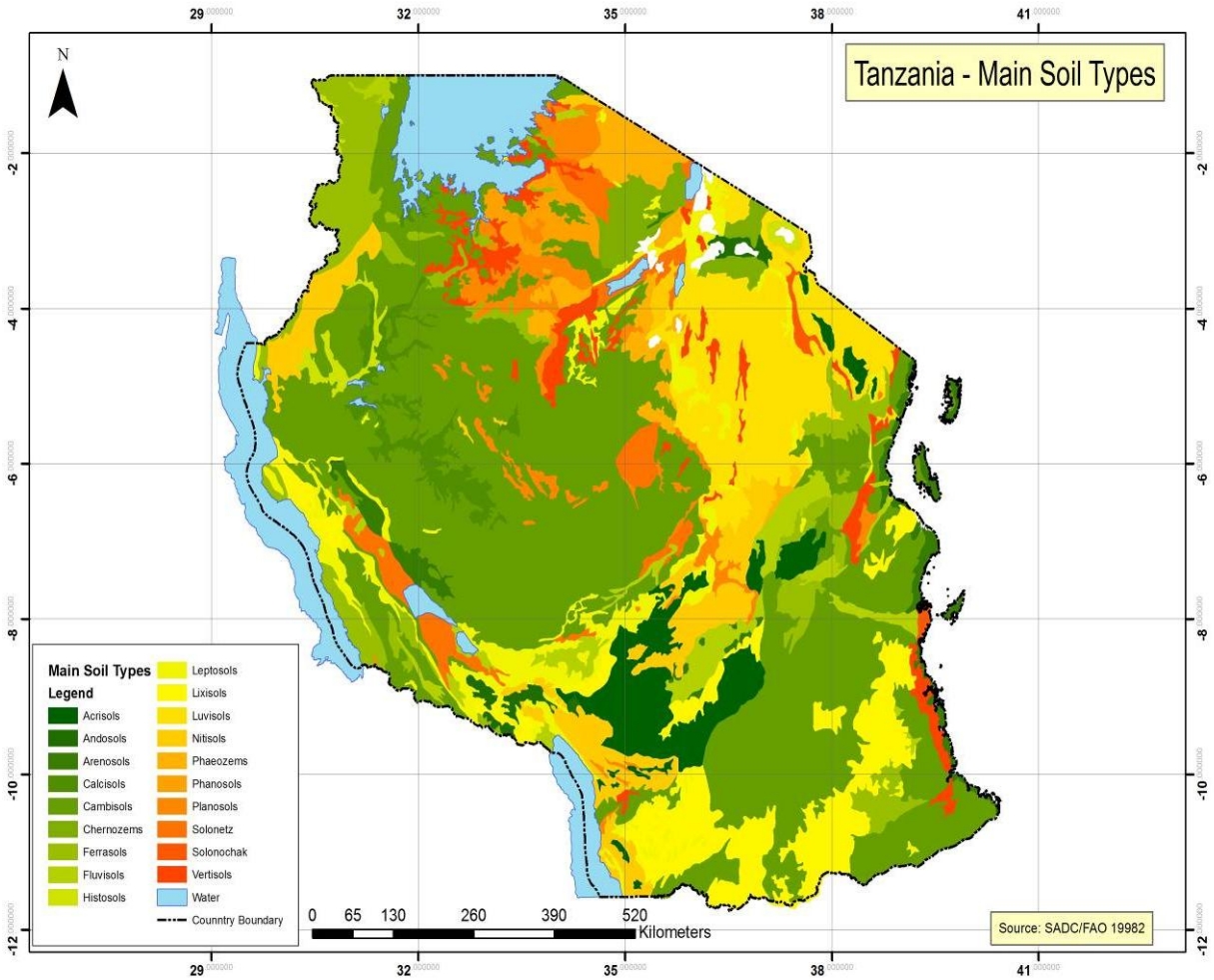
For this reason, an Integrated Coastal Zone Management (ICZM) approach, conservation and restoration of critical habitats and areas of high biodiversity are important intervantions. These intervatntions are carried in line to ensuring that the coastal people continue to benefit from the sustainable use of the resources, and most importantly, building the capacity of both human and institutions for managing the coastal zone in an integrated manner.

1.1.4 - Soil Characteristics

Map 1.4 indicates soil types in Tanzania. The most dominant soil type in Tanzania is Cambisols (37 %). This type of soil is characterized by slight or moderate weathering of parent material and by absence of appreciable quantities of illuviated clay, organic matter and aluminium or iron compounds. Other dominant types of soils are Luvisols (7.6 %), Lixisols (6.7 %) and Ferrasols (5.7 %). The remaining soil types have composition of less than 5 %. Luvisols are fertile soils and suitable for a wide range of agricultural uses. They are important soils in Morogoro, Dodoma, Arusha, Manyara, Kilimanjaro, Tanga and Ruvuma regions. Perennial crops are

preferred over annual crops in Lixisols and they are important soils in Lindi, Mtwara, Ruvuma and Mbeya regions. Most Ferrasols in Tanzania have good physical properties, less susceptible to erosion and easy to work. Ferrasols are mainly found in Kigoma, Rukwa, Mbeya, Morogoro, Tanga, Kilimanjaro, Dar es Salaam and Mtwara regions.

Map 1. 5: Soil Types in Tanzania



Source: **SADC/FAO**

1.2. Land Cover, Ecosystems and Biodiversity

1.2.1- Land Cover

The most recent statistics on land cover types are presented in National Forest Monitoring and Assessment of Tanzania Mainland, 2015 (NAFORMA, 2015). A similar assessment was

conducted by Hunting Technical Services Limited (HTSL) between 1993 and 1995. Such assignments are costly and it takes a long time, usually ten years, before another assessment is done. Results from NAFORMA Land Use Land Cover change indicate that the rate of deforestation between 1995 and 2010 was 372,816 ha per year compared to 130,000 ha and 500,000 ha per year that was reported by Tanzania to the Global Forest Resource Assessment (FRA) covering the period 1990 -2000.

More than 60 % of Tanzania is covered with forest/woodland/bushland as indicated in Table 1.11. Cultivated land is around 20 % but there is a small percentage imbedded in forest/woodland/bushland and to a greater extent in grasslands.

Table 1. 11: Land Cover (Vegetation Types), Tanzania Mainland, 2015

Land Cover	Sub-types	Area (ha)	Percent
Forest	Humid montane	995,300	1.1
	Lowland	1,656,500	1.9
	Mangrove	158,100	0.2
	Plantation	554,500	0.6
Woodland	Closed Woodland	8,729,000	9.9
	Open Woodland	35,997,300	40.8
	Woodland with scattered cropland	2,530,900	2.9
Bushland	Thicket	971,900	1.1
	Dense Bushland	2,012,400	2.3
	Bushland with Emergent Trees	309,400	0.4
	Thicket with Emergent Trees	308,300	0.4
	Open Bushland	2,843,500	3.2
	Bushland with scattered cropland	1,162,700	1.3
Grassland	Wooded Grassland	4,712,300	5.3
	Bushed Grassland	438,900	0.5
	Open Grassland	3,091,100	3.5
	Grassland with scattered cropland	596,600	0.7
Cultivated land	Agro-forestry system	1,373,000	1.6
	Wooded crops	1,521,100	1.7
	Herbaceous crops	5,045,400	5.7
	Mixed tree cropping	154,700	0.2
	Grain crops	9,866,700	11.2
Open land	Bare Soil	161,100	0.2
	Salt Crusts	18,300	0.0
	Rock outcrops	73,100	0.1
Water	Inland water	154,700	0.2
	Swamp	1,007,900	1.1
Others	Unspecified (built up areas etc.)	1,892,700	2.1
Total		**88,337,400**	**100.0**

Source: NAFORMA Report -2015

1.2.2- Ecosystems and Biodiversity

Key Message

Natural ecosystems in Tanzania are classified into three major types namely: - terrestrial; inland water; and coastal and marine ecosystems.

Tanzania is constituted by Tanzania Mainland and Zanzibar with a total surface area of 945,087 Km^2 comprised of land area of 883,749 Km^2 (881,289 Km^2 mainland and 2,460 Km^2 Zanzibar Islands), plus 59,050 Km^2 inland water bodies (VPO, 2014).

Natural ecosystems in Tanzania can be categorized into three major types namely: - terrestrial ecosystem; inland water ecosystem; and coastal and marine ecosystem. Terrestrial ecosystems include forest and agricultural areas. Inland water ecosystems include wetlands, freshwater lakes, rivers and their catchments and dams. Coastal and marine ecosystems include mangroves, coral reefs, **seaweed**s and sea-grass beds (URT, 2014).

Key Message

Terrestrial Ecosystems which relates to forest ecosystems occupy 55 % of the total land area of which Agricultural ecosystem occupies 45 % of terrestrial ecosystems.

Terrestrial Ecosystems relates to forest ecosystems which occupy 55 % of the total land area, equivalent to about 48 million ha (480,000 Km^2), of which 93 % is covered by woodlands and only 3 % is covered by other forest ecosystems including coastal forests, humid montane forest and plantations (VPO, 2015).

Woodlands- Woodlands in the country include miombo and *Acacia-commiphora* woodlands. Miombo is a vernacular word that has been adopted by ecologists to describe those woodland ecosystems dominated by trees in the genera *Brachystegia, Julbernardia* and *Isoberlinia*. Miombo woodlands cover more than 20 million ha or about 40 % of Tanzania's land area. *Acacia-commiphora* woodlands cover much of northern and central Tanzania, extending around the eastern margins of Lake Victoria. *Montane forests* - which are located in the mountainous areas, cover about 2 million hectares of land (or about 4 % of the total forest cover) (URT, 2014).

Agricultural ecosystems - Tanzania is endowed with about 44 million hectares of arable land (approximately, 45 % of total land area), out of which only 24 % is under crop production (URT, 2014). It is estimated that about 80 % of the cultivated land consists of traditional subsistence farming systems in which there is considerable diversity of crops and species grown and sizeable variety in the ways in which they are grown.

Inland Water Ecosystems occupy about 20 % of the total land area. They are comprised of wetlands (10 %) including those of international importance – Ramsar sites (5.5 %); freshwater lakes (6.1 %); and rivers and their catchment areas. Tanzania has over 2,810 rivers and streams including permanent and seasonal, 2,325 springs, 440 lakes and dams, and 22,379 deep boreholes (URT, 2014).

***Wetlands*-** There are about 115 different wetlands ecosystems occupying 10 % of the total land area of Tanzania mainland (approximately 88,300 Km^2) harbouring over 650 associated species, such as molluscs, crustaceans, echinoderms and fish (VPO, 2015). The major wetlands include Kilombero, Malagarasi-Muyovosi, Rufiji-Mafia, Lake Natron and Ihefu. In terms of their distribution, 60 % extend over village land while the remaining 40 % is located over public land (URT, 2014).

***Lakes*-** Tanzania comprises a chain of freshwater and alkaline lakes located mainly on the Rift Valley covering a total area of 54,337 Km^2 (or about 6.1 % of the total country's surface area). The major lakes are: - are Victoria, Tanganyika and Nyasa.

***Rivers*-** Majority of the river ecosystems are not protected with few exceptions such as those under protected montane forests and Ramsar sites. The major rivers include Rufiji, Ruvu, Pangani, Malagarasi and Mara (URT, 2014; VPO, 2015).

***Dams*-** Dams cover over 85,000 ha of land area in Tanzania. The major dams include two large reservoirs of Mtera (610 Km^2) and Nyumba ya Mungu (180 Km^2). Three medium–large dams include Hombolo (1,537 Km^2), Kidatu (10 Km^2) and Pangani. There are also many other small dams and reservoirs (URT, 2014; VPO, 2015).

Key Message

Coastal and Marine Ecosystems cover an area of about 20 % of total land area of the country and it includes mangrove ecosystems.

Coastal and Marine Ecosystems occupy an area of 241,500 Km^2 or about 20 % of the total land area of the country (VPO, 2015). A wide range of important and valued species are found along the coast, including an estimated 150 species of corals in 13 families; 8,000 species of invertebrates; 1,000 species of fish; 5 species of marine turtles, 428 species of seaweeds and 44 species of marine birds (URT, 2014).

Mangroves **-** All mangrove forests in Tanzania are gazetted as forest reserves and occupy about 0.3 % (1,440 Km^2) of the forest cover in the country (URT, 2014). They cover 115,500 ha of Tanzania mainland and 18,000 ha on Zanzibar (VPO, 2015).

Coral reefs **-** Coral reefs are located along 600 Km of the country's continental shelf, covering an area of about 3,500 Km^2 (or about 11 % of the total area of territorial sea).

Seagrass beds **-** The area covered by seagrass beds and the relative species densities in Tanzania are not known.

Seaweed*s* - The area covered by seaweeds is not known (URT, 2014).

Table 1. 12: Types of Ecosystem, 2014

S/N	Type of ecosystem (Major ecosystem)	Area (Km^2)	Details (Sub ecosystems)	Ecosystem services
1.	Terrestrial ecosystem	920,000	Forests ecosystem occupies 480,000 Km^2 (55 %) of total land area.	Forest ecosystem provides about 40 % of the total household consumption of forest and woodland products such as firewood, building materials, medicinal herbs, wild fruits and other food materials in nearby communities.
			Agricultural ecosystem occupies 440,000 Km^2 (45 %) of total land area.	Agricultural ecosystem- Mostly consists of traditional subsistence farming systems in which there is considerable diversity of crops and species grown and sizeable variety. The most favorable conditions for agricultural biodiversity are considered to occur under extensive and/or traditional agricultural management.
2.	Inland water ecosystem	146,545.40	Lakes, Rivers, Dams and Wetland (Lakes about 54,337 Km^2); Dams about 2,337 Km^2; Rivers about 31,701.8 Km^2; Wetlands about 88,374 Km^2.	Wetland ecosystems are one of the most productive supporting numerous natural resource user groups such as fishermen, pastoralists, farmers (i.e. irrigation, crops and vegetables), hunters (Bush-meat) and producers of non-timber products. Other services include electricity (hydro-electric power - HEP); key to wildlife habitats and serve as important wildlife corridors. Indirectly, wetland plays an important role in flood control, water purification and waste management. Wetlands interrupt freshwater discharge, (sink for organic and inorganic materials as well as pollutants); store rainwater captured by mountain forest ecosystems and contribute to the provision of water resources during the dry season. Wetland ecosystem accounts for most of hydro-power generation, rural, urban and industrial water supply and the dry season water and grazing of livestock and wildlife and sustain the tourism economy.
3.	Coastal and Marine ecosystem	241,500	Mangroves occupy about 0.3 % of the forest cover in the country (1,440 Km^2), coral reefs (3,500 Km^2, 11 %) of the total area of territorial sea, sea grass beds, seaweeds, sandy beaches, rocky shores and numerous islets.	Seafood and reef mining, and services like recreational, coastal protection, as well as aesthetic and cultural benefits. Coral reefs serve as physical buffer for oceanic currents and waves, creating a suitable environment for sea grass beds and mangroves. Sea grasses serve as breeding, nursery and feeding areas for many invertebrates and vertebrate species; they are a source of food for herbivorous invertebrates, fish and turtles; they trap and bind sediments thereby reducing particulate pollutants over coral reefs; and they provide protection to shorelines by dissipating wave energy.

Source: VPO; Tanzania Forest Services (TFS)

1.2.2.1: Known Flora and Fauna Species

1.2.2.2: Tanzania's Endemic Flora and Fauna Species

Endemic flora and fauna species are species which occur in only one geographical region. Tanzania ranks the fifth as a mega-biodiversity region globally as it harbours a number of endemic flora and fauna. According to USAID, 2012; SAN, 2013; Birdlife International, 2014; and URT, 2014, the total number of endemic flora and fauna species in Tanzania is not well known but it's estimated to range between 400 - 3000 species.

It is difficult to identify the exact number of endemic species due to the high diversity of species found in different regions of Tanzania. International organizations such as IUCN and Birdlife International, as well as researchers have made efforts to identify some endemic flora and fauna species found in Tanzania. However, there are still gaps in knowledge about the exact numbers since individual researcher and international organizations have tended to identify and collect information in the area of interest only thus not covering all parts of Tanzania.

1.2.2.3: Endemic Flora

Saintpaulia species is the most famously known African violets belonging to family Gesneriaceae. These herbaceous perennial flowering plants are found in Tanzania adjacent to southern Kenya in eastern tropical Africa. *Saintpaulia goetzeana* and *Saintpaulia shumensis* are the two species that are endemic to Tanzania. The Nguru Mountains harbours high concentration of *Saintpaulia goetzeana* making this Saintpaulia species endemic in those mountains while *Saintpaulia shumensis* sub-population has been found in Shume-Magamba Forest Nature Reserve (FNR) in Tanga region and Nguru forest reserve in Morogoro region. Other endemic flora species include *Allanblankia stulhmanii* (Mkimbo), *Ocotea usambarensis* (camphor), *Afrocarpus usambarensis, Allanblackia uluguruensis* (Mkani) etc.

Table 1.13 describes some of the few known endemic flora species found in Tanzania and their localities. The six mentioned endemic species are located in similar areas of mountainous regions, high altitudes, which are safe for undisturbed growth and most endemic flora species can be found. Also most of the endemic flora species are likely to be found within the Eastern Arc Mountains as they are famously known to harbour a diverse number of flora and fauna.

Table 1. 13: Some of the Known Endemic Flora Species in Tanzania

S/N	Endemic Flora Species	Locality
1	*Saintpaulia goetzeana*	Nguru Mountains
2	*Saintpaulia shumensis*	Shume-Magamba FNR
3	*Allanblackia stulhmanii*	Usambara and Uluguru Mountains
4	*Allanblackia uluguruensis*	Uluguru Mountains
5	*Ocotea usambarensis*	Usambara Mountains
6	*Afrocarpus usambarensis*	Usambara Mountains

Source: TAFORI

1.2.2.4: Invasive Alien Species (Flora and Fauna)

Invasive species are those which are non native to the ecosystem whose introduction cause economic and environmental harm. They are among the significant drivers of environmental change worldwide and important causes of biodiversity loss. They hinder sustainable development, economic growth and cause ecological problems in various areas in the world including Tanzania.

Key Message

Invasive species are among the significant drivers of environment change worldwide and important causes of biodiversity loss.

In Tanzania, there has been a massive increase of invasive species. The introduction of these species may be deliberate or accidental. Deliberate introduction of invasive species may have come about through efforts to improve the prospects of agricultural productivity, among others, while accidental introduction may be caused by pollinators in case of plant invasive species.

1.2.2.5: Invasive Flora Species

In the forestry sector, invasive species have appeared to be dangerous to the growth of the sector as they destroy the ecosystems and cause loss of potential plants. There are four common forest invasive species as shown in Table 1.14.

The invasive flora species are plant species which have been introduced in the ecosystem and cause harm to other plants as well as animals present in the ecosystem. Plant species such as *Leuceana species* and *Cedrella Mexicana* were previously introduced as multipurpose trees. However, these species are considered as weeds in some areas and since they are good seeders,

they spread in almost all ecological regions and to other regions and are thus considered as invasive alien species.

Maesopsis eminii (Mhesi) was previously introduced as timber species and also used to nurse other tree species e.g. *Newtonia buchananii* (Mkufi)) in East Usambara. However, a pollinator known as a hornbill has facilitated pollination of Maesopsis seeds and its spread to other areas in the Usambara, thus it is now considered as an invasive species and is widely spread.

Table 1. 14: Forest Invasive Flora Species

Category	Forest Invasive Flora Species
Plants	*Maesopsis eminii*
	Leucaena spp
	Lantana camara
	Cedrela Mexicana

Source: TAFORI

1.2.2.6: Invasive Fauna Species

Most of the invasive fauna are introduced accidentally. In the case of forestry, the seven listed forest invasive insect species which have been a threat to timber species as they affect productivity are presented in Table 1.15. Invasive insects such as Cinnara cupressi attack trees member of the conifers family (Cupressus, Thuja, Juniperus, Chamaecyparis and Callitris). Other insects such as *Pine boerneri* attack pine trees while *Hetropsylla cubana* attack Leuceana, and *Eucalyptus chalcid* attacks Eucalyptus.

Table 1. 15: Forest Invasive Fauna Species

Category	Forest Invasive Fauna Species
Insects	*Cinnara cupressi*
	Heteropsylla cubana
	Leuceana psyllid
	Pinus boerneri
	Pine wholly aphid
	Phorocantha semipunctata and Phorocantha recurva
	Eucalyptus chalcid

Source: TAFORI

1.2.2.7: Control and Management of Invasive Species

There are several approaches for controlling invasive species, the following are the most commonly used approaches in Tanzania:-

i) **Biological control**: by introducing biological predators that can destroy specific invasive species;

ii) **Chemical control**: use of pesticides and fungicides to eliminate the invasive species;

iii) **Mechanical control**: use of mechanical measures to eliminate invasive species mostly done to flora invasive species such as *Lantana camara* by uprooting;

iv) **Administrative controls**: improving border inspection by improving the enforcement of quarantines at border posts.

1.2.2.8: Protected Terrestrial Area

Game Controlled areas, National Parks and Game Reserves both are homes to wild animals but differ in aspects such as activities, organization, and conservation status as described below:-

- **Activities**

Generally, protected areas are famously known for a variety of activities such as mountain hiking, tourist hunting, fishing, photography, camping etc. Game reserves and Game Controlled areas are protected areas which only allow tourist hunting and fishing with permits, while in the national parks consumptive wildlife utilization is not allowed.

- **Organization**

Game reserves and Game Controlled areas in Tanzania are operated underthe Tanzania Wildlife Management Authority (TAWA). The National parks on their part are managed by Tanzania National Parks (TANAPA). The two institutions are both government agencies.

- **Conservation Status**

Some of the protected areas are considered World Heritage Sites since such areas are listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as of special cultural or physical significance. These areas include Serengeti National Park, Ngorongoro Conservation Area and Selous National Park.

1.2.2.9: National Parks

Key Message

Out of 57,424 Km^2 covered by national parks in Tanzania, Ruaha is the largest national park with an area of 20,300 Km^2 (35.4 %) of total area of national parks.

Table 1.16 shows the list of national parks in Tanzania which comprise a total area of 57,424 Km^2. Ruaha is the largest national park with an area of 20,300 Km^2 (35.4 %) of total area of national parks. Serengeti is the second largest national park with an area of 14,763 Km^2 which is about 25.7 % of the total area of Tanzania's national parks. Saanane is the smallest national park covering an area of 50 Km^2. Additional information concerning national parks, year of gazzettment, bordering districts and available flora and fauna are shown in Table 1.16.

Table 1. 16: List of National Parks by Area, Year Gazzetted, Bordering Districts and Available Flora and Fauna, 1960 - 1992

S/N	Name	Area (Km^2)	Year Gazzetted	Bordering Districts	Flora and Fauna
1	Arusha National Park	552	1960	Arumeru (Arusha region)	Giraffe, Cape Buffalo, Elephant, Zebra, Dik-Dik, Hippopotamus, Waterbuck, Warthog, Leopard, Eland, Spotted Hyena, Klipspringer, Baboon, Blue Monkey, Black-and-White Colobus, Greater Flamingo, Lesser Flamingo, Sacred Ibis, Maccoa Duck, Egyptian Goose, Turaco, Narina Trogon, Broadbill, Red-Hot Poker, Spanish Moss, Giant Lobelia
2	Gombe Stream National Park	52	1968	Kasulu, Kigoma urban (Kigoma region)	Chimpanzee, Olive Baboon, Redtailed Monkey, Red Colobus, Diademed Monkey, Leopard, Bushbuck, Buffalo, Waterbuck, Barbet, Palm-Nut Vulture, Forbes Plover, African Fish Eagle, Peters's Twinspot
3	Katavi National Park	4,471	1974	Mpanda (Rukwa region)	Eland, Sable Antelope, Roan Antelope, Hippopotamus, Crocodile, Lion, Leopard, Elephant, Zebra, Buffalo, Topi, Pelican, Waterfowl
4	Kilimanjaro National Park	1,668	1973	Siha, Hai, Moshi rural (Kilimanjaro region), Longido (Arusha region)	Abbott's Duiker, Grey Duiker, Red Forest Duiker, Bushbuck, Eland, Elephant, Leopard, Buffalo, Small Antelope, Blue Monkey, Black-and White Colobus, Galago Crassicaudatus, Kilimanjaro Tree Hyrax, Abbot's Starling, Raven, Papiliosjoestedti, Giant Lobelia, Moss, Lichen
5	Kitulo National Park	465	2004	Makete (Iringa region), Mbeya rural, Rungwe (Mbeya region)	Red-Hot Poker, Aloe, Protea, *Pelargonium* Geranium, Giant Lobelia, Lilies, Asters, Denham's Bustard, Blue Swallow, Mountain Marsh Widow, Cisticolanjombe, Kipengere Seedeater, Mountain Reedbuck, Eland, Chameleon, Lizards, Frogs
6	Lake Manyara National Park	648	1959	Babati, Mbulu (Manyara region), Karatu, Monduli (Arusha region)	Elephant, Cape Buffalo, Lion, Hippopotamus, Impala, Giraffe, Zebra, Wildebeest, Bushbuck, Leopard, Baboon, Lesser Flamingo, Greater Flamingo, White Pelican, Yellow-Billed Stork, White-Breasted Cormorant, Palm-Nut Vulture, Ayres's Hawkeagle, Nile Monitor, Cobra
7	Mahale National	1,613	1980	Kigoma rural	Chimpanzee, Redcolobus, Red-Tailed

	Park			(Kigoma region), Mpanda (Rukwa region)	Monkey, Blue Monkey, Giant Squirrel, Red-Legged Sun Squirrel, Brush-Tailed Porcupine, Bushy-Tailed Mongoose, Angolan Black-And-White Colobus, Sharpe's Grysbok, Red-Collared Widowbird, Speckled Mousebird, Crowned Eagle, Bee-Eaterroller, Crested Guineafowl, Ross' Turaco, White-Browed Robin-Chat, Red-Wingedstarling, Violet-Backed Starling Parrots
8	Mikumi National Park	3,230	1964	Kilosa, Morogoro, Mvomero (Morogoro region)	Eland, Greater Kudu, Yellow Baboon, Velvet Monkey, Serval, Sable Antelope, Hippopotamus, Zebra, Lion, Wildebeest, Impala, Buffalo, Giraffe, Elephant, Lilac-Breasted Roller, Yellow-throated Longclaw, Bateleur Eagle, Waterbirds
9	Mkomazi National Park	3,254	2007	Same, Mwanga (Kilimanjaro region), Lushoto, Korogwe, Mkinga (Tanga region)	Oryx, Kudu, African Wild Dog, Black Rhinoceros, Big Mammal
10	Ruaha National Park	20,300	1964	Iringa rural (Iringa region), Mbarali, Chunya (Mbeya region), Chamwino (Dodoma region)	Elephant, Hornbill, Kingfisher, Sunbird, White Stork, African Wild Dog Sable Antelope, Greater Kudu, Crested Barbet, Yellow-Collared Lovebird
11	Rubondo Island National Park	456	1977	Muleba (Kagera region), Sengerema (Mwanza region), Geita, Chato (Geita region)	Yellow-Spotted Otter, Nile Perch, African Fish Eagle, Hippopotamus, Vervet Monkey, Genet, Mongoose, Bushbuck, Sitatunga, African Grey Parrot, Malachite Kingfisher, Paradise Flycatcher, Herons, Storks, Spoonbills
12	Saadani National Park	1,062	2004	Bagamoyo (Coast region), Pangani, Handeni (Tanga region)	Giraffe, Buffalo, Warthog, Waterbuck, Reedbuck, Hartebeest, Wildebeest, Red Forest Duiker, Greater Kudu, Eland, Sable Antelope, Yellow Baboon, Verve Monkey, Elephant, Lion, Leopard, Spotted Hyena, Black-Backed Jackal, Hippopotamus, Crocodile, Mangrove Kingfisher, Lesser Flamingo, Green Turtle
13	Saanane Island National Park	50	2012	Nyamagana District	-

14	Serengeti National Park	14,763	1951	Meatu, Bariadi (Shinyanga region), Magu (Mwanza region), Bunda, Serengeti, Tarime (Mara region), Ngorongoro (Arusha region).	Wildebeest, Zebra, Lion, Leopard, Elephant, Rhinoceros, Buffalo, Cheetah, Gazelle, Giraffe, Spotted Hyena, Jackal, Aardwolf, Serval, Agama Lizard, Rock Hyrax, Secretary Bird, Ostrich, Black Eagle
15	Tarangire National Park	2,850	1970	Babati, Kiteto, Simanjiro (Manyara region), Monduli (Arusha region), Kondoa (Dodoma region)	Oryx, Gerenuk, Elephant, Baobab, Lesser Kudu, African Wild Dog, Lion, Kori Bustard, Ground Hornbill, Ostrich, Yellow-Collared Lovebird, Rufous-Tailed Weaver, Ashy Starling, Dwarf Mongoose, Red-And-Yellow Barbet
16	Udzungwa Mountains National Park	1,990	1992	Kilombero, Kilosa (Morogoro region), Kilolo (Iringa region)	Rufous-Winged Sunbird, Udzungwa Partridge, Sanje Crested Mangabey, Iringa Red Colobus, Rungwecerbus Kipunji, Matundu Dwarf Galago, Mountain Dwarf Galago, Reptiles and Amphibians, Hyrax, Squirrel and Big Mammals
Total		**57,424**			

Source: Ministry of Natural Resources and Tourism – TANAPA, -www.tanzaniaparks.go.tz

"-" Data not available

1.2.2.10: Game Reserves and Other Protected Areas

Game reserves are wildlife protected areas which are declared for the purpose of conservation. Consumptive and non-consumptive wildlife utilization is allowed after obtaining permits. These game reserves are famously known in Africa as areas for variety of activities.

Tanzania has a total of 28 game reserves covering an area of 117,755.4 Km^2. Selous is the largest game reserve covering an area of 50,000 Km^2 (Table 1.17) which is 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.

Table 1. 17: Distribution of Game Reserves by Government Notice, Area, Bordering Region and Year of Gazettement, 1959 -2012

S/N	Name of Game Reserve	Government Notice (GN)	Area (Km^2)	Bordering Region	Year of Gazzettment
1	Biharamulo	-	1,300.0	Kagera	1959
2	Burigi	-	2,200.0	Kagera	1972
3	Grumeti	214 of 1994	2,000.0	Mara	1993
4	Ibanda	-	200.0	Kagera	1972
5	Ikorongo	214 of 1994	3,000.0	Mara	1993
6	Kigosi	-	7,000.0	Shinyanga/Tabora	1983
7	Kijereshi	215 of 1994	300.0	Mwanza	1994
8	Kimisi	-	1,026.2	Kagera	2005
9	Kizigo	-	4,000.0	Singida	1972
10	Liparamba	-	571.0	Ruvuma	1959
11	Lwafi	-	2,228.0	Rukwa	1993
12	Lukwati	459 of 1997	3,146.0	Rukwa	1997
13	Lukwika-Lumesule	-	444.0	Mtwara	1995
14	Maswa	-	2,200.0	Shinyanga	1969
15	Mkungunero	-	700.0	Dodoma/Manyara	1996
16	Moyowosi	-	6,000.0	Kigoma	1981
17	Mpanga-Kipengele	-	1,574.3	Iringa	2003
18	Msanjesi	-	210.0	Mtwara	1995
19	Muhesi	217 of 1994	2,000.0	Singida	1994
20	Pande	216 of 1994	12.0	Dar Es Salaam	1994
21	Rukwa	-	4,000.0	Rukwa	1995
22	Rumanyika	-	800.0	Kagera	1965
23	Rungwa	-	9,000.0	Singida/Tabora/Mbeya	1951
24	Selous	-	50,000.0	Pwani/Morogoro/Lindi/Ruvuma	1920
25	Swagaswaga	-	871.0	Dodoma	1996
26	Ugalla	-	5,000.0	Tabora	1965
27	Uwanda	-	5,000.0	Rukwa	1959
28	Piti	-	2,972.9	-	2012
Total			**117,755.4**		

Source: MNRT
*"-" **Data Not Available***

1.2.2.11: Game Controlled Areas (GCAs)

Table 1.18 presents statistics on Tanzania's game-controlled areas. There are a total of 42 game-controlled areas covering 55,565.02 Km^2. Kilombero is a dominant game-controlled area covering 6,500 Km^2, equivalent to 11.7 % of the total game-controlled area. There is no significant difference in areas covered by the remaining game-controlled areas.

Table 1. 18: Game Controlled Areas by Size, Year of Establishment and Bordering Regions, 1974 - 1974

S/N	Name of GCA	Area (Km^2)	Year of Establishment	Bordering Region - District
1	Burunge	400	1974 (GN 269)	Arusha - Babati
2	Chabula Marsh	100	1974 (GN 269)	Mwanza - Mwanza
3	Enduleni	600	1974 (GN 269)	Arusha - Ngorongoro
4	Gombe	3,000	1974 (GN 269)	Tabora - Urambo
5	Handeni	3,500	1974 (GN 269)	Tana - Handeni and Kilindi
6	Igombe Dam	100	1974 (GN 269)	Tabora - Tabora
7	Kalimawe	300	1974 (GN 269)	Kilimanjaro and Tanga – Same and Lushoto
8	Kihirumira Pool	100	1974 (GN 269)	Lindi - Liwale
9	Kilombero	6,500	1974 (GN 269)	Morogoro - Kilombero and Ulanga
10	Kitwai	3,500	1974 (GN 269)	Arusha - Kiteto
11	Kongwa	1,500	1974 (GN 269)	Dodoma - Kongwa
12	Lake Daramatai	0.02	1974 (GN 269)	Dodoma - Kondoa
13	Lake Kwela	70	1974 (GN 269)	Rukwa - Sumbwanga
14	Lake Manka	20	1974 (GN 269)	Tanga - Lushoto
15	Lake Natron	3,000	1974 (GN 269)	Arusha - Longido
16	Lihogosa	30	1974 (GN 269)	Iringa - Njombe
17	Loliondo	4,000	1974 (GN 269)	Arusha - Ngorongoro
18	Lokisale	1,500	1974 (GN 269)	Arusha - Monduli
19	Longido	1,500	1974 (GN 269)	Arusha - Longido
20	Luganzo	2,500	1974 (GN 269)	Tabora - Kaliua
21	LundaMkwambi	1,000	1985 (GN 38)	Iringa - Iringa (R)
22	Masasi River	180	1974 (GN 269)	Kagera - Biharamulo
23	Meserani Dam	75	1974 (GN 269)	Arusha - Monduli
24	Mlele	3,000	1974 (GN 269)	Katavi - Mpanda
25	Msima	2,000	1974 (GN 269)	Katavi - Mpanda
26	Mto-wa-Mbu	1,500	1974 (GN 269)	Arusha - Monduli
27	Muhuwesi	1,500	1974 (GN 269)	Ruvuma - Tunduru
28	Mwadui	10	1974 (GN 269)	Shinyanga - Shinyanga
29	Mwambesi	1,000	1974 (GN 269)	Ruvuma - Tunduru
30	Nchwa – Nkima	50	1974 (GN 269)	Kagera - Biharamulo
31	Ngeju – Nijro Dam	30	1974 (GN 269)	Arusha
32	Nyonga	3,500	1974 (GN 269)	Katavi and Tabora – (Mpanda and Tabora)
33	Rau Forest	100	1974 (GN 269)	Kilimanjaro - Moshi
34	Rungwa River	1,500	1974 (GN 269)	Katavi - Mlele
35	RuvuMaasai	1,500	1974 (GN 269)	Arusha - Simanjiro
36	Ruvu – Same	1,000	1974 (GN 269)	Kilimanjaro - Same
37	Sanya – Lelatema	800	1974 (GN 269)	Ilimanjaro and Arusha
38	Simanjiro	2,000	1974 (GN 269)	Arusha - Simanjiro
39	Speke Gulf	300	1974 (GN 269)	Mara - Bunda
40	Ugunda	1,500	1974 (GN 269)	Tabora - Sikonge
41	Umba River	300	1974 (GN 269)	Tanga - Lushoto and Tanga
42	Utengule Swamps	500	1974 (GN 269)	Mbeya - Mbarali [harmonize all hyphens]
Total		**55,565.02**		

Source: MNRT

1.2.2.12: Forest Reserves

Key Message

Forest nature reserves are strictly for protection purposes as recognized by the forest legislation of 2002. Only research; education and nature-based tourism activities are allowed in the reserves.

Forest nature reserves are areas that are protected and managed in order to preserve a particular type of habitat and its flora and fauna, which are often rare or endangered. The reserves are essential areas for study and research, they provide tourist attraction areas, they provide catchment sources which help supply water to communities surrounding the reserves, they also play an important role in climate regulation and most preservation of nature reserve biodiversity.

The urge to form Nature Reserves in Tanzania begun in the 1990s. The forest legislation of 2002 in Tanzania identifies forest nature reserves as protected forest areas of high importance for the conservation of biodiversity. The main challenges for the sustainability of the nature reserves include: - illegal mining, poaching and logging activities; conversion of forest to farmland; fire attacks; invasive plant species; and animal grazing.

Table 1.19 lists forest nature reserves found in Tanzania, their total areas, flora and fauna and years in which they were gazzetted.These forests are managed by Tanzania Forest Services (TFS). Kilombero is the largest forest nature reserve covering an area of 134,511 ha which is about 43.2 % of total area under forest nature reserves. The second largest forest nature reserve is Udzugwa with an area of 32,763 ha, equivalent to 10.5 % of the total forest nature reserves area. Mt. Hanang is the smallest, covering an area of 5,871 ha.

Amani Nature Reserve, established in 1997, is among the earliest established nature reserve in the country. The reserve has a high biodiversity and it is a home to different scientific studies on ecology and biodiversity. Other forest reserves were in existence before 1997 but had not been upgraded to nature reserve until after the year 2005.

All the 12 nature reserve are rich in flora of different species, the most common ones in all the reserves being- *Ocotea usambarensis*, *Albizia gummifera*, *Parinari excelsa*, *Maesopsis eminii* (i.e. endemic and invasive in some nature reserves) and *Allanblackia stulhmanii*. These flora species have grown largely in Chome, Kilombero, Magamba, Amani, Rondo, Uluguru, Minziro and Nilo Nature Reserves.The fauna composition in the nature reserves include birds, insects, mammals, reptiles, amphibians etc. Fauna species are different from one nature reserve to another since they are found in different ecological areas. This wide variation results to endemic species.

Eight of the twelve forest nature reserves are found in the the Eastern Arc Mountains (Chome, Magamba, Nilo, Amani, Mkingu, Uluguru, Kilombero and Udzungwa Scarp). The other four are scattered in different locations in the country: one in the Southern Highlands (Rungwe); one in the coastal forest Southern part of Tanzania (Rondo); one in the forest of recent dormant volcano (Mt. Hanang) and one in the lowland swamp forest (Minziro), Map 1.5 show the locations of the forest nature reserves.

Table 1. 19: Forest Nature Reserves in Tanzania, by Area, Flora and Fauna and Year of gazettement

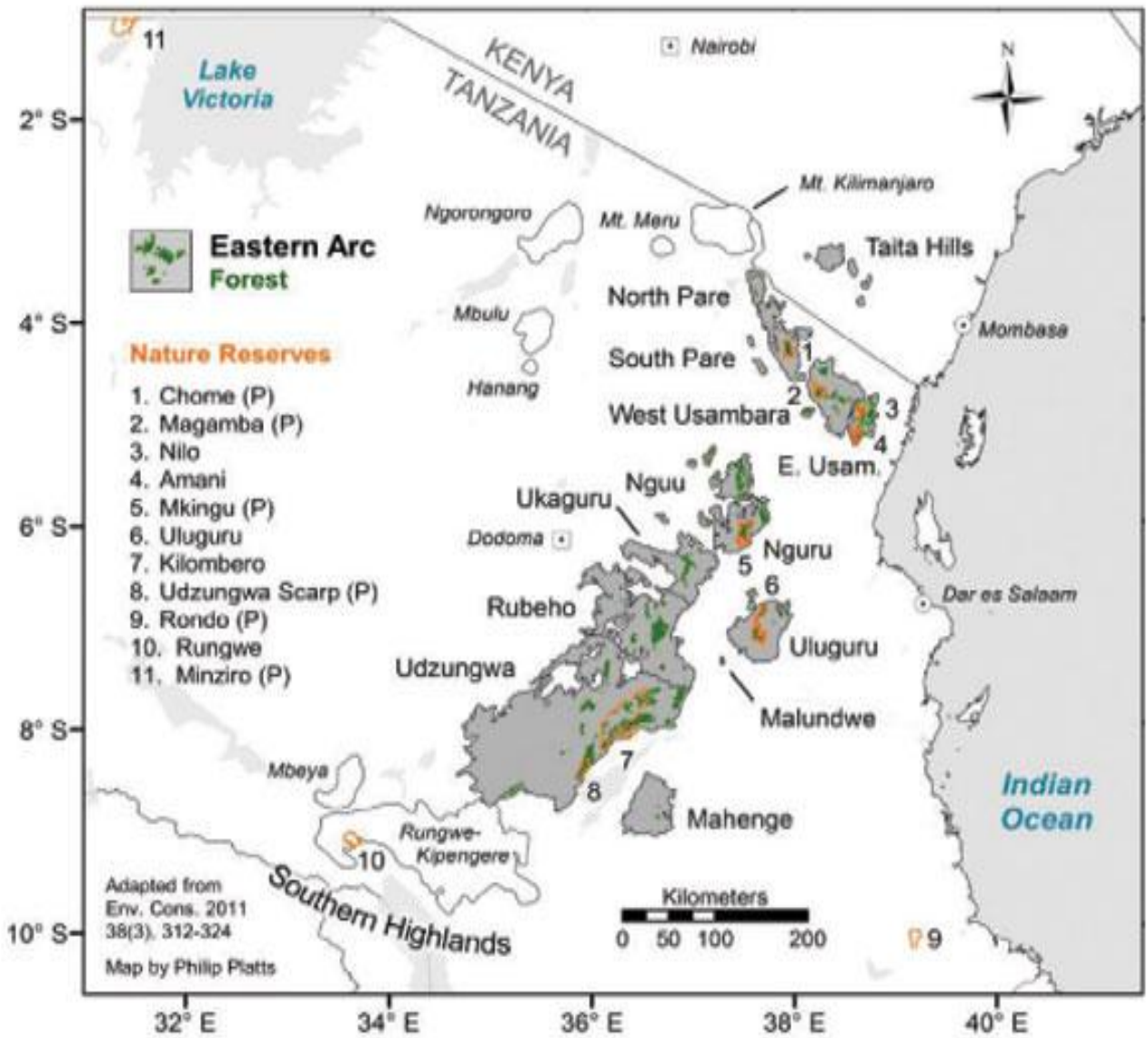
Name	Area (Ha)	Region	Year Established	Flora	Fauna
Amani Nature Reserve	8,380	Tanga	1997	*A.stuhlmanii*, *Isoberlinia scheffleri*, *Macaranga capensis*, *Cephalosphaera usambarensis*, *Myrianthus holstii*, *Newtonia buchananii*, *Parinari excelsa.* **Invasive spp**- *Maesopsiseminii*	Mites, spiders, freshwater crabs, dragonflies, beetles, butterflies, millipedes, mollusks, duikers, bushpigs, money **Endemic spp**-Usambara weaver (Ploceusnicolli), Usambara alkalat, Usambara hyliota, Usambara eagle-owl (Bubo vosseleri)
Chome Nature Forest	14,283	Kilimanjaro	2016	*Ocotea usambarensis*, *Erica arborea*	Birds and monkeys
Nilo Nature Reserve	6,225	Tanga	2007	Saint paulia (African violet flower), Allanblankia stuhlmanii, Sorindeia madagascariensis, Leptonychia usambarensis	Banded green sunbird, Red-capped forest warbler, Angolan pied colobus, Usambara three-horned cameleon, zanj elephant shrew

Minziro Nature Reserve	25,000	Kagera	2016	*Baikiaea-Podocarpus, Acacia spp, Manilkara obovata, Syzygium cordatum, Maesopsis eminii etc.* **Endemic spp**- *Afrocarpus dawei, Coffea canephora*	58 Birds spp, butterflies, Thomas galago, Grey-cheeked mangabey, Viper snake, great blue turaco
Uluguru Forest Nature Reserve	24,115	Iringa	2007	*Parinari excelsa, Draceana steudneri, Rauvolfia manii, Solanecio manii, Passiflora edulis, Solanum terminale* etc.	Angola piedcolobus, yellowbaboon, savannah monkey, bluemonkey, small-eared galago, zanj elephant shrew, Zanzibar galago, usambara galago, honey buzzard, African black duck etc. **Endemic spp.-** Afrixalus uluguruensis (leaf frog)
Kilombero Forest Nature Reserve	134,511	Morogoro	2007	*Cassipourea gummifla, Maesa lanceolate, Syzygium guineense, Ocotea usambarensis, Hagea abyssinica, Bridelia micrantha, Furea spp, Khaya anthotheca, Rauvolia caffra, Millicia excelsa* etc.	Sanje mangabey, Red colobus monkey, black and white colobus monkey, yellow monkey, sykee's monkey, Senegal galago
Rungwe Forest Nature Reserve	13,652	Mbeya	2009	*Aphloiathei formis, Ficalhoa laurifolia, Maesa lanceolata, Trichpcladus ellipticus, Albizia gummifera, Macaranga kilimandscharica, Bridelia micrantha*	Abbott's duiker, Tanganyika mountain squirrel, Livingstone turaco **Endemic spp.**- Rungwe-cebus kipunji, Rungwe galago
Magamba Forest Nature Reserve	9,283	Tanga	2016	*Ocotea usambarensis, Tabernaemontana pachysiphon, Macaranga conglomerate, Albizia gummmifera, Syzygium guineense, Flacourtia indica, Grewia benguelensis, Dodonea viscosa* etc.	Bush-pig, black and white colobus monkey, rabbits, antelope, lizards, snakes, Nectarinia usambaricus, Turdus roehli, black billed weaver etc.
Mkingu Forest Nature Reserve	23,388	Tanga	2015		Black and white colobus monkeys, mountains galagos, black and rufous elephant shrew, moreau's sunbird, banded green sunbird. Endemic spp.- Werner's three horned chameleon, the Nguru spiny pygmy chameleon
Udzungwa scarp Forest Nature	32,763	Iringa	2016	*Brachystegia spp, Protea spp, Uapaca kirkiana, Hagenia abyssinica, Casspoure*	Udzungwa re colobus, Tana river mangabey, grey-faced sengi

Reserve				*agummiflua, Myrica salicifolia, Croton macrostachyus etc.*	**Endemic spp.**- Bicolored frog, orange breasted sunbird
Rondo plateau Forest Nature Reserve	14,000	Lindi	2016	*Afzelia quanzensis, Albizia gummifera, Albizia adianthifolia, Dialium holtzii, Ficus spp, Parinari excelsa, Faurea saligna, Cussonia, zimmermanii*	The rondo dwarf galago and the East coast Akalat.
Mount Hanang Forest Nature Reserve	5,871	Manyara	2016	*Juniperus excelsa, Albizia spp, Fagaropsis angolensis, Oliniaro chetiana, Euclea divinorum, Catha edullis, Ficus spp, Prunus africana, Clodendrum capense*	Silky blesmol, bush duck, python, olive baboon, bush pigs, leopard, spotted hyena
TOTAL	**311,471**				

Source: Ministry of Natural Resources-nature-reserves.go.tz

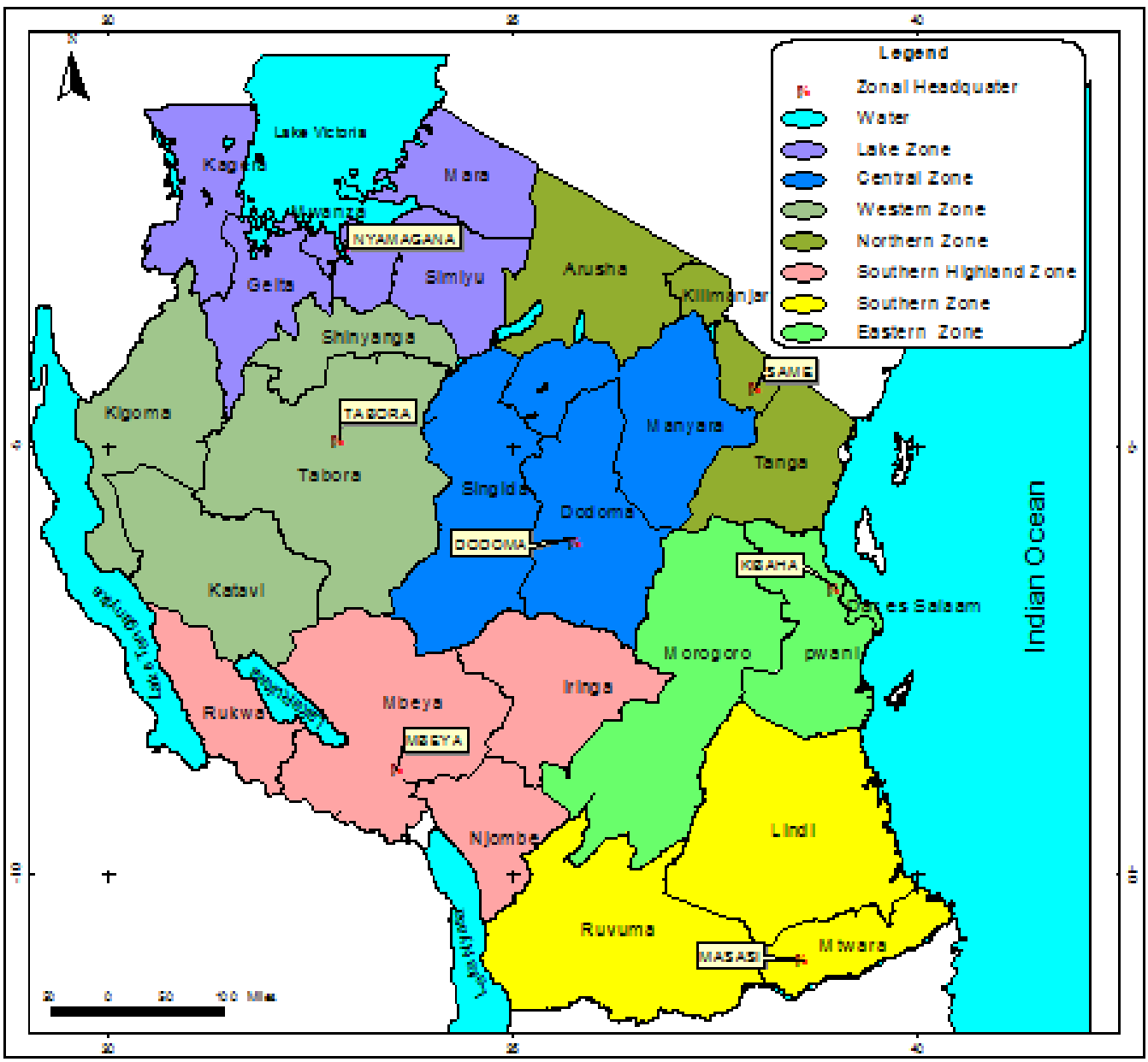
Map 1. 6: Forest Nature Reserves of Tanzania



1.2.3- Forests

Tanzania Forest Services (TFS) Agency operates within the governance model stipulated in its Establishment Order No. 269/2010 under the Ministry of Natural Resources and Tourism. TFS operates in seven zones as indicated in the Map 1.7.

Map 1. 7: Tanzania Forest Services Agency Zone Distribution



A Forest is defined as a piece of land with trees more than 0.5 ha and a canopy cover of at least 10 % and where the trees have a height of more or equal to 5 metres. Forest resources means a forest and forest products including anything which is produced by or from trees or grows in a forest or is naturally found in the forest. The forest produce include things such as bamboos, bark of trees, branch wood, canes, charcoal, fibre, firewood, fruits, gums, latex, leaves, poles, plants, resins, withies, seeds, timber, trees, wax, wood oils, roots, sap, litter, and any other living or inanimate object declared by the Forest Act to be a forest product.

Tanzania is endowed with vast areas of forest resources, which offer considerable social and economic potential, unique natural ecosystems rich in biological diversity and wildlife habitats. Furthermore, forest and bee resources contribute significantly to the socio-economic wellbeing in terms of raw material supply, employment, food security, energy and environmental protection among others. Most of the rural communities are highly dependent on forest resources for their livelihood.

Furthermore, forests are important for the provision of numerous goods and services both in the national economy and to the society at large. The goods include timber, wood fuel, food, fodder and medicine while services include watershed, shelter, employment, recreation, habitats for wildlife, and carbon sequestration. They also provide a range of unique natural ecosystems, landscape and biological diversity and genetic resources. In terms of linkage and support to other sectors, forests stabilize stream flows and therefore reduce disasters such as landslides, erosion and floods in areas of steep topography and high precipitation. Forests also have an important function in the supply of irrigation water for lowland farming and fish production.

In order to minimize damage to the ecosystem due to human activities, the forest policy (1998) aims to carry out Environment Impact Assessment (EIA) before carrying out large investment projects, which convert forestlands to other land uses. These include activities such as forest industries, mining, road construction, agriculture, dams, refugee settlement, shrimp farming and tourism (URT, 1998).

The forest policy spells out several strategies and measures to ensure ecosystem conservation and management in areas of biodiversity, watershed, soil, and wildlife. These strategies and measures are inferred from the policy statements, which include:

(i) New forest reserves for diversity conservation will be established in areas of high biodiversity value;

(ii) Forest reserves with protection objectives of national strategic importance may be declared as nature reserves;

(iii) Involvement of local communities and other stakeholders in conservation and management will be encouraged through joint management agreements;

(iv) Biodiversity research and information dissemination will be strengthened in order to improve biodiversity conservation and management;

(v) Biodiversity conservation will be incorporated in the management regimes of natural production forests and plantations;

(vi) The replacement of natural forests by exotic plantations will be minimized;

(vii) New catchment forest reserves for watershed management and soil conservation will be established in critical areas; and

(viii) EIA will be required for investments, which convert forestland to other land use or may cause potential damage to the forest environment.

Forest resources cover 48.1 million hectares (ha) equivalent to 55 % of the total surface land area of Tanzania Mainland. Woodlands cover 44.6 million ha (93 %) of the forestland, while catchment forests, mangroves, coastal forests and government forest plantations occupy 3.4 million ha (7 %). Furthermore, about 20 million ha of the forestland is production forests and 28 million ha are protected forests found in forest reserves and other protected areas.

According to international vegetation formation description, the main types of forests in the country are clustered as extensive miombo woodland in the lowland areas across the central and southern parts; the acacia woodlands in the northern regions, the coastal forest/woodland mosaics in the east, mangrove forests along the Indian Ocean and closed canopy forests on the ancient mountains of the Eastern Arc. The distribution of forests in terms of ownership includes 16.6 million hectares (35 %) under the Central Government managed by TFS; 3.1 million ha (7

%) under Local Government Authorities; 22 million ha (45.7 %) under Village Governments; 3.5 million ha (7 %) of private sector; and 2.73 million ha (5.7 %) as forests in general lands.

Woodlands are low-density forests forming open habitats with plenty of sunlight and limited shade; woodlands may support understories of shrubs and herbaceous plants including grasses and sometimes form a transition to shrub land under drier conditions.

Table 1.20 shows forest area distribution in Tanzania. Statistics in the table show areas under TFS jurisdiction only. Statistics on forests owned by LGAs, village lands and privately owned forest are not included.

The forest area planted with trees is showing an increasing trend, from 189,741.7 ha in 2013 to 206,074.0 ha in 2016. It is also observed that, in the same period, there has been a general decrease of forest areas affected by fires. Area under natural forest has not changed much.

Table 1. 20: TFS Forest Area Distribution, 2013 - 2017

Forests	Unit of Measure	2013	2014	2015	2016	2017
Total	**Area (Ha)**	**48,100,000.0**	**48,100,000.0**	**48,100,000.0**	**48,100,000.0**	**48,100,000.0**
1. Natural	Area (Ha)	28,814,258.3	28,811,252.0	28,807,497.0	28,802,853.0	28,797,926.0
2. Planted	Area (Ha)	189,741.7	192,748.0	196,503.0	201,147.0	206,074.0
3.Protected forest areas	Area (Ha)	19,096,000.0	19,096,000.0	19,096,000.0	19,096,000.0	19,096,000.0
4. Forest area affected by fire	Area (Ha)	9,872,485.0	10,255,576.7	7,884,130.1	9,667,395.5	8,349,727.7

Source: TFS
Note- *The statistics in the table shows areas under TFS areas of jurisdiction only; they do not necessarily add up to total.*

1.3. Environmental Quality

1.3.2: Freshwater Quality

Freshwater quality problems are mainly caused by economic activities, climate, and pollution. The problem is sometimes aggravated due to non-uniform distribution of rainfall and extended droughts. During droughts, there are low flows and extended heat raises water temperatures and increases salinity levels in rivers and streams.

The Ministry of Water and Irrigation is implementing a National Water Quality Management and Pollution Control Strategy (WQMPCS). In recent times it has been observed that, as a result of intensive catchment degradation caused by rapid changes in land use, non-point sources of pollution are on the rise. Few cases of water-borne diseases have been reported in connection with the use of river water for domestic uses especially in rural areas (URT 2011).

Different freshwater source for example lakes, river, spring face different water quality issues. At the moment there are no established water quality standards for receiving freshwater bodies such as lakes, river, and springs. The available standards are only for treated drinking water for human consumption and for effluent water that enters the receiving freshwater bodies such as lakes and rivers.

1.3.2.1: PANGANI BASIN

Surface Water Quality

Both point source and non-point source pollution are experienced in the Pangani Basin. Municipal sewerage effluent and industrial discharges are the main sources of point source pollution. Effluents from most of the industries do not meet the required effluent standards. The city/municipal effluent treatment systems are insufficient and their discharges do not meet the required standards. Most of the populations in large settlements are not connected to the wastewater treatment systems. In addition, not all large settlement areas are equipped with wastewater treatment systems. This situation leads to the presence of high values of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) within water bodies near large settlement areas in the Pangani Basin (PBWB-IUCN, 2011).

Non-point source pollution in the Pangani basin is largely attributed to agricultural activities. Potential agricultural effects include reduced river flows, loss of native riparian vegetation, change in seasonal flows, excess nutrients, excess sediment load, change in both pH and Electric Conductivity (EC) values and water contamination with agro chemicals and sewage (PBWB-IUCN, 2011).

Groundwater Quality

The quality of groundwater in the Pangani Basin varies from fresh to saline. In general, some areas along the coast and areas of valleys or depression within the metamorphic basement area with low rainfall show elevated EC values (>1000 µs/cm). Fluoride problems occur in the volcanic areas of Arusha town down to the Sanya plains. Kahe plains have high fluoride values with less salinity problems. Fluoride decreases towards areas of Usagara metamorphic rocks

Many water sources in the Pangani Basin receive some kind of agro-chemical and industrial pollution such as pesticides and heavy metals. High salinity, iron (Fe) and nitrate (NO_3) are experienced eastwards of the Pangani basin towards the coastal zone. Aquifers within municipal areas suffer from effluent discharges resulting in higher BOD, COD and pH values (PBWB-IUCN, 2011).

1.3.2.2: LAKE VICTORIA BASIN

Surface Water Quality

Polution in the Lake Victoria Basin is attributed to both point source and non-point sources. Municipal effluent, mining and industrial discharges are the main sources of point source pollution. As a result of availability of high value minerals, there are small scale and large scales mining activities in various areas within the basin. These activities are the major source of heavy metals, low pH values, high sulphide content and turbidity contaminations in both surface and groundwater bodies.

Lack of sufficient city/municipal effluent treatment systems and lower connection to the wastewater treatment systems has led to high presence of TDS, pH, NO_3-, EC, BOD, COD and nutrients within water bodies near large settlement areas in Lake Victoria Basin. The discharge from textile industries also bears intense colorations derived from the dyes of fibrous materials. Non-point source pollution in the basin is largely attributed to agricultural activities. Potential agricultural effects include reduced river flows, loss of native riparian vegetation, change in seasonal flows, excess nutrients, excess sediment load, change in both pH and EC values and water contamination with agro-chemicals and sewage.

Groundwater Quality

The groundwater quality of the Lake Victoria Basin is mostly affected by industrial, agricultural and mining activities, leading to higher values of Electric Conductivity (EC), Nitrates (NO_3), Iron (Fe), Mercury (Hg), Copper (Cu), Arsenic (As) and other heavy metals. Aquifers within municipal areas suffer from effluent discharges resulting in higher BOD, COD, phosphates and nitrates values. In addition, both high and low pH values are manifested depending on the nature of the pollutant.

The geological nature of the Lake Victoria Basin has less impact on groundwater quality, except for aquifers in volcanic terrains, where sulphur and carbonates are suspected, and in Malagarasi super group terrain where carbonates are pronounced. Aquifers within the superficial deposits and the Nyanzian-Kavirondian formations are generally of good water quality except in localized gold mineralized zones where sulphides, silicates and carbonates are the common contaminants, along with anthropogenic contamination related to extraction of mineral ores. In addition, mining activities are causing high heavy metal content and low pH values in groundwater.

1.3.2.3: WAMI_RUVU BASIN

Surface Water Quality

In the Wami-Ruvu Basin, Municipal sewerage effluent, Irrigation, Mining and Industrial discharges are the main sources of point source pollution. The most affected parameters are Temperature, pH, colour, odour, taste, coliforms, turbidity, EC, TDS, COD and BOD. Other parameters are Nitrates, Sulphates, Phosphates, Mercury (Hg), Iron (Fe), Manganese (Mn), Cadimium (Cd), Lead (Pb), Copper (Cu), Chromium (Cr), Zinc (Zn), Nickel (Ni), Arsenic (As), Cyanide as well as Total Petroleum Hydrocarbon (TPH).

Non-point source pollution in the basin is largely attributed to agricultural activities with potential agricultural effects such as reduced river flows, loss of native riparian vegetation, change in seasonal flows, excess nutrients, excess sediment load, change in pH, TDS, COD, BOD, Nitrates, EC values and water contamination with agro-chemicals and sewage.

Groundwater Quality

The groundwater quality of the Wami Ruvu Basin is mostly affected by industrial, agricultural and mining activities leading to higher values of EC, NO_3, Fe, Hg, Cu, As and other heavy metals. Aquifers within municipal areas suffer from effluent discharges resulting in higher BOD, COD, coliforms, phosphates and nitrates values. In addition, both high and low pH values are manifested depending on the nature of the pollutant.

The geological nature of the basin has an impact on groundwater quality. High EC values and high mineral content in groundwater are attributed to the geological nature of aquifers. The high electric conductivity areas are observed in the areas from the centre of Dar es Salaam to the centre of Bagamoyo, the northern part of Bagamoyo District, western part of Kibaha District, Morogoro Urban, southern part of Kongwa District and the southern part of Kiteto District.

1.3.2.4: RUFIJI BASIN

According to WREM (2012), the water resources of the Rufiji Basin, both surface and groundwater, have relatively good chemical quality, but poor physical and bacteriological quality. Surface waters have generally poorer physical quality than groundwater s. The common physical quality problems are turbidity, colour, total suspended solids, and odour. Iron-humic acid complexes present a water treatment challenge in surface waters draining swampy or heavily forested areas. Both surface and groundwater s are contaminated with microorganisms of faecal origin. Surface waters have a higher occurrence of faecal contamination, and higher numbers of faecal coliform organisms per unit volume than groundwaters.

With respect to mineral content, both surface and groundwaters are relatively fresh, with the larger proportion of waters having low concentrations of dissolved substances. Surface waters are relatively fresher and softer than groundwaters. Electrical conductivity (a proxy for mineral content), ranges from 5 to 1740 µS/cm in surface waters and 7 to 7960 µS/cm in groundwaters. The 75^{th} percentile for conductivity is 106 µS/cm and 391 µS/cm in surface and groundwater sources, respectively. Despite the lowly mineralized character of most waters inn this basin, there are pockets of highly mineralized waters, especially in the Great Ruaha and Lower Rufiji sub-basins.

Chemical quality problems occur in some waters. The key problem parameters in relation to chemical quality, which are more common in groundwaters than surface waters, are acidic and alkaline reaction (sometimes is considered a physical property), hardness and relatively high concentrations of Sodium, Chlorides and Sulphates. There is great variability in the degree of acidity or alkalinity of the waters. The pH ranges from 5.2 to 9.0 units in surface waters and 4.3 to 10.7 units in groundwaters. The mean pH is 7.07 and 6.86 units for surface and groundwaters, respectively.

Based on the above observed water quality characteristics, the waters of the basin, both surface and ground, only require minor treatment (to remove colour, turbidity and microorganisms) to be fit for human consumption and other uses. If water is abstracted from remotely-located and well protected water catchment areas, it may be supplied without treatment.

There is strong seasonality in water quality in both surface and groundwaters. In the wet seasons, turbidity, colour and bacteriological contamination problems increase while the chemical content gets diluted by rainwater. The opposite is observed in the dry seasons. Available data is inadequate to infer the extent and impact of salt water intrusion in the Rufiji Delta.

1.3.2.5: INTERNAL DRAINAGE BASIN (IDB)

The National Sanitation Foundation developed a standardized method for comparing the water quality of various water bodies in 1970. The water quality index is classified as follows: For indexes between 91-100 the water quality is classified excellent, indexes between 71-90 is good, indexes between 51-70 is medium, indexes between 25 - 50 is bad and below 25 is very bad. Based on this classification, 25 % of water samples in the basin had good quality, 71.5 % of the samples were in medium condition, and a single sample (Manyara Lake) had a bad water quality index. About 83.7 % of samples from rivers were in medium condition (YEKOM/FBNE, 2015).

The most important pollution sources in the IDB aredomestic pollution sources, agricultural pollution sources, industrial waste pollution, and livestock pollution sources. Domestic pollution sources emanate within population centres (cities and villages). Wastewater and solid waste produced from these population centres includes garbage from urban and commercial places (30 %), ashes and residuals (23 %), demolition and construction materials (3 %), domestic organic

rubbishes (22 %) and plastics (22 %). The solid waste accumulated in urban and rural areas is highly concentrated with BOD and must be isolated from surface water and groundwater resources. It is estimated that 1,156,288 tonnes of solid waste are produced annually in the basin, with Lake Eyasi sub-basin, where most of the population centers are located, producing almost 60 % of all solid waste (YEKOM/FBNE, 2015).

Wastewater from domestic human activities is the most important pollution source in urban areas. About 115 Million Cubic Metre (MCM) of wastewater are produced annually in the Internal Drainage Basin releasing 113,527 tonnes of BOD, 27,330 tonnes of total nitrogen and 4,205 tonnes of total phosphorus into the environment (YEKOM/FBNE, 2015).

The Internal Drainage Basin is highly populated with livestock waste due to the social setup of its inhabitants. Livestock related waste contributes 135,147 tonnes /yr BOD, phosphorus (5,005 tonnes /yr), and nitrogen (162,677 tonnes /yr) pollutions in the basin. Agricultural pollution in the Internal Drainage Basin is very limited as usage of fertilizers and pesticides is very low and could be ignored. Similarly, industrial wastes in the basin are limited to mining activities whereby heavy metals (Calcium and Mercury), lower pH, higher EC, high carbonates and turbidity are the main concerns (YEKOM/FBNE, 2015).

The quality of the basin's water resources is highly affected by both higher Electric Conductivity (EC) values and higher fluoride concentrations, caused by high magnesium and other alkaline metals present due to the geological nature of its rocks. Relatively high nitrate concentrations are observed in some areas and are mostly attributed to anthropogenic origins.

1.3.2.6: RUVUMA RIVER AND SOUTHERN COAST BASIN

Surface Water

Surface water in the basin is considered to be of good quality except in highly populated areas, where surface water quality is affected by municipal wastes. High nitrate, pH, BOD and COD contents are observed in polluted surface water around settlement areas. There are no major industries in the basin, the only major industrial pollution emanates from mining activities. High

heavy metal concentrations, low pH and high turbidity values are observed in surface water around mining areas.

Groundwater

Groundwater in Ruvuma River and Southern Coast is affected by both natural and anthropogenic sources. Aquifers in coastal formations are saline in some places due to either sea water intrusion or type and source of the sediments contained in it. Marine sediments contain high carbonate materials that affect groundwater quality. Low pH values and higher salinity are observed in these aquifers.

Basement aquifers depicts low pH, high salinity, medium to high EC and low Total Dissolved Solids (TDS) values due to mineral content of the rock mass. Karoo, alluvial and ligoriths aquifers are generally of good water qualities. The unconsolidated and partially consolidated formations generally contain waters that are high in iron and manganese, and total dissolved solids (TDS), possibly as a result of contact with Tertiary and Quaternary, or even Mesozoic formations. High pH values have been observed in spring flows emanating from dolomitic formations.

1.3.2.7: LAKE RUKWA BASIN

The main water quality issues in the basin include high silt loads from widespread catchment degradation; poor rural sanitation leading to physical and bacteriological contamination of surface and **groundwater** resources; poor urban sanitation leading to heavy pollution of streams draining urban areas; high iron from suspected pipe rust; high iron occurring naturally in rock formations; high fluoride naturally occurring in groundwater sources; high levels of mineralization and hardness in groundwater; and heavy metal pollution from mining activities (WREM International, 2014).

Generally, the basin's surface waters and groundwater have relatively poor physical and bacteriological quality, but have good chemical quality. Poor physical quality is most pronounced in surface water. There is strong seasonality in water quality, with poor water quality observed more often during the rainy seasons. Both surface and groundwater in several basin areas is contaminated with bacteria of faecal origin. The problem is most serious in surface

waters, where about 75 % of tested water samples had higher coliform counts. However, only 10 % of groundwater sources exhibited this problem (WREM International, 2014).

Lake Rukwa is an alkaline lake with a sodium-bicarbonate water type. The pH of the lake ranges from 8.8 to 9.8; alkalinity is about 900 mg $CaCO_3$ per litter, and electrical conductivity ranges from 2,200 to 2,800 μS/cm. The lake has poor physical and bacteriological quality. The lake is turbid and strongly coloured. Colours vary with seasons from dull brown, through brick red and brilliant green, to greenish-grey. Turbidity values are typically in excess of 100 Nephelometric Turbidity Unit (NTU) while colour, which comes from algal pigments, humic compounds, suspended solids and iron complexes, typically exceeds 100 True Colour Unit (TCU). Faecal coliform concentrations are in excess of 200 colony-forming unit (cfu)/100mL reflecting the poor environmental sanitation challenges in the drainage basin, and the favourable climate within the basin for the growth and proliferation of bacteria (WREM International, 2014).

Heavy metal pollution from gold mining poses the greatest threat to water quality. Artisanal mining activities increasingly mobilize heavy metals from goldfields and transport them into surface water bodies. Heavy metals are present and are likely accumulating in Lake Rukwa (WREM International, 2014).

1.3.2.8: LAKE NYASA BASIN

Surface Water

The analysis of water quality for the major rivers in the basin (Songwe, Kiwira, Mbaka, Lufilyo and Lumbira) is identified in three groups based on the chemistry of water (SMEC, 2015). Songwe, Lumbira, and Lufilyo had Ca/Cl and Na/Cl ratios higher than the lake water, which was associated with presence of bedrock in the catchments drained by the rivers. Mbaka showed low Ca/Cl and Na/Cl ratios and so did Kiwira River-which is impacted by hydrothermal springs in its catchment.

The Songwe and Kiwira Rivers contribute 4 % and 5 % of the annual river input to Lake Nyasa respectively and, therefore, have significant influence on the lake's water quality. Atmospheric inputs to the lake accounts for 33 % of new phosphorus and 72 % of new nitrogen to Lake

Nyasa. The lake is particularly sensitive to nutrient enrichment and pollution because of its large surface area and slow water-flushing rates (SMEC, 2015).

Only turbidity and high sediment content are contaminants associated with mining activities within the basin. Agricultural related pollution mainly occurs in flood plains where paddy irrigation and maize plantations are taking place in relatively large scale. High EC, BOD, COD, pH and TDS values in surface water around irrigation schemes can be attributed to both municipal agricultural contaminants.

Groundwater

Available data indicates that groundwater quality is generally good with a range of electrical conductivity (EC) from 100 to 4,180 µS/cm with only a few samples (six out of 99) exceeding the Total Dissolved Solids (TDS) limit (SMEC, 2015). Both municipal effluents and agricultural wastes affect groundwater quality in aquifers with high water tables, such as alluvial aquifers around Kyela Township where high EC, BOD, COD and pH values have been observed. In addition, these aquifers experience high values of coliform bacteria due to sewerage contamination.

1.3.2.9: LAKE TANGANYIKA BASIN

Deterioration of water quality is likely to place the beneficial uses of the basin's water resources at risk in some areas and have the potential to have a more serious impact in the future, including on sustainability and biodiversity of aquatic ecosystems (SMEC, June 2015). The deterioration in water quality is caused, among others, by: faecal contamination from poor domestic waste management in rural and urban areas, which threatens water sources for human use. Other sources of polution are sediment, nutrients and agrochemicals exported from catchments, due to poor land use practices, and uncontrolled discharge of mining wastes, which threaten human, livestock and wildlife drinking water sources and aquatic ecosystems. Eutrophication, threaten the human use of aquatic resources, the sustainability and biodiversity of aquatic ecosystems in large lakes; naturally occurring fluoride in potable water sources threaten the suitability of water for human and livestock use.

Surface water

Surface water quality has been found to be generally good. However, pollution sources have existed in various parts of the basin. The pollution sources are linked to urban domestic and industrial wastewater (from Rivers Ntahangwa, Bujumbura, Burundi), Chlorinated hydrocarbons, and pesticides (from Cotton plantations near the Rusizi River), Heavy metals (from Northern (Burundi) lake waters), Sediment and nutrients from fertilizers (from Rusizi and Malagarasi rivers), Mercury from gold mining operations (from Malagarasi River sub-basin), Ash residues (from cement works, Kalemie, DR), Organic wastes, sulphur dioxide (from Sugar refinery plant, near Uvira, DRC), and shipping operations (from Lake-wide oil depots, e.g. Bujumbura) (SMEC, 2015).

Groundwater

Groundwater quality within the basin generally falls within Tanzania standards for drinking water, with the major components analysed being; EC generally less than 2,000 µS/cm, pH between 6 and 9, and fluoride less than 4 mg/L. pH greater than 6, fluoride greater than 4 mg/L and EC greater than 2000 µS/cm have been recorded in the eastern parts of the Basin and are associated with pollution from artisanal mining and farming.

Lowest pH of 5.1 was recorded in Tabora Rural and Mpanda Districts. Only one sample in Tabora Rural District recorded a pH of greater than 9.2. There is a high correlation between prevalence of low pH and geology. Slightly acidic pH is found mostly within granites and Archaean basement geology and mostly in the eastern part of the basin in the Tabora Region.

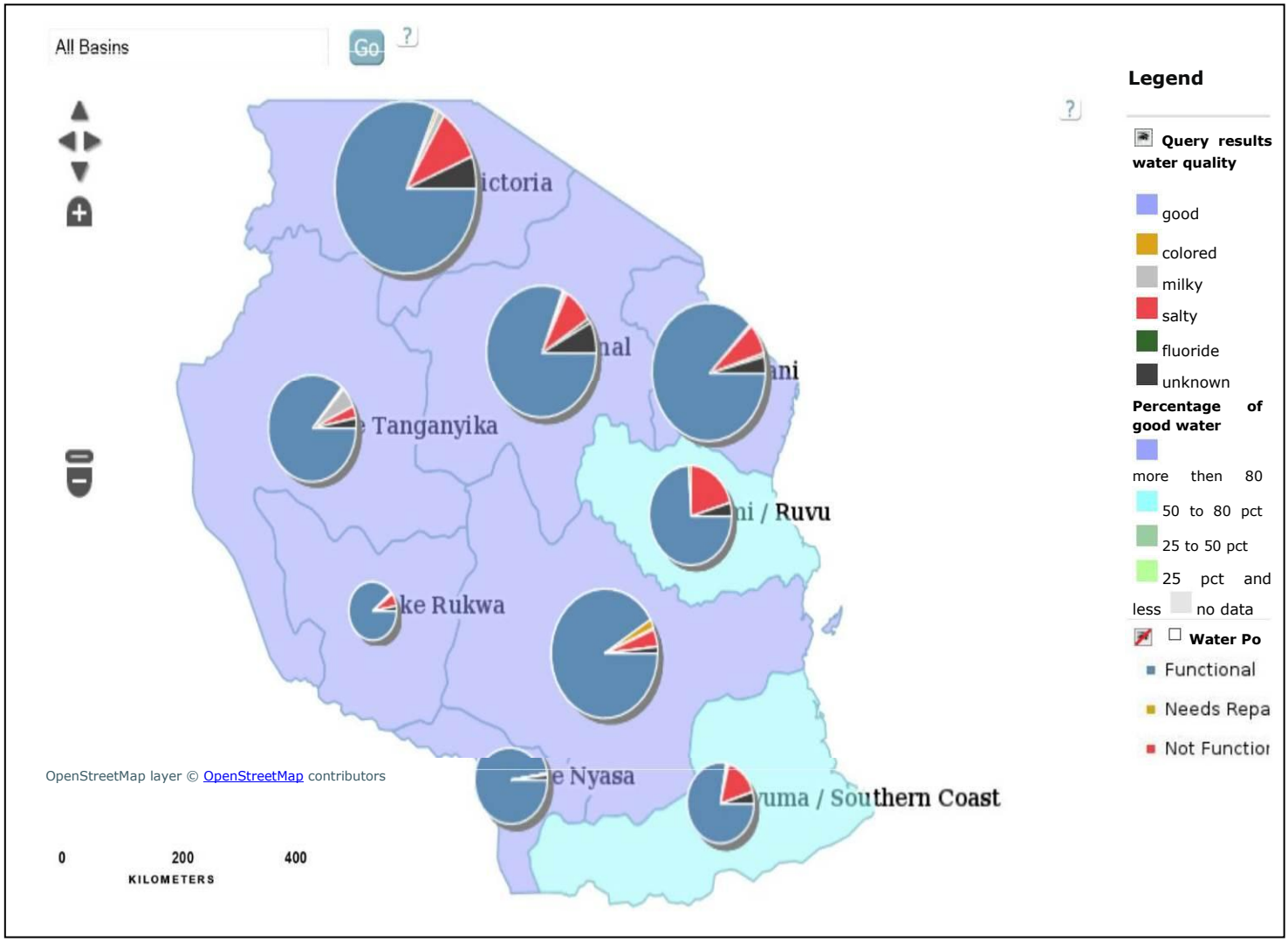
Within the Lake Tanganyika Basin, fluoride concentrations of greater than 1.5 mg/L have been observed in Tabora urban and rural areas, and in Kahama and Nzega Districts. A correlation of fluoride concentration with geology shows that high fluoride in groundwater is associated with granites. Maximum groundwater fluoride in the basin is 5.5 mg/L in Tabora rural at Kukundi B Village.

Saline groundwater is found in Uvinza where brine is being mined for salt production. This saline groundwater is associated with deep groundwater flow. All groundwater samples analysed in the basin predominantly show nitrate levels of less than 10 mg/L. Nitrate levels of

greater than 40 mg/L were observed in the villages of Mazwe-Mpanda district, Usunga and Isanjandugu. Moreover, nitrate levels of 50 to 100 mg/L were observed in Sikonge and Tukutuku area in Tabora urban. All these elevated nitrate levels were from shallow wells (SMEC, June 2015).

More information on the physical and chemical water quality in the nine water basin is indicated in map 8.1.

Map 1. 8: Freshwater Quality



Source: Ministry of Water, Water Point Mapping Database

Table 1. 21: Freshwater Quality Data, Lake Victoria 2013 - 2017

Parameters		Unit of Measurement	2013	2014	2015	2016	2017
a. Nutrients and chlorophyll	1. Concentration level of nitrogen	Concentration (mg/l)	0.18	0.16	0.22	0.24	0.21
	2. Concentration level of phosphorous	Concentration (mg/l)	0.152	0.133	0.122	0.097	0.126
	3. Concentration level of chlorophyll A	Concentration (mg/l)	0.0023	0.0023	0.002	0.002	0.002
b. Organic matter	1. Biochemical oxygen demand (BOD)	Concentration (mg/l)	3	2	1	3	2.2
	2. Chemical oxygen demand (COD)	Concentration (mg/l)	11	9	8	10	9.5
c. Pathogens	1. Concentration levels of faecal coliforms	Concentration (mg/l)	30	31	10	15	21
d. Metals (e.g., mercury, lead, nickel, arsenic, cadmium)	1. Concentrations levels in sediment and freshwater	Concentration (mg/l)	0	0	0	0	0
	2. Concentration levels in freshwater organisms	Concentration (mg/l)	-	-	-	-	-
e. Organic contaminants (e.g. PCBs, DDT, pesticides, furans, dioxins, phenols, and radioactive waste)	1. Concentration levels in sediment and freshwater	Concentration (mg/l)	-	-	-	-	-
	2. Concentration levels in freshwater organisms	Concentration (mg/l)	-	-	-	-	-
f. Physical and chemical characteristics	1. pH/Acidity/Alkalinity	Level	8.6	8.6	6.1	7.2	7.6
	2. Temperature	Degrees	26.2	27	27.4	27	23.9
	3.Total suspended solids (TSS)	Concentration	18	24	32	24	24
	4. Salinity	Concentration	0	0	0	0	0
	5. Dissolved oxygen (DO)	Concentration	4.5	5	5.3	5.5	5

CHAPTER TWO

ENVIRONMENTAL RESOURCES AND THEIR USE

2.1: Mineral Resources

Key Message

Tanzania's Development Vision 2025 plans the mining sector to account for 10 % of the GDP in 2025. This will require more efforts on value addition and more mineral sector integration with other sectors of the economy.

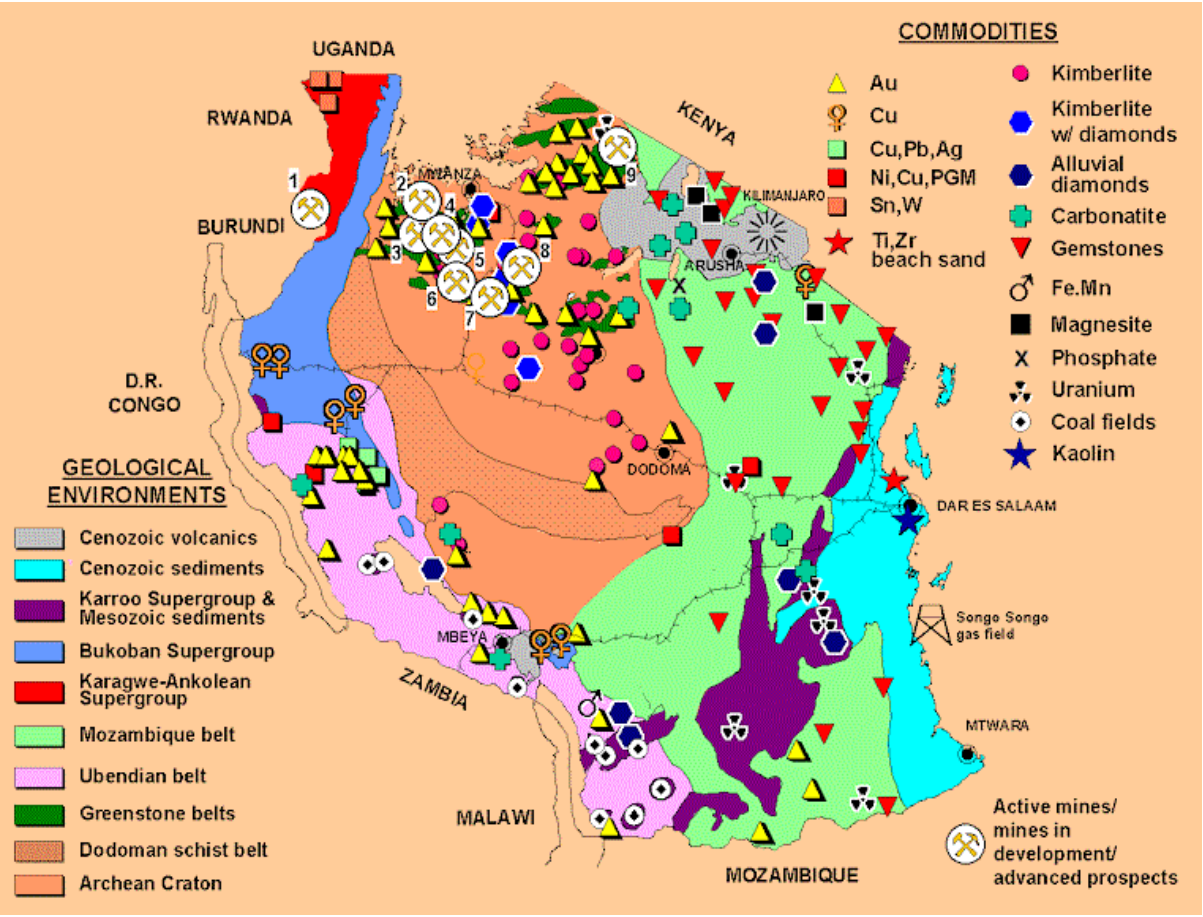
Tanzania has various mineral resources found on the surface of the earth and in the subsoil. These include metallic minerals such as gold, iron, silver, copper, platinum, nickel and tin; gemstones such as diamonds, Tanzanite, ruby, garnet, emerald, alexandrite and sapphire; industrial minerals such as kaolin, phosphate, lime, gypsum, diatomite, bentonite, vermiculite, salt and beach sand; building materials such as stone aggregates and sand; and energy minerals such as coal and uranium. Mining activities in the country are of three main types: large scale, medium and small scale operations (MEM, 2014).

Tanzania is one of the major mining countries in the continent (4th largest gold producer in Africa) and a major recipient of foreign investment in its mining industry. The sector contributed 4.8 % of GDP in 2016 and about 50 % of the country's foreign exchange earnings from exports apart from traditional exports. Based on Tanzania's Development Vision 2025 plan, the mining sector is expected to account for 10 % of the GDP by 2025. The sector attracts various players i.e. miners, prospectors, project developers and financiers, critiques and many more. The main focus of the Mineral Policy of 2009 is to increase mineral sector integration with other sectors of the economy in order to maximize the contribution of the sector to GDP and contribute to poverty alleviation.

Since the early 1990s, changes in Government policy and the approach to the mining sector, and increasing international investment, have led to its rapid growth and the influx of international mining giants such as Barrick Gold Corporation and AngloGold Ashanti Limited. This, coupled with the stable political climate and improved business environment, has made Tanzania an increasingly attractive destination for foreign direct investment (FDI). There are now a large number of mining operations across Tanzania, and production of gold and diamonds has increased significantly since the 1990s. However, the recent global price volatility for commodities such as gold has stifled the growth rate in the last two years. The Government will strategically participate in mineral exploration, mining, smelting, refining and value addition activities. It will also create a conducive environment for Tanzanians to participate in medium and large scale mining operations.

Map 2.1 presents information on geological and mineral occurrences in Tanzania.

Map 2. 1: Geological and Mineral Occurences in Tanzania



Source: Ministry of Minerals

2.1.1- Stocks and Changes of Mineral Resources

Key Message

Most recently the Governent has formulated the Natural Wealth and Resource Sovereignty Act of 2017 which recognize the permanent sovereignty of Tanzania over all of its natural wealth.

The mineral reserves estimation are essential for daily operation of mine, it also represent the future asset of the mine. The Mineral Policy of 2009 will continue to attract investment in exploration and mining; underpin development of small scale miners; and promote public participation in mining activities. Furthermore, the Policy provides a clear guidance to attract investors in exploitation and sustainable exploitation of mineral resources of Tanzania in a win - win situation.

Gold reserves in Tanzania are estimated to be 29 million troy ounces. Gold exploration has been centered mostly on the greenstone belts around Lake Victoria and Lupa Gold Field in Chunya and Mpanda areas, where several large deposits have already been discovered and are being developed. Iron reserves in Tanzania are located mainly in Liganga, Uluguru Mountains, Mbabala near Lake Tanganyika and Itewe. The Liganga iron ore mine holds the biggest iron resources in Tanzania with a proven reserve of 126 million tonnes. In addition, recent exploration programmes in Tanzania are revealing presence of substantial amounts of uranium and base metals.

Table 2.1 shows the cumulative reserves of different minerals available in Tanzania since the commencement of mining activities until 2015.

Table 2. 1: Tanzania Mineral Reserves for Selected Minerals, 2015

Type of mineral/ indicator	Unit of Measurement	Reserve Quantity
Gold	million troy ounces	28.57
Tanzanite	million carats	109
Tsavorite	million carats	1.4
Diamonds	million carats	33.1
Nickel	million tonnes	107
Cobalt	tonnes	9,240
Uranium	million pounds	156.12
Coal	million tonnes	588.4
Iron Ore	million tonnes	219
Titanium	tonnes	175,000
Vanadium	tonnes	5,000

Source: Ministry of Minerals

2.1.2- Production and Trade of Minerals

2.1.2.1: Production of Minerals

Key Message

Unsustainable mining of mineral resources can lead to adverse adverse effects on environment and the community.

Two commonly used methods in mineral extraction are surface and underground mining. Tanzania major mining projects includes Geita Gold mine, North Mara Gold mine, Williamson Diamond Limited, Bulyanhulu Gold Mine, Buzwagi Gold mine, Kiwira Coal Mine and Tanzanite One. Some of these mines use open cast mining and others use underground mining technique. Pitting is the main mining technique that is used by artisanal and small scale miners. Pits are usually supported by timber to prevent walls from collapsing (MEM, 2014).

Tanzania is the sole producer country of the precious gemstone known as Tanzanite in the world and has large amount of known reserves of gold, diamond, nickel, iron, coal, varieties of high-value precious colored gemstones, such as emerald, ruby, tsavorite and sapphire, as well as industrial minerals as shown in Table 2.1.

Gold production in Tanzania stands at an average of 43.5 tonnes per year from 2013-2016. This makes the country the 4th largest gold producer in Africa after South Africa, Ghana, and Mali.

The mineral policy of 2009 aims to promote and develop the mining activities and to ensure the gemstone mines are owned by Tanzanians to not less than 50 % shares.

Mining sector activities in Tanzania have continued to grow over the years, but still face some challenges which have led to low a relatively low contribution of the sector to the economy compared to its growth. These challenges include: low integration with other sectors of the economy, slow development of small scale mining, low levels of value addition of minerals, and environmental degradation. The mineral policy recognizes the need for environmental sustainability in mining, and promotes best practices for health, and safety and environmental management in mining areas (MEM, 2009). Mining activities have environmental impacts such as environmental pollution, soil erosion, loss of biodiversity, deforestation etc. so the exploitation activities need to be sustainable. This requires, among others, that mining companies comply with regulatory requirements, and conduct their activities while protecting the environment, safety and health of the community (MEM, 2014).

Table 2.2 shows the mineral production in Tanzania. The analysis of the 2013-2016 mineral production data shows fluctuations in this period. Gold production increased by 1.5 %, Diamond (6.8 %), coal (22.1 %), Silver (11.8 %), Copper (6.2 %) whereas Tanzanite decreased by 17.1 %. Sand production decreased in 2016 when compared to 2015 although the average production from 2013 to 2016 shows an increase of 18.5 %.

Table 2. 2: Mineral Production in Tanzania, 2013 - 2016

Mineral type	Unit of Measurement	2013 Weight (000)	2014 Weight (000)	2015 Weight (000)	2016 Weight (000)	Total Production Weight (000)
Diamonds	carats	179.6	252.9	216.5	240.0	889.0
Gold	kg	42.5	40.5	46.0	45.2	174.2
Tanzanite	kg	24.8	18.5	6.4	13.9	63.6
Other Gemstones	kg	2,649.5	3,069.2	1,878.41	2,541.0	10,138.0
Silver	kg	11.0	14.5	15.6	18.0	59.1
Copper	pounds	12,654.0	14,027.0	14,252.3	16,247.2	57,180.6
Phosphate	tonnes	1,023.0	738.0	222.8	23.7	2,007.5
Bauxite	tonnes	49,952.3	25.6	205.1	73.0	50,255.7
Coal	tonnes	84.8	246.1	257.3	276.0	864.3
Limestone	tonnes	3,899.2	1,754.5	3,174.7	4,170.1	12,998.4
Gypsum	tonnes	280.5	200.2	254.8	213.7	949.2
Salt	tonnes	34.0	58.6	92.2	145.7	330.5
Pozzolana	tonnes	52.4	68.9	342.6	230.0	693.9
Copper ore	tonnes	5.6	4.7	2.0	0.9	13.1
Galena ore	kg	1.0	0.6	0.3	0.1	2.0
Marble	tonnes	10.7	607.1	1,037.6	58.5	1,714.0
Carbon dioxide gas	kg	5,243.6	4,744.2	2,748.3	6,193.3	18,929.4
Kaolin	tonnes	1.8	3.8	2.0	0.00065	8.2
Tin	kg	157.1	78.7	191.5	0.1	570.2
Calcite	tonnes	0.00205	-	0.2	0.00073	0.2
Sandstone/Clay/Red soil	tonnes	9,488.3	1,929.3	5,793.1	979.1	18,189.8
Sand	tonnes	1,501.4	7,283.2	29,799.9	10,596.1	49,180.6
Aggregates	tonnes	8,449.1	2,363.9	7,676.0	21,084.2	39,573.2
Stones	tonnes	3.9	69.8	222.5	297.3	593.5

Source: Ministry of Minerals

2.1.2.2: Importation of Minerals

Importation of minerals or samples of minerals into Tanzania require an import Permit from the ministry responsible for minerals. Most of the imported minerals shown in Table 2.3 below are used as inputs in different industries. For example Cement Industries use coal as heating sources. Importation of coal was restricted in 2016 by the Ministry responsible for Minerals to enhance internal production and market for coal in the country. The drastic increase in the importation of coal in 2015 is associated with the increase in number of cement factories in Tanzania.

Table 2. 3: Mineral Importation in Tanzania, 2010 - 2017

Mineral type	Unit of Measurement	2010 Weight (000)	2011 Weight (000)	2012 Weight (000)	2014 Weight (000)	2015 Weight (000)	2016 Weight (000)	2017 Weight (000)
Coal	Metric tonnes	0.065	0.079	0.025	0.025	269.34	-	-
Gypsum	Metric tonnes	-	-	-	-	38.00	-	-
Petroleum Coke	Metric tonnes	-	-	-	-	51.772	-	-
Coltan	Metric tonnes	-	-	-	-	0.05	-	-
Clinker	Metric tonnes	-	-	-	-	50.00	-	-
Hessonite	Metric tonnes	-	-	-	-	0.01	0.008	0.039
Silicon manganese	Metric tonnes	-	-	-	-	-	0.081	0.056

Source: Ministry of Minerals
"-" Not imported or not available

2.1.2.3: Exportation of Minerals

Table 2.4 presents mineral export statistics from 2013 to 2016. It is indicated that, mineral exports amounted to USD 2.05 billion in 2016 with gold accounting for more than 89 % of all mineral exports. The total value of diamond exports was USD 90.4 million, while other minerals exports' value was USD 134.7 million. Tanzania exports gold mainly to South Africa, India, Switzerland and Australia, while diamonds are being exported almost entirely to Luxembourg.

Table 2. 4: Mineral Exports in Tanzania, 2013 - 2016

		2013		2014		2015		2016	
Mineral type	Unit of Measurement	Weight (000)	Value (US$-Mil)	Weight (000)	Value (US$-Mil)	Weight (000)	Value (US$-Mil)	Weight (000)	Value (US$-Mil)
Diamonds	carats	171.4	42.9	252.9	82.1	216.5	56.0	239.9	90.4
Gold	kg	42.5	1,752.7	40.5	1,640.1	46.0	1,625.8	45.2	1,824.8
Tanzanite	kg	24.8	39.3	14,591.7	29.2	6,370.4	25.3	13,942.6	29.1
Other Gemstones	kg	2,649.5	11.1	3,069.2	20.0	1,878.4	15.1	2,541.0	45.7
Salt	tonnes	34.0	2.4	54.8	5.3	92.2	4.8	145.7	4.8
Phosphate	tonnes	1.0	0.2	738.0	0.1	222.8	0.1	23.7	0.7
Bauxite	tonnes	49,952.3	4.4	25,641.2	2.0	204,955.5	2.1	72,778.5	1.2
Gypsum	tonnes	171.6	1.1	200.2	2.5	254.8	4.5	213.7	6.3
Silver	kg	11.0	17.2	14.5	10.3	15.5	7.8	18.0	9.9
Copper	pounds	12,654.0	42.1	14,027.0	43.7	14,127.6	35.4	16,247.2	35.4
Copper Ore	tonnes	5,559.4	1.6	4,685.3	2.2	2,000.6	0.5	885.0	0.2
Marble	tonnes	10.7	0.9	607.1	0.2	1,037.5	0.7	58.5	1.4
Total Value (US$-Mil)			**1,915.8**		**1,837.6**		**1,778.1**		**2,049.9**

Source: Ministry of Minerals

2.2. Energy Resources

The energy sector is vital for the socio-economic development of any country. The Government of Tanzania has put in place strategies and master plans to develop the sector to ensure availability, affordability, reliability and access to modern energy services in the country. These are: - The Power System Master Plan (PSMP) to promote generation mix in power sub-sector, the Natural Gas Utilization Master Plan (NGUMP) 2016-2045 and the Biomass Energy Strategy in Tanzania (BEST), (MEM, 2015).

Key Message

The national energy balance in Tanzania is dominated by biomass which accounts for 85 %, other sources include petroleum (9 %), electricity (5 %) and renewable energies (1 %).

Tanzania has an abundance of indigenous energy resources, both renewable and non-renewable. These resources include hydro, coal, natural gas, uranium, biomass, geothermal, tidal wave, wind and solar. Non-renewable energy resources are subject to change over time because they are being exploited, or due to new discoveries or reclassification of previously unrecoverable resources, or catastrophic losses. However, renewable energy resources are not subject to depletion in the same way as non-renewable energy resources because these resources are naturally replenished on a human timescale. The national energy balance is dominated by biomass which accounts for 85 %. Other sources include petroleum (9 %), electricity (5 %) and renewable energies (1 %). Despite these resources, the supply of modern energy services is still an insufficient to meet the demand for it (MEM Quarter Digest Report, 2016).

2.2.1- Stocks and Changes of Energy Resources

Key Message

Coals were discovered in parts of Tanzania such as Mchuchuma, Liganga, Kiwira and Ngaka and are estimated to be 1.9 billion tons of which 25 % is proven.

Reserves in the energy resources, particularly non-renewable resources can be well estimated and described. Non-renewable energy is a finite resource, their extraction and use in the economy depletes resources and limiting its availability for future generation. Statistics on the magnitude of their stocks through time are required to assist in the sustainable management of these resources.

Coal resource is not exploited for electricity generation although some industries are using coal for thermal applications. Coals were discovered in parts of Tanzania such as Mchuchuma, Liganga, Kiwira and Ngaka and are estimated to be 1.9 billion tonnes of which 25 % is proven. Uranium deposits, which are estimated to be 200 million pounds

and have not yet been utilized. Uranium deposits were discovered in Namtumbo (Mkuju), Bahi, Galapo, Minjingu, Mbulu, Lake Natron, Songea, Tunduru, Madaba and Nachingwea. Natural gas exploration activities in Tanzania have a history of more than 50 years. The first discovery was made in 1974 at Songosongo Island, followed by Mnazi Bay in 1982. Table 2.5 shows statistics on natural gas reserves for the reporting period of 2013 to 2017.

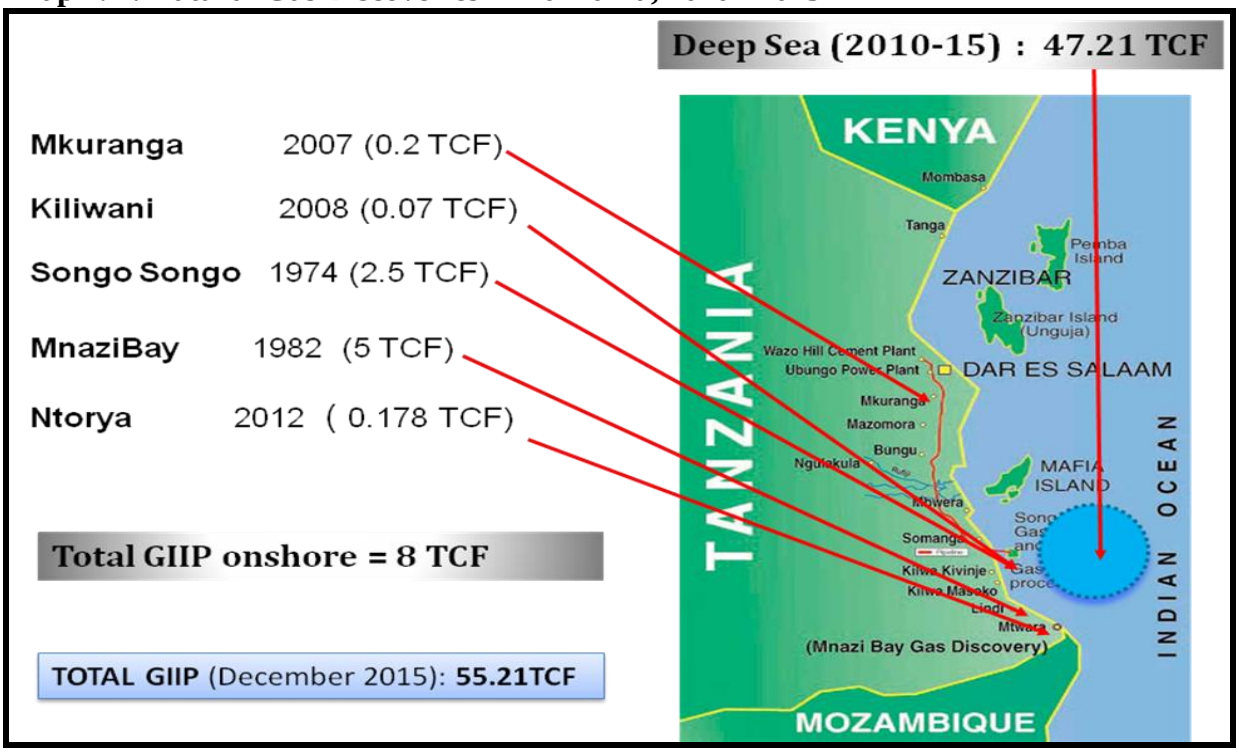
Table 2. 5: Tanzania Natural Gas Reserve, 2013 - 2017

Year	Recoverable Natural Gas (est.70 % of Gas Initial in Place (GIIP) - Trillion Cubic Feet (TCF)	Natural Gas Discovery (GIIP) – Trillion Cubic Feet (TCF)
2013	29.89	42.7
2014	35.12	50.17
2015	35.12	55.21
2016	40.75	57.25
2017	40.75	57.25

Source: Ministry of Energy, 2017

Natural gas was discovered on onshore and offshore sites in Tanzania. Onshore gas reserves were discovered at Songosongo, Mnazi Bay, Mkuranga, Kiliwani and Ntorya; whereas offshore reserves were discovered in the deep sea off the coast of Tanzania (Lindi and Mtwara) (Map 2.2). The National Energy Policy, 2015 (NEP) and Power System Master Plan (2016 update) aim to increase the use of other energy resources in electricity generation in the near future. Gas is already being utilized for electricity generation. The NEP and PSMP furthermore, aim to develop and maintain an efficient petroleum database, information system, infrastructure and exploitation of local and trans-boundary petroleum resources.

Map 2. 2: Natural Gas Discoveries in Tanzania, 2010 - 2015



Source: Ministry of Energy and Minerals, 2015

2.2.1.1: Extraction of Energy Resources

Key Message

Unsustainable extraction of energy resources can result in environmental problems such as land degradation, pollution, deterioration of aquatic systems, and climatic changes.

Energy resources are important for generation of electricity, thermal applications in industrial production, commerce and socio-economic activities. Unsustainable extraction of energy resources can lead to negative environmental problems such as degradation, deterioration of aquatic system, climate change, and pollution. Statistics are available on coal and natural gas production. Uranium production has not started, although the government is considering using it in power generation by 2040 after building enough capacity for its use (PSMP, 2016).

Key Message

Songosongo field has been the major contributor of natural gas production from 2012 to 2017 with more than 55 % of annual production coming from the area.

The natural gas produced in Songosongo stands at 64 to 85 Million Standard Cubic Feet per Day (MSCFD)while Mnazi Bay stands at 50 (MSCFD). Demand for natural gas has been increasing in recent years due to its use in industries and power generation. Furthermore, the completion of Mtwara-Dar es salaam pipeline and Kiliwani gas field which started operation in 2016 have accelerated both supply and demand of natural gas in industries and power generations. Plans for utilization of natural gas are outlined in the Natural Gas Utilization Master Plan (NGUMP) (2016-2045). It describes the strategy to supply gas to the domestic market and export to international markets, as well as plans for construction of Liquefied Natural Gas (LNG) pipeline for domestic and export of LNG to other countries in the region.

Table 2.6 shows statistics on natural gas production from 2012 to 2017 on three gas fields. The trend reveals an increase innatural gas production, from 36,905.15 MCFT in 2012 to 51,041.21 MCFT in 2017 which is equivalent to an increase of 38.3 %. Songosongo field has been the major contributor in natural gas production from 2012 to 2017 with more than 55 % of annual production. However, there has been a noticeable decline in productions at Songosongo during the periods.

Table 2. 6: Natural Gas Productions in Tanzania, 2012 - 2017

Years	Gas Field (MCFT)			
	Songosongo	Mnazi Bay	Kiliwani	Total Production
2012	36,233.01	672.14	-	36,905.15
2013	19,918.41	715.02	-	20,633.43
2014	33,061.00	784.69	-	33,845.69
2015	31,383.00	5,799.41	-	37,182.41
2016	29,747.48	15,732.28	2,767.45	48,247.21
2017	29,487.32	17,960.30	3,593.59	51,041.21

Source: Tanzania Petroleum Development Corporation (TPDC)

"-" Not started production

2.2.2- Production, Trade and Consumption of Energy

Key Message

The total share of Biomass in Primary Energy Supply is expected to decrease by 49 % by 2040 due to increase of modern energy supply/services.

It is important, for both energy planning and environment concerns, to distinguish between energy production from non-renewable and renewable sources. Many non-renewable energy sources emit high levels of CO_2, example coal, crude oil and natural gas, and are therefore high contributors to Green House Gases (GHGs) globally in 2010.

Wood and charcoal are the main sources of energy for households in rural areas and accounts for 85 % of total final energy consumption (NEP, 2015). Without appropriate interventions, current projections show that demand for charcoal will double by 2030 from approximately 2.3 million tonnes of charcoal per year in 2012 (PSMP, 2016).

The intention of the government is to replace wood and charcoal consumption with more supply of electric power, gas and petroleum products. This is very important since heavy dependence on biomass contributes to deforestation. Already, there are signs of growing use of LPG as a source of heating and cooking energy for households. Statistics show that the yearly volume of imported LPG has increased to 90,296 MT in 2016, from 24,470 MT imported in 2011. With electricity and gass use increasing, the government expects that the share of charcoal and wood in the final

energy consumption will reach 49 % in 2040 (MEM-JESR, 2013), thus helping reduce problem of deforestation.

Production of energy is the capture, extraction or manufacture of fuels or other energy products in forms which are ready for general consumption. In energy statistics, two types of production are distinguished, primary and secondary energy. Primary energy products are extracted or captured directly from natural resources such as crude oil, coal and natural gas. Secondary energy products are produced by transforming primary energy products. Table 2.7 presents statistics on production and consumption of primary energy in Tanzania.

Table 2. 7: Production, Trade and Consumption of Energy, 2013 - 2016

		Years			
Indicator	**Unit**	**2013**	**2014**	**2015**	**2016**
Total Energy production	**ktoe**	**21,308**	**22,170**	**23,114**	**24,228**
Production from non-renewable sources	ktoe	868	913	968	1,114
Production from renewable sources	ktoe	20,440	21257	22,146	23,114
Primary Energy production	ktoe	20,291	21,033	21,899	22,468
Imports of energy	ktoe	2,903	2,870	2768	2,694
Total energy supply	ktoe	24,020	24,834	25,626	26,273
Final consumption of energy	ktoe	20,636	21,456	22,461	23,108

Source: MEM & IEA

2.2.2.1: Electricity Generation and Consumption

Electricity which is produced and supplied through the national grid comes from hydro, biomass and thermal generation units owned by Tanzania Electric Supply Company (TANESCO) and Independent Power Producers (IPPs). Demand for electricity has been rising, both for industrial and domestic use. Growth of demand for electric power ranges between 10-15 % per year. As a result, the installed power capacity must increase from 1,583.0 MW (April, 2014) to at least 10,000 MW by 2025 and transmission and distribution systems must also be expanded. To address these challenges in the electricity sub-sector the Government is attracting private investment in the subsector and has embarked on reforming the Electricity Supply Industry (ESI).

Key Message

The government plan is to increase installed capacity from 1,583.0 MW in 2014 to 10,000 MW by 2025 and increase connection level from 32 % in 2016 to 75 % by 2033.

The Government is planning expansion of distribution systems and increase in connection levels from 36 % in 2016 to 60 % by 2025, and further to75 % by 2033. To achieve the GoT is implementing rural electrification program under Rural Energy Agency (REA). It is anticipated that there will also be further growth of investments by small power producers (Off-grid) to ensure adequate, reliable, and affordable energy supply in rural areas. Table 2.8 shows statistics from TANESCO on electricity generation by type of fuel and consumption by different groups.

Electricity generation from 2011 – 2017 was largely dominated by gas, which accounted for 21,817.4 GWh (51.3 %), followed by hydro power with 14,972.9 GWh (35.2 %). Diesel/HFO/GO accounted for 5,649.4 GWh (13.3 %) and Biomass 116.9 GWh (0.3 %). It is also revealed that, electricity generation increased from 5,057.6 GWh in 2011 to 7,006.6 GWh in 2017.

Table 2. 8: Electricity Generation (GWh) by Type of Fuel, 2011 - 2017

Fuel Source	2011	2012	2013	2014	2015	2016	2017	Total
Gas	2,265.0	2,664.0	2,872.2	2,624.0	2,873.8	4,196.4	4,322.0	21,817.4
Hydro	1,992.6	1,769.9	1,721.3	2,613.5	2,124.4	2,382.1	2,369.1	14,972.9
Diesel/HFO/GO	781.1	1,083.5	1,133.2	784.9	1,183.2	389.1	294.4	5,649.4
Biomass	19.0	20.4	6.2	6.6	14.5	29.1	21.1	116.9
Total	**5,057.6**	**5,537.8**	**5,732.8**	**6,029.0**	**6,195.9**	**6,996.7**	**7,006.6**	**42,556.5**

Source: Tanzania Electric Supply Company

2.2.2.2: Electricity Consumption

Key Message

Tanzania has lower electricity consumption per capita compared to Sub-Saharan Africa and global averages.

In June 2017, the average electricity consumption per capita was 138 kWh/year which is quite small compared to 2,500 kWh/year global average and 550 kWh/year for Sub-Saharan Africa. The average growth rate for electricity demand in Tanzania ranges between 10 % and 15 % per annum. Electricity consumption statistics show that the largest user group in 2017 was general use (T1) which accounted for 36.7 % of total electricity consumption. This is followed by high Voltage use (T3) which accounted for 35.8 %. The lowest electricity consumption group was domestic use (D1) which accounted for 3.6 % of total consumption in the year. Table 2.9 shows Electricity consumption in GWh for the period of 2011-2017.

Table 2. 9: Electricity Consumption (GWh), 2011 - 2017

User Group	2011	2012	2013	2014	2015	2016	2017	Total
Domestic Use (D1)	331.2	320.8	279.8	217.3	229.8	324.5	324.7	2,028.1
General Use (T1)	1,283.5	1,510.2	1,737.6	1,921.9	2,012.7	2,080.9	2,348.1	12,894.9
Low Voltage Supply (T2)	517.7	549.4	562.9	580.7	580.9	598.6	622.4	4,012.6
High Voltage Supply (T3)	1,433.6	1,581.8	1,663.5	1,832.4	1,918.1	1,991.7	2,164.0	12,585.1
Zanzibar (T5)	278.3	298.6	352.9	348.5	344.6	360.8	383.2	2,366.9
Kahama Gold Mine (T8)	156.2	168.7	168.5	181.3	198.8	195.3	185.3	1,254.1
Total	**4,000.4**	**4,429.5**	**4,765.2**	**5,082.1**	**5,284.8**	**5,551.7**	**6,027.7**	**35,141.4**

Source: Tanzania Electric Supply Company

2.2.2.3: The National Energy Policy issues and challenges

Key Message

Tanzania is encouraging the use of renewable energy sources for electricity generation in order to reduce CO_2 emission from non-renewable energy sources.

The National Energy Policy (2015) provides guidance for sustainable development and utilization of energy resources to ensure optimal benefits to Tanzanians and to contribute towards transformation of the national economy. The main focuses are electricity generation, transmission, distribution, interconnection, power trading and rural electrification.

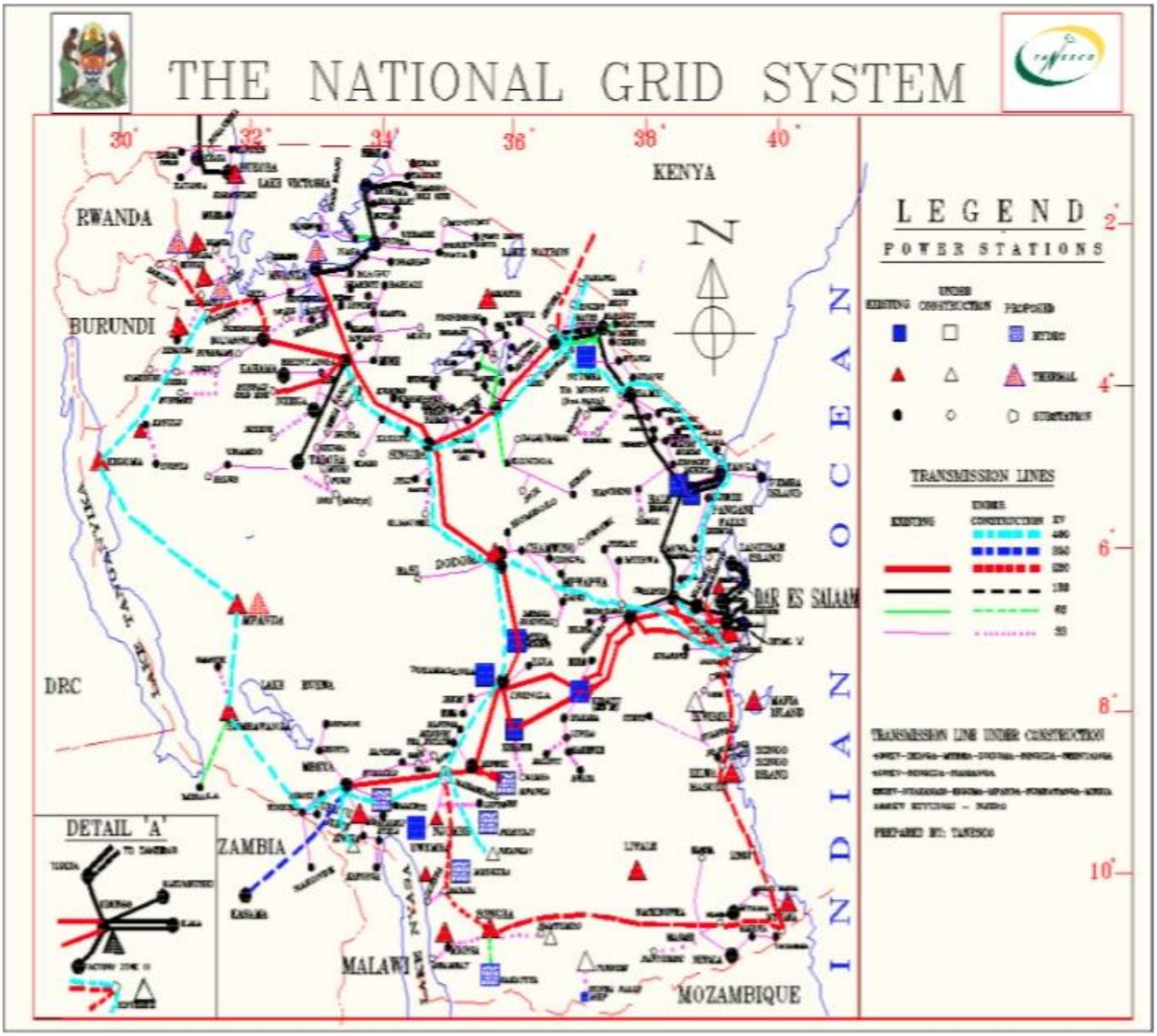
The policy underscores five major issues related to electricity sector in the country, one of which is ensuring sufficient power for the domestic market and participation in cross-border trade. During the past few decades the country has been highly depended on hydro generation where hydropower contributed 80 % of electric power supply in the country. However, due to discovery and commercialization of other energy resources such as gas, biomass, geothermal and so forth as well as changes in the hydrological trends, the country's power system has shifted from dependence on hydropower to generation mix. Despite that cross-border trading of electricity in the country has not changed much. Utilization of both renewable and non-renewable energy resources has to some extent helped to ensure sufficient power supply for domestic market.

Statistics reveal a steady increase in connections and accessibility of electricity to consumers in recent years. As of December, 2017 the total number of customers connected to electricity, through the National Grid, were 2,105,734. It is also estimated that 67.5 % of the country population already have access to electricity, even though issues around reliability remain a challenge to be addressed.

Although generation mix might contribute a solution to access issues, efficient use of energy resources will also need to be enhanced in order to ensure sustainable development. Use of non-renewable energy resources such as oil and gas in one way or another will continue to contribute

to environmental pollution. Therefore, further additions of renewable resources, such as geothermal, hydro, wind and solar in the generation mix will be helpful in minimizing environmental pollution and contributing to building of a green economy.

Map 2. 3: National Grid System



Source: Ministry of Energy and Minerals

2.3. Land

2.3.1- Land Use

2.3.1.1: Potential Irrigated Area

Introduction

Key Message

Sustainable irrigation is the sole solution to rain-fed agriculture activities for optimal crop production.

In order to harness irrigation potential in Tanzania, the Government formulated the National Irrigation Policy (NIP) in 2010 to provide direction for the implementation of irrigation interventions for optimal availability of land and water resources for agricultural production and productivity. Subsequently, the National Irrigation Act No. 5 of 2013 was enacted to guide development of the sector. The Act among other issues provides for establishment of the National Irrigation Commission and development, operation and maintenance of irrigation and drainage systems and effective implementation of the National Irrigation Policy. For effective implementation of irrigation activities, the National Irrigation Regulations, 2015 were formulated as per requirement of Section 74 of the National Irrigation Act 2013. The Regulations details the procedures for formation, registration, conduct of irrigators' organizations, formulation of irrigation projects and construction and maintenance of irrigation works. The Comprehensive Guideline for irrigation schemes development (CGL 2002) revised in 2016 was also prepared as a guide to irrigation development. The CGL is divided into three parts; project formulation, implementation, and operation and maintenance.

Irrigation development, while a key solution to agriculture productivity, can lead to negative environmental impacts if not well planned. Such effects may include water quality, water quantity, unsustainable resettlement, erosion, salinity problems and water related diseases.

As of 2017, Tanzania's total irrigation development potential is pegged at 29.4 million ha, of which 2.3 million ha are classified as high potential; 4.8 million ha as medium potential; and 22.3 million ha as low potential. However, out of this potential area, only 468,338 hectares equivalent to 1.6 % of the potential irrigation area is under irrigation and contributes about 24 % of the national food requirement as of June 2017. The area under irrigation comprises of 2,418 irrigation schemes distributed across the country of which 124 are fully operational and provided with some basic irrigation infrastructure. The remaining 2,294 irrigation schemes comprises partially completed and deteriorated irrigation water abstraction infrastructures, including traditional irrigation schemes characterized with temporary irrigation water abstraction infrastructures and hence low water and crop productivity (Table 2.10).

Table 2.11 indicates that on average, the annual irrigation development is 19,620 ha. The National Five Year Development Plan (FYDP II – 2016/17 – 2020/21) has set the target of 1,000,000 ha to be attained by 2025 whereas 700,000 ha are to be attained by 2020 through Government and Development Partners support. The cumulative incremental area required in order to achieve this target is 531,662 ha over five year's period considing with the FYPD time frames. With the current trend of developing an average area of 19,620 ha annually, it will take much longer to meet the target of one million hectares. This requires huge amount of funds, for example, it is estimated that a total of TZS 6.7 trillion is required within five (5) year period to achieve the set target by year 2021. In this case concerted efforts are required among stakeholders including involvement of the farmers themselves, the government, private sector and development partners.

The major factors to be considered for accelerated irrigation development are:

i) Adequate and reliable resources on part of the government, e.g. funds and technical personnel;
ii) Proper management of irrigation funds by Local Government Authorities;
iii) Planning of irrigation schemes to include full feasibility studies;
iv) Setting irrigation investment criteria to focus on few but potential areas;
v) National coordination for irrigation development among stakeholders;
vi) Proper supervision of irrigation construction;
vii) Adequate private sector involvement in irrigation development;

viii) Operationalization of the Irrigation Development Fund (IDF) with sustainable sources of funds.

Table 2. 10: Potential Irrigation Areas

S/N	Item	Quantity	Remarks
1	Total potential area for irrigation (million ha)	29.4	
2	High potential area for irrigation (million ha)	2.3	Availability of water, land, irrigators and accessibility as criteria
3	Medium potential area for irrigation (million ha)	4.8	One of the criteria above is missing
4	Low potential area for irrigation (million ha)	22.3	More than one criteria mentioned above are missing
5	Area under irrigation (ha)	468,338	Equivalent to 1.6 % of the total potential area
6	Total number of irrigation schemes as of July 2017	2,418	Improved and unimproved irrigation schemes
7	Improved and Operational irrigation schemes	124	Improved irrigation schemes

Source: National Irrigation Master Plan (2002) and progress reports

Table 2. 11: Cumulative Total Area Equipped with Irrigation Infrastructure, 2007/08 – 2016/17

Year	Area Developed (ha)	Incremental Area (ha)
2007/08	289,245	15,300
2008/09	310,745	21,500
2009/10	331,490	20,745
2010/11	345,690	14,200
2011/12	363,514	8,522
2012/13	363,514	9,302
2013/14	450,392	86,878
2014/15	461,326	10,934
2015/16	461,326	-
2016/17	468,338	7,012

Source: NIRC annual progress reports 2017

"-" Data Not available

2.3.2 - Use of Forest Land

2.3.2.1: Forest Area by Forest Designated Functions

According to NAFORMA report (2015), forests resources are categorized by type of vegetation cover, usage and legal status. With regard to type of vegetation cover, 93 % of the total forest area was covered by woodlands. This was followed by Lowland forests (3.4 %), Humid Montane forest (2.0 %), Plantation Forest (1.2 %) and Mangroves (0.3 %), which are very important for

sustainance of ecosystem. In terms of usage, the productive forest area comprised 60.3 % of the total forest area while 39.7 % of the forest area was accounted for by protected forest areas most of which are catchment areas and natural reserves. Production forest is an area of land covered by forest, reserved or used principally for purpose of sustainable production of timber and other forest produce while protection forest is an area of land covered by forest, reserved or used principally for purpose of protection of watersheds, soil, and the protection of biodiversity. Furthermore, as concerns legal status about 23.3 % of the forest area is under wildlife-protected areas.

There are 455 National Forest Reserves that are managed by TFS (GN. 269/2010), with a total area of 16,610,581 hectares. These forests include 12 Nature Forest Reserves; areas under mangrove forests (115,000 ha), 9 declared bee reserves, 23 forest plantations and areas of forests on general lands covering approximately 2,405,000 ha. It is therefore, important to maintain these forest resources sustainably by ensuring that resources assessments are conducted in all forests and management plans are prepared and followed accordingly for the benefit of present and future generations (TFS 2014), Table 2.12.

Table 2. 12: Forest Areas by Designated Functions, 2013 - 2017

Forest Designated Function	Unit of Measure	2013	2014	2015	2016	2017
(i) Production forest						
(a) Forest plantations	Area (Ha)	189,741.7	192,748.0	196,503.0	201,147.0	206,074.0
(b) Natural forests	Area (Ha)	28,814,258.3	28,811,252.0	28,807,497.0	28,802,853.0	28,797,926.0
(ii) Protected forest	Area (Ha)		19,096,000.0	19,096,000.0	19,096,000.0	19,096,000.0

Source: TFS

In the endeavour to bridge the gap between demand and supply of wood raw materials in the country, TFS has continued to secure new areas for establishment of forest plantations including changing status of degraded forest reserves for the same and acquisition of new areas. Six new plantations namely, Morogoro (Morogoro), North Ruvu (Pwani), Korogwe (Tanga), Chato (Geita), Mpepo (Ruvuma), and Iyondo Mswima (Mbeya) were established. A total of 121,922 ha

was secured for plantation establishment of the new Chato-Biharamulo plantation, and work has since commenced by conducting awareness meetings, mapping and land compartmentation in the planting area. Acquisition of 5,000 ha in TFS Northern Zone has also commenced by conducting village meetings in five villages targeting at acquiring 2,000 ha from Mkinga district and 3,000 ha from Pangani district (Table 2.13).

Table 2. 13: New Forest Plantations Established by TFS Between 2014 and 2017

S/N	Plantation name	Year established	Total area (ha)	Area planted (ha) to date	Remarks
1	Morogoro	2014/15	12,950	37	Forest reserve area converted to plantation
2	North Ruvu	2014/15	20,000	523	Forest reserve area converted to plantation
3	Chato - Biharamulo	2017/18	50,000	440	Part of FR converted to plantation.
4	Mpepo	2017/18	2,017.21	395	Newly acquired area.
5	IyondoMswima	2017/18	12,000	200	Forest reserve area converted to plantation.
6	Korogwe	2014/15	10,805	220	Degraded Forest reserve area converted to plantation
7	Pagale	2017/18	12,950	-	Degraded Forest reserve area converted to plantation. It is under management of Mtibwa forest plantation
8	Buhigwe	2016/17	1,200	60	Newly acquired area and planting to start this FY
Total			**121,922.21**	**1,875**	

Source: TFS Annual Implementation Reports

"-" Data Not available

2.3.2.2: Area Deforested

Deforestation can be defined as the conversion of forests to other land uses. In Tanzania deforestation is driven by expansion of agricultural activities, including shifting cultivation, wildfires, lack of clearly defined boundaries, illegal logging, and livestock grazing. Other contributing factors are unsustainable charcoal production for domestic and industrial use, lack of systematic management, and introduction of alien and invasive species. These driving forces are depreciating the country's natural stock of forest ecosystem assets. Thus, the benefits of forests in terms of regulating water run-off, reducing soil erosion, capturing and sequestering carbon are impared. Deforestation rate is estimated at 372,000 ha per annum between 1995 and 2010 (NAFORMA, 2015), Table 1.16.

2.3.2.3: Area Reforested

Reforestation is known as replanting of the previously planted trees once harvested. Table 2.14 shows that, the total area reforested between 2010 and 2017 was 37,177.7 ha with the largest area of 6,897 ha having been replanted in 2010. In some plantations the planting of trees is mixed with food crops such as maize, sunflower, carrots and cabbages the common terminology for this is Taungya farming which contributes a lot to food security to communities living adjacent to forest plantations.

Table 2. 14: Trend of Reforestation in TFS forest Plantations, 2010 - 2017

Year	Area Reforested (Replanted) in Ha
2010	6,897.0
2011	5,383.0
2012	4,653.3
2013	4,219.0
2014	4,378.4
2015	2,987.0
2016	3,732.0
2017	4,927.0
Total	**37,177.7**

Source: TFS

2.3.2.4: Area afforested

Afforestation is an establishment of forest through planting and/or deliberate seeding on land that, until then was not classified as forest. **Plantation forest** is a forest area that has been established through afforestation or reforestation for commercial purposes. Afforestation is commonly used when trees are planted in areas where there is either grassland or forest degradation. The following are the major objectives of establishing forest plantations in Tanzania:

(i) To produce timber and other forest products for domestic consumption, industrial requirements and exports;

(ii) To complement and reduce pressure on the demand for timber and wood products from natural forests.

(iii) To contribute to climate amelioration and environmental protection;

(iv) To provide employment directly and indirectly, and,

(v) As a source of government revenues.

Key Message

The total land area under forest plantations stood at 308,442 ha in 2017, of which Sao Hill forest has the largest land area (45.2%)

There is a substantial increase in the number and area of forest plantations contributed by establishment of new forest plantations and continued planting in extension areas annually as shown in Table 2.15 and Table 2.16. Overall, the total land area under forest plantations stood at 308,442 ha in 2017, of which Sao Hill has the largest land area (45.2 %), followed by North Ruvu, occupying 10.4%. tree planting by LGAs, village lands, privates sector and other out growers due to difficulties in coordinating these stakeholders.

In line with the strategies of increasing plantation areas, TFS has been collaborating with Tanzania Forestry Research Institute (TAFORI) and Forest Development Trust (FDT) by shifting from planting normal exotic tree species to fast growing species, which are produced from improved seeds and clonal materials for various end uses such as Eucalyptus. The advantages of using Eucalyptus clones are:

(i) They are fast growing thus can help bridge the gap between demand and supply for wood materials;
(ii) Have diversified use as they can be used for saw logs, poles and pulp making;
(iii) They are self pruning thus reduces the tending cost;
(iv) Low establishment costs because once planted no weeding is needed;
(v) Seldom catches fire because the canopy closes rapidly and hinders undergrowth.

Table 2. 15: Areas Under Forest Plantations, 2017

S/N	Name of Forest Plantation	Location	Planted Area (Ha)	Expansion Area (Ha)	Catchment Forest Area (Ha)	Total Area (Ha)
1	Buhindi	Mwanza	5,850.0	5,700.0	10,880.0	22,430.0
2	Kawetire	Mbeya	2,607.0	1,135.0	1,306.0	5,048.0
3	Kiwira	Mbeya	2,784.0	0.0	0.0	2,784.0
4	Korogwe	Tanga	217.0	5,000.0	5,229.0	10,446.0
5	Longuza	Tanga	1,992.0	400.0	440.0	2,832.0
6	Mbizi	Rukwa	1,227.0	1,793.0	20,427.0	23,447.0
7	Meru/Usa	Arusha	5,873.0	466.0	0.0	6,339.0
8	Mtibwa	Morogoro	2,104.0	170.0	895.0	3,169.0
9	North Kilimanjaro	Kilimanjaro	5,099.0	462.0	505.0	6,066.0
10	North Ruvu	Pwani	323.0	19,607.0	12,000.0	31,930.0
11	Rondo	Lindi	1,169.0	830.0	0.0	1,999.0
12	Rubare	Kagera	2,613.0	1,842.0	2,924.0	7,379.0
13	Rubya	Mwanza	2,062.0	0.0	122.0	2,184.0
14	Sao Hill	Iringa	57,485.0	31,933.0	49,900.0	139,318.0
15	Shume	Tanga	4,085.0	0.0	84.0	4,169.0
16	Ukaguru	Morogoro	1,959.0	400.0	0.0	2,359.0
17	Morogoro	Morogoro	30.0	12,920.0	0.0	12,950.0
18	West Kilimanjaro	Kilimanjaro	3,410.0	600.0	2,583.0	6,593.0
19	Wino-Ifinga	Ruvuma	2,838.0	14,162.0	0.0	17,000.0
Total			**103,727.0**	**97,420.0**	**107,295.0**	**308,442.0**

Source: TFS

Table 2. 16: Use of Forest Land, 2013 - 2017

	Unit of measure	2013	2014	2015	2016	2017
Area deforested	Area (Ha)	372,000.0	372,000.0	372,000.0	372,000.0	372,000.0
Area reforested	Area (Ha)	4,653.3	4,219.0	4,378.4	2,987.0	3,732.0
Area afforested	Area (Ha)	3,006.0	3,755.0	4,644.0	4,825.0	4,927.0
Natural growth	Area (Ha)	47,728,000.0	47,728,000.0	47,728,000.0	47,728,000.0	47,728,000.0
Total		**48,100,000**	**48,100,000**	**48,100,000**	**48,100,000**	**48,100,000**

Sourc: TFS

Note1: *Sum of individual observations in the table do not necesarily add up to totals*

Note2- It is assumed that the deforestation rate in Tanzania has remained at 372,000 ha per year (NAFORMA, 2015), while the statistics for reforested areas and afforested areas were captured from Central Government forests whose area is managed by TFS only.

2.3.2.5: Extension Areas in Forest Plantations

Extension areas in forest plantations are the areas which were gazetted for the purpose of tree planting but for some reasons, these areas were not planted. Since the establishment of TFS, about 24,779.5 ha of trees were planted (Table 2.17).

Table 2. 17: Extent of Planting in Extension Areas in Forest Plantations, 2011 - 2017

Year	Area (ha)
2011	949.2
2012	2,673.0
2013	3,006.3
2014	3,755.0
2015	4,644.0
2016	4,825.0
2017	4,927.0
Total	**24,779.5**

Source: TFS

2.3.2.6: Forest Coverage by Region

Table 2.18 shows regional areas covered by forests. Tanzania has total forest coverage area of 48,241,299 ha. Katavi region has the largest forest coverage of 3,591,507 ha, equivalent to 82.7 % of the total regional area, followed by Lindi 5,238,431ha (77.2 %) and Mbeya region with a forest coverage of 4,311,112 (70.6 %). Mwanza region has the least forest coverage area of 156,193 ha (14.3 %).

Table 2. 18: Forest Coverage (Ha) by Regions in Tanzania Mainland, 2015

Region	Total Regional Area(Ha)	Forest Coverage (Ha)	Forest and Woodland (Percent of Total Area)
Dar es Salaam	150,809	49,013	32.5
Morogoro	6,886,883	4,380,058	63.6
Pwani	3,196,403	1,876,289	58.7
Lindi	6,785,532	5,238,431	77.2
Mtwara	1,794,853	743,069	41.4
Ruvuma	6,338,030	4,728,170	74.6
Rukwa	2,167,494	893,008	41.2
Njombe	2,194,407	811,931	37.0
Iringa	3,453,694	1,799,375	52.1
Mbeya	6,106,391	4,311,112	70.6
Manyara	4,469,962	2,033,833	45.5
Dodoma	4,183,192	1,372,087	32.8
Singida	4,856,938	2,219,621	45.7
Mara	2,189,924	343,818	15.7
Simiyu	2,345,074	422,113	18.0
Mwanza	1,092,257	156,193	14.3
Kagera	2,527,312	1,372,330	54.3
Geita	2,098,555	1,009,405	48.1
Tabora	7,595,994	4,648,748	61.2
Shinyanga	1,853,931	317,022	17.1
Kigoma	3,819,825	2,307,174	60.4
Katavi	4,342,814	3,591,507	82.7
Kilimanjaro	1,250,496	607,741	48.6
Arusha	3,822,918	1,662,969	43.5
Tanga	2,810,612	1,346,283	47.9
Total/Average	**88,334,300**	**48,241,299**	**54.6**

Source: NAFOMA, 2015

2.5. Biological Resources

2.5.1- Timber Resources

Forests provide a range of resources both primary and derived, such as timber and derivative products like paper, charcoal and many others. Other benefits also arise from forest resources and are also important for the economy, though they may not always be quantifiable or priced, except in shadow prices. These include such aspects as the ability of forest soils to purify water for domestic and industrial use, regulation of runoff to support hydroelectric power generation and sequester carbon.

A study commissioned by the Tanzania Revenue Authority (TRA) in 2012 to undertake value chain analysis of the forestry sector found that, the forestry sector's contribution to GDP is about 4 %. The study however also concluded that the available data was too incomplete to present a

formal figure of the forestry sector's GDP. Instead Industry Output Estimates for the main forestry sectors could be used to calculate reasonable estimates. These figures do not take account of subsistence production in forestry, such as firewood for domestic use. The estimated forestry contribution to GDP of 4 %, used this approach, and was still greater than the contributions from Mining and Quarrying (3.3 %); Electricity and Gas (1.8 %); and Communications (2.2 %) as shown in Table 2.19.

Table 2. 19: Estimated Contribution of Forestry Sector to GDP in Tanzania, 2010

Forest products	Total Output (TZS Billion) as 2010 GDP	Total Output (TZS Billion) as % of 2010 GDP
Charcoal	867	2.89
Natural forest timber	44	0.15
Plantation timber	290	0.97
Tobacco fuel wood	3.7	0.01
Total	**1,202**	**4.01**

Source: TRA by JUHUDI 2012

Timber resources can be from natural forests or from plantation forests. Natural Forests are forest areas that occur naturally while plantation forests are forest areas that have been established through afforestation or reforestation for commercial purposes. Harvesting of timber resources in natural forests is approved by Districts Harvesting Committees, which are headed by District Commissioners. In forest plantations, customers are allocated volumes to harvest trees for production of various timber resources. Haversting quotas allocated from 2014/15 to 2017/18 were 1,712,262 M^3 for timber, 5,968,157 bags of charcoal and 14,210 pieces of poles. In addition, 804,033 M^3 of logs and 4,500 M^3 of firewoods were allocated for the first half of fiscal year 2017/18 (July - December). TFS stations in both natural and plantation forests carry supervision of harvesting, logging and revenue collection from sales of standing trees. Harvesting Committees conducted various meetings to allocate harvesting of timber, charcoal and poles as detailed in Table 2.20.

Table 2. 20: Harvesting Quota Allocated by District Harvesting Committees, 2014/15 – 2017/18

Year	Number of District	Timber (M^3)	Charcoal (bags)	Poles (pieces)	Logs (M^3)	Firewood (M^3)	Approved dealers
2014/15	41	637,469	2,430,978	3,000	-	-	-
2015/16	37	246,878	1,276,894	3,000	-	-	-
2016/17	22	333,215	1,491,001	3,610	-	-	-
2017/18 July-December	32	494,700	769,284	4,600	804,033	4,500	500
Total	**132**	**1,712,262**	**5,968,157**	**14,210**	**804,033**	**4,500**	**500**

Source: TFS

"-" Data not available

2.5.1.1: Forest Resources Management

Harvesting of forest resources can be from fellings, removals and felling residues. Harvesting of trees for timber products is carried either manually or mechanically. Harvesting in forest plantations is done by individuals/companies with harvesting permits. Collection of logs in some compartments is done by machines/plants that move randomly in the harvested area causing soil compaction which is more severe during the rainy season and can cause poor performance of trees**.** Table 2.21 shows that about 6,917,657.5 M^3 of timber resources were harvested using the three outlined harvesting methods from 2013 to 2017.

When trees are planted they are planted with specific management objectives towards the end of a specified maturity time which is called rotation age. Rotation age can be either biological or economic. The biological rotation age is a specific time when the trees attain an age where there is no more growth while economic rotation age is a time when the planted trees can be harvested at break even point for the grower in terms of input and output costs. Trees from natural forest take longer to mature compared to trees from forest plantations.

For example, for a natural forest trees the rotation age is more than 50 years and 25 years for soft wood species. The rotation age for hard wood species varies with respect to productivity and market demand (AFF, 2011). Table 2.21 indicates that, about 1,976,635.0 M^3 of timber resources were harvested by felling method from 2013 to 2014. Harvesting of timber resources through fellings is known as clear felling where all the trees on a certain piece of land are cleared.

Harvesting of timber resources from removals is known as thinning or selective harvesting which is carried out for management purposes. In this process, the weaker and crooked trees are removed to give room to stronger trees to attain reasonable heights and widths for quality end products. Without reliable data on the extent of felling harvesting method for 2015 to 2017, removal or thinning seems to have been the dominant method, account for about 3,344,640.0 M^3 (48.3 %) of total harvests from all methods from 2015 to 2017.

After harvesting of trees through either fellings or removals, it is technically estimated that 30 % of the trees remain as felling residues. These residues are used for various purposes in wood industries. They are used for production of match boxes, tooth picks, pallets, furniture, paper and charcoal briquettes. Table 2.21 indicate the volume of timber resources which were harvested from TFS forests between 2013 and 2017.

Table 2. 21: The Volume (M^3) of Timber Resources Harvested from TFS Forests, 2013 - 2017

Method of Harvesting	2013	2014	2015	2016	2017	Total
1. Fellings	976,890.0	999,745.0	-	-	-	1,976,635.0
2. Removals	77,306.0	195,400.0	1,887,934.0	252,400.0	931,600.0	3,344,640.0
3. Felling residues	316,258.8	358,543.5	566,380.2	75,720.0	279,480.0	1,596,382.5
Total	**1,370,454.8**	**1,553,688.5**	**2,454,314.2**	**328,120.0**	**1,211,080.0**	**6,917,657.5**

Source: TFS

"-" Data not available

2.5.1.2: Forest Production by Type of Product

Apart from forests being used for environmental protection and conservation, they are also used as sources of income for the Government. Revenues are accrued from sales of forest and bee products and services from production forests (natural forests and commercial tree plantations). Sales of standing trees particularly from forest plantations form the main source of revenue. Types of forest and bee products and services including their sources and markets are summarized in Table 2.22.

Table 2. 22: Types of Forest, Bees Products and Services

Types of Products/ Services	Sources	Markets	Sources of Complementary of Products and Services
Standing trees for logs, pulp, veneer and poles	Forest plantations, Natural forests including Mangrove forests, Forest Reserves and forests in general lands	Sawmills, pulp & paper, chip &fibre board mills, Wood preservation plants, construction industry, furniture industry, foreign market	Local Government forests, Village land forests, Private forests, Woodlots, Steel & other substitutes industry, import
Logs and sawn timbers	Logging and sawmilling	Sawmills, pulp & paper, chip &fibre board mills, construction industry, furniture industry, foreign market	Wood processing industries and other substitute industries
Wood fuel (charcoal and firewood)	Forest Plantations, Natural forests and General lands	Households, Manufacturing Industry, Institutions, hotels and restaurants	Electricity, Generators, Gas supplies, coal mines, kerosene, Solar, Biogas, Wind
Ecotourism	Forest plantations, Catchment forests, Nature Reserves and Mangroves	Domestic and foreign tourists	Private forests, local government forests and village land forests
Research sites and materials	Forest plantations, Catchment forests and Nature Reserves	Individual researchers, Academic institutions, research organizations and Training Institutions	Private forests, local government and village land forests.
Telecommunication n tower sites	Forest plantations, Catchment forests and Nature Reserves	Telecommunication industry	Land sat receivers; Private forests, local government and village land forests
Mining and prospecting sites	Forest plantations, Natural Forests	Mining companies	Private forests, local government and village forest reserves
Medicinal values	Forest plantations and Natural Forests	Pharmaceutical industry, Traditional healers	Synthetic pharmaceuticals, acupuncture
Honey, bees wax and bee colonies	Bee reserves, Apiaries in plantations and natural forests and beekeeping production centres	Foreign and domestic markets; Industry (pharmaceutical inclusive), Traditional healers, Households& Hotels	Private bee reserves, apiaries in local government and village land forests, Private forests/farms
Others (bark- cinchona, mimosa) essential oils, palm leaves, gums, resins, raphia and bamboo	Plantations and natural forests	Industries and households	Private forest, Local government and village lands forests

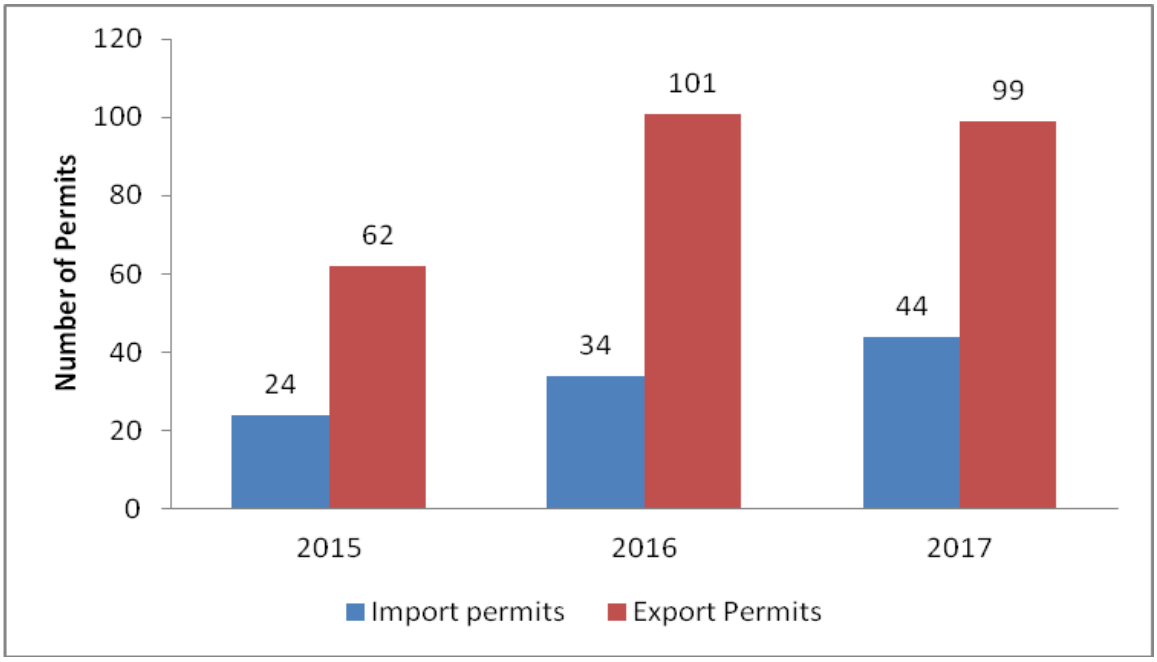
Source: TFS

2.5.1.3: Imports and Exports of Forest Products

The government of Tanzania has established protocols for licensing, issuance of permits and registration for harvesting, trade and transportation of forest and bee products. The aim of the protocols is to ensure compliance on the conditions and terms on possession and utilization of forests and bee resources. Figure 2.1 shows the trend of import and export permits issued for forest products between 2015 and 2017. The number of import permits issued increased from 24 in 2015 to 44 in 2017.

Through TFS, Tanzania is piloting identification and empowerment of primary and secondary wood based industries. Through this initiative, the Government aims to promote internal wood industry's productive capacity, enhance contribution of forest sector to GDP and employment. It is also revealed that, the number of export permits for forest products issued each year is more than twice the number of imports.

Figure 2. 1: Number of Import and Export Permits for Forest Products, 2015 - 2017



Source: TFS Annual Implementation Reports

2.5.1.5: Export Quantities of Forest Products

Timber inspection and grading for export is usually carried out at ports of exit in Dar es Salaam Port, Namanga, Holili, Horohoro, Sirari, Mtukula, Tunduma, Kasumulo, Mtambaswala, Kigoma and Mtwara.

Table 2.23 shows export quantities of forest products and values. Data on export for 2014/15 were captured from TFS HQ office in Dar es Salaam only. The trend of quantities and values for export of forest products shows an increase in year 2014/15 but a decline in the subsequent year.

Exports of forest products provide a source of foreign exchange for the country. Table 2.23 shows exports of wood and non-wood forest products. TFS is strategizing on commercial beekeeping and diversification of forest products to boost the contribution of forest products to the National economy. For example, TFS has started diversification of forest products by tapping resin from soft wood trees specifically pines, which will be exported to earn foreign exchange. Resin is a non-wood product harvested from living trees. Pine resin is a fluid (organic substance) that is secreted from pine trees. Resins are used in the manufacture of a wide range of products including paints and lacquers, rubber, soaps, linoleum, essential oils, furniture polishes and pesticides. Recently, ATY Tanzania International LTD Company from China showed interest on harvesting resin from Sao Hill Forest Plantation. After meeting all the requirements in accordance with Government Notice (GN), the company was granted permits to harvest resin.

As regards bee products, tTanzania is currently exporting honey and bee wax only. However, other bee products such as pollen, propolis and royal jelly can be exported as well. TFS is working towards creation of a more conducive environment for the sector's activities to thrive as part of its contributions towards achievement of the Tanzania Vision of becoming a middle income industrialized country by 2025. The aim for the sector is to ensure that most of the forest products are processed within the country before being exported.

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Table 2. 23: Export Quantities of Forest Products and Values

	2014/2015			2015/2016			2016/2017			Total		
	Quantity		Value (USD)	Quantity		Value (USD)	Quantity		Value (USD)	Quantity		Value (USD)
Product	Volume (CBM)	Weight (KGS)		Volume (CBM)	Weight (KGS)		Volume (CBM)	Weight (KGS)		Volume (CBM)	Weight (KGS)	
Hard woods (other)	8,995	-	3,275,245	280,789	-	16,459,941	9,452	-	2,999,333	299,236	-	22,734,519
Teak	67,609	-	5,773,028	-	-		717,340	-	8,236,140	784,949	-	14,009,168
Mpingo clarinets	76	-	456,880	73,004	-	264,296	252	-	1,202,131	73,332	-	1,923,307
Wattle bark	-	2,056,612	3,885,721	-	690,965	2,475,867	-	2,423,390	3,744,952	-	5,170,967	10,106,540
Sandal wood oil	-	7,700	2,428,540	-	-	2,416,206	-	75,750	1,456,934	-	83,450	6,301,680
Sandal wood spent dust	-	158,124	86,950	18,745	-	-	-	-	-	18,745	158,124	86,950
Handcraft	-	2,592	89,492		5,336	157,634	-	9,467	105,801	-	17,395	352,927
Veneer	1,586	-	41,780	-	-	-	2,781	-	247,200	4,367	-	288,980
Gum arabica	-	300,003	244,620	-	-	-	-	202,000	181,430	-	502,003	426,050
Poles	512	-	72,459	74	-	12,268	-	-	-	585	-	84,727
Wild fruits	-	51,300	-	-	-	-	-	-	-	-	51,300	-
Carvings	-	16,537	81,489	-	5,004	47,395	-	9,486	28,345	-	31,027	157,229
Furniture	-	489	17,151	-	525	23,163	-	14,199	22,495	-	15,213	62,809
Baobab	-	15,000	30,000	-	1,007	116,365	-	29,864	40,527	-	45,871	186,892
Medicinal	-	-	-	-	-	-	-	84,834	1,474	-	84,834	1,474
Withies	-	-	-	-	-	-	100	-	278,700	100	-	278,700
Cinchona	-	-	-	-	19,720	27,411	-	2	15	-	19,722	27,426
Cinnamon	-	-	-	-	-	-	-	10	-	-	10	-
Wooden sample	-	-	-	-	-	-	0	-	405	0	-	405
Softwood	-	-	-	-	-	-	149	-	33,253	149	-	33,253
Raffia	-	-	-	-	1,480	97,536	-	-	-	-	1,480	97,536
Honey	-	152,600	574,966	-	259,860	617,992	-	240,780	580,682	-	829,240	2,289,508
Bee wax	-	220,220	1,923,049	-	251,930	2,228,637	-	203,850	3,091,762	-	1,329,000	13,421,292
Total	**78,778**	**2,981,177**	**18,981,370**	**372,612**	**1,235,827**	**24,944,711**	**730,074**	**3,293,632**	**22,251,579**	**1,181,463**	**8,339,636**	**72,871,372**

Source: TFS

"-" Data is not available

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2.5.1.6: Fertilizer Demand in Tanzania

Fertilizer demand (Table 2.24) reflects amount of fertiliser required for agricultural production. In the table below, the demands for Urea fertilisers (41.1 %) and DAP (16.1 %) were higher than other fertilizers because they were mostly supplied by the government to farmers during the National Agricultural Inputs Voucher Scheme (NAIVS). Through that scheme, farmers who were selected to participate in the scheme were provided with vouchers to get the required inputs, mainly seeds and fertilizers.

Table 2. 24: Fertilizer Demand (Tonnes) in Tanzania, 2011/12-2016/17

Type of Fertilizer	2011/12	2012/13	2013/14	2014/15	2016/17
Sulphate of Ammonia (SA)	11,690	8,771	8,771	8,771	8,771
Calcium Ammonium Nitrate (CAN)	23,400	74,612	74,612	74,612	74,612
UREA	204,640	189,706	189,706	189,706	189,706
Tripple Supper Phosphate (TSP)	10,000	24,258	24,258	24,258	24,258
Diammonium Phosphate (DAP)	50,100	80,780	80,780	80,780	80,780
Muriate of Potash (MOP)/Others	1,670	2,700	2,700	2,700	2,700
NPK 6:20:18/10:18:24	40,439	29,568	29,568	29,568	29,568
NPK 25:5:5	7,482	4,062	4,062	4,062	4,062
NPK 4:17:15	-	-	-	-	-
NPK 20:10:10	10,579	15,234	15,234	15,234	15,234
MRP	25,000	55,309	55,309	55,309	55,309
Total	**385,000**	**485,000**	**485,000**	**485,000**	**485,000**

Source: Agricultural Inputs Section, Ministry of Agriculture

2.5.1.7: Fertilizer Availability

Fertilizer availability increased from 275,220 tonnes in 2008/09 to 302,453 tonnes in 2011/2012, and then later decreased to 289,795 tonnes in 2012/13, due to due to subsidisation through implementation of NAIVS. There are important variations in compositions of fertilisers available in each year and, in general, for many types of fertilisers, the supply did not steadily increase throughought, except for other fertilizers category that increased from 3,703 tonnes in 2008/09 to 23,701 tonnes in 2012/13. There was noticeable decrease in availability of NPK 17-17-17 fertilizers from 3,070 tonnes in 2008/09 to just 553 tonnes in 2012/13 (Table 2.25).

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Table 2. 25: Fertilizer Availability (Tonnes) in Tanzania - 2008/09-2012/13

Type of fertilizer	2008/09	2009/10	2010/11	2011/12	2012/13
S/A	6,157	15,346	4,002	10,314	7,946
CAN	31,933	26,940	35,898	32,020	24,632
UREA	91,029	104,427	90,491	81,664	92,982
TSP	1,427	769	1,962	1,436	1,821
DAP	30,121	47,858	42,909	69,918	33,318
NPK 20-10-10	11,494	12,030	7,171	9,540	6,041
NPK 25-5-5	9,033	9,257	238	4,658	-
NPK 6-20-18/10-18-24	24,593	27,340	51,005	35,198	32,917
NPK 17-17-17	3,070	13,432	7,258	4,767	553
MOP/SOP	4,160	2,192	3,952	3,297	2,236
MRP	58,500	39,564	30,806	25,423	63,648
OTHER	3,703	2,844	3,424	24,218	23,701
Total	**275,220**	**301,999**	**279,116**	**302,453**	**289,795**

Source: Agricultural Inputs Section, Ministry of Agriculture

2.5.1.8: Fertilizer Utilisation

Utilisation of fertilizers, as seen in the Table 2.26 increased from 251,715 tonnes in 2011/12 to 994,898 tons in 2015/16. This increase is associated with government efforts through the implemention of NAIVS. In 2015/16, NPK 17-17-17 was highly used with 513,030 tonnes , followed by MRP (259,627 tonnes) and UREA (114,105 tonnes).

Table 2. 26: Fertilizer Utilization (Tonnes) in Tanzania from 2011/12-2015/16

Type of fertilizer	2011/12	2012/13	2013/14	2014/2015	2015/2016
SA	4,126	3,178	5,957	6,300	6,643
CAN	12,808	9,853	9,367	8,260	7,153
UREA	69,000	65,855	100,455	107,280	114,105
TSP	1,436	728	-	-	-
DAP	69,918	21,000	35,911	38,824	41,736
NPK 20-10-10	9,540	2,416	6,996	7,488	8,791
NPK 25-5-5	4,658	-	1,812	1,531	1,250
NPK 6-20-18/10-18-24	35,198	32,917	30,567	32,129	33,692
NP K 4-17-15	-	-	-	-	-
NP K 17-17-17	4,000	553	80,783	197,490	513,030
MRP	20,338	64,000	190,797	222,689	259,627
MOP	1,319	894	233	324	448
Other	19,374	9,480	7,143	8,229	8,423
Total	**251,715**	**210,874**	**470,021**	**630,544**	**994,898**

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2.5.1.9: Policy and Environmental Related Issues

Key Message

Fertilizer use is very important for increasing crop production as well as food security.

The government emphasizes on the use of inorganic fertilizers byfarmers for increased crop production. From 2008/09 the government, through the Ministry of Agriculture, provided subsidies to farmers through the NAIVS in some regions of Tanzania, especially those having high potential for production of cereals like maize and paddy. The subsidy was provided for inorganic fertilizers and improved seeds to some farmers who were selected to get the subsidy. Each selected farmer got inputs (fertilizers and seeds) which enabled him/her to cultivate one acre of land i.e. one acre package.

One of the objectives of NAIVS was to create awareness on the use of inorganic fertilizers and to increase the use of fertilizers by the farmers, because most of the farmers have a mentality that inorganic fertilizers destroy the soil. In order to increase availability of inorganic fertilizers to farmers all over the country, in the fiscal year 2017/18, the government decided that the fertilizers should be procured in bulk (bulky procurement) so as to enable most of the farmers to afford buying fertilizers at affordable prices fixed by the government and use them on their farms to increase food production as well as increasing food security and reduce poverty.

When inorganic fertilizers are washed off by rainfall or during irrigation and mixed with water for domestic consumption like river water, lake water or other water bodies, they contaminate the water and may bring bad effects to human beings, animals and other living organisms.

Fertilizers are chemical substances used to add nutrients to the soil to promote soil fertility and increase plant growth. However, excessive use of chemical fertilizers in agriculture results in a large number of environmental problems because some fertilizers contain heavy metals (e.g. cadmium and chromium). Later, such heavy metals are constituted in plants and some of them result in accumulation of inorganic pollutants.

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NEGATIVE EFFECTS OF FERTILIZERS ON THE ENVIRONMENT

Water Pollution

Environmentalists are aware of harmful effects of nitrogenous fertilizers on the environment. Nitrogen in agricultural areas reaches the water environment by three ways: Drainage, leaching and flow. Nitrate leaching in particular is linked to agricultural practices especially after fertilizer application and during cultivation. Nitrate accumulated in the soil is leached in varying amounts depending on conditions. In the soil, fertilizers are converted into nitrate through nitrification by microorganisms. Due to having negative charges, nitrate can reach groundwater. Even in ideal conditions, plants use 50 % of nitrogenous fertilizers applied to soil; 2 to 20 % is lost through evaporation; 15 to 25 % reacts with organic compounds in the clay soil; and the remaining 2 to 10 % interfere with surface and groundwater.

Soil Pollution

According to research findings, the effects of chemical fertilizers on the soil are not immediately obvious. Because soils have strong buffering power due to their components, repeated inorganic fertilizer application without additional organic amendments enhances activities of soil microorganisms for short durations, increasing mineralization of existing soil organic matter and depletion of carbon out of soil. Loss of soil organic carbon (humus) reduces the capacity of soil to maintain its natural nutrient reserves (fertility), deteriorates soil structure, weakens its resistance to erosion, reduces vegetation/biomass cover and consequently leads to land degradation.

Excessive application of fertilizer is not a problem in Tanzanian smallholder farmer crop production, but balanced nutrient supply is a problem. Application of nitrogen bearing fertilizer like urea without phosphorus or potassium, as practised by some farmers, leads to dangerous accumulation of nitrate in the soil. Nitrogen supplied as fertilizer cannot be fully utilized by the plant as absence of phosphorus becomes the limiting factor leading to its accumulation and pollution of the environment (Ministry of Agriculture, FAO, 2006).

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Air Pollution

Fertilizers are known to be among the most important inputs in agricultural production. When they are applied inadequately, there are losses of productivity and quality and on the other hand, when too much fertiliser is applied, it causes air pollution by nitrogen oxides emissions. This gas, combined with others gases, contributes to the depletion of the ozone layer.

Table 2. 27: Summary of Environmental and Social Impacts of Inorganic Fertilizers

Environmental and Social Components		**Impacts**
Physical environmental	Soils Water Resources Air Quality	**Salinization of soils** - Contamination of groundwater - Pollution of surface water **Heavy metals** - Dust - Air pollution
Biological Environmental	Fauna and flora	**Promoting weed growth** - Loss of natural plant and wildlife habitats and species - Increased pest problems
Social Environmental	Aesthetic & landscape Historical/Cultural Sites. Human health Human communities	**Loss of natural recreational, historical and archaeological sites** - Health risks - Increased use of labour saving technologies

2.5.2- Aquatic Resources

2.5.2.1: Fish Capture Production

The fishery sector plays a significant role in development by contributing to the economic and social wellbeing of the country. Among the contributions of the sector are supply of animal protein, income generation, employment and recreation, tourism and food security all of which are crucial for the attainment of the FYDP II and SDGs.

During 2016 the sector supported a total of 203,529 people as fishers deriving their livelihood from the various fishery resources in the country. Also the sector supported more than 4 million people directly and indirectly, working as fishers, traders, processors and suppliers (Fisheries annual statistics report, 2013). The statisticsfor the sector further indicate that, total fish production increased from 327,845 metric tonnes in 2007 to 375,158 metric tonnes in 2013, even

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though it later decreased to 362,595 metric tonnes in 2016. The poor performance in 2016 is linked to decrease in fish production in freshwaters, from 364,602 metric tonnes in 2013 to 308,772 metric tonnes in 2016.

The Tanzanian fishery is mainly artisanal. The artisanal fishery accounts for almost all the inland and marine water catches and consequently it is currently the most important fishery in the country. There are, however, also a few commercial/industrial vessels and long liners owned by Distant Water Fishing Nations (DWFN) which operate under license in Tanzanian Economic Exclusive Zone (EEZ) targeting Tuna and Tuna like species.

Tanzanian fishery is dominated by multi-species, however, only a few species dominate landings in terms of volume. On average the quantities of fish which is caught annually is about 350,796 metric tonnes (Table 2.28). The most notable species are; Nile perch (*Lates niloticus*), Tilapia (*Oreochromis niloticus*) and Lake sardine locally known as "dagaa" *Rastrineobola argentea* from Lake Victoria. Species from Lake Tanganyika fisheries includes lake sardines (dagaa), *Stolothrissa tanganicae* and *Limnothrissa miodon* together with their predators the *L. Stappersii, L. Marie and L. microlepis*. Lake Nyasa too has good stocks of various species of Tilapia, *Haplochromis spp* and Lake sardines *Engraulicypris sardella*. (Fisheries annual statistics report, 2013).

Marine fisheries resources also contribute to the total annual catch, the main commercial marine species are sardine and anchovy, which together forms 30 - 50 % of the total fish landing. Other fish species being landed include: *Lethrinus rhodopterus* (changu), *Carrotomus spinidens* (pono), *Caranx cynodon* (kolekole), *Siganus oramin* (Tasi), Tuna (*jodari*), *Scomberomorus plurilineatus* [(Kingfish) (nguru)], *Restrelliger chrysozonus* (Vibua), *Carcharinus falciformis* (papa), *Hypolophussephen* (taa), *Panulirus ornatus* (kamba kochi), *Penaeus bubulus* (kamba) *Anchoviella commersonii* (dagaa) and *Octopus chromatus* (Pweza), (Fisheries annual statistics report, 2013).

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Table 2. 28: Fisheries Statistics, Tanzania Mainland, 2007 - 2016

Years	Fish Production											
	Freshwater				Marine				Totals			
	Fishers	F-Vessels	Weight M.Tonnes	Value (000's TZS)	Fishers	F-Vessels	Weight M.Tonnes	Value (000's TZS)	Fishers	F-Vessels	Weight M.Tonnes	Values (000's TZS)
2007	126,790	44,362	284,347	252,525,197	36,247	7,489	43,499	39,239,352	163,037	51,851	327,845	291,764,549
2008	133,791	44,838	281,691	319,639,171	36,247	7,489	43,130	51,756,216	170,038	52,327	324,821	371,395,387
2009	135,769	45,234	288,059	342,492,879	36,321	7,664	47,616	67,930,600	172,090	52,898	335,674	410,423,479
2010	141,206	47,635	294,474	684,844,019	36,321	7,664	52,683	89,639,934	177,527	55,299	347,157	774,483,953
2011	141,206	47,635	290,474	1,031,883,681	36,321	7,664	50,592	166,954,953	177,527	55,299	341,066	1,198,838,634
2012	147,020	49,721	322,313	1,248,903,393	36,321	7,664	50,079	195,529,127	182,741	56,985	365,023	1,444,432,520
2013	147,644	50,120	364,602	1,287,248,813	36,321	7,664	52,846	207,649,600	183,431	57,385	375,158	1,494,898,413
2014	147,479	49,627	314,062	1,551,653,651	36,321	7,664	51,912	241,563,754	183,800	57,291	365,974	1,793,217,405
2015	147,479	49,627	309,922	1,270,856,680	36,321	7,664	52,723	210,892,897	183,800	57,291	362,645	1,481,749,577
2016	149,018	49,688	308,772	1,270,856,672	54,511	9,650	53,823	211,891,899	203,529	59,338	362,595	1,486,377,303

Source: Ministry of Livestock and Fisheries

2.5.2.2: Import of Fish and Fishery Products

The per capita consumption of fish is high, between at least 25 and 40 kg/person annually. Fish production has been increasing for the past few years, mostly attributed to fish farming, and more people becoming fishers. Despite the increase in fish production, Tanzania still needs more fish to meet the rising demand and supply gap due to population growth and booming tourism industry.

Some of the constraints facing the fishery industry include inadequate technical expertise, management skills, insufficient financial resources and lack of adequate tools to manage and control the development process. To bridge the gap between demand and supply, the government has put in place strategies, which include allowing importation of fish from abroad. Statistics for the period between 2010 to 2016 show that there has been a steady rise in importation, from 1.92 million kilograms in 2010, to 13.92 million Kilograms in 2016 (Table 2.29).

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Table 2. 29: Trend of Import of Fish Products from 2010-2016

Year	Weight (Kg)	Value in US $	Value in TZS	Royalty in TZS
2010	1,919,770.00	1,229,344.00	1,668,374,629.00	657,934,406.00
2011	2,659,435.00	-	-	978,402,385.00
2012	4,885,689.00	3,512,976.00	5,507,054,266.00	1,681,166,953.00
2013	6,642,398.00	5,718,245.60	9,027,183,853.10	2,649,611,644.00
2014	6,792,259.80	6,009,654.90	9,889,823,440.20	2,818,169,085.90
2015	16,743,964.40	15,338,684.90	32,211,238,339.30	7,247,564,250.00
2016	13,917,656.98	12,749,582.82	26,774,123,924.68	8,519,807,734.03

Source: Ministry of Livestock and Fisheries

"-" Data not available

2.5.2.3: Export of Fish and Fishery Products

Appart from its other contributions, the fish and toehr fishery resources contribute to foreign exchange earnings and government revenue. For the past sixteen years (i.e. 2001 – 2016), an average of 43,541,440 kilograms of fish and fishery products worth USD 161,752,485 was exported (Table 2.30) every year. The most important fish and fishery products for exports include Nile perch from Lake Victoria, sardines from Lake Tanganyika as well as shell fish from marine waters such as prawns, lobsters and crabs; and molluscs (*squids and octopus*).

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Table 2. 30: Trend of Export Performance from 2001 - 2016

Years	Weight in Kgs	Aquarium Fish in Pieces	Value in US $	Value in TZS	Royalty in TZS
2001	41,640,247.9	80,577.0	95,435,102.4	82,982,764,242.1	5,244,333,672.0
2002	32,662,878.2	28,301.0	105,779,930.6	99,294,249,903.5	5,957,654,995.0
2003	42,352,738.1	24,500.0	129,605,815.4	132,862,401,373.8	7,789,955,962.7
2004	46,011,033.4	15,784.0	112,761,195.1	121,922,686,607.3	7,190,356,743.1
2005	57,289,083.6	21,025.0	141,597,362.2	162,619,492,949.1	9,142,768,083.8
2006	44,495,623.4	21,741.0	138,120,145.1	170,184,661,003.1	6,236,615,179.2
2007	57,795,513.6	25,502.0	173,272,670.4	213,211,258,838.2	7,589,576,913.9
2008	51,426,207.3	33,066.0	174,409,214.4	205,054,092,453.0	6,629,846,700.1
2009	41,148,261.0	53,188.0	161,053,645.7	207,447,119,888.5	6,410,191,232.0
2010	39,771,833.7	40,552.0	187,427,053.5	263,131,442,027.7	5,876,103,557.4
2011	37,996,433.3	61,215.0	152,973,356.8	233,714,590,010.8	6,153,278,023.3
2012	41,394,267.9	45,550.0	163,299,365.5	254,901,017,111.3	6,819,926,007.1
2013	38,573,605.9	44,260.0	147,659,778.6	234,884,628,955.9	6,117,769,193.7
2014	43,354,399.5	42,100.0	188,101,262.0	314,489,903,877.1	7,490,632,355.2
2015	41,059,452.1	87,630.0	259,286,762.2	547,228,222,095.5	13,097,411,199.2
2016	39,691,462.0	65,841.0	257,257,100.5	526,228,222,095.5	14,302,761,906.9

Source: Ministry of Livestock and Fisheries

2.5.2.4: Aquaculture Production

Aquaculture is the method of breeding fish and animals in a controlled marine or freshwater environment. As the demand for fish and fish products increased, technology has made it possible to grow food in coastal marine waters and the open ocean. However, despite abundant potential areas the country is endowed with, aquaculture technology adoption in Tanzania is still at infancy stage. Its development is determined by several factors such as availability of water, suitable land for fish farming, awareness within the community on the economic potential in fish farming and motivation.

2.5.2.5: Freshwater Aquaculture

Freshwater aquaculture is the method of breeding fish in controlled freshwater environments. Generally, production of fish in ponds increased significantly in the twelve-year period from 2005 to 2016, rising from 651 MT to 3,840 MT. This has been accompanied by an increase in the number of fish farmers from 11,245 to 18,900 in the same period. Income generated from fish farming also increased significantly from TZS 2,602 Million in 2005 to TZS 22,000 million in 2016.

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Table 2. 31: Number of Fish Ponds, Aqua Farmers and Production

Year	Number of Ponds	Number of Farmers	Production (MT)	Value (TZS) (000,000)
2005	13,011	11,245	651	2,602
2006	14,300	11,897	715	2,860
2007	16,121	13,861	806	4,030
2008	16,800	14,136	865	4,323
2009	17,511	14,907	936	5,616
2010	18,200	15,227	952	5,711
2011	19,174	15,982	959	5,752
2012	19,800	16,873	972	5,832
2013	20,100	17,511	2,990	17,937
2014	20,493	17,840	3,000	21,000
2015	21,300	18,201	3,118	21,826
2016	22,545	18,900	3,840	22,000
Total	**219,355**	**186,580**	**19,802**	**119,489**

Source: Ministry of Livestock and Fisheries

SEAWEED FARMERS AND PRODUCTION

Seaweed farming has often been developed as an alternative to improve economic conditions and to reduce fishing pressure and over exploitation of fisheries. Statistics in Table 2.32 indicate that seaweed farming and production is very feasible in the country. Categorized into four years' periods, seaweed farming and production is shown to have increased in the most recent four years period (2013 – 2016), with both the number of farmers (14,000), and production volume (1,979.7 MT), as well as the value of seaweeds produced (TZS 1,011,411) being much higher compared to the earlier periods.

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Table 2. 32: Seaweed Farmers and Production from 2005 – 2016

Year	Number of Farmers	Production (MT)	Value (TZS) (000)
2005	1,000	170.0	25,500
2006	1,000	194.3	29,145
2007	1,000	200.1	40,020
2008	1,000	329.6	65,920
Sub-Total	**4,000**	**894**	**160,585**
2009	2,000	449.1	112,275
2010	2,000	552.8	165,840
2011	2,000	688.5	206,550
2012	3,000	651.9	260,760
Sub-Total	**9,000**	**2,342.3**	**745,425**
2013	3,000	401.1	160,440
2014	3,000	179.3	89,650
2015	3,000	222.8	133,680
2016	5,000	1,176.5	627,641
Sub-Total	**14,000**	**1,979.7**	**1,011,411**
Grand-Total	**27,000**	**5,216.0**	**1,917,421**

Source: Ministry of Agriculture Livestock and Fisheries, 2016

2.5.3 Crops

2.5.3.1: Area and Production of Food Main Crops

Agriculture is the science and art of cultivating the soil to grow plants, harvesting crops and raising livestock for human needs**.** It includes the cultivation and tillage of the soil, growing, and harvesting of any agricultural or horticultural commodities, the raising of livestock or poultry and any practices performed by farmers. The sector is the mainstay of Tanzania's economy contributing about 29 % of GDP (2016), *30 % of export earnings*, with more than US$1 billion from cash crop exports, and employs about 75 % of the total labour force.

In 2016, Tanzania had over 44 million hectares of arable land with only 33 % of this land in cultivation. Land is a vital asset in ensuring food security. Almost 70 % of the population lives in rural areas and they are involved in agriculture. Among the main food crops in Tanzania are; Maize, Sorghum, millet, rice, wheat, beans, cassava, potatoes, and bananas. The main cash crops are coffee, sisal, cashewnuts, tea, cotton, and tobacco.

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The agricultural sector faces various challenges and its development has been the governments' top priority, in a bid to reduce poverty. Factors influencing farmers' efficiency include inadequate finances and lack of education on modern farming methods. Other challenges are; low productivity of land, labour and production inputs, underdevelopment of irrigation potential, poor rural infrastructure, infestation and outbreak of pests and diseases, environmental degradation and fluctuations of agricultural products prices.

2.5.3.2: Annual Crops

In Tanzania Mainland, the dominant annual food crops are cereals (Maize, Paddy, Sorghum, Millet) and legumes (Beans, Cowpeas and Pigeon peas) grown in almost all twenty six regions. Other crops such as tubers (Cassava, Potatoes) and Banana and plantains are also grown in many parts of the country. Production levels are normally dictated by weather conditions and other events like draught, floods, crop diseases and pests. Other factors include; fertilizer cost, input price, area where the crop grown, test and market of the crop.

Production of food crops has been fluctuating over the period (2012 - 2016). Table 2.33 shows that, the production of annual food crops increased from 21, 497 thousand tonnes in 2012 to 24,356 thousand tonnes in 2014, then decreased to 22,146 thousand tonnes in 2015 and later increased to 25,928 thousand tonnes in 2016. The decrease in production of food crops in 2015 was in part due to unfavourable cereal market conditions experienced in 2014, and in part due to weather vagaries. In the same period, the area under cerelas cultivation increased from 9,604 ha in 2012 to 12,067 in 2016. Moeover, there was also a significant increase in the production of paddy from 1,800 thousand tonnes in 2012 to 3,429 thousand tonnes in 2016 (90.5 percent change).

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Table 2. 33: Annual Crops Production (Tonnes), 2012 – 2016

Annual Crop	2012 Area (ha)	2012 Prod	2013 Area(ha)	2013 Production (000)	2014 Area(ha)	2014 Production (000)	2015 Area(ha)	2015 Production (000)	2016 Area (ha)	2016 Production (000)
Maize	4,118	5,104	4,120	5,356	4,146	6,734	3,788	5,903	3,584	6,149
Paddy	799	1,800	928	2,195	957	2,586	1,154	2,980	1,122	3,429
Cassava	955	5,462	864	4,755	800	4,993	1,095	5,886	1,112	6,614
Beans	1,265	1,199	1,151	1,114	1,114	1,115	1,125	1,202	1,181	1,307
Sorghum	839	839	711	35	851	37	756	39	726	42
banana	442	2,525	470	2,679	505	3,192	453	3,585	352	3,183
I/Potato	168	1,235	203	1,768	190	1,783	175	1,481	158	1,342
P/Peas	257	206	287	247	251	248	253	262	266	285
S/Potato	651	3,018	789	3,470	736	3,501	736	736	3,501	3,501
Wheat	110	109	107	104	101	167	86	72	65	76
Total	**9,604**	**21,497**	**9,630**	**21,723**	**9,651**	**24,356**	**9,621**	**22,146**	**12,067**	**25,928**

Source: Ministry of Agriculture

2.5.3.3: Perennial Crops

Perennial crops are crops that exist for more than one year after being planted and are harvested multiple times, thus reducing the need for replanting year after year. Perennial crops can also reduce top soil loss due to erosion, increase biological carbon sequestration within the soil and reduce waterway pollution through agricultural runoff. In Tanzania the main perennial crops include Coffee, Sisal, Tea, Pyrethrum, Sugarcane and Cashew nuts. Production of perennial crops is normally affected by fertilizer and pesticide usage, input prices, weather and demand in the international market.

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Table 2.34 shows that, production of perennial crops increased from 8,404 thousand tonnes in 2012 to 9,685 thousand tonnes in 2016. In addition, the area under perennial crop production also increased from 1,240 ha in 2012 to 1,676 ha in 2016. It is also observed that, coffee and sugarcane were the most dominant crops over the period, contributing production volumes of 6,614 thousand tonnes and 2,839 thousand tonnes in 2016 respectively.

Table 2. 34: Production of Perennial Crops (Tonnes "000"), 2012 - 2016

	2012		2013		2014		2015		2016	
CROPS	**Area (ha)**	**Prod**	**Area (ha)**	**Prod**	**Area (ha)**	**Prod**	**Area (ha)**	**Prod**	**Area (ha)**	**Prod**
Tea	9	33	21	34	21	34	23	36	23	33
Coffee	955	5,462	864	4,755	800	4,993	1,095	5,886	1,112	6,614
Sisal	58	26	35	35	41	37	49	39	35	42
Pyrethrum	9	6	16	6	18	7	13	6	7	2
Sugar	57	2,717	59	2,992	58	2,967	44	3,133	42	2,839
Cashewnut	152	160	411	128	434	130	483	198	457	155
Total	**1,240**	**8,404**	**1,406**	**7,950**	**1,372**	**8,168**	**1,707**	**9,298**	**1,676**	**9,685**

Source: Ministry of Agriculture

Figure 2.2 shows the average production of perennial crops from 2012 to 2016. On average coffee production had the highest contribution, making 63.7 % of the total output over the period, followed by sugarcane with 33.7%. The remaining perennial crops production accounted for less than 3 % of total production.

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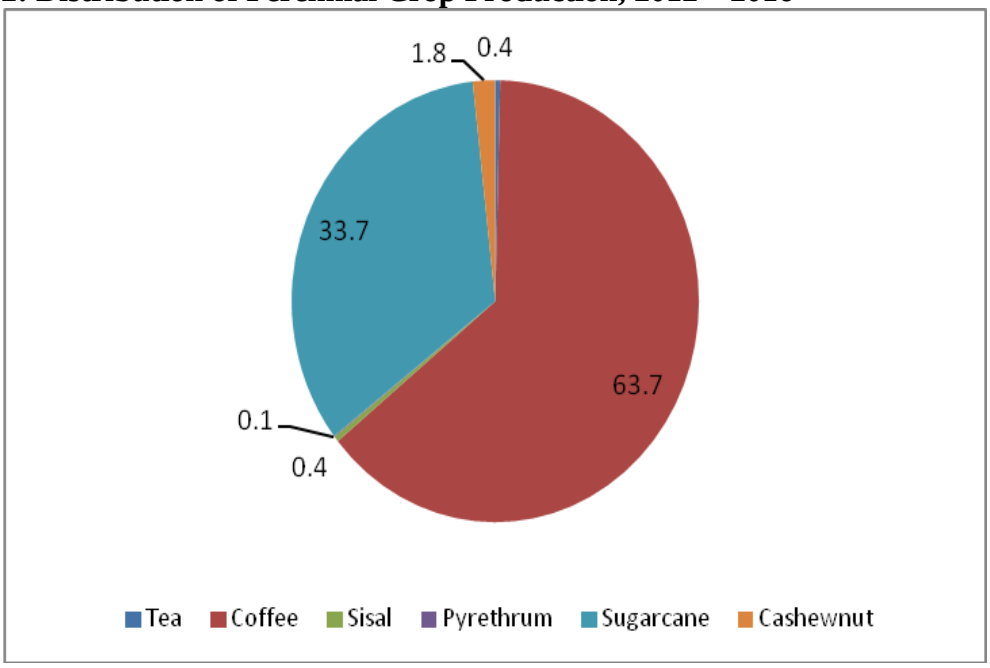
Figure 2. 2: Distribution of Perennial Crop Production, 2012 – 2016



2.5.3.4: Imports and Exports of Agricultural Crops

Agribusiness is still in its infancy in Tanzania and commercial ventures are found mostly in traditional export crops such as coffee, tea, cotton, cashews, tobacco and, on a much smaller scale, cloves and sisal. Food exports are a promising option for Tanzania, with potential to grow cross border trade with eight African countries which are neighbours with Tanzania (Burundi, Democratic Republic of Congo, Kenya, Malawi, Mozambique, Rwanda, Uganda and Zambia).

Tanzania's major trading partners are the European Union and Asia which account for about 29 and 24 % of respectively, of the total imports. The same trading blocks account for 38 and 32 % of Tanzania's exports respectively. Intra-African trade remains relatively small, accounting for 12 and 11 % of the country's imports and exports respectively. Trade with Kenya and Uganda, which together with Tanzania are also members of the East African Community accounts for 6 - 7 % of trade flows with Tanzania. Tanzania's horticultural sector (vegetables, fruits and cut flowers) is still very small and contributes a little more than 1 percent to total merchandise exports.

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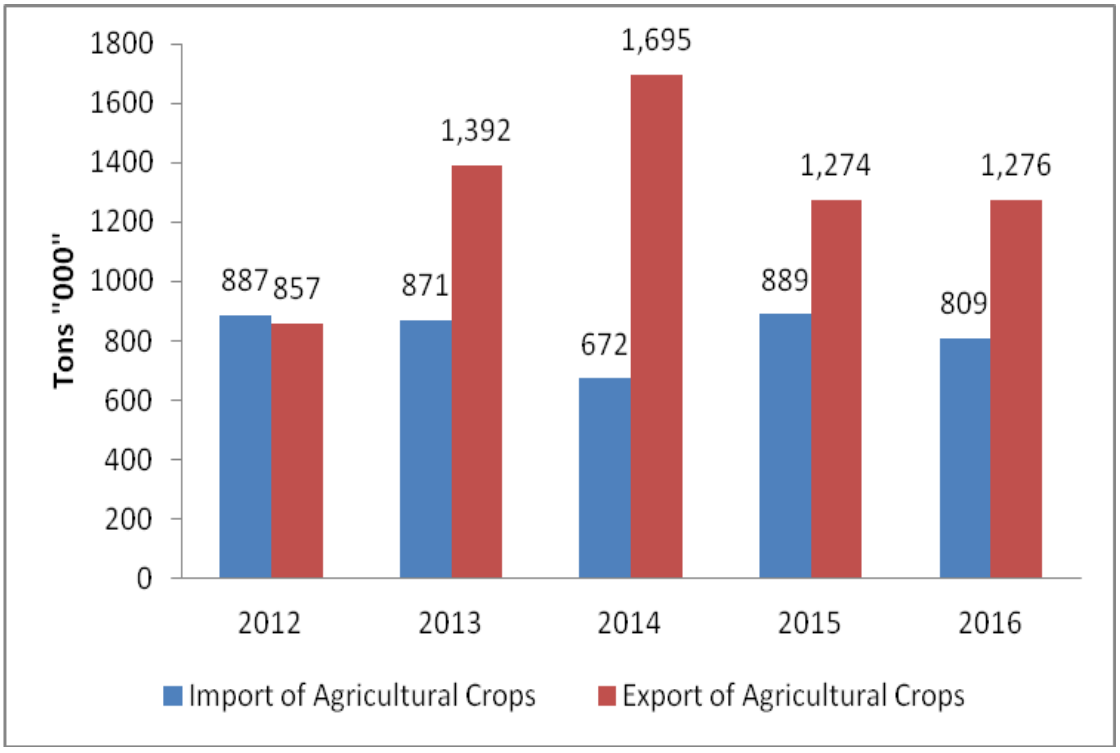
Agricultural crop imports have been fluctuating from year to year due to various factors. Figure 2.2 indicates that, the highest importation in the five years period from 2012 was 889 thousand tonnes, recorded in 2015 and the lowest importation was 672 thousand tonnes, recorded in 2014. Generally, importation of agricultural crops decreased from 887 thousand tonnes in 2012 to 809 thousand tonnes in 2016.

On the other hand, agricultural crop exportation has been increasing from 857 thousand tonnes in 2012, to 1,695 thousand tonnes in 2014, but there was a decreased to 1,276 thousand tonnes in 2016. The highest agricultural crop exportation was observed in 2014 in which 1,695 thousand tonnes were exported (Figure 2.3).

Figure 2. 3: Import and Export Data for Agricultural Crops, 2012 – 2016



Source: Tanzania Revenue Authority

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2.5.3.5: Link of Agriculture and Environmental Issues

Agricultural development is strongly dependent on environmental resources such as land, forest, air and water. Sustainable utilization of these resources in agriculture is very important to safeguard the environment. Not only does the intensification of agriculture exert pressure on natural resources, it also contributes to natural carbon pool, hence increasing agriculture's contributions to climate change mitigation. There is a scientific consensus that concentration of greenhouse gases, human driven emissions of carbon dioxide and land-use changes are the processes primarily responsible for climate change in the Africa region. Climate change is also an attribute of unsustainable farming methods and systems including deforestation, land clearing and bushfires. Tanzanian agriculture is constrained by unsustainable farming methods and systems, unavailability of reliable methodologies for measuring and monitoring carbon sequestration in agriculture sector and weak enforcement of laws and regulations.

The environment provides rural farmers with the resources for their farming activities, such as marine or sea water, soil, forest, green vegetation and biodiversity. Apart from farming, which forms the major source of income for majority of the rural population, the rural population depends on other complementary income generation activities that rely on the environment such as hunting, fishing, herbal medicine, craft and cottage industry.

Land degradation, particularly the deterioration of soils due to harmful agricultural practices such as bush burning, poor irrigation systems, short fallow period and use of marginal land for farming and grazing; cause serious challenge to agricultural environments conservation initiatives in Tanzania. Moreover, degradation of environmental resources caused agricultural activities in rural areas is often not given the serious attention it deserves. Careful management of the soil is therefore necessary for sustainable food production. Some of the conservational practices used in agricultural production include;

- Planting of cover cropping –which prevent exposition of degraded land to erosion and marsh formations
- Practicing of crop rotation and shifting cultivation - which improves soil fertility and reduces acidification of the soil.

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- Reduced bush burning - which lessens the effects of fire and heat on soil fertility and texture
- Longer fallow periods - which ensure the replenishment of micro - organisms and water table after reasonably long fallow periods.
- Soil management practices such as use of compost manure which improves soil fertility instead of industrial fertilizers and other chemicals.
- Reforestation– which ensures that trees which are cut down are replaced accordingly
- Rotational grazing- which reduce chances of erosion due to desertification.

2.5.4- Livestock

The Livestock sector plays a significant role to the National economy and has potential to contribute solutions to the major challenges facing the country due to rising poverty levels, food insecurity and unemployment. The livestock industry in Tanzania is categorized into two major production systems namely extensive and intensive. Extensive livestock production systems are systems where animals are kept in fee-range for the most part or all the year of production cycle. Intensive livestock production systems, on the other hand, involve zero grazing - in doors and semi indoor - where animals are housed and fed. The main types of livestock raised are cattle, goats, sheep, pigs and chicken of which most are indigenous. Besides meat production, other products from livestock include hides, skin, milk, eggs and manure.

2.5.4.1: Number of Livestock by Type in Tanzania

Tanzania has the third largest population of livestock in Africa after Ethiopia and Sudan. About 50 million ha of rangelands are suitable for livestock grazing but only 24 million ha are currently being utilized. The rest (about 40 %) of land suitable for livestock keeping is currently not being utilized due to tsetse flies which are widespread in the country. Distribution of livestock is therefore skewed towards areas that are mostly free from tsetse flies. The regions with the largest heads of cattle are Shinyanga, Dodoma, Singida, Arusha and Tanga.

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Table 2.35 shows that, the number of livestock increased from 96,338,348 in 2010 to 173,859,905 in 2013 and then decreased to 100,825,224 in 2016. Most of livestock had a steady growth in numbers except chicken of which the number decreased from 123,562,110 in 2013 to 41,935,537 in 2016.

Table 2. 35: Number of Livestock by Type in Tanzania, 2010 - 2016

Type/Year	2010	2011	2012	2013	2014	2015	2016
Cattle	19,245,648	21,300,000	23,967,902	24,531,673	25,800,000	26,713,643	27,748,838
Sheep	3,592,700	6,400,000	4,388,877	7,656,250	8,700,000	6,168,295	7,200,444
Goats	13,600,000	15,200,000	14,913,515	16,010,526	16,700,000	18,026,051	18,774,126
Pigs	1,900,000	2,010,000	2,054,155	2,099,346	2,400,000	4,370,221	5,166,279
Chickens	58,000,000	60,000,000	86,103,000	123,562,110	69,000,000	39,848,549	41,935,537
Total	**96,338,348**	**104,910,000**	**131,427,449**	**173,859,905**	**122,600,000**	**95,126,759**	**100,825,224**

Source: Ministry of Livestock and Fisheries

2.5.5- Other Non-cultivated Biological Resources

2.5.5.1: Regulated Hunting

Hunting particularly for wildlife trophy (the animal or part of the animal kept, and usually displayed, to represent the success of the hunt) such as ivory, skins, skulls, horns, antlers, claws and teeth takes place in Game Reserves, Game Controlled and open areas. This kind of hunting is usually undertaken for human recreation**.** It is specific and selective legal form of wildlife use that involves payment for a hunting experience and the acquisition of a trophy by the hunter. Trophies are often kept as souvenir displayed in the hunter's home or office, and usually in specially designed "trophy rooms" sometimes called "game rooms" or "gun rooms" in which the hunter's weaponry is displayed as well. Other uses of hunted trophies include bracelets, trinkets and the like.

For the sake of ensuring sustainability of this kind of hunting, the management authority sets maximum number of individual species (*quota*) to be hunted in each hunting season which usually starts from 1st July to 31st December each year. Table 2.36 reveals that, buffalos had the highest number allowed for hunting with a provision of 2,130 buffalos per hunting season. The percentage of hunted buffalos in relation to the allowed quota, however, decreased from 75.7 % in 2006 to 2.5 % in 2012. Furthermore, the number of elephants allowed to be hunted increased

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from 50 in 2000 to 200 in 2012 whereas the proportion of hunted elephants in relation to the quota decreased from 64.0 % in 2000 to 20.5 % in 2012.

Table 2. 36: Trend of Some of the Wild Animals (Big five) Hunted From 2000 - 2012

SPECIES	Year/Hunting Season												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Elephant													
Quota	50	50	50	100	100	100	100	200	200	200	200	200	200
Number of hunted animals	32	35	41	45	36	54	65	87	99	98	96	45	41
% of Quota	**64.0**	**70.0**	**82.0**	**45.0**	**36.0**	**54.0**	**65.0**	**43.5**	**49.5**	**49**	**48**	**22.5**	**20.5**
Lion													
Quota	-	-	-	-	-	-	315	315	315	315	315	315	315
Number of hunted animals	-	-	-	-	-	-	278	176	105	120	98	27	37
% of Quota	**-**	**-**	**-**	**-**	**-**	**-**	**88.3**	**55.9**	**33.3**	**38.1**	**31.1**	**8.6**	**11.7**
Leopard													
Quota	-	-	-	-	-	-	500	500	500	500	500	500	500
Number of hunted animals	-	-	-	-	-	-	331	170	265	149	205	44	40
% of Quota	**-**	**-**	**-**	**-**	**-**	**-**	**66.2**	**34.0**	**53.0**	**29.8**	**41.0**	**8.8**	**8.0**
Hippopotamus													
Quota	-	-	-	-	-	-	450	450	450	450	450	450	450
Number of hunted animals	-	-	-	-	-	-	**95**	282	142	153	158	38	40
% of Quota	**-**	**-**	**-**	**-**	**-**	**-**	**21.1**	**62.7**	**31.6**	**34.0**	**35.1**	**8.4**	**8.9**
Buffalo													
Quota	-	-	-	-	-	-	2,098	2,130	2,130	2,130	2,130	2,130	2,130
Number of hunted animals	-	-	-	-	-	-	1,588	1,676	735	1,061	1,108	47	53
% of Quota	**-**	**-**	**-**	**-**	**-**	**-**	**75.7**	**78.7**	**34.5**	**49.8**	**52.0**	**2.2**	**2.5**

Source: Ministry of Natural Resources and Tourism

NOTE:

- *Some years have no allocation for quota for certain species due to the status of individual species during a particular hunting season/year.*
- *The number of hunted individual specie depends on various factors including availability of the animal with desirable trophy as per hunting regulations thus not all individuals allocated in the quota are hunted per season/year.*

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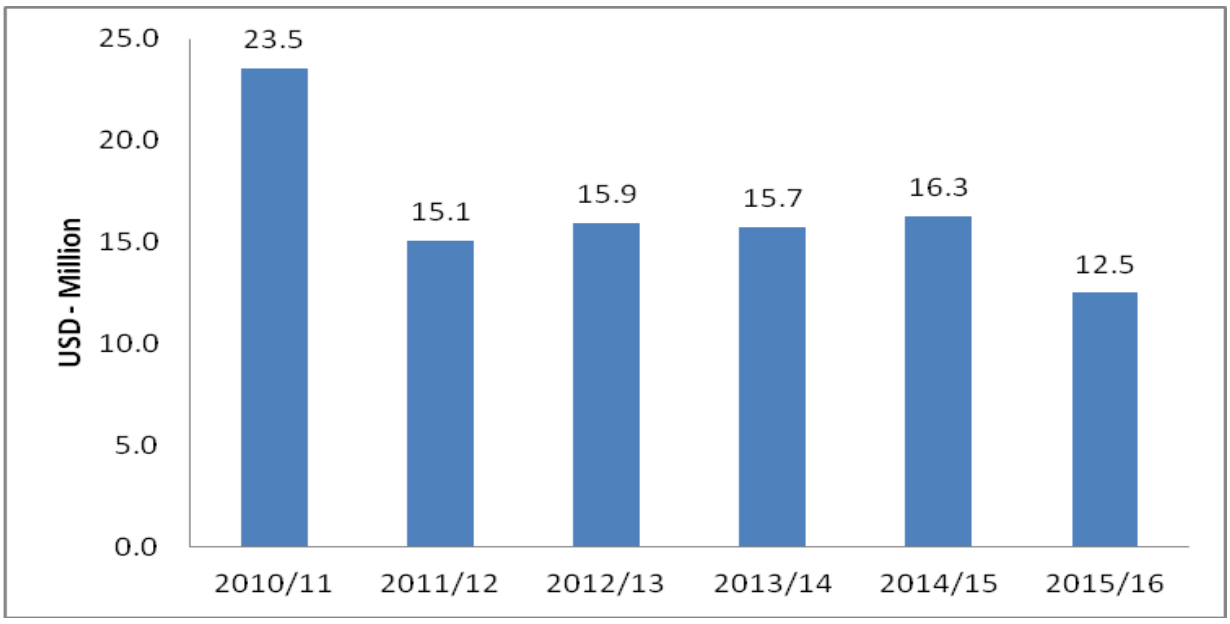
In order for the Tourist hunter to be allowed to hunt, she/he must obtain a relevant written permission called hunting permit from Tanzania Wildlife Management Authority (TAWA). The trophy hunter possessing the permit will be allowed to hunt under the guidance of a Professional Hunter (PH) and supervision of Wildlife Ranger/Officer from TAWA.

Through trophy hunting the country is getting foreign exchange. For instance total annual average of 16.5 USD million was earned from year 2010/2011 to 2015/2016 (Figure 2.4).

Figure 2. 4: Trends of Revenue Accrued from Tourist Hunting, 2010/11 – 2015/16



Source: Ministry of Natural Resources and Tourism

Trophy hunting plays an important role to communities neighbouring the areas where hunting is taking place (Game Reserves, Game Controlled Areas and Open Areas). About 25 % of the money earned by the Government from the business are disbursed to the communities through their respective district administrations. For example, during the financial year 2015/2016 fifty four (54) districts received TZS 1,306,395,164.20 (Table 2.37).

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Table 2. 37: Amount of Money (TZS) from Trophy Hunting Disbursed to Different Districts from 2010/2011 to 2015/2016

S/N	District	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Total
1	Arumeru	-	-	-	-	-	-	-
2	Babati	6,947,782.2	9,043,736.9	6,219,734.2	-	-	-	22,211,253.3
3	Bariadi	21,563,089.4	26,179,105.4	34,514,830.0	-	48,125,457.1	6,014,748.2	136,397,230.1
4	Biharamulo	1,831,719.0	2,636,527.1	-	-	9,209,489.7	4,176,017.4	17,853,753.2
5	Bukombe	2,204,145.8	3,080,890.0	-	-	1,770,431.3	3,909,523.2	10,964,990.2
6	Bunda	22,927,632.4	27,807,216.4	4,397,410.2	-	25,771,675.4	27,163,020.0	108,066,954.5
7	Chunya	60,893,463.6	73,106,328.1	44,779,347.0	-	137,040,892.1	113,815,193.8	429,635,224.7
8	Handeni	-	-	-	-	-	-	-
9	Igunga	1,660,664.5	2,432,432.6	3,703,447.1	-	-	-	7,796,544.2
10	Iramba	-	-	3,703,447.1	-	-	-	3,703,447.1
11	Iringa Vijijini	18,931,944.8	23,039,742.7	12,075,773.6	-	15,736,122.6	19,816,121.8	89,599,705.4
12	Itilima	-	-	-	-	49,969,849.2	5,083,848.2	55,053,697.4
13	Kaliua	-	-	-	-	62,968,027.2	23,938,575.0	86,906,602.2
14	Kahama (Ushetu)	2,204,145.8	3,080,890.0	-	-	4,949,308.2	3,909,480.4	14,143,824.4
15	Kakonko	-	-	-	-	1,819,393.0	-	1,819,393.0
16	Karagwe	1,335,344.6	2,044,275.6	809,325.6	-	3,100,045.3	1,108,070.6	8,397,061.6
17	Kasulu	3,184,582.6	4,250,702.8	4,650,268.6	-	14,141,870.9		26,227,424.9
18	Kibondo	8,035,552.7	10,038,660.7	7,987,444.4	-	46,808,540.9	14,854,275.0	87,724,473.7
19	Kigoma (R)	-	-	-	-	-	-	-
20	Kilindi	-	-	-	-	-	-	-
21	Kilombero	37,334,919.8	44,997,339.8	31,368,494.1	-	68,383,846.7	28,542,207.2	210,626,807.6
22	Kilosa	2,946,011.5	3,966,050.5	2,020,339.0	-	-	-	8,932,400.9
23	Kilwa	28,556,129.2	34,522,884.0	15,368,243.4	-	7,111,042.2	10,432,500.0	95,990,798.8
24	Kisarawe	-	-	-	-	-	-	-
25	Kiteto	13,609,058.9	16,688,716.2	24,183,632.4	-	54,453,590.9	15,861,958.2	124,796,956.5
26	Kondoa	-	-	-	-	18,805,445.9	5,390,125.0	24,195,570.9
27	Liwale	49,894,594.5	59,982,975.3	25,033,898.2	-	53,761,203.4	56,396,040.6	245,068,712.0
28	Longido	54,531,111.3	59,721,444.0	12,603,122.2	-	60,366,628.4	62,434,478.6	249,656,784.4
29	Manyoni	82,262,509.5	98,602,906.7	125,320,267.1	-	252,641,060.4	127,269,095.6	686,095,839.3
30	Masasi	-	-	-	-	-	-	-
31	Mbarali	-	-	-	-	-	-	-
32	Mbogwe	-	-	-	-	1,770,431.3	-	1,770,431.3
33	Meatu	62,685,278.0	75,244,240.0	27,549,935.0	-	40,017,158.3	27,711,138.2	233,207,749.4
34	Mlele	-	-	-	-	55,261,198.9	6,112,375.0	61,373,573.9
35	Monduli	78,763,916.5	94,428,543.9	101,335,836.1	-	148,984,823.9	110,574,463.4	534,087,583.8
36	Morogoro	-	-	17,825,588.4	-	-	-	17,825,588.4
37	Morogoro (R)	5,930,701.2	7,527,247.2	-	-	14,901,123.9	-	28,359,072.3
38	Mpanda	65,626,539.8	78,753,620.5	62,978,721.7	-	19,450,216.8	82,290,318.8	309,099,417.6
39	Muleba	-	-	-	-	3,015,847.6	191,936.6	3,207,784.2
40	Namtumbo	21,883,922.4	26,561,908.9	42,074,080.1	-	44,496,658.2	19,846,574.0	154,863,143.6
41	Nanyumbu	18,016,688.7	11,202,254.9	10,796,224.5	-	-	-	40,015,168.2

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42	Ngara	-	-	-	-	3,015,870.6	-	3,015,870.6
43	Ngorongoro	69,098,241.0	82,895,897.3	10,928,131.2	-	170,248,103.5	219,085,089.4	552,255,462.3
44	Nkasi	8,458,444.2	10,543,235.8	-	-	4,469,270.9	-	23,470,950.9
45	Nsimbo	-	-	-	-	8,955,791.3	6,941,625.0	15,897,416.3
46	Rufiji	30,148,177.2	36,422,443.7	26,309,550.4	-	-	-	92,880,171.2
47	Serengeti	42,348,525.5	50,979,347.1	3,048,231.8	-	114,734,124.3	139,350,722.4	350,460,951.0
48	Sikonge	48,182,871.6	57,940,625.0	35,968,933.3	-	48,346,381.6	14,380,949.8	204,819,761.3
49	Simanjiro	60,265,695.9	72,357,304.2	90,176,532.9	-	196,363,593.7	80,954,167.0	500,117,293.8
50	Songea	7,327,002.5	9,193,250.7	-	-	37,804,228.6	11,620,200.0	65,944,681.8
51	Sumbawanga (R)	13,462,453.3	16,513,793.0	4,239,661.8	-	-	-	34,215,908.0
52	Tunduru	22,143,896.1	26,872,097.7	14,227,306.0	-	16,323,485.5	11,669,056.2	91,235,841.5
53	Ulanga	26,355,545.6	31,897,247.3	23,108,293.5	-	56,384,112.5	29,625,646.4	167,370,845.3
54	Urambo	23,103,796.7	28,017,407.6	38,433,128.5	-	28,351,081.5	15,925,623.2	133,831,037.5
	Total	**1,024,656,098.0**	**1,222,573,289.2**	**867,739,179.3**	**-**	**1,949,827,423.5**	**1,306,395,164.2**	**6,371,191,154.2**

Source: Ministry of Natural Resources and Tourism

"-" Data not available

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2.5.5.2: Importation and Exportation of Wild Animals

The other use of wildlife, which ranges from recreation to aesthetic beauty, necessitates its exportation and importation. In most cases, exportation involves trophies obtained from controlled hunting. Such trophies include elephant tusks, tails, skulls, feet, ears and hair products; hippopotamus teeth, skins, skulls, tails and feet; zebra skins; lion claws, skulls, teeth, bone carvings, and skin; buffalo skulls; crocodile skin and skulls, and leopard skins**.** Common uses of these trophies include decoration and prestige.

Tanzania also imports wildlife and wildlife products from other countries of the world. Like exportation, importation also involves trophies obtained from legal hunting undertaken elsewhere in the world. Although rare, importation of live wild animal species have been done on occasions for the purpose of conservation (e.g., restoration of threatened species like Rhinoceros and Kihansi Spray Toad (*Nectophrynoides asperginis*) **(**Table 2.38).

Table 2. 38: Wildlife Products/Live Species Imported into Tanzania in 2015 and 2016

Year 2015					
S/No	**Taxonomy**	**Common name**	**App.**	**Class**	**Term and quantity**
1	*Nectophrynoides asperginis*	Kihansi Spray Toad	I	Amphibia	1,500 live
2	*Alligator mississippiensis*	American alligator/Common alligator	II	Reptilia	15 leather products; 2 specimens
3	*Chlorocebus aethiops*	African green monkey	II	Mammalia	10 specimens
4	*Papio anubis*	Olive baboon	II	Mammalia	1 trophy
5	*Crocodylus niloticus*	Crocodile	II	Reptilia	2 trophies
6	*Panthera leo*	Lion	II	Mammalia	1 trophy
7	*Hippopotamus amphibius*	Hippopotamus	II	Mammalia	12 teeth
8	*Tayassu pecari*		II	Mammalia	24 leather products

Year 2016 S/No	**Taxonomy**	**Common name**	**App.**	**Class**	**Term and Quantity**
1	*Nectophrynoides asperginis*	Kihansi Spray Toad	I	Amphibia	2,100 live
2	*Loxodonta africana*	African elephant	I	Mammalia	20 ivory pieces
3	*Diceros bicornis*	Rhinocerous	I	Mammalia	1 live
4	*Loxodonta africana*	African elephant	II	Mammalia	3 ivory carvings
5	*Panthera leo*	Lion	II	Mammalia	1 skins
6	*Ara ararauna*	Blue-and-yellow macaw/ Blue-and-gold macaw	II	Aves	1 live
7	*Python reticulatus*	Reticulated python	II	Reptilia	1 leather products (small)

Note- APP - Appendix

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CHAPTER THREE

RESIDUALS

3.1. Emissions to Air

3.1.2- Consumption of Ozone Depleting Substances (ODS)

Key Message
Life on Earth is dependent on the Ozone Layer which plays a crucial role in protecting human, animal and plant life from harmful ultraviolet radiation emanating from the sun.

Tanzania is a low volume consuming country in terms of ODS alternatives in all sectors. The latest technology particularly in the Refridgeration and Air Conditioning RAC sector is slowly penetrating the market. This includes technology related to hydrocarbons, Hydrofluoro Olefins HFOs and carbon dioxide. The use of refrigeration and air conditioning is expanding as people want to improve their socio-economic status in line with global trends. Most households in urban centres have refrigeration appliances and those in medium to low density suburbs have installed air conditioning units. Most of the refrigeration and air conditioning appliances depend on Hydoro-fluorocarbon (HFCs) and HFC blends with the latest models using Hydorocarbon (HC) refrigerants. Tanzania has mostly non-formal refrigeration appliances manufacturing companies. Manufacturing equipment range from state of the art automated to manually operated equipment for freezers, fridges, cold-rooms and display chillers for supermarkets and butcheries. The appliances manufactured are for domestic and commercial uses. There is no manufacturing of air conditioning appliances though some companies have been appointed as agents for international manufacturing companies such as Samsung, LG, and Midea among others.

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Key Message

Adoption of ODS Alternatives such as HFCs and HFC blends are part of the Nationally Determined Contributions under the United Nations Framework Convention on Climate Change.

The Vice President's Office - Division of Environment serves as the National Focal Point for the Vienna Convention, Montreal Protocol and the United Nations Framework Convention on Climate Change (UNFCCC). The Division of Environment also coordinates the implementation of these commitments in the country, and hosts the National Ozone Unit (NOU) whose function is to coordinate and facilitate implementation of ODS phase out programmes and projects. The Division, in collaboration with other stakeholders, is also responsible for raising awareness to general public on ozone and climate change related issues.

Controls for ODS alternatives in the country are now contained in the Environment Management Regulations adopted in 2007. The Regulations control the import and export of ODS alternatives and ODSs that were phased out in 2015 such as methyl bromide and methyl chloroform. The ODS alternatives such as HFCs and HFC blends are included in the list of controlled substances in the Regulations.

Table 3. 1: Sectors and Sub-Sectors Using ODS Alternatives in the Country

Sector/Subsector	Entities Involved
RAC Manufacturing	Manufacturing companies
RAC servicing	Servicing companies and technicians
Fire suppression	Companies and fire fighting organisations
Imports	Importers, wholesalers and distributors

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3.1.2.1: Refrigeration Sector

Key Message

The Environment Management Regulations control the production, import, export, trade, disposal and use of ozone depleting substances (ODS) and their products. They also make it mandatory for importers and exporters of ODSs, HFCs and ODS or HFC based appliances to apply and be allocated import or export quotas.

The refrigeration sector in Tanzania covers the servicing and repairs as well as installation and decommissioning of appliances such as domestic fridges and cold rooms. Some refrigeration companies buy panels from local manufacturing companies or from other countries for installation of appliances such as cold-rooms. The refrigeration sector includes subsectors such as domestic refrigeration, commercial refrigeration, industrial refrigeration and transport refrigeration.

3.1.2.2: Domestic Refrigeration

The domestic refrigeration sub-sector comprises domestic refrigerators and freezers mainly for food storage in households and in non-commercial areas such as offices. Common refrigerants in domestic refrigeration in the country are HFC-134a and Isobutene (HC-600a). This sub-sector accounts for about 55 % of the total consumption of R-134a in the country. However, its consumption shows a general increasing pattern from 20 MT in 2012 to 33.4 MT in 2015 which is about a 67 % increase (ODS Alternatives National Survey Report, Dec 2016).

3.1.2.3: Commercial Refrigeration

Commercial refrigeration encompasses equipment installed in malls, hotels, bars, restaurants, filling stations, bus terminals, butcheries and supermarkets. The commercial refrigeration sub-sector comprises equipment that are used to store and dispense frozen and fresh foods and beverages where chilled foods are maintained in the range of 1°C−14 °C and frozen foods in the range of –12°C to –20°C. The types of refrigerators used may be stand-alone or self-contained systems (ice-cream freezers, ice machines, beverage vending machines, display cases and vaccine coolers), condensing unit systems (typically installed in bakeries, butcheries), and centralized and distributed systems (mainly supermarkets). Available refrigerant options for commercial refrigeration found in the local market include Isobutene (R-600a), Propane (R-290), HFC blends (mainly R-404A, R-407C, R-507A and R-508B) and Carbon dioxide (R-744).

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3.1.2.4: Industrial Refrigeration

Industrial refrigeration sector covers cooling systems for production, storage or distribution of food, beverages, chemicals, pharmaceuticals and other products, specialized cooling requirements for mining industry; and commercial ice making. Refrigerants options for industrial refrigeration applications typically found in Tanzania include R-134a, HFC blends (R-404A and R-410A) and Ammonia (R-717). HCFC-22 (R-22). R-134a is mostly used in industrial chillers and ice making machines. The amount of R-134a consumed during 2012 was 2.8 MT and increased to 4.6 MT in 2015, accounting for about 7.5 % of the total consumption of R-134a in the country (ODS Alternatives National Survey Report, Dec 2016).

3.1.2.5: Transport Refrigeration

Transport refrigeration includes transport of chilled or frozen products by means of road vehicles, railcars, intermodal containers, and small insulated containers and boxes. Typically the task of a transport refrigeration system is to keep the temperature constant during transportation.

3.1.2.6: Air Conditioning Activity

The air conditioning activity in Tanzania covers the installation, servicing and repairs as well as decommissioning. There is no manufacturing of air conditioning appliances in the country though some companies are designated agents for SAMSUNG, DAIKIN, LG, Midea, among others. The Air Conditioning activity includes sub-activities such as stationary air conditioning and Mobile air conditioning.

3.1.2.7: Aerosols Activity

Significant proportions of Chloroflorocarbon (CFCs) were used as propellant gas in aerosols mainly for non-technical applications mostlyin the cosmetics or household sub-sectors prior to their global ban. Typical aerosol applications found in the household and cosmetic sectors include spray deodorants, hair sprays and insecticide sprays.

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Key Message

The market for ODS alternatives in Tanzania is exclusively dominated by imports which amounted to about 290.78 MT in 2012 as compared to 723.08 MT in 2015.

In order to establish the trends in consumption of ODS alternatives in Tanzania, the government in collaboration with other stakeholders conducted a national survey on consumption of Ozone Depleting Substances (ODS) alternatives. The survey was carried out in August – October 2016. It assessed historical data (from 2012 to 2015) and projections of consumption of ODS alternatives, including medium, low and high-global warming potential (GWP) alternatives, and their distribution by sector and subsector. The survey was based on the "MLF Guide for Preparation of the Surveys of ODS Alternatives" and covered the period from 2012 to 2015. A total of 10 out of 31 regions were targeted, covering both Tanzania Mainland and Zanzibar. It covered Refrigeration and Air Conditioning (RAC) and Aerosols activities. Table 3.2 presents some of the results obtained from the survey. It is revealed that, HC 600a is one of the most common ODS alternatives used in Tanzania with an increasing trend from 232.6 MT in 2012 to 636.4 MT in 2015.

Table 3. 2: Estimated Use by ODS Alternative (Metric tonnes - MT)

Alternative	***Estimated Use (MT)***			
	2012	***2013***	***2014***	***2015***
HFC				
HFC-134a	18.2	20.9	27.0	30.4
HFC-227ea/HFC-365mfc	-	-	-	-
HFC blends				
R-404A	0.4	0.5	0.6	0.7
R-407C	0.5	0.6	0.7	0.9
R-410A	0.8	1.4	1.8	1.9
R-507A	0.2	0.4	0.5	0.6
HFO				
HFO-1234yf	-	-	-	-
OTHERS	-	-	-	-
HC-290	5.1	7.2	10.1	23.0
HC-600a	232.6	330.2	587.6	636.4
Pentane (C, N, I)	*0.0*	*0.0*	*0.0*	*24.7*
R-744	0.8	0.8	0.8	1.0
R-717	16.7	23.4	27.5	30.2
Others	275.5	385.8	657.0	725.5

Source: Ozone Depleting Substances Alternative National Survey Report, Dec 2016

"-" Data not available

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3.1.2.8: The Use of ODS Alternatives in Economic Activities

Table 3.3 indicates that the use of HC-600a as a component of ODS alternatives has been on the deline, falling fom 623.91 MT in 2012 to 323.30 MT in 2015. Results from the survey further show that the use of HFC134a also decreased from 27.00 MT in 2012 to 20.59 MT in 2015. On the other hand, the use of HC 290 increased from 0.43 MT in 2012 to 23.08 MT in 2015 while the use of R717 increased from 16.79 MT in 2012 to 30.31 MT in 2015.

Table 3. 3: Summary of Refrigerants Usage in all Activities for 2012 - 2015 (MT)

Alternative	Refrigeration and Air-Conditioning				Aerosol			
	Servicing							
	2012	2013	2014	2015	2012	2013	2014	2015
HFC								
HFC-134a	27.00	18.50	30.44	20.59	-	-	-	-
R-404A	0.40	0.40	0.40	0.40	-	-	-	-
R-407C	0.45	0.90	0.45	0.45	-	-	-	-
R-410A	0.80	1.90	1.90	1.43	-	-	-	-
R-507A	0.24	0.40	0.40	0.40	-	-	-	-
Others	0.35	0.35	0.35	0.35	-	-	-	-
HFO								
HC-290	0.43	-	7.13	23.08	-	-	-	-
HC-600a	12.73	8.40	11.75	6.60	623.91	411.58	575.77	323.30
R-744	-	-	3.80	-	-	-	-	-
R-717	-	16.79	7.17	30.31	-	-	-	-

Source: Ozone Depleting Substances Alternative National Survey Report, Dec 2016

"-" Data not available

3.1.2.9: Historical and Predicted Consumption of ODS Aternatives

The statistics in Table 3.4 were computed from the historical data obtained through the survey. Projections of the estimated consumption of ODS alternatives for the years 2016-2030 in a business-as-usual scenario, suggests that compared to 2015 values, consumption of ODS alternatives will almost triple by 2030.

The survey on consumption ODS alternatives also revealed the following: -

- The market for ODS alternatives in Tanzania is exclusively dominated by imports which amounted to 723.08 MT in 2015 compared to 290.78 MT in 2012.
- The most consumed ODS alternatives are Isobutene (R-600a) (72.7 %); Ammonia (R-717) (6.9 %). The remaining proportion is accounted for by HFC blends (R-404A, R-407C, R-410A and R-507A and Carbon dioxide (R-744).
- The main sectors/sub-sectors that use ODS alternatives are refrigeration servicing (domestic, commercial, industrial and transport); air conditioning servicing (stationary and

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mobile air conditioning); and aerosols. Comparatively, the aerosol sector accounts for about 70.5 % whereas the refrigeration and air conditioning (RAC) servicing use about 29.5 % of the total amount of alternatives consumed in the country in 2015;

Table 3. 4: Historical and Predicted Consumption of ODS Aternatives, 2012 – 2030

ODS Alternative	Historical data				Predicted/Forecast Data		
	2012	2013	2014	2015	2020	2025	2030
HFC-134a	18.2	20.9	27.0	30.4	103.6	146.1	188.6
R-404A	0.4	0.5	0.6	0.4	1.3	1.8	2.4
R-407C	0.5	0.6	0.7	0.5	1.6	2.4	3.1
R-410A	0.8	1.4	1.8	0.8	3.9	5.8	7.7
R-507A	0.2	0.4	0.5	0.2	1.2	1.8	2.4
HC-290	5.1	7.2	10.1	23.0	48.2	76.6	105.0
HC-600a	232.6	330.2	587.6	636.4	700.7	1,067.9	1,435.1
R-717	0.8	0.8	0.8	1.0	1.3	1.6	1.9
R-744	16.7	23.4	27.5	30.2	53.4	75.6	97.9

Source: Ozone Depleting Substances Alternative Survey Report, Dec 2016

3.1.2.10: Challenges and Opportunities in Adopting ODS Alternatives

Key Message
Tanzania has put in place a licensing system for ODS to further regulate trade. The ODS Regulations obliges that any person intending to import or export a controlled substance or product to lodge an application with the Director of Environment (Vice President's Office – Division of Environment).

There are several challenges that are hindering the adoption of ODS Alternatives in Tanzania. These challenges range from lack of technology, lack of capacity, unavailability, affordability, safety and health issues to lack of policy and regulatory measures to promote ODS alternatives. Most refrigeration technicians lack the skills and knowledge on the correct use of HFC blends especially on charging. There is therefore need for capacity building on adoption of refrigerants that are recommended for use in the country. Another challenge is that ODS alternatives prices are much higher compared to ODSs such as HCFC-22 forcing technicians to resort to the seemingly more affordable ODS. At the same time, due to costs involed, refrigerants like R407C are not readily available in the local market. There have also been some cases of contaminated R-134a refrigerants which have damaged compressors.

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3.2. Generation and Management of Wastewater

3.2.1- Generation and Pollutant Content of Wastewater

3.2.1.1: Sewerage Services and Sanitation in Urban Areas

Key Message

By 2016, only 10 towns/cities had sewerage systems which covered only 20 % of total urban population.

The broad objective of Urban Water Supply and Sanitation (UWSS) is to establish functional sewerage systems as part of overall sanitation strategies in the towns/locations where they work. By 2016, only 10 towns/cities had sewerage systems, and even then they covered a very small proportion of the population (only 20 % of total urban population). This shows that sewerage services in urban areas need more attention.

The use of onsite sanitation in areas where sewerage system is not provided is highly encouraged. Rather than focusing on expensive central piped sewerage systems, utilities can plan for the future sanitation services at town level including alternative solutions, and jointly with the LGAs, plan and implement safe sanitation service chain in their towns. Safe removal and transport of wastewater to waste stabilization ponds or sludge digesters for treatment is highly encouraged.

Figure 3. 1: Trends in Sewerage Connections in Regional WSSAs and Dar es Salaam

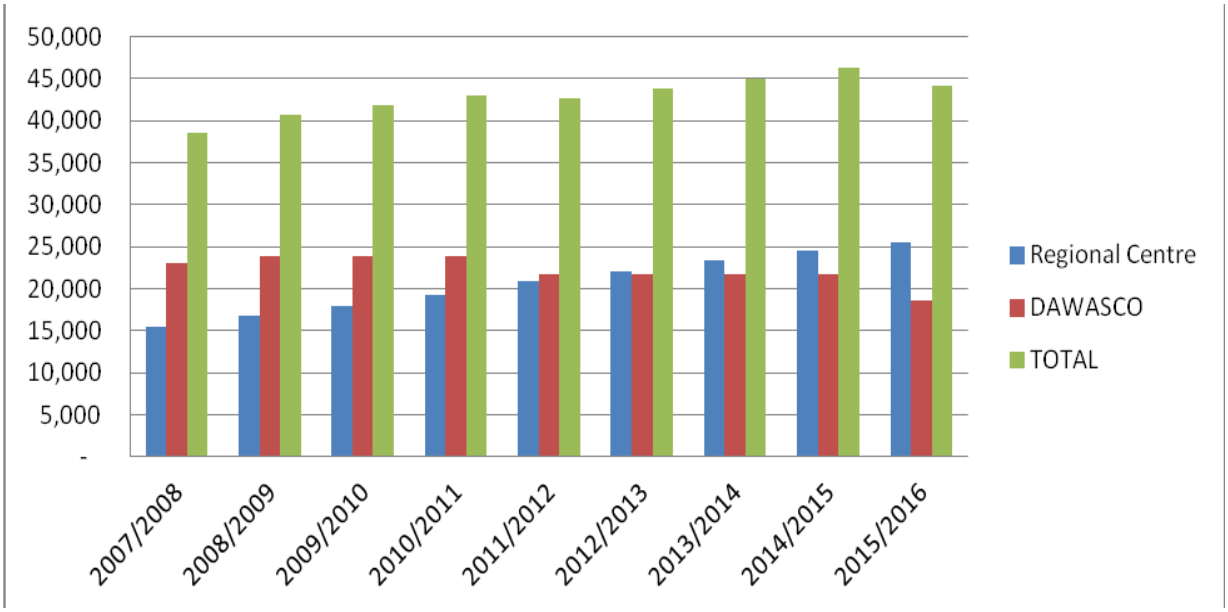

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Table 3. 5: Generation, Collection, Treatment and Disposal of Wastewater for the City of Dar es Salaam, 2013 - 2017

		Unit of Measurement	2013	2014	2015	2016	2017
Generation and Management of Wastewater							
Topic 3.2.1- Generation and pollutant content of wastewater							
a. Volume of wastewater generated		Volume (M^3)	73,858,142	70,500,810	71,341,424	82,859,144	100,078,972
b. Pollutant content of wastewater		Mass	-	-	-	-	-
Topic 3.2.2- Collection and treatment of wastewater							
a. Volume of wastewater collected		Volume (M^3)	16,300,673	16,190,413	16,197,881	16,199,957	16,329,545
b. Volume of wastewater treated		Volume (M^3)	16,300,673	16,190,413	16,197,881	16,199,957	16,329,545
c. Total urban wastewater treatment capacity	1. Number of plants	Number	8	8	8	8	8
	2. Capacity of plants	Volume (M^3)	296,666	296,666	296,666	296,666	296,666
d. Total industrial wastewater treatment capacity	1. Number of plants	Number	-	-	-	-	-
	2. Capacity of plants	Volume (M^3)	-	-	-	-	-
Topic 3.2.3- Discharge of wastewater to the environment							
a. Wastewater discharge	1. Total volume of wastewater discharged to the environment after treatment	Volume (M^3)	16,300,673	16,190,413	16,197,881	16,199,957	16,329,545
	2. Total volume of wastewater discharged to the environment without treatment	Volume (M^3)	57,557,470	54,310,397	55,143,543	66,659,187	83,749,428
b. Pollutant content of discharged wastewater		Mass	-	-	-	-	-
a. Volume of wastewater generated		Volume	73,858,142	70,500,810	71,341,424	82,859,144	100,078,972
b. Pollutant content of wastewater		Mass	-	-	-	-	-

Source: DAWASCO

"-" Data not available

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Key Message

About 16.3 million M^3 (20 %) of wastewater generated was collected and treated from 2013 to 2017.

In 2013 Dar es Salaam City had a high demand of water supply resulting from high population increase. Wastewater generated is assumed to be 80 % of the amount of water supply. Therefore, on average the amount of wastewater generated is directly proportional to the amount of water supplied. After completion of the expansion of Lower Ruvu and Upper Ruvu water supply treatment plant by 2017 the consumption of water supply to the city became high hence an increased volume of wastewater.

Table 3.5 indicates that, the volume of Wastewater generated is higher compared to volume of wastewater collected in five years starting from 2013 to 2017. It is observed that generation of wastewater increased from about 73.9 million M^3 in 2013 to 100.0 million M^3 in 2017. This is largely attributed to the population increase. However, wastewater collection is low, with about 16.3 million M^3 (20 %) of wastewater generated being collected and treated over the period.

3.3. Generation and Management of Waste

3.3.1- Generation of Waste

Introduction

Key Message

Solid waste is a global issue which results into serious environment pollution with harmful effects upon people's health, animals, biodiversity and the environment if not well managed.

Solid waste is defined as any solid, discarded material generated by municipal, industrial, or agricultural practices. Municipal Solid Waste (MSW) is a worldwide problem. When solid waste is not efficiently and effectively managed it results into serious environmental pollution which has harmful effects upon people's health, animals, biodiversity and the environment. There is a high demand for statistics on the generation and management of waste to monitor the implementation of different development programmes. Waste generation and management have been emphasized under SDG Goal 12 particularly, on indicators number 12.4.1, 12.4.2 and 12.5.1. These indicators collectively call for

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statistics on the number of parties to international multilateral environmental agreements on hazardous waste; hazardous waste generation and treatment, and the national recycling rate.

This section presents statistics on various attributes of generation and management of solid waste such as generation of waste by source and categories and management of hazardous waste. These statistics are presented at national level and Dar es Salaam City due to its economic and industrial importance.

3.3.1.1: Solid Waste Generation in Tanzania

Key Message

57% of total waste generated is household waste and 13.3% is construction waste.

Waste generation refers to activities involved in identifying materials which are no longer usable and are either gathered for systematic disposal or thrown away. It is estimated that the quantity of municipal solid waste generated countrywide amounts to more than 10,000 tonnes per day. The indicative generation rate ranges from 0.1 - 1.0 kg/cap/day. As much as 80 – 90 % of solid waste generated in urban areas is not collected and most of the domestic waste, which accounts for about 60 % of the total solid waste generated daily, is disposed of by burning or burying.

Due to limitation of waste management data in Tanzania, only a few regions were selected for data collection including Arusha, Dodoma, Songwe, Songea, Mwanza and Rukwa. Table 3.6 shows the amount of solid waste generated by source for selected regions in Tanzania Mainland from year 2013 to 2015. Out of 2,101,500 tonnes (total waste generated), 1,196,900 tonnes (57 %) is household waste and 279,400 tonnes (13.3 %) construction waste. Generation of waste from mining and quarrying sector is of a small amount compared to the other sectors like manufacturing, agriculture and other economic activities.

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Table 3. 6: Generation of Waste by Source for Selected Regions in Tanzania Mainland, 2013 - 2015

S/No	Category	Unit	2013	Key	2014	Key	2015	Key	Total	Average
1.	Agriculture, forestry and fishing (ISIC 01-03)	1000 t	34.5	B	35.8	B	41.7	C	112.1	37.4
2.	Mining and quarrying (ISIC 05-09)	1000 t	-	-	-	-	2.6	D	-	2.6
3.	Manufacturing (ISIC 10-33)	1000 t	71.8	F	72.5	F	8.0	F	155.4	51.8
4.	Construction (ISIC 41-43)	1000 t	70.8	A	87.0	B	121.6	G	279.4	93.1
5.	Other economic activities excluding ISIC 38	1000 t	7.0	H	7.0	H	18.0	I	32.0	10.7
6.	Households	1000 t	363.8	K	415.3	K	417.8	K	1,196.9	399.0
7.	**Total waste generation (=1+2+3+4+5+6)**	**1000 t**	**678.9**	**J**	**733.1**	**L**	**689.5**	**J**	**2,101.5**	**700.5**

Code	Footnote text
A	Data refer to Dodoma and Songwe only.
B	Data refer to Dodoma, Songea and Songwe only.
C	Data refer to Arusha, Dodoma, Songea and Songwe only.
D	Data refer to Arusha only.
E	Data refer to Dodoma only.
F	Data refer to Dodoma and Moshi only.
G	Data refer to Arusha, Dodoma and Songea only.
H	Data refer to Songwe only.
I	Data refer to Arusha and Songwe only.
J	Data refer to Dodoma, Rukwa, Songea and Songwe only.
K	Data refer to Dodoma, Mwanza, Songea and Songwe only.
L	Data refer to Arusha, Dodoma, Rukwa, Songea and Songwe only.

Source: National Bureau of Statistics

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3.3.1.2: Generation of Waste in Dar es Salaam City

Introduction

Key Message

Solid waste generation has been steadily increasing in Dar es Salaam City from less than 2,000 tonnes per day in 1998 to more than 4,600 tonnes per day in 2017.

Dar es Salaam City Council estimated that Dar es Salaam City could be generating over 12,000 tonnes per day by 2025.

Dar es Salaam is the largest and most important industrial and commercial centre with an estimated population of more than 4.3 million (2012 census) and a population growth rate of 4.3 %. The City has six Local Government Authorities namely: - Dar es Salaam City Council, Ilala, Kinondoni, Ubungo, Temeke and Kigamboni Municipal Councils. Using a population growth rate of 4.6 % and a generation rate of 0.815 kg/cap/day, Environment Resources Consultancy (ERC) and Dar es Salaam City Council estimated that Dar es Salaam City could be generating over 12,000 tonnes of waste per day by 2025.

3.3.1.3: Waste Generation and Composition

Solid waste generation has been steadily increasing in Dar es Salaam City from less than 2,000 tonnes per day in 1998 to more than 4,600 tonnes per day in 2017. The solid waste generation rate is estimated to be about 0.815 kg/day per capita (2012 Population and Housing Census), which is higher than typical values for developing countries, ranging from 0.4 to 0.6 kg/day per capita. Approximately 50 – 60 % of the waste is readily biodegradable. It is estimated that 80 % of the generated waste can be categorized as Municipal waste whereby Households constitute 75 %, Institutions 0.5 %, Markets 3.5 %, Street sweeping 0.5 % and other sources 0.5 %. The other 20 % is produced by the private sector (industry and commercial). Therefore, this means that every person in Dar es Salaam produces a daily average of 0.9 kg/day per capita of household waste.

Table 3.7 shows generation of waste by institution and waste category. It is indicated that, total generation of waste in Dar es Salaam increased slightly from 1,991 in 2013 to 2,243 in 2016. The largest contributor institution for generation of waste is non industrial with 5,904 thousand tonnes (69.7 %), followed by residential 2,374 thousand tonnes (28.0 %). Waste generated from industrial sources accounted for 183 thousand tonnes (2.2 %) for the period.

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Table 3. 7: Waste Generated by Source (Dar es Salaam City), 2013 - 2016

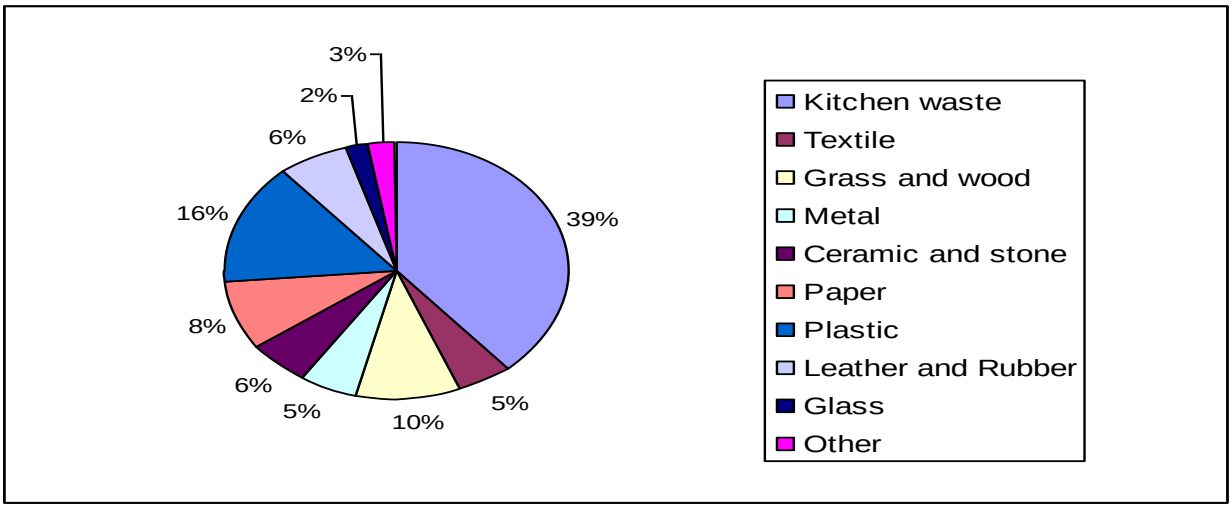
	Years					
A). Waste Generated by Source	**2013 Tonnes (000)**	**2014 Tonnes (000)**	**2015 Tonnes (000)**	**2016 Tonnes (000)**	**Total Tonnes (000)**	**Average Tonnes (000)**
Residential Sources	558	582	605	629	2,374	594
Industrial Sources	43	45	47	48	183	46
Non Industrial Sources	1,388	1,447	1,505	1,564	5,904	1,476
Total	**1,991**	**2,075**	**2,159**	**2,243**	**8,468**	**2,117**
B). Amount of Waste Generated by Selected Waste Category						
Kitchen Waste	558	582	605	629	2,374	594
Textile	77	80	80	81	318	80
Grass and Wood	143	149	155	161	608	152
Metal	78	81	84	87	330	83
Ceramic and Stone	93	94	95	97	379	95
Paper	114	119	124	129	486	122
Plastic	242	248	254	258	1,002	251
Leather and Rubber	93	95	95	97	380	95
Glass	29	30	31	32	122	31
Other	45	47	48	48	188	47
Total	**1,471**	**1,524**	**1,571**	**1,619**	**6,185**	**1,546**

Source: Dar es Salaam City Council

3.3.1.4: Waste Composition in Dar es Salaam

Information on the composition of the solid waste is important in evaluating tools and equipment needs, collection systems, disposal methods and management plans. The composition of solid waste in Dar es Salaam to a great extent is food waste (kitchen waste which is 39 % of all waste produced), garden waste, grass and wood, plastic, metal and textile as shown in Figure 3.2.

Figure 3. 2: Waste Composition in Dar es Salaam



Source: Dar es Salaam City Council

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3.3.2 - Management of Waste

3.3.2.1: Solid Waste Management in Tanzania

Key Message
The primary goal of solid waste management is reducing and eliminating adverse impacts of waste materials on human health and environment to support economic development and superior quality of life.

Improper solid waste management contributes to air pollution, surface and groundwater contamination and public health challenges. Municipal solid waste (MSW) management is commonly the largest single budget item for communities, and this sector is often one of the largest employers as well. Thus, it is imperative to move towards a green economy in the solid waste sector by prioritizing waste avoidance, minimization and promoting the "Three Rs" (Reduce, Reuse and Recycle). In addition, moving this important sector towards responsible stewardship will contribute to the main targets of the Sustainable Development Goals (SDGs): end poverty, promote prosperity and well-being for all, protect the environment and address climate change.

Solid waste management can be defined as a discipline associated with the control of generation, storage, collection, transfer, processing and disposal of municipal solid waste in a way governed by the best principles of public health, economics, engineering, aesthetics and other environment considerations. In developing countries, solid waste management is considered to be one of the most serious environment problems confronting most urban areas.

Waste management is gradually becoming a serious concern in Tanzania due to limited sorting at source and improper storage, collection, transportation, treatment and final disposal. This implies that significant proportions of the waste generated end up in the environment in unacceptable ways of disposal which accentuate environment and public health risks. The waste management problem is more pronounced in squatter settlements, where 70-80 % of the urban population resides without the necessary infrastructure and waste collection services.

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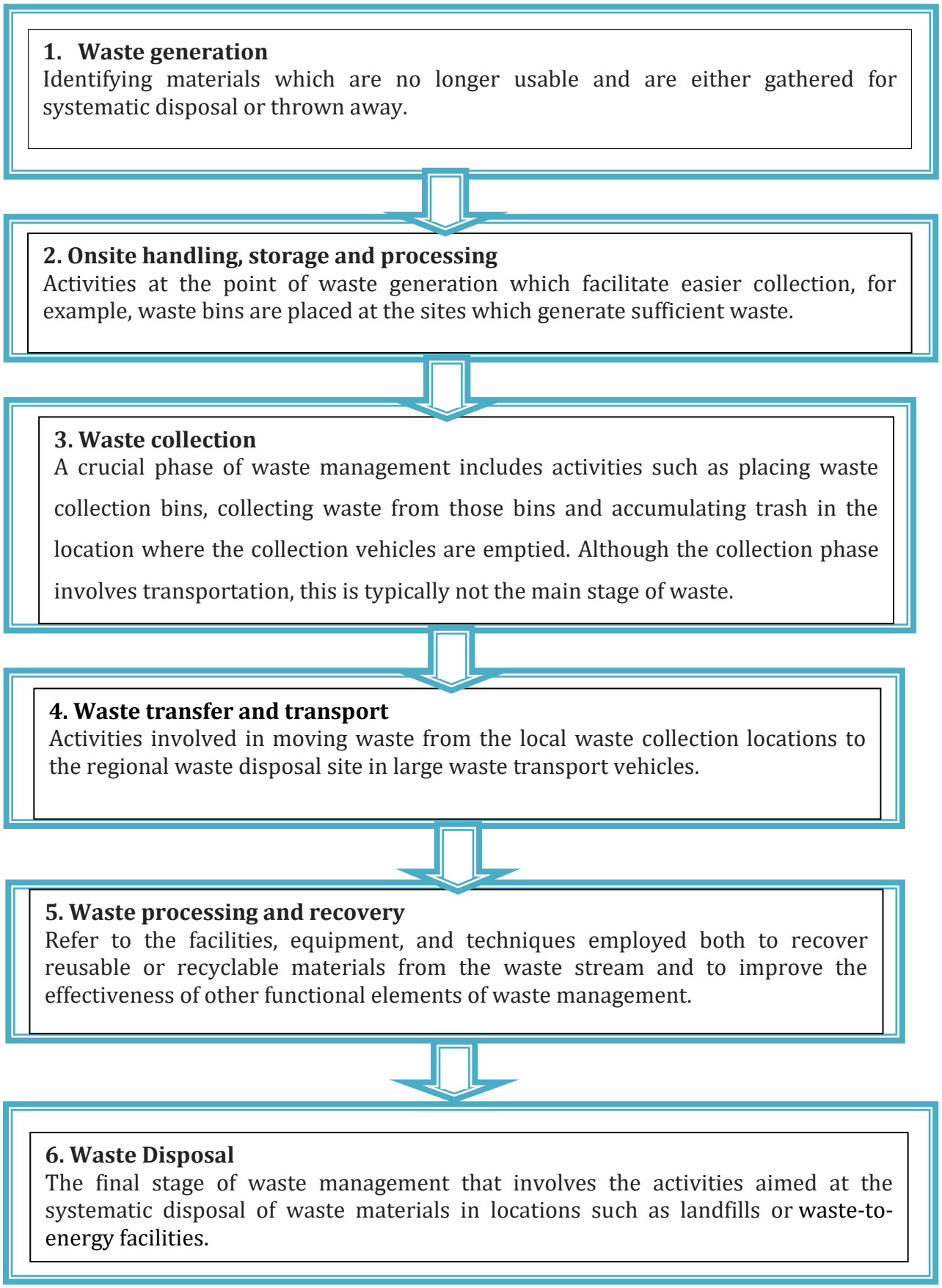
Figure 3. 3: Functional Elements of the Waste Management System



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Solid waste management is one of the key duties of all urban authorities in Tanzania. This is a legal obligation in accordance with the Local Government Act 1982 section 55 (g) and the Environment Management Act of 2004. Efficient municipal solid waste management is an essential public service, which should benefit all urban residents. Since the Colonial era, Solid Waste Management in Urban areas has been regarded as a public good or service whereby the Government has the duty to provide the Solid Waste Management Services, and the public has to pay for that service. However, due to rapid urban growth, coupled with scarcity of funds, many urban authorities are facing challenges including lack of coordination and waste management awareness.

Additionally, other challenges facing solid waste management are lack of enforcement of environmental laws, regulations, as well as unwillingness of the urban dwellers to pay for the waste management services. While cities and towns are generating an ever-increasing volume of waste, the effectiveness of their solid waste collection, transportation and disposal systems are declining. Urban local Authorities' problems are often considered as problems that need long-term solutions, which cannot be achieved in the short run.

3.3.2.2: Legislation Governing Municipal Solid Waste (MSW) Management

The Environment Management Act (EMA) of 2004 is the umbrella law on environment management in Tanzania. Section 114 (1), 118 and 119 of the Act stipulates the duty of local government authorities in managing and minimizing solid waste. It provides for the existence of the National Environment Management Council (NEMC).

Other legislations governing municipal solid waste management includes; Environment (Solid Waste Management) Regulations, of 2009; which applies to all matters pertaining to Solid waste and the Environment Management (Hazardous Waste Control) Regulations of 2009 which applies to all categories of hazardous wastes, including e-waste for which currently there is no specific policy/regulations.

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3.3.2.3: Management of Hazardous Waste in Tanzania

Key Message

Based on the available data, about 53 tons (equivalent to 87%) of hazardous waste generated is treated or disposed of. Although, the remaining 13% of untreated hazardous waste seems to be low at face value it could still have potential consequences on human health, biodiversity and the environment in general.

"Hazardous waste" means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment. These include materials which are toxic, flammable, corrosive, radioactive, and shall also include motor oil, diesel, fuel, gasoline (petrol), paint, solvents, dry cell and batteries, pesticides and infectious or medical wastes from hospitals and clinics, metallic and/or oily sludge or solvents from commercial and industrial establishments, asbestos materials, pesticides, radioactive wastes, and the like.

Gradually, hazardous waste management is becoming an issue of concern in Tanzania. In the past, hazardous waste management had not been accorded its due importance and recognition essentially because of a low-level of awareness, financial and technical constraints. The population explosion and economic development accompanied by massive production of solid waste, including hazardous waste, has triggered discussions that are aimed at targeting the lessons from developed countries that can help avert public health and environmental catastrophes in Tanzania. Industrial activities, agricultural, agro industry, medical facilities, commercial centers, household and informal sectors are the major sources of hazardous waste in Tanzania. This has posed a challenge of developing an effective hazardous waste management system; which may result in environmental health consequences.

Beginning in 1996, there have been reports that agricultural hazardous wastes have been mismanaged, but these do not portray the full gravity of the problem due to poor records and deficiency in relevant studies. (Hazardous Waste Management, Case Study by Kaseva and Mbuligwe, 2011). Table 3.8 shows that there is inadequate harmonization of hazardous waste data management in the country. This limits regional data comparison on management of hazardous waste. Basing on the available statistics, results indicate a decreasing trend for hazardous waste

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generation from 66 tonnes in 2013 to 59 tonnes in 2015. On the other hand, about 53 tonnes (equivalent to 87 % of hazardous waste generated has been treated or disposed of. Although, the remaining 13 % of untreated hazardous waste seems to be low at face value it could still have potential consequences on human health, biodiversity and the environment in general. Waste recycling and waste to energy technologies is not much adopted in Tanzania currently.

Table 3. 8: Management of Hazardous Waste for Selected Regions in Tanzania Mainland, 2013 - 2015

S/N	Category	Unit of Measurement	2013		2014		2015	
1	Stock of hazardous waste at the beginning of the year	tonnes	-	-	-	-	-	-
2	Hazardous waste generated during the year	tonnes	66	C	61	C	59	C
3	Hazardous waste imported during the year	tonnes	-	-	-	-	-	-
4	Hazardous waste exported during the year	tonnes	-	-	-	-	-	-
5	Hazardous waste treated or disposed of during the year (=6+7+9+10)	tonnes	53	D	55	D	53	D
6	*Amounts going to-* Recycling	tonnes	1	E	1	E	1	E
7	Incineration	tonnes	50	A	51	A	51	A
8	*of which*- with energy recovery	tonnes	-	-	-	-	-	-
9	Land filling	tonnes	-	-	-	-	-	-
10	Other	tonnes	-	-	-	-	-	-
11	**Stock of hazardous waste at the end of the year (=1+2+3-4-5)**	**tonnes**	-	-	-	-	-	-
Code	**Footnote text**							
A	Data refer to Dodoma and Mbeya only.							
B	Data refer to Dodoma, Mbeya and Mpanda only.							
C	Data refer to Dodoma, Mbeya, Mpanda and Songea only.							
D	Data refer to Dodoma, Mbeya and Songea only.							
E	Data refer to Dodoma only.							

Source: National Bureau of Statistics

"-" No data available

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Key Message

Recent economic and technological advancements have led to increased use of ICT. This poses a challenge on appropriate methods to dispose end-of- use electronic products without destroying the environment, jeopardize people's health and without loss of data and information stored in these products.

3.3.2.4: Management of E-waste in Tanzania

E-waste: Is defined as end-of-use or end-life of electronic products, components and peripherals such as: computers, fax machines, phones, Personal Digital Assistants (PDAs), radios and TVs. Recent economic and technological advancements have led to increased use of ICT. This is manifested by the number of mobile subscribers, mobile services providers, internet service providers, data operators and internet users. This poses a challenge on appropriate methods to dispose end- of-use electronic products without destroying the environment, jeopardize people's health and without loss of data and information stored in these products.

The effects of e-waste on human health and well being include: - respiratory problems, oxidative stress, DNA damage and the possibility of causing cancer. The reasons for the damaging effects to human health and environment of e-waste is caused by its chemical and physical characteristics which sets it apart from other forms of wastes that are produced by human activities or industrial waste. The e-waste contains both hazardous and valuable component that calls for specialized skills in handling, disposing and recycling in order to avoid contamination with the environment and safe guard the human health.

Tanzania has no specific policy or regulation related to e-waste management. However, there are a number of policies and regulations which aim at protecting the environment and human health. Examples of these policies are: National Environment Policy (1997), the Sustainable Industrial Policy (1996) and National ICT Policy (2016).

There are uncoordinated efforts to collect and disseminate e-waste statistics in the country. This has led to challenges on the reliability of data for planning purposes. However, NBS in collaboration with the Vice President's Office, which is responsible for the environment in Tanzania, have started putting efforts on capacity building for data management on e-waste. This initiative will help to bridge the data gap on e-waste.

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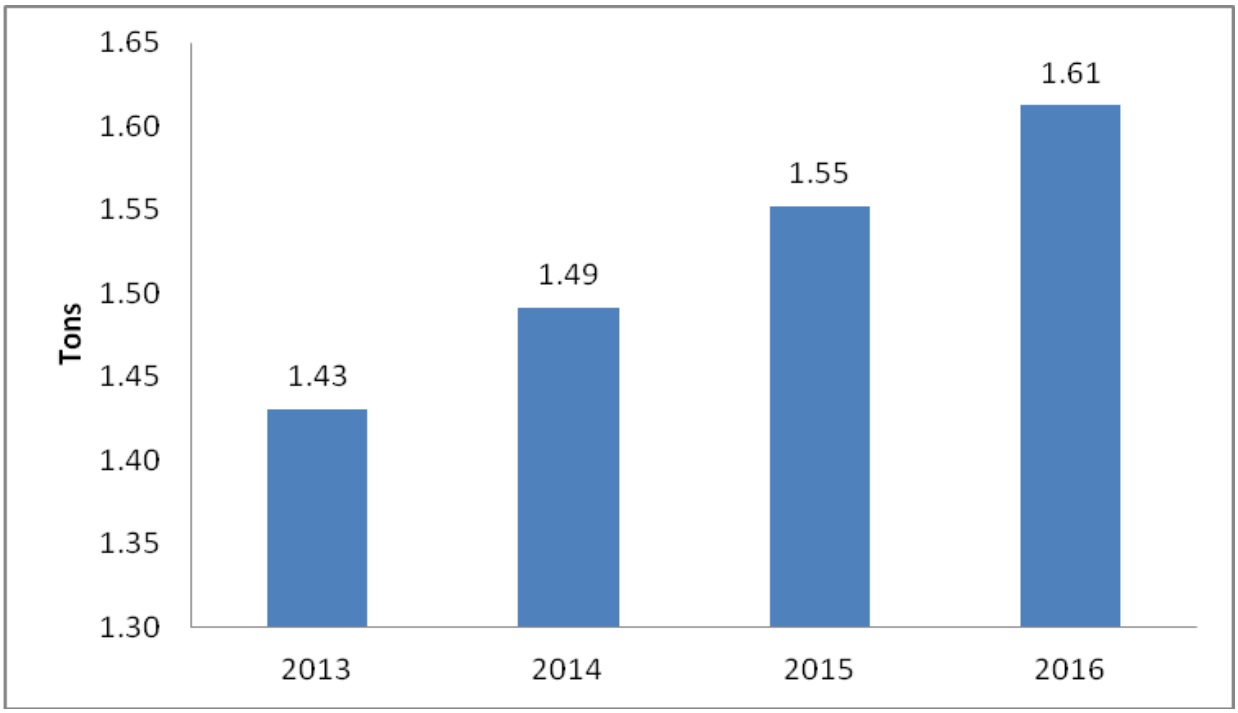
3.3.2.5: Management of Waste in Dar es Salaam City

Currently, waste management is a growing problem in Dar es Salaam City due to increasing urbanization, rural-urban migration, rising standards of living and rapid development associated with population growth, that have resulted in increased solid and liquid waste generation by industrial, domestic and other activities.

Figure 3.4 shows the collection of municipal waste in Dar es Salaam. It is indicated that, municipal waste collection has an increasing trend from 1.43 million tonnes in 2013 to 1.61 million tonnes in 2016.

Figure 3. 4: Municipal Waste Collected in Dar es Salaam City (000,000 Tonnes), 2013 - 2016



Source: Dar es Salaam City Council

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3.3.2.6: Waste Collection and Transportation in Dar es Salaam City

Solid waste collection and transportation in urban areas are done by Municipal Councils or Private/community groups on behalf of the Councils. Waste collection done in a mixed type of operations involving door to door collection for the planned areas and a selected collection point for inhabitants in unplanned areas. Waste is transported from households to the collection points (primary collection). In places where there is no operating solid waste contractor, municipalities provide a standby trailer to a ward or sub ward. The Public Private Partnership (PPP) is in place between Municipalities and contractors like Community Based Organizations (CBOs) which don't receive money from the Dar es Salaam Local Authorities (DLA).

Unattended waste pile in one of the markets in Dar es Salaam City Council.

Note: *Types of waste transportation trucks in Dar es salaam (Compactor Trucks and open trucks).*

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3.3.2.7: Recovery and Recycling in Dar es Salaam

Key Message

The largest number of recycling industries is in the category of plastic or nylon with 24 establishments (72.1 %) of all recycling industries and the smallest number was in the market and vegetable waste category (3.0 %).

Resource recovery is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. It is the third component of *reduce*, *reuse* and *recycle* hierarchy. The idea behind recycling is to reduce energy usage, volume of landfills, air and water pollution, greenhouse gas emissions and preserve natural resources for future use.

Dar es Salaam City Council has formulated a Recycling Policy of 2016. The purpose of the policy is to encourage and formalize recycling and composting activities. These activities would greatly reduce the amount of solid waste that has to be disposed, thus reducing the costs that have to be incurred by the municipalities. Furthermore, such formalization will attach an economic value to recyclable materials and hence encourage source separation as required by the Environment Management Act, 2004 and the Public Health Act, 2009.

Typical Raw Materials for Recycling

In 2017, Dar es Salaam City Council and five municipalities carried out a survey to identify recycling centers, types and amount of waste recycled in the city. The suvey results reveal that, out of 92,606 tonnes of waste recycled, 16,248 tonnes (17.5 %) were exported and there was no official data for importation. Table 3.9 shows that, there were 33 recycling industries which recycled 221 tonnes of waste per day. These industries created jobs for 2,021 persons. The largest number of recycling industries was in the category of plastic or nylon with 24 establishments (72.1 %) of all recycling industries and the smallest number was in market and vegetable waste (3.0 %).

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Table 3. 9: Waste Recycling Industries in Dar es Salaam City, 2017

Type of Waste Recycled	Number of Industries	Amount of Waste Collected/ Day (Tonnes)	No. of Staff
Plastic or Nylon	24	140.3	1,327
Metal	3	60.0	320
Batteries	3	20.0	324
Sandals/Slipers/ Old Shoes	2	0.3	50
Market and Vegetable Waste	1	0.4	-
Total	**33**	**221.0**	**2,021**

Products Made From Recycled Waste in Dar Es Salam City

Source: Dar es Salaam City Council

3.3.2.8: Waste Disposal in Dar es Salaam City

Waste collected through the formal scheme is delivered to a large centralized dumpsite (Pugu Kinyamwezi) which is located 30 Km from the city centre. Solid waste is disposed in an open dump without any engineered safety features: no liner, no soil cover, gas collection mechanism and leachate treatment pond. Although it was initially designed to operate as a sanitary landfill, due to inadequate resources it is operating only as an open dumpsite.

The current disposal practices are substandard and therefore may cause threat to the environment and public health. The area is 65 hectares of which around 45 hectares is almost covered with solid waste heaps (2 to 3 metres high). The Dumpsite receives an average of 2,200 tonnes per day which is only 48 % of the waste generated in the City.

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3.4. Release of Chemical Substances

3.4.1- Release of Chemical Substances

3.4.1.1: Chemical Fertilizers (also in 2.5.1.b and 2.5.3.b)

The government of the United Republic of Tanzania has undertaken various initiatives to improve agricultural sector development in efforts aimed at addressing the pressing issues of poverty and food insecurity by increasing food production and greater diversity of food supplies (IFDC, 2012). Increased food production has resulted in increased use of chemical fertilizers made available to small holder farmers through various mechanisms like fertilizer and seed subsidies.

The most used fertilizers in Tanzania as shown in Table 3.10 are urea, DAP and NPK (6:20:18 / 10:18:24). The use of fertilizers inevitably leads to the release of chemical compounds in the soil and water sources. Of all the major fertilizer nutrients, nitrogen is the main nutrient affecting soil pH, and soils can become more acidic or more alkaline depending on the type of nitrogen fertilizer used. Phosphoric acid is the most acidifying phosphorus fertilizer. Potassium fertilizers have little or no effect on soil pH. Urea is one of the most used fertilizers and has the potential of releasing Nitrogen to the soil and water sources while NPK has the potential of releasing Phosphorus.

The main environmental problem associated with fertilizer use is contamination of water with nitrates and phosphates. The nitrogen from fertilizers and manures are eventually converted by bacteria in the soil to nitrates. The biggest issue facing the use of chemical fertilizers is groundwater contamination. Nitrogen fertilizers break down into nitrates and travel easily through the soil. Since nitrates are water-soluble and can remain in groundwater for decades, the addition of more nitrogen over the years has a cumulative effect. Jokha (2015) found that the concentration of Nitrates and Phosphates in Weruweru sub-catchment in Kilimanjaro region to be higher than the recommended limits in drinking water regardless of the season.

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Table 3. 10: Fertilizer Utilization (Tonnes) in Tanzania from 2011/12-2015/16

Type of fertilizer	2011/12	2012/13	2013/14	2014/2015	2015/2016
S/A	4,126	3,178	5,957	6,300	6,643
CAN	12,808	9,853	9,367	8,260	7,153
UREA	69,000	65,855	100,455	107,280	114,105
TSP	1,436	728			
DAP	69,918	21,000	35,911	38,824	41,736
NPK 20-10-10	9,540	2,416	6,996	7,488	8,791
NPK 25-5-5	4,658	-	1,812	1,531	1,250
NPK 6-20-18/10-18-24	35,198	32,917	30,567	32,129	33,692
NPK 4-17-15	-	-	-	-	-
NPK 17-17-17	4,000	553	80,783	197,490	513,030
MRP	20,338	64,000	190,797	222,689	259,627
MOP	1,319	894	233	324	448
OTHERS	19,374	9,480	7,143	8,229	8,423
Total	**251,715**	**210,876**	**283,579**	**309,088**	**325,919**

Source: Ministry of Agriculture

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CHAPTER FOUR

EXTREME EVENTS AND DISASTERS

4.1. Natural Extreme Events and Disasters

4.1.1 and 4.1.2, Occurrence of natural extreme events and disasters; and Impact of Natural Extreme Events and Disasters

Tanzania like many other countries is not immune to natural hazards, all of which have the potential of disrupting the community, causing casualties, and damaging or destroying public or private property. An example of potential natural hazards may include: floods, drought, cyclones/ strong winds, earthquakes, landslides, tsunami, beach erosion, infestations and epidemics.

Some statistics pertaining to the occurrence of natural events and disasters such as type of disaster, date of occurrence and their magnitude are indicated in Table 4.1. The latest natural disasters were an earthquake which hit Kagera region in 2016 and droughts which affected Dodoma, Kilimanjaro, Kagera, Lindi, Geita, Pwani and Simiyu regions in 2016/17. The casualities associated with the Kagera earthquake were 17 deaths and 440 injuries. The damage to infrastructure included total demolition of 2,072 private houses and 2,191 public buildings. On the other hand, 14,595 private houses were partially damaged.

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Table 4. 1: Recent Natural Disasters Events and Interventions in Tanzania

Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
1998	Floods	Mererani Mines- Arusha	66 people died			
1-Dec-00	Floods	Mwanza city	32 people died, 2,761 affected	122 tonnes of maize, 20 boxes of oral sachets	Government, CARITAS, IPP	86 houses were destroyed
2000	Drought	Korogwe District-Tanga	All wards in the district	500 mts of maize 125 MTS	Government WFP	
Jan- March 2000	Rodent Infestation	Liwale District-Lindi	12,737 people affected in 43 villages, 15 wards	-	-	4,795 acres of different crops were damaged (Estimate of 599,375,000Tshs damage)
Jan. 2001	Floods	Kigoma	12 died, 10 affected, and 197 homelees	197 home-	-	
18/01/2001	Floods	Mtanga village-Kigoma District	7 dead, 209 affected, 10 injured, 11 goats and 65 ducks dead	-	-	32 Houses were damaged (Estimate of 10,553,500/= damage)
2001/2002	Rodent Infestation	Ruangwa District-Lindi	76,420 people affected in 44 villages, 13 wards in Ruangwa District	-	-	28,173 acres of different crops were damaged (Estimate of 3,521,625,000 TZS damage)
31/01/2002	Floods	Ndatapa village in Mlembwe ward in Liwale district	165 people affected	-	-	65 acres of different crops and 20 houses were damaged (Estimate of 6,200,000/= damage)
18/05/2002	Earthquake	Bariadi, Shinyanga (eps. Nhobola, Sunzula Itubukilo villages)	2 dead, 5 injured	-	-	1326 houses affected,636 houses got cracks, 690 houses destroyed, 12 classrooms destroyed at sunzula village, 1 school latrine, 2 schools affected Sunzula A & B)
12/12/2003	Cyclone, Heavy rainfall	8 villages of Bahi-Dodoma Rural	2 dead, 137 cattle died, 422 goats died, 24 sheep died and 13 donkey died	-	Districts	13 houses were damaged (estimate of 20,000,000 damage)
2003/2004	Rodent Infestation	Ruangwa, Nachingwea, Liwale and Lindi rural districts	160,000 people affected	-	-	1392 Acres of different crops were damaged (estimate of

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
						174,000,000/= damage)
2003/2004	Drought	All districts of Lindi region (85 wards, 175 villages)	316,521 people affected	2,550 tonnes of maize	Government of Tanzania WFP	
1/2/2004	Heavy rainfall and strong wind	Village of Chamwino-Dodoma rural		Food	Regional and National level (Gvt of Tanzania)	97 houses and food were destroyed (estimate of 15,000,000 damage)
2004/2005	Rodent Infestation	All districts of Lindi region	255,000 affected	-	-	101,400 acres of different crops were damaged (estimate of 12,675,000,000/= damage)
2005/2006	Drought	Bahi district	4,871 cattle, 1,974 goat and sheep died, some household were affected	Food--quantify	Government of Tanzania	Estimate of 361,000,000—provide unit of measurement damage
2005/2006	Army worm infestation	All districts of Lindi region	321,000 people affected	100 sprayers, 2,000 litres of insecticides	Government of Tanzania	27,974 different crops of grass type were damaged (estimate of 3,496,750,000/= damage)
3/8/2006	Cyclone	Village of Muungurumo, ward of liwale in Liwale district	225 pupils aged (5-18) and 5 teachers affected	-	-	5 classrooms and 2 offices were damaged (estimate of 97,722,000 damage)
July 2006-June 2007	Drought	Arusha, Dodoma, Iringa, Manyara, Shinyanga, Singida, Tabora and Mwanza,	-	9,323.4 tonnes of maize were distributed to Affected population in the districts	-	-
Julai 2007-June 2008	Drought	Arusha, Dodoma, Iringa, Kilimanjaro, Manyara, Shinyanga, Lindi, Singida, Tabora and Mwanza,	-	46,661.100 tonnes of maize and 1,403.67 tonnes of sorghum were distributed to affected population in the districts	-	-
1880, 1917, 1921, 1940, 1966, 1967, 2007 and 2008	Volcano eruption at Oldonyo Lengai hills	Oldonyo Lengai hills-Ngorongoro, Monduli-Arusha	-	-	-	Environment was destructed
28/03/2008	Floods	Mererani Mines- Arusha	74 people died	Tsh. 50,000,000/= was	Government of	

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
				provided	Tanzania	
2008/2009	Drought	Longido, Ngorongoro and Monduli districts	-	Tsh. 4,349,996,650/= were provided for buying animals seed stock and distributed to the affected population	Governemnt of Tanzania	
July 2008-June 2009	Drought	Mara, Singida, Kilimanjaro, Arusha, Mwanza, Shinyanga, Iringa, Manyara, Coast, Dodoma, Mara, Morogoro, Mtwara and Tanga regions	-	33,347 tonnes of maize and TZS. 2,696,116,450/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
1/7/2009	Landslides	Same district	24 people died, 60 cows died	15 tents, 25 blankets, 25 mattresses, 1.8 tonnes of maize and TZS. 83,000,000/=	Government of Tanzania	15 kilometre road was damaged, 15 Ndiva (Irrigation reservoirs) were damaged
27/12/2009	floods	Kilosa	2 people died, 9 wards of 5,981 households with 25,637 people were affected	Food, Mattresses, tents, bed nets, Blankets, cements, sheets, and TZS 9,803,895,160/=	Government of Tanzania, Red Cross	5,981 houses, 4 schools and number of dug wells were damaged
July 2009 - June 2010	Drought	Arusha, Dodoma, Kilimanjaro, Iringa, kagera, Lindi, Mara, Manyara, Mwanza, Mtwara, Morogoro, Mbeya, Singida, Shinyanga, Tanga and Coast,	-	107,451.72 tonnes of maize and TZS. 6,532,576,360/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	Farms with crops dried….quantify
July 2010 - June 2011	Drought	Arusha, Dodoma, Shinyanga, Kilimanjaro, Singida, Manyara, Mara, Morogoro, Mwanza, Iringa, Lindi and Tabora	-	50,524 tonnes of maize and TZS. 2,669,935,041/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	Farms with crops dried….quantify
1/4/2011	Floods	Kilombero- Morogoro	6,643 people were affected	Food, bed nets, clothes, blankets, tents and TZS 756,442,000/= were	Government of Tanzania, Plan Tanzania, St. Andrew,	2731.5 hetres of farms were destroyed, 6 bridges, 677 houses and roads

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
				provided	Illovo, and Red Cross.	were damaged
27/12/2011	Floods	Dar es Salaam	41 people died, and more than 5,000 affected	T. Sh. 1,844,111,521.80 /= and surveyed plots were provided	Government of Tanzania	
July 2011-June 2012	Drought	Shinyanga, Arusha, Mara, Kilimanjaro, Iringa, Tanga, Mwanza, Tabora, Dodoma, Singida, Manyara, Kagera, Mbeya, Mtwara and Coast,	-	69,958.05 tonnes of maize and tsh.5,450,721,612/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
July 2012-June 2013	Drought	Arusha, Dodoma, Kilimanjaro, Lindi, Mara, Manyara, Morogoro, Mtwara, Mwanza, Simiyu, Singida, Shinyanga, kagera, Iringa, Mbeya, Tabora, Tanga, and Coast	-	70,319.08 tonnes of maize and tsh. 4,115,566,168/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
July 2013-June 2014	Drought	Arusha, Dodoma, Kilimanjaro, Lindi, Iringa, Manyara, Mara, Morogoro, Mtwara, Mwanza, Simiyu, Singida, Shinyanga, Tabora, Tanga, and Coast	People and Livestocks were affected ….quantify	29,871.45 tonnes of maize and TZS. 2,505,014,771.30/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
4/12/2014	Floods	Dar es Salaam	10 people died			Houses and roads were damaged
July 2014-June 2015	Drought	Arusha, Dodoma, Lindi, Manyara, Mara, Mtwara, Mwanza, Simiyu, Shinyanga, Tabora and Tanga	People and Livestocks were affected ….quantify	14,530.41 tonnes of maize and tsh.1,466,195,875/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
23/03/2015	Hail storm accompanied by	Mwakata, Magung'unhwa and	47 people died, 3,500 people displaced; 67	-	Governemnt of Tanzania	634 houses were damaged

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
	strong winds and heavy rainfall	Nhumbi villages in Msalala district	cows and 236 goats were killed			
6-7 May 2015	Floods	Dar es Salaam	8 people died			Houses and roads were damaged
July 2015-June 2016	Drought	Arusha, Dodoma, Kilimanjaro, Iringa, Kagera, Lindi, Manyara, Mara, Morogoro, Njombe, Simiyu, Shinyanga, Singida, Tabora and Tanga	-	32,783.5 tonnes of maize and TZS.1,152,631,870/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-
10-Sep-16	Earthquake	Kagera Region (Bukoba, Misenyi, Muleba, Karagwe and Kyerwa)	17 people died, 440 people were injured	TZS 6,417,327,168.60/= was collected and used for reconstruction and rehabilitation of damaged infrastructures (Primary and Secondary Schools, dispensaries and other public buildings	Gvt, International Organisations, NGOs, CBOS, PRIVATE Companies, Individuals	2,072 houses were totally damaged, 14,595 houses were partially damaged and 2,191 public buildings were damaged
2016/2017	Drought	Dodoma, Kilimanjaro, Kagera, Lindi, Geita, Coast and Simiyu	-	1,135 tonnes of maize and TZS. 45,650,000/= for transportation cost were distributed to affected population in the districts	Government of Tanzania	-

Source: Prime Minister's Office, Disaster Management Division

"-" Data not available

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4.2. Technological Disasters

4.2.1 and 4.2.2, Occurrence of Technological Disasters; and Impact of Technological Disasters

Tanzania is equally exposed to technological hazards, all of which cause disruption. Some common technological or man-made disasters are fire outbreaks, road accidents, power failures, environmental degradation and pollution, marine accidents, train accidents, collapse of buildings, oil spill, aircraft accidents, explosions and industrial accidents.

Table 4.2 present statistics on technological or manmade disasters from 1979 to 2013. The most recent recorded event is the collapse of a 16 storey bulding in Dar es Salaam in 2013 which killed 39 people. Another event, which happened in 2012, was the capsizing of MV Skagit in Zanzibar which killed 144 people.

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Table 4. 2: Recent Technological/ Manmade Disasters Events and Interventions in Tanzania

Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
1979	Civil Strife	Kagera, & Mwanza Region	6,600 people were affected	Medicines, food shelter and clothing	West Lake Residents Tanzania Goverments Tanzania Red Cross	Roads, Bridges TANESCO na TPTC poles and houses.
11/11/1983	Accident	Train Derailment	20 killed and 79 injured			
1984	Fire	Bank of Tanzania	230 million TZS	Fire Extinguishing Service	Fire Tender Service Police	-
1986	Fire	Central Medical store	141 million drugs destroyed	Fire Extinguishing Service	Fire Tender Service	-
21-May-96	MV Bukoba vessel capsized	Lake Victoria- near Bukoba	833 people died and 110 affected			Passengers and cargo were damaged
1997	Fire	Makuyuni Ward-Tanga				Sisal plantation devastated (estimate of 4,600,000 TZS damage)
12/08/2000	Conflict, farmers Vs Livestock keepers		27 deaths and 23 injured	17 tonnes maize food	Gvt.	54 Houses were burnt
20/11/2001	2 boats collided	Lake Tanganyika, Kigoma	20 + dead		Gvt.	boats destroyed
04/11/2002	Ulanga ferry-capsized	Ifakara, Kilombero	13 dead.(Total of 58 people bought tickets), 6 people missing			1 Police land cruiser sank (had 4 people all not seen again) STJ 963 and 1 canter lorry sank (had 2 people all not seen again) TZQ7375
19/06/2002	Mines bad gas inside (it happened at 11 pm night)	Mererani Mines, Simanjiro-Arusha	39 dead, 3 missing			

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
24/06/2002	Train Accident	Village of Msangali-Dodoma	283 dead and 466 Injuries	Medicine, equipment, water, flesh milk, free communication, medics	US Gvt, African Muslim, Vodacom, German Embassy	Railway Line, Wagons and Passengers properties were damaged
24/4/2003	Fire	Makata village of Makata ward in Lindi District	4 affected--specify			Health centre burned (Estimate of TZS 3,000,000 damage)
10/01/2005	Fire	Village of Kineng'ene, ward of Mtanda in Lindi district	2 affected-specify			25 acres of cashew nuts were burned (estimate of TZS 3,750,000 damage)
10/05/2005	Fire	Village of Mtene, Ward of Rondo in Lindi district	12 affected-specify			2655 acres of trees,1 car, 2250 tonnes of wood and 10 Kiosks were burned were burned (damage of TZS 27,000,000)
29-Mar-2009	Bad Mining practices- Blusting of dynamites in the mines	Mgusu Mines- Geita, Mwanza	7 people died and 3 affected	TZS. 45,400,000 were provided	Government of Tanzania	
29-Apr-2009	Bomb blast	Mbagala Military camp-Mbagala kuu Dar es Salaam	26 people died and 9,704 Affected	TZS. 11,570,435,186 were provided to victims	Government of Tanzania	9,519 buildings were damaged
16/02/2011	Bomb blast	Gongo la Mboto Military camp- Ilala, Dar es Salaam	30 people died and 1,693 households were affected	TZS 5,828,692,200 were provided	Government of Tanzania	1,693 houses were damaged

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Date	Type of Disaster	Place	Disaster Scale	Assistance Provided	Source of Assistance	Damage to Infrastructure
09/10/2011	MV Spice Iceslender vessel capsized	Zanzibar	203 people died, 1,370 missing and 619 passengers rescued	TZS 300,000,000, blankets, sleeping bags, dead body bags, medicines, tarpaulins were provided	Government of Tanzania	
18/07/2012	MV Skagit vessel capsized	Zanzibar	144 people died	TZS 332,286,500, were provided	Government of Tanzania	
29/03/2013	Building Collapsed	Dar es Salaam	39 People died		Government of Tanzania	16 floor residential apartments building was damaged

Source: Prime Minister's Office, Disaster Management Division

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CHAPTER FIVE

HUMAN SETTLEMENTS AND ENVIRONMENTAL HEALTH

5.1. Human Settlements

A human settlement is an organized grouping of human habitation. There are two major types of settlements which are urban and rural. Urban settlements are usually densely populated with many people who have mostly non-agricultural occupations. Rural settlements, on the other hand, are generally sparsely populated with a low density. Most of the rural populations are involved in farming and livestock keeping.

5.1.1 Urban and Rural Population

5.1.1.1: Urban Population

Key Message

Significant growth in urban population implies increase in environmental pollution in urban areas which increases the risk to public health.

It is noted that about 90 % of urban growth will take place in African and Asian countries (The 2014 Edition, World Urbanization Prospects). Table 5.1 shows that as of 2012, 29.6 % of Tanzania Mainland population was living in urban areas. Like other urban areas of Africa and the rest of the world, increase in urban population in the country is also associated with increase in demand for social services as well as increase in environmental pollution. With more people living in a condensed space, pollution levels rise, sanitation systems come under pressure and public health is more at risk.

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5.1.1.2: Rural Population

Key Message

Seven out of ten persons in Tanzania Mainland's live in rural areas where agriculture is the mainstay. Therefore, linking agriculture with sustainable environmental protection practices is crucial.

Rural population refers generally to the population in areas that have a lower population density than urban areas and are overall more spread out than urban areas. These areas are typically more agricultural than urban areas. It has also been noted that rural population is generally higher in developing countries than in developed countries. Furthermore, the United Nations predict that the percentage of people living in rural areas will steadily decrease as people migrate from rural areas to urban areas (United Nations, World Population Prospects Report, 2017).

According to the Population and Housing Census of 2012 Tanzania Mainland rural population accounted for 70.4 % of the total population of 44,928,923 (Table 5.1). Farming and livestock husbandry are the dominant sources of livelihood for the rural population. In as far as population density in rural areas is smaller than in urban areas, level of environmental pollution is lower than in urban areas.

Table 5. 1: Population Living in Urban and Rural Areas, Tanzania Mainland; 2012

Area	Number	Percent
Urban	13,305,004	29.6
Rural	31,623,919	70.4
Total	44,928,923	100.0

Source: Population and Housing Census, 2012

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5.1.2- Access to Selected Basic Services

5.1.2.1: Improved Drinking Water Sources

An improved drinking-water source is one that by nature of its construction, or through active intervention, is protected from outside contamination and is likely to make water safe to drink. These sources include piped water, public taps, stand pipes, tube wells, boreholes, protected dug wells and springs, rain water, and bottled water. The most recent available statistics on Tanzania (2015/16) indicate thatabout 6 out of 10 persons (59.7 % of the population) get their drinking water from improved sources (Table 5.2). The 2015/16 statistics moreover show that nearly 9 out of 10 Tanzania Mainland urban residents obtain their drinking water from improved sources. Mainland's urban populations that get water piped directly into their dwellings/yards/plot stands at 25.6 %, while those who collect their water from piped connections into their neighbours' yards are 23.7 %.

Key Message

In Tanzania, about 6 out of 10 persons (59.7 %) have access to improved sources of drinking water.

Protected dug wells and public taps/standpipes are the next most common sources of improved water (14.2 % and 11.7 % respectively). By contrast, more than half (53.0 %) of Tanzania Mainland rural population obtain their drinking water from unimproved sources. The two most common sources of drinking water among Tanzania Mainland rural population are public tap/standing pipe (16.5 %) and protected dug well (15.1 %). The next two most common sources are improved sources such as tube well or borehole (4.4 %) and piped to neighbor (3.5 %). Distribution of other improved sources among urban and rural population is as shown in Table 5.2.

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Table 5. 2: Percentage Distribution of the Population Using an Improved Drinking Water, Tanzania Mainland

Characteristic	Urban	Rural	Total
Population using Improved drinking water source	86.4	47	58.6
Piped into dwelling/yard plot	25.6	3	9.6
Piped to neighbour	23.7	3.5	9.4
Public tap/standpipe	11.7	16.5	15.1
Tube well or borehole	5	4.4	4.6
Protected dug well	14.2	15.1	14.8
Protected spring	2.8	3.3	3.1
Rain water	1.2	1.3	1.2
Bottled water, improved source for cooking/washing	2.3	0	0.7

Source: Tanzania Demographic and Health Survey and Malaria Indicator Survey Report, 2015/16

5.1.2.2: Improved Sanitation Facilities

Key Message
Use of improved sanitation facilities is more common in urban area than in rural areas.

Improved sanitation facilities are ones that are used by not more than one household and includes the following sanitation amenities: flush or pour flush toilets to sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, pit latrines with a slab, and composting toilets. Generally, improved sanitation facilities ensure better and safe management of faecal wastes by controlling discharges of untreated wastewater into the environment so as to prevent people from coming into contact with human waste and thus reduce the transmission of cholera, typhoid, and other diseases.

Table 5.3 Shows that, about 19.0 % of population in Tanzania Mainland used improved sanitation facilities. Improved sanitation facilities are more common in urban areas (41.9 %) than in rural areas (9.5 %). Pit latrines with slabs are the most common improved sanitation facility in Tanzania Mainland (8.3 %).

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Table 5. 3: Percent Distribution of Population Using an Improved Sanitation Facility, 2015/16

	Tanzania Mainland				
Improved (Not shared toilet facility)	**Urban**	**Rural**	**Total**	**Zanzibar**	**Tanzania**
Flush/pour flush to piped sewer system	1.3	0.1	0.4	0.2	0.4
Flush/pour flush to septic tank	5.6	0.5	2.0	0.3	1.9
Flush/pour flush to pit latrine	19.6	1.8	7.0	26.5	7.6
Ventilated improved pit (VIP) latrine	2.5	0.6	1.2	6.7	1.3
Pit latrine with slab	12.9	6.4	8.3	27.3	8.8
Composting toilet	0.0	0.1	0.1	0.0	0.1
Total Percentage of population in Tanzania using improved (not shared toilet facility)	**41.9**	**9.5**	**19.0**	**61.0**	**20.1**

Source: Tanzania Demographic and Health Survey and Malaria Indicator Survey Report, 2015/16

Note- *Toilet facilities would be considered improved if they were not shared by two or more households*

5.1.3 - Housing Conditions

Housing condition is among the indicators usually used to determine living standards of a household. It is also used as proxy indicator in measuring economic status of households. Housing conditions includes the physical conditions of dwellings, types of dwellings, house tenure, surrounding environment and availability of amenities.

5.1.3.1: Urban Population Living in Slums

Key Message

Rapid growth of urban population has not gone hand in hand with urban planning processes. This has resulted into growth of urban population living in squatter areas which exposed to many environment pollution risks.

According to Tanzania Ministry of Land, Housing and Human Settlements Development, there are no slums in Tanzania but rather unplanned settlements. Within this framework, urban population living in slums is referred to as population living in unplanned settlements. Rapid urbanization and inadequate capability to cope with the housing needs of people in urban areas have contributed to the growth of unplanned settlements. Living in these settlements often poses significant health risks caused by poor sanitation and drinking water quality which exposes inhabitants to a wide range of pathogens, as houses act as breeding grounds for vectors.

Figure 5.1 shows the proportion of urban population living in unplanned settlements for selected regions. Arusha (80.0 %) and Tanga (79.0 %) regions had the highest proportion of urban

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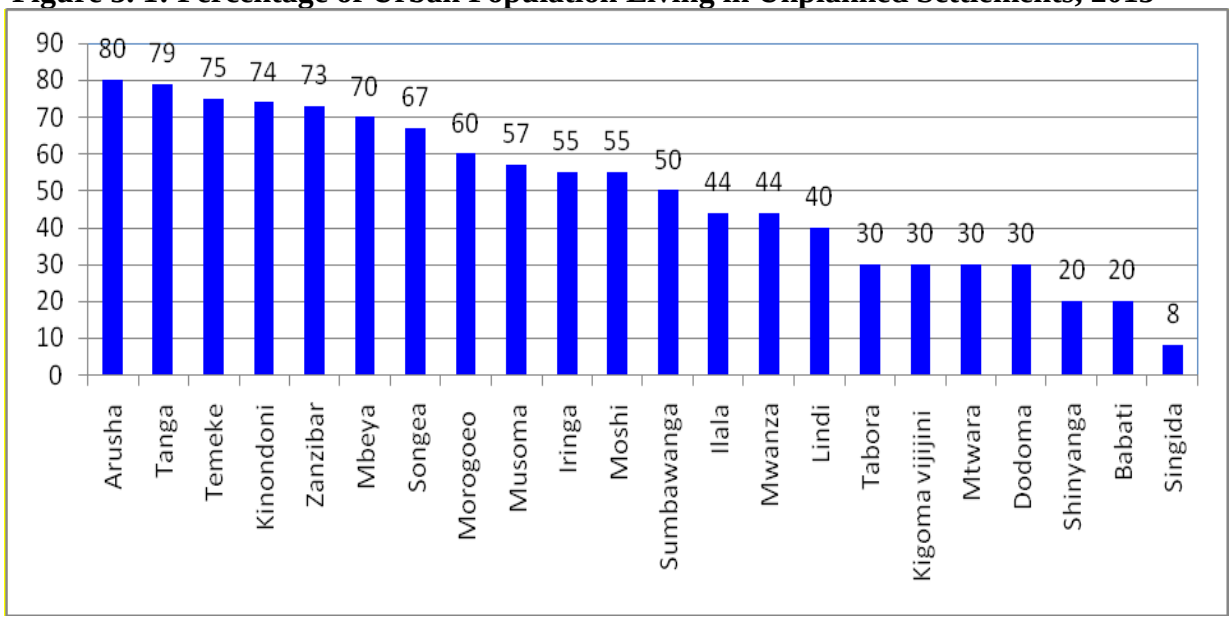
population living in unplanned settlements in 2015. Singida (8.0 %) and Babati in Manyara region (20.0 %) had comparatively lower proportions of population living in unplanned urban settlements.

Figure 5. 1: Percentage of Urban Population Living in Unplanned Settlements, 2015



Source: Tanzania Cities Network (TACINE), 2015

5.1.3.2: Population Living in Hazard Prone Areas

5.1.3.3: Hazard Prone Areas

Hazard is a potential source of harm or adverse health effect on persons. For instance, droughts and floods are among primary hazards affecting some parts of the country. Map 5.1 presents major hazards in Tanzania by agro ecological zones. Agro ecological zones (AEZs) are geographical areas exhibiting similar climatic conditions influenced by latitude, elevation, temperature and rainfall. The identified hazards are disease outbreaks, droughts, HIV/AIDS, floods and major accidents.

The central plateau agro ecological zone is more vulnerable to droughts, disease outbreaks and HIV/AIDS with the first two hazards causing more risks to people living in the zone. Coastal and Southern Highlands zones together are exposed to droughts, disease outbreaks and also experience floods more frequently. Eastern plateau is mainly endangered by droughts and disease outbreaks. Other remaining zones with respect to hazards exposure is as shown in Map 5.1.

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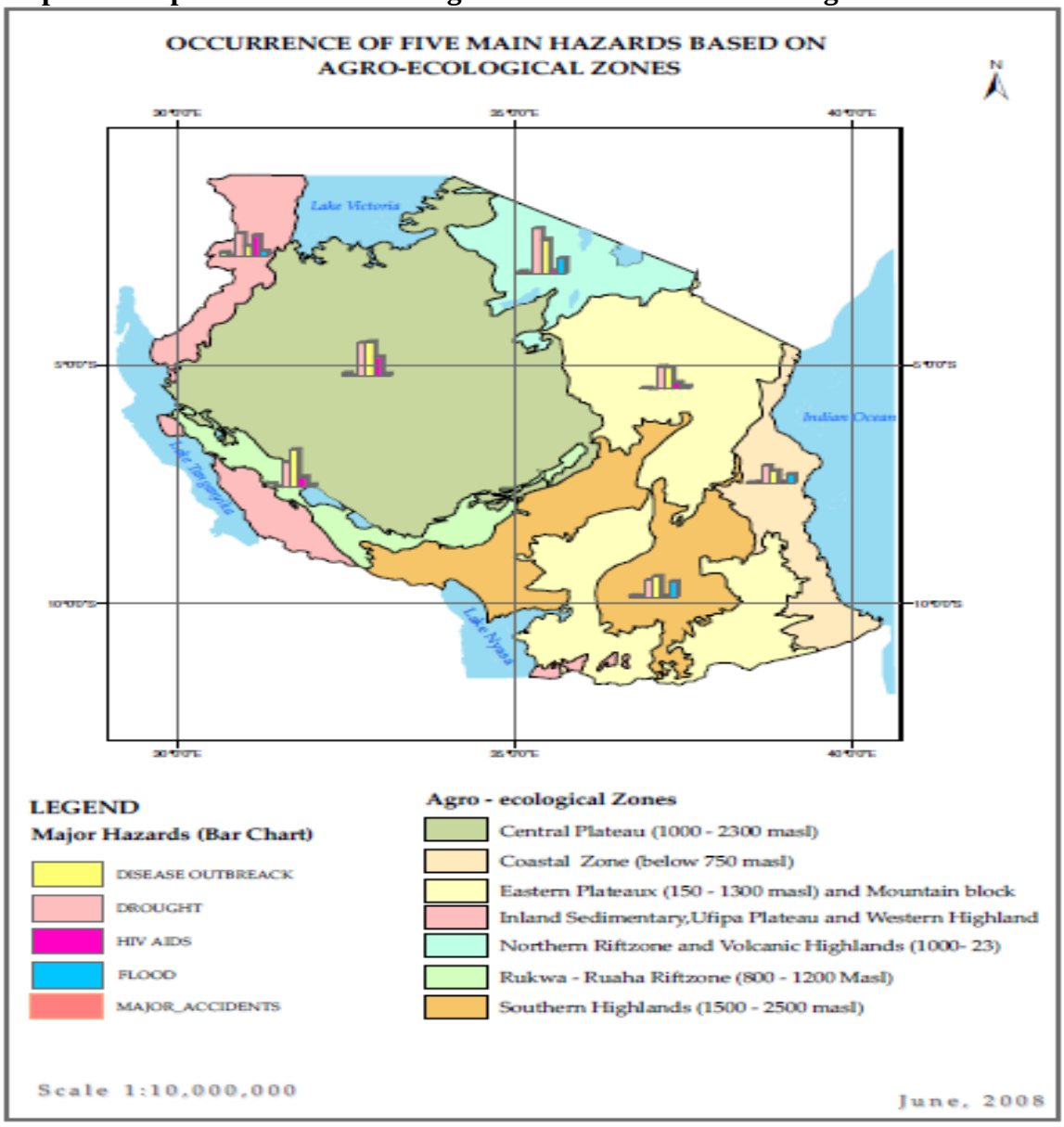
Map 5. 1: Map of Tanzania Showing Five Main Hazards Affecting the Areas



Source: Prime Minister's Office, Disaster Management Division

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5.1.3.4: Number of Dwellings with Adequacy of Building Materials Defined by National Standards

Adequacy of building materials refer to suitability or appropriateness of materials used in construction. It is used to determine the quality of the physical characteristics of the building in which households live. These characteristics include type of flooring, walls and roofings. However, adequate building materials are crucial in controlling potential hazards associated with building materials. It is therefore important to set construction standards which will conform to certain essential requirements including requirements for hygiene, health and protection of environment.

Key Message

In 2011/12 the largest proportion of Tanzania Mainland houses' walls were constructed using baked/burnt bricks (27.3 %), mud bricks (24.7 %) and mud and poles or stones (23.6 %).

Table 5.4 presents the distribution of households by main materials used for housing construction. In 2011/12 the largest proportion of Tanzania Mainland houses' walls were constructed using baked/burnt bricks (27.3 %), followed by mud bricks (24.7 %) and mud and poles or stones (23.6 %). Larger differences existed between Dar es Salaam and Other Urban areas where most of the houses in Dar es Salaam (96.9 %) had their house walls constructed using concrete, cement bricks, and stones compared to 25.8 % in Other Urban Areas.

It was also revealed that most of houses (42.0 %) in other urban areas were constructed using baked or burnt bricks. In rural areas the houses with walls of concrete, cement and stones were only five percent. Statistics in Table 5.4 makes it apparent that there has been a significant increase in the proportion of houses constructed using mud bricks, baked or burnt bricks and concrete or cement or stone between 2007 and 2011/12.

Overall, most of households were living in dwellings with floors made of earth (58.5 %) followed by cement (39.4 %). However, in rural areas 77.3 % of households were in housing units with floors made of earth. In Other urban areas, 68.4 % of the dwellings had cement floors and 30.8 % had earth floor. It is also revealed that households living in dwellings with floor made of cement or tiles increased by 7.6 % points between 2007 and 2011/12.

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Increase in use of cement as main material used for both walls and flooring means increased demand for cement which in turn calls for more production leading to soil degradation in quarrying areas and ecosystem disturbance.

Table 5. 4: Percentage Distribution of Households' by Construction Materials and Area, Tanzania Mainland, 2000/01, 2007 and 2011/12 HBS's

Construction Material	Dar es Salaam			Other Urban			Rural			Tanzania Mainland		
	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12
House floor												
Earth	6.7	8.7	3.2	38.3	37.1	30.8	86.6	83.1	77.3	74	67	58.5
Cement, tiles	92.4	90.4	96.5	61.1	61.9	68.4	12.5	15.6	20	25.2	31.8	39.4
Other	0.9	1	0.3	0.5	0.9	0.8	0.9	1.3	2.8	0.8	1.2	2.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
House walls												
Poles, branches, grass	0.9	1.5	0.0	5.3	4.6	0.2	19.3	16.9	1.0	16	13	0.7
Mud & poles or stones	5.2	4.7	2.5	13.1	10.9	11.9	21.8	22	31.1	19.4	18.2	23.6
Mud only	2.2	1.9	-	12.1	10.3	-	18.1	12	-	16.1	10.7	-
Mud bricks	3.2	1.3	0.3	30.8	22.6	19	23.5	26.4	31	23.3	23.2	24.7
Baked or burnt bricks	1.3	1.6	0.2	15.9	29.9	42	13.7	18.8	28.1	13.2	19.3	27.3
Concrete, cement, stone	87.2	88.3	96.9	22.4	20.7	25.8	3	3.1	5.0	11.5	14.8	20.9
Other	0	0.5	0.1	0.4	1	1	0.6	0.9	3.8	0.5	0.9	2.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
House Roof												
Grass, leaves, bamboo	1.1	2.1	0.8	14.3	12.3	7.4	55.7	48.2	38.6	45.8	36.8	27.5
Mud & leaves	0.7	0.4	0.0	1.5	2.6	1.8	12.5	9.2	5.7	10.1	7.1	4.2
Concrete, cement	3.6	1.2	0.6	0.5	0	0.3	0	0	0.1	0.3	0.1	0.2
Galvanized metal sheets/iron sheets	91.7	94.4	95	81.9	84.1	88.5	31.1	41.8	54.2	42.8	55.1	66.3
Asbestos sheets	0.5	0.3	0.4	0.3	0.3	0.3	0	0.2	0.3	0.1	0.2	0.3
Tiles	2.4	1.2	3.2	1	0.2	1.4	0.1	0	0 .2	0.4	0.2	0.8
Other	0	0.3	0.0	0.5	0.5	0.3	0.5	0.6	0.9	0.5	0.5	0.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: 2011/12 Household Budget Survey

"-" Data not available

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5.1.5- Environmental Concerns Specific to Urban Settlements

5.1.5.1: Number of Private and Public Vehicles

Key Message

In 2015, the Tanzania Mainland road network was 441,773 Kms. Out of this network, 8.9 % were paved and 91.7 % unpaved.

Improving transportation infrastructure is a key priority for the Government. The ability of the country to upgrade and improve its road infrastructure is one of the key factors for economic growth. Road infrastructure is classified into four categories: trunk/national roads, regional roads, district/urban and feeder roads. Trunk/national roads are primary roads or international roads/routes connecting one region to another or region to a border or other countries. Regional roads are secondary roads/routes connecting centres/important centres to trunk road(s) within a region. District/urban roads are tertiary roads providing linkage between district headquarters to ward or important centres. Feeder roads are villages' access roads available in village/rural areas. Each of the defined road categories can either be paved meaning tarmac or unpaved referring to gravel or earth roads.

Table 5.5 shows that as of 2015, Tanzania Mainland had a total of 441,773 kilometres of road network. Out of this network, 8.9 % was paved and 91.1 % unpaved. More than a half (61.4 %) of the road network was local roads. Trunk roads constituted the least proportion of 13.9 % of the road network. The government intention is to further improve the road network by increasing the network of paved roads in the country.

Despite playing a big role in economic growth, roads development too may have negative impact on the environment. Ecological effects are the biggest disturbances on the environments caused by roads constructions. Air pollution tends to increase with development of roads due to the associated growth of volume of traffic on the roads. Road construction also may cause physical disturbance of land which promotes landslides due to unstable soil and steep slopes. Paved road surfaces can increase water discharge rates in watersheds, thus increase landslides due to floods from streams and rivers. Furthermore, deforestation rate becomes high with improved road infrastructure as it facilitates easy transportation of forest products such as logs and charcoal. A good example of this is the construction of paved road from Dar es Salaam to southern regions of Lindi and Mtwara which has increased the rate of transportation of forest products from these regions.

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Table 5. 5: Road Network in Kilometres by Status, Tanzania Mainland, 2010 – 2015

Category / Year/ Road Type	National Roads						Local Roads			Total Roads Network		
	Trunk Roads			Regional Roads			District, Urban and Feeder Roads					
	Paved	Unpaved	Total	Paved	Unpaved	Total	Paved	Unpaved	Total	Paved	Unpaved	Overall
2010	5,377	6,822	12,199	780	20,490	21,270	842	56,798	57,640	6,999	84,110	91,109
2011	5,377	6,822	12,199	780	20,490	21,270	746	52,603	53,349	6,903	79,915	86,818
2012	6,219	5,987	12,206	1,067	20,990	22,057	1,031	53,348	54,379	8,317	80,325	88,642
2013	6,292	5,912	12,204	1,082	21,047	22,129	966	52,241	53,207	8,340	79,200	87,540
2014	6,565	6,221	12,786	1,240	20,974	22,214	988	51,676	52,664	8,793	78,871	87,664
2015	29,830	31,764	**61,594**	4,949	103,991	**108,940**	4,573	266,666	**271,239**	39,352	402,421	**441,773**
Percent			**13.9**			**24.7**			**61.4**	**8.9**	**91.1**	**100.0**

Source: TANROADS and PO-RALG

5.1.5.2: Population Using Public Modes of Transportation

5.1.5.3: Railway Transport

Key Message

From 2010 - 2016, railway lines in Tanzania Mainland transported about 2.7 million tons of freight out of which 54.5 % was transported through TAZARA. Increased railway transport has a good bearing on the environment as it reduces transport carbon related emissions.

Table 5.6 represents the ammount of freight and number of passengers transported by Tanzania Railways Corporation (TRC) and Tanzania Zambia Railways (TAZARA) from 2010 to 2016. During the reference period a cumulative total of 2,755,600 tonnes of freight were transported. Out this transported freight, more than half (54.5 %) was transported through TAZARA and the remaining 45.5 % through Tanzania Railways Corporation rail line.

The freight tonnage transported by both railways kept fluctuating, but was at its peak in 2010 when 805,000 tonnes were transported. This is equivalent to 29.2 % of the total tonnage of freight transported in all seven years starting from 2010. The lowest freight tonnage of 160,000 (5.8 %) was recorded in 2014. On the other hand, over the reference period a total of 6,854,400 passengers were transported by both railways of which more than half (51.9 %) travelled by TAZARA and 48.1 % by Tanzania railway. The highest number of passengers, 2,147,000 persons (31.3 %) was recorded in 2016, while the lowest number of passengers, 457,000 persons (6.7 %) was recorded in 2014.

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Due to its ability to carry large volumes of freights and number of passengers, there is potential for reducing the transport related carbon emissions through increased use of railway as means of transport in the country. The Government plans for construction of a standard gauge railway from Dar es Salaam to Morogoro Region is therefore, a good start towards reducing air pollution and accident risks caused by road transportation.

Table 5. 6: Freight and Passengers Transported by Railway, Tanzania Mainland; 2010-2016

Type of Transport	2010	2011	2012	2013	2014	2015	2016	Total			
Railways											
Tanzania Railways	-	-	-	-	-	-	-	**Freight (000' tonnes)**	**%**	**Passengers ('000')**	**%**
Freight (000 tonnes)	265	138	154	185	127	282.6	102	1,253.6	45.5	-	-
Passengers (000)	284	227	339	373	170	196.4	1,707	-	-	3,296.4	48.1
Tanzania Zambia Railways (TAZARA)											
Freight (000 tonnes)	540	248	259	245	33	81	96	1,502.0	54.5	-	-
Passengers (000)	758	414	678	654	287	327	440	-	-	3,558.0	51.9
Total- Freight (Both Railways)	**805**	**386**	**413**	**430**	**160**	**363.6**	**198**	**2,755.6**	100.0	-	-
Percent (Freight)	29.2	14.0	15.0	15.6	5.8	13.2	7.2	**100**	-	-	-
Total- Passengers (Both Railways)	**1042**	**641**	**1017**	**1027**	**457**	**523.4**	**2,147**	-	-	**6,854.4**	-
Percent (Passengers)	15.2	9.4	14.8	15.0	6.7	7.6	31.3	-	-	-	**100.0**

Source: Ministry of Works, Transport and Communication

"-" Not relevant

5.1.5.4: Marine Transport

Key Message

From 2010 – 2016, a total of 14,587 ships were operating in three ports of Dar es Salaam, Tanga and Mtwara. Among them, 82.0 % were operating in Dar es Salaam port.

Marine transport involves both transportation of cargo and passengers in ocean/sea. From 2010 to 2016 a total of 14,587 ships were recorded as operating or arriving from other countries in the three major ports of Dar es Salaam, Tanga and Mtwara, as shown in Table 5.7. Dar es Salaam port recorded the highest proportion of ships (81.6 %) followed by Mtwara (11.9 %) and Tanga ports (6.5 %). The highest number of ships 4,257 (29.2 %) of the total ships in the seven years period was recorded in 2015 while the lowest number of 1,173 ships (8.0 %) was recorded in 2013.

Exports and imports of cargo are among major activities in the ports. Table 5.7 shows that, from 2010 – 2016, Dar es Salaam port recorded the highest proportion of cargo (92.1 %) followed by

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Tanga port (5.7 %) and Mtwara port (2.2 %). The highest share (20.0 %) of all cargo was recorded in 2016, while the lowest was recorded in 2010 at 9.3 %.

It is also indicated that a total of 5,071,000 passengers used ships for travelling. Almost all the passengers (99.3 %) used Dar es Salaam port and there were no passengers travelling through Mtwara port. The highest number of passengers 1,748,000 (34.5 %) travelled in 2016 whilst the lowest number of passengers, 228,000 persons (2.2 %) were recorded in 2010.

Marine transport has a big role to play in economic growth. Improving safety measures in marine transport is paramount for reduction of accident risks as one of the man-made or technological environmental hazards.

Table 5. 7: Marine Transportation of Cargo and Passengers, 2010-2016

Type of Transport	2010	2011	2012	2013	2014	2015	2016	Total					
Marine Transport													
Dar es Salaam Port								**Ships (Number)**	**%**	**Cargo (000' DWT)**	**%**	**Passengers ('000')**	**%**
Ships (Number)	1,274	1,232	1,600	742	1,426	4,028	1,600	11,902	81.6	-	-	-	-
Cargo ('000' DWT)	4,954	5,432	10,122	5,547	9,082	9,369	10,814	-	-	55,320.0	92.1	-	-
Passengers (000)	228	312	375	347	1,000	1,023	1,748	-	-	-	-	5,033	99.3
Tanga Port													
Ships (Number)	215	201	232	92	64	63	87	954	6.5	-	-	-	-
Cargo ('000' DWT)	529	508	608	271	536	475	500	-	-	3,427	5.7	-	-
Passengers (000)	0	23	13	2	0	0	0	-	-	-	-	38	0.7
Mtwara Port													
Ships (Number)	58	129	498	339	428	166	113	1,731	11.9	-	-	-	-
Cargo ('000' DWT)	107	112	178	144	248	125	379			1,293	2.2	-	-
Passengers (000)	0	0	0	0	0	0	0					0	-
												-	-
Total- Ships	1,547	1,562	2,330	1173	1,918	4,257	1,800	**14,587**					
Percent (Ships)	10.6	10.7	16.0	8.0	13.1	29.2	12.3		**100**				
Total- Cargo	**5,590**	**6,052**	**10,908**	**5,962**	**9,866**	**9,969**	**11,693**			**60,040**			
Percent (Cargo)	9.3	10.1	18.2	9.9	16.4	16.6	19.5				**100**		
Total- Passengers	**228**	**335**	**388**	**349**	**1,000**	**1,023**	**1,748**					**5,071.0**	
Percent (Passengers)	4.5	6.6	7.7	6.9	19.7	20.2	34.5						**100.0**

Source: Ministry of Works, Transport and Communication

DWT = Dead Weight Tonnes

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CHAPTER SIX

ENVIRONMENTAL PROTECTION, MANAGEMENT AND ENGAGEMENT

6.2. Environmental Governance and Regulation

This chapter provides a general view of government efforts towards sustaining and managing the environment. Policymakers, analysts and civil society require statistics on environment governance and regulation at the national level. The data on scope of these activities can inform about the extent of institutional development, availability of resources, and the existence and enforcements of regulatory and market instruments whose primary purpose is to protect, regulate and manage the changing environment.

6.2.1- Institutional Strength

6.2.1.1: National Environment Management Council (NEMC)

The National Environment Management Council (NEMC) came into being in 1983 when the Government of Tanzania enacted the National Environment Management Act No. 19 of 1983. NEMC was established with a broad mandate in response to the national need for such an institution to oversee environmental management issues and also implement the resolutions of the Stockholm Conference (1972), which called upon all nations to establish and strengthen national environment councils, so as to advise governments and the international community on environmental issues.

The enactment of the Environment Management Act No. 20 of 2004 (EMA, 2004) by Parliament in October 2004, repealed the National Environment Management Act No.19 of 1983 and re-established NEMC. EMA 2004 provides for a legal and institutional framework for sustainable management of the environment, prevention and control of pollution, waste management, environment quality standards, public participation, environment compliance and enforcement. Furthermore, it gives NEMC the mandate to undertake enforcement, compliance, review and monitoring of environmental impact assessments, research, facilitate public participation in environment decision-making, raise environmental awareness, and collect and disseminate environment information. The objective and purpose for which NEMC is established is to

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undertake environment enforcement, compliance, review and monitor environmental impact statements, research and awareness raising.

6.2.1.2: Annual Budgets of the Main Environment Authority

A budget is the sum of money allocated for a particular purpose and the summary of intended expenditures along with proposals for how to meet them. For many years NEMC's budget was dependent on the government treasury, but in 2015, the government directed NEMC to focus on raising and utilising income from its own sources to cover its expenses, except costs for Personal Emoluments (PE). Therefore, the council has taken several measures to expand opportunities of revenue collection. The trend of financial resources allocated to NEMC from 2012/2013 to 2017/2018 is shown in the Table 6.1 below.

Table 6. 1: Annual Budget of the Main Environment Authority, 2012/13 – 2017/18

Year	Budget (Tsh)
2012/2013	14,995,930,875
2013/2014	11,258,241,000
2014/2015	11,282,193,750
2015/2016	9,708,432,000
2016/2017	13,122,179,465
2017/2018	19,955,306,338

Source: Corporate Planning Unit (CPU)at NEMC

6.2.1.3: Number of Staff in the Main Environment Authority

Employees are valuable assets to an organization and the key to its success. The number of NEMC staff has been changing with time due to normal reasons such as retirement, death, and other reasons for labour turn over. The NEMC staff are divided between its headquarter and five Zonal Offices located in Dar es salaam, Mwanza, Arusha, Mbeya and Mtwara. Table 6.2 shows the number of NEMC staff from 2013 to 2017 and Table 6.3 shows number of staff at different NEMC operation zones.

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Table 6. 2: Number of Staff in the Main Environment Authority, 2013 - 2017

Year	No of Staff
2013	137
2014	167
2015	160
2016	153
2017	142

Source: Directorate of Finance and Administration (DFA) at NEMC

Table 6. 3: NEMC Zones and Number of Staff, 2017

Zone name	Eastern Zone	Lake Zone	Northern Zone	Southern Highlands Zone	Southern Zone
Regions	Dar es Salaam, Morogoro, Pwani Tanga	Mwanza, Geita, Simiyu, Shinyanga, Mara Kagera	Arusha, Manyara, Kilimanjaro	Mbeya, Sogwe, Katavi, Iringa, Njombe and Rukwa	Mtwara, Lindi Ruvuma
No of staff	**12**	**5**	**4**	**5**	**5**

Source: NEMC

6.2.2- Environmental Regulation and Instruments

6.2.2.1: Environment Management Act No. 20 of 2004 (EMA, 2004)

The Environment Management Act (EMA) of 2004 provides the legal and institutional framework for the sustainable management of the environment in Tanzania Mainland. It is a comprehensive piece of legislation that includes compliance and incentive mechanisms for environmental management from the national level to the sub-national level, involving district and village representatives in the management of environmental resources and enforcement of the law.

6.2.2.2: Number of Applications for Licenses Received and Approved Per Year

Among the crucial functions of NEMC is to register and review Environmental Impact Assessment (EIA) and Environment Audit (EA) for different projects. Minister of state, Vice President's Office Environment and Union Affairs is responsible for approving environment certificates after receiving recommendations for the specific projects from NEMC. The number of approved EIAs and EAs has been growing from year to year due to increase in investment activities in different sectors and rise of environment awareness in the country. All projects with potential adverse

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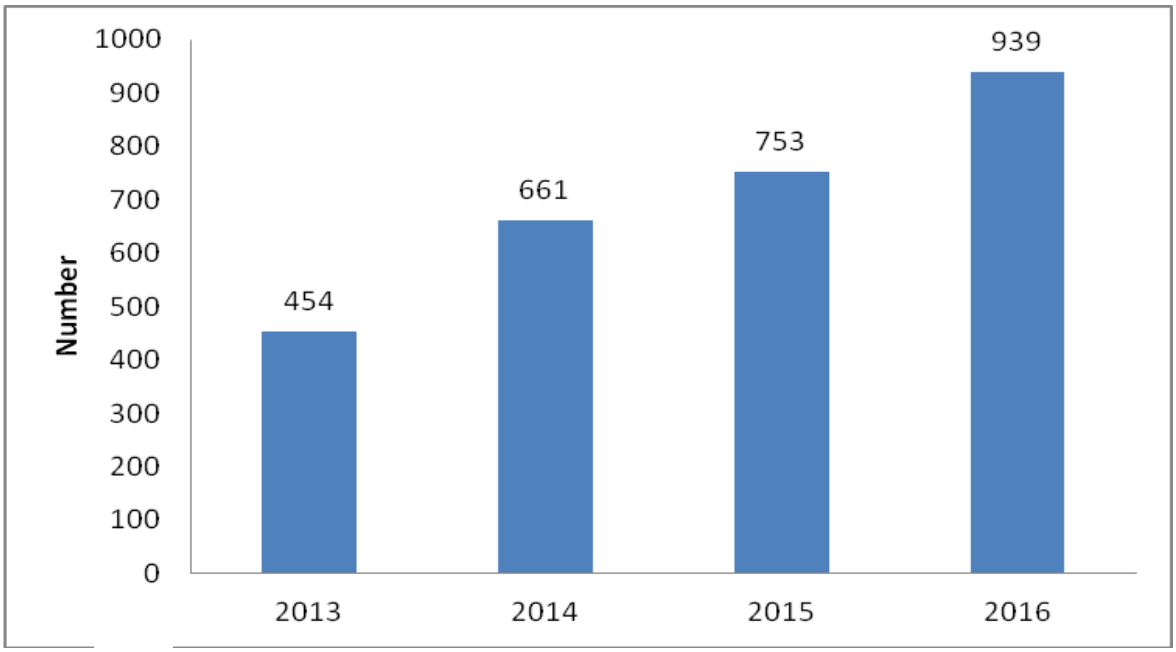
impacts to the environment after screening by initiating officers are subjected for EIAs. Projects observed to have low negative impacts on the environment after the screening processes are allowed to proceed but with some conditions. Figure 6.1 depicts statistics on approved EIAs and EAs for the year 2013 to 2016. The number of approved EIAs and EAs increased between 2013 and 2016 from 454 to 939.

Figure 6. 1: Number of Applications for EIAs and EAs Received and Approved, 2013 - 2016



Source: NEMC

Note- EIA - Environment Impact Assessment
EA - Environment Audit

6.2.2.3: Budget and Number of Staff Dedicated to Enforcement of Environment Regulations

NEMC has five directorates and one of them is Directorate of Environment Compliance and Enforcement (DECE) of which staff are dedicated to compliance and enforcement of environment regulations. The budget for this directorate mained almost constant from 2012/2013 to 2015/2016 and started to increase in 2016/17 and 2017/18 as a result of NEMC expansion of its sources of revenue.

The number of staff from DECE changed only slightly due to new employment, retirement, death and transfer to other directorates. Also, in a bid to increase the number of staff dedicated to enforcement of environment regulations, the Minister has been given a mandate by law to appoint

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environment inspectors from among the employees of NEMC or to designate any employee of local authorities, ministries or any other public institution either by name or office to be an environment inspector. Environment inspectors have more powers to deal with enforcement of environment regulations.

Table 6. 4: Budget and Number of Staff Dedicated to Enforcement of Environment Regulations, 2012/13 – 2017/2018

Year	Budget (TZS)	Number of Staff
2012/2013	344,390,000	18
2013/2014	324,390,000	22
2014/2015	326,965,000	21
2015/2016	326,965,000	17
2016/2017	633,647,500	16
2017/2018	1,930,296,000	16

Source: NEMC

6.2.3- Participation in MEAs and Environment Conventions

Tanzania being part of the international community has the obligation of ensuring that it cooperates with the international community in addressing global environment challenges. In this regard, Tanzania is participating in the implementation of a number of Multi-lateral Environmental Agreements (MEAs) and other related environment conventions. The country has also ratified a number of these MEAs through international and regional conventions aimed at addressing various environment issues. List of MEAs ratifications is indicated in Table 6.5.

Participation in a MEA means that the country or area has become a party to the agreements under the treaty or convention, which is achieved through various means depending on the country's circumstances. Such circumstances include accession, acceptance, approval, formal confirmation, ratification, and succession. Countries or areas that have signed but not become party to the agreements under a given convention or treaty are not considered to be participating.

Tanzania is also actively participating in various international foras related to these MEAs and projecting the national position on matters of national interest. In domesticating this MEAs Tanzania has been formulating and implementing a number of strategies, programmes and projects

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aimed at addressing environment challenges as addressed by the respective MEAs. The MEAs to which Tanzania is a party are listed in Table 6.5.

Table 6. 5: List and Description of MEAs to which Tanzania is a Party

S/N	Name of MEAs	Year of Ratification
1	Nagoya Protocol on Access to Genetic Resources and Benefit Sharing and the Fair and Equitable Sharing of Benefits arising from their utilization	24th Mar-17
2	Stockholm Convention on Persistent Organic Pollutants (POPs)	30th April 2004
3	Convention on Sustainable Management of Lake Tanganyika	12th June 2003
4	Cartagena Protocol on Biosafety	24th April 2003
5	Kyoto Protocol to United Nations Framework on Climate Change	26th August 2002
6	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	26th August 2002
7	Convention on Wetlands of International Importance (Ramsar Convention)	13th August 2000
8	United Nations Convention to Combat Desertification	19th June 1997
9	United Nations Framework Convention on Climate Change (UNFCCC)	17th April 1996
10	Convention on Biological Diversity (CBD)	8th Mach 1996
11	Montreal Protocol on Substances that deplete the Ozone Layer (ODS)	16th April 1993
12	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal	7th April 1993
13	Vienna Convention for the Protection of the Ozone Layer	7th April 1993
14	Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movements of Hazardous Wastes Within Africa	17th March 1990
15	Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region	15th July 1985
16	Convention on Migratory Species (CMS)	21st October 1985
17	United Nations Convention on the Law of the Sea	30th September 1985
18	Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)	29th November 1979

Source: Vice President's Office, MEAs Directory, April, 2007

6.3. Extreme Event Preparedness and Disaster Management

6.3.1 and 6.3.2 - Preparedness for Natural Extreme Events and Technological Disasters

At national Level, there is a Disaster Management Department (DMD) which coordinates all disaster management activities including preparedness for natural extreme events and technological disasters. The following are the National Disaster Management institutional arrangements, tools and resources which are in place for natural and technological disaster events preparedness and disaster management.

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6.3.2.1: Disaster Management Institutional Arrangement

6.3.2.2: Tanzania Disaster Management Committee (TADMAC)

Tanzania Disaster Management Committee (**TADMAC**) is Inter-Ministerial Committee organ, empowered for overseeing and coordinating overall disaster and relief operations. It is supreme body of emergency and disaster management at the national level established by Act. No.9 of 1990 and supported by Act No. 7 of 2015. The Permanent Secretary in the PMO (policy and coordination) chairs the Committee. Members of the Committee are Permanent Secretaries from Government disasters line Ministries and heads of Early Warning Institutions.

6.3.2.3: National Platform for Disaster Risk Reduction

Disaster Management Department formed the National Platform for Disaster Risk Reduction (DRR) in November 2005. Members for DRR were drawn from Government Ministries, Departments and Agencies, Civil Societies, NGOs, UN Agencies, and other DRR stakeholders.

6.3.2.4: Disaster Management Committees

Disaster Management Committees at Regional, District, Ward and Village levels have the mandate to carryout disaster relief duties as per Act No. 9 of 1990 and Act No. 7 of 2015 and give feedback about the general operation performance to Disaster Management Department for information consolidation.

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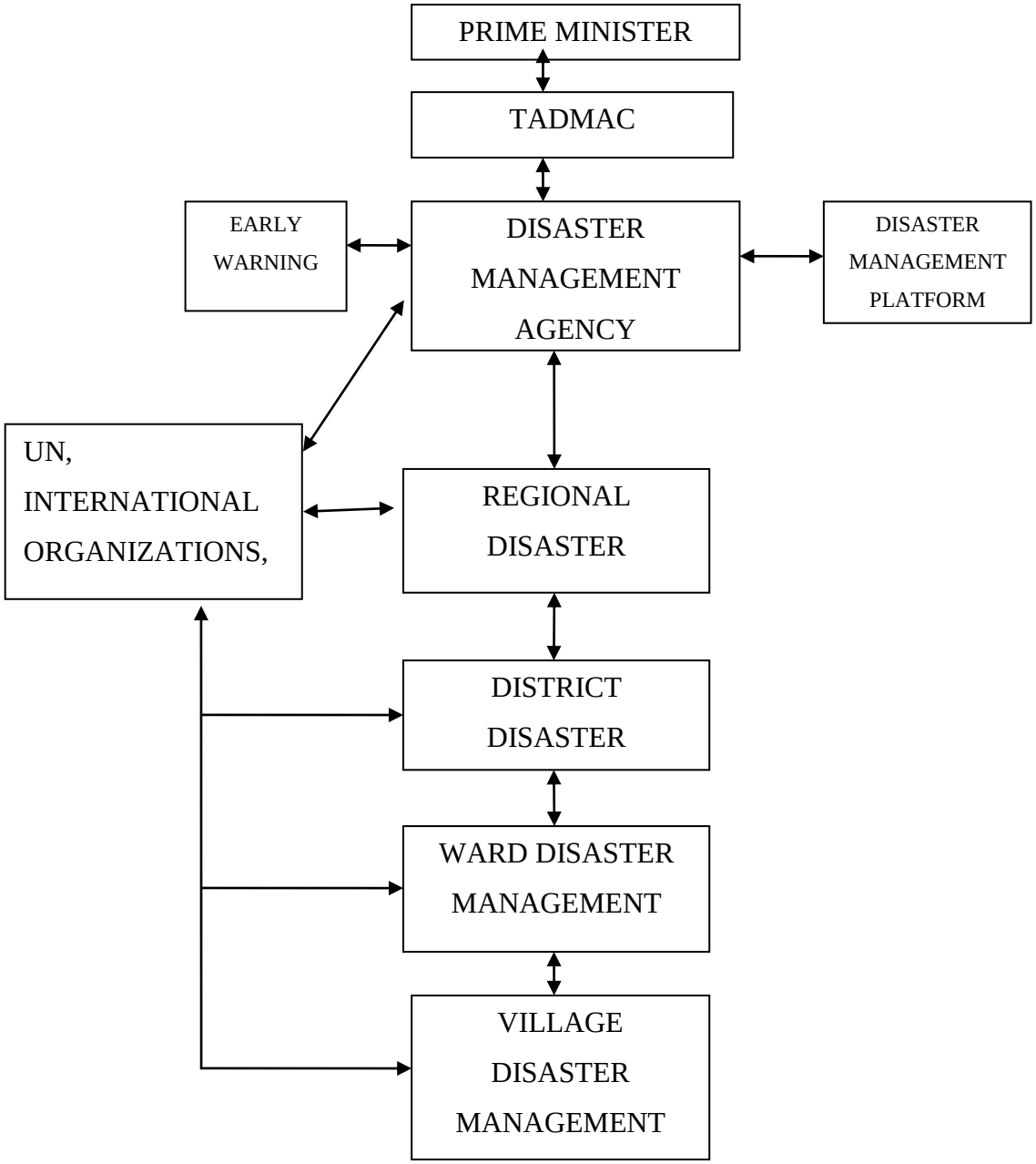
Figure 6. 2: Disaster Management Organogram



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6.3.2 - Preparedness for Technological Disasters

As part of preparedness for technological disasters, the government has established the National Disaster Management Tools and resources outlined below:-

6.3.2.1: National Disaster Management Tools

i. Disaster Management Act No. 7 of 2015;
ii. Disaster Relief Coordination Act No. 9 of 1990;
iii. National Disaster Management Policy of 2004 (Under review)
iv. National Operational Guidelines of 2014
v. Tanzania Emergency Preparedness and Response Plan (TEPRP) of 2013
vi. Tanzania Disaster Communication Strategy (TDCS) of 2013
vii. District's Emergency Preparedness and Response Plans for eighteen (18) districts
viii. Integrated Disaster Management Training Manual (IDMTM)
ix. Disaster Rapid Damage and Need Assessment Tool and Reporting Template
x. Capacity and Need Assessment Report (2008)
xi. Vulnerability Assessment Report (2003)

6.3.2.2: National Disaster Management Resources

i. National Disaster Relief Fund - For Mitigation, Preparedness, Response and Recovery disaster management activities
ii. Strategic Disaster Relief Warehouses located in six zones of the country stocked with non food relief items. These warehouses are located at North Eastern (Kilimanjaro), Coast (Dar es Salaam), Central (Dodoma), Lake (Shinyanga), Northern Highlands (Mbeya) and South Eastern (Lindi);
iii. Emergency Operations Centre (EOC). This Department has been established to strengthen early warning and communication for effective and efficient disaster preparedness and response efforts. The new EOC is located in Dar es Salaam City, at Fire station building along Morogoro road.

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6.4. Environmental Information and Awareness

6.4.1- Environmental Information

6.4.1.1: National Environment Statistics Programmes

The government has been putting efforts in strengthening production of official statistics for monitoring implementation of various development programmes. These include among others; enactment of Statistics Act, 2015 which mandates the National Bureau of Statistics (NBS) to coordinate production and dissemination of official statistics within the National Statistics System (NSS) and; establishment of the Environment Statistics and Further Analysis Department at NBS in 2004 to better coordinate compilation of environment statistics within the NSS. In addition, the need to integrate environment aspects into national development plans, policies, and strategies for sustainable development is underscored in Tanzania's Development Vision 2025. The Vision is being implemented in shorter phases of Five Year Development Plans (FYDPs). For instance, about 10 % of statistical indicators for monitoring progress of the current FYDP, 2016/17– 2020/21 are environment-related.

Other efforts undertaken in mainstreaming environment aspects include; among others, formulation of the National Environment Policy (1997); development of the National Environment Action Plan (NEAP, 2012 - 2017), National Environment Statistics Action Plan (NESAP, 2017/18) and consideration of including environment statistics in the next phase of the National Strategy for the Development of Statistics in Tanzania known as the Tanzania Statistical Master Plan (TSMP) for 2018/19 financial year. In addition, Tanzania has ratified and is implementing various Multilateral Environment Agreements (MEAs) with the aim of ensuring global and country's environment sustainability.

6.4.1.2: Number and Type of Environment Statistics Products and Periodicity of Updates

The growing pressure on environment issues and increased environmental awareness by the general public have generated a need for reliable information on environment to facilitate scientific planning and decision making on environment related matters.

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Historical background on compilation of environment statistics dates back to 1994 when the National Bureau of Statistics in collaboration with the Statistics Sweden compiled the first pamphlet on Environment Statistics. Due to lack of resources, the National Bureau of Statistics could not manage to maintain periodicity of compiling environment statistics reports. The next publication was compiled in 2012, followed by 2014 and this publication marks the first comprehensive National Environment Statistics Report in Tanzania Mainland which is compliant with the international Framework for the Development of Environment Statistics (FDES 2013). NBS is planning to update this publication after every two years and also produce environment statistics booklet on annual basis to inform the public on the status of environment for selected high frequency environment statistics such as climate change.

6.4.1.3: Existence and Number of Participating Institutions in Inter-agency Environment Statistics Platforms or Committees

Environment statistics is a cross-cutting statistical domain with specific complexities. The demand for environment statistics is increasing rapidly everywhere and its production requires combined technical expertise on environment themes, technical and institutional coordination capacities. Basing on the nature of compilation of environment statistics; NBS established the National Technical Working Group (NTWG) on environment statistics (Table 6.6). Members of this group were drawn from different institutions basing on their expertise on environmental issues. The main objectives of the NTWG is to facilitate the harmonization of methods for compilation of environment statistics which are in line with international standards, specifically, the Framework for the Development of Environment Statistics (FDES 2013).

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Table 6. 6: National Technical Working Group (NTWG) on Environment Statistics, 2017

S/N	Name of Institution	Number of Representatives
1.	Tanzania Forest Service (TFS) Agency	1
2.	National Environment Management Council	1
3.	Vice President's Office	1
4.	Prime Minister's Office	1
5.	Planning Commission	1
6.	Dar es Salaam City Council	1
7.	Ministry of Natural Resources and Tourism	1
8.	University of Dar es Salaam	1
9.	Ministry of Water and Irrigation	2
10.	Ministry of Agriculture	2
11.	Ministry of Livestock and Fisheries	1
12.	Tanzania Ports Authority	1
13.	Tanzania Meteorological Agency	1
14.	Tanzania People's Defence Forces (TPDF)	1
15.	Ministry of Energy	1
16.	Ministry of Mineral	1
17.	Tanzania Electric Supply Company Ltd	1
18.	Tanzania Forest Research Institute	1
19.	Ardhi University (ARU)	1
20.	National Bureau of Statistics	6
	Total	**29**

6.4.3- Environmental Perception and Awareness

Environmental Perception and awareness in Tanzania has increased over time attributed to the growing understanding of the public on the importance of environment and the close link between environment and their livelihoods. Environmental awareness proves important for several reasons; it fosters a sense of connection to the natural world, promotes sustainable development and encourages conservation of irreplaceable natural resources and vulnerable plant and animal species**.** Environmental awareness essentially serves as an educational tool, helping people in the country understand the economic, aesthetic and biological importance of preserving resources and reducing or eliminating the harmful impacts of man-made alterations. It also helps the public understand the consequences of human activities on various lands and identifies remedial solutions.

The increasing environmental awareness and perception in Tanzania has been accelerated by the adoption of the first National Environmental Policy in 1997. The Policy among other things is aimed at promoting public awareness and participation in environment matters. This has enabled the formulation and implementation of a number of awareness programmes aimed at increasing

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public awareness on the importance of environment conservation and sustainable use of environment resources for their livelihoods and economic development. This has been done by both the government and non state actors including NGOs and Community Based Organisations (CBOs). Different strategies and mediums have been used to carry out awareness including preparation and airing radio and TV programes, use of national and international commemoration days, focus group discussions, newsletters, specific articles on environment in local newspapers and involvement of leaders in environmental awareness campaigns across the country.

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