



THE UNITED REPUBLIC OF TANZANIA

ENVIRONMENT STATISTICS 2014



TANZANIA MAINLAND



National Bureau of Statistics
Ministry of Finance
Dar es Salaam

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VISION

“To become a one-stop centre for official statistics in Tanzania”

MISSION

“To produce quality official statistics and services that meet needs of national and international stakeholders for evidence-based planning and decision making”

TABLE OF CONTENTS

List of Tables	iv
List of Figures	viii
List of Maps	viii
Abbreviations	ix
Foreword	xii
Chapter One	1
Background Information	1
1.0 Introduction	1
1.1 Collection of Environment Statistics	1
1.2 Historical Background of Environment Statistics in Tanzania	3
1.3 Policy Framework of Environment in Tanzania	3
1.4 Definitions of Common Terms and Concepts in Environment	3
1.4.1 Environment	4
1.4.2 Environmental Audit	4
1.4.3 Environmental Degradation	4
1.4.4 Environmental Disease	4
1.4.5 Environmental Impact	4
1.4.6 Environmental Impact Assessment (EIA):	4
1.4.7 Environmental Indicators	4
1.4.8 Environmental Quality	4
1.5 Profile of Tanzania Mainland	5
1.5.1 Population	5
1.5.2 Population and Livelihood	7
1.5.3 Tanzania's Location and Physical Features	8
1.5.4 Climate	12
Chapter Two	15
Agriculture	15
2.0 Introduction	15
2.1 Soils	15
2.2 Agro-Ecological Zones	16
2.3 Farming	22
2.3.1 Area under Irrigation	22
2.3.2 Irrigation Development Programme at Regional Level	29
2.3.3 Temporary Crops	30
2.3.4 Planted Area Used by Small-Scale Farms	30
2.3.5 Fertilizers	34
2.3.6 Pesticides	38
2.4 Livestock	38
2.4.1 Grazing Area	38
2.4.2 Carrying Capacity of Livestock	39
2.4.3 Livestock Population	40

Chapter Three	47
Forestry and Wildlife	47
3.0 Introduction.....	47
3.1 Forest Area.....	47
3.2 Vegetation and Afforestation.....	48
3.2.1 Forest Plantations.....	50
3.2.2 Impact of Forests	51
3.3 Forest Products	52
3.4 Deforestation.....	56
3.4.1 National Actions to Reduce Deforestation and Forest Degradation.....	57
3.5 Wildlife	58
3.5.1 Hunting	58
3.5.2 Government Trophies	59
Chapter Four	63
Fisheries	63
4.0 Introduction.....	63
4.1 Fishing Gear.....	65
4.1.1 Fish Sources in Tanzania Mainland.....	66
4.2 Artisanal Fishing.....	70
4.3 Export of Fish and Fish Products.....	70
4.4 Fisheries Management	72
Chapter Five	73
Mining	73
5.0 Introduction.....	73
5.1 How Mining Affects the Environment	73
Chapter Six	77
Energy	77
6.0 Introduction.....	77
6.1 Electricity.....	77
6.2 Motor Vehicles	80
6.3 Petroleum Products	80
6.4 Domestic Energy.....	82
6.4.1 Round Wood, Fuel Wood and Charcoal.....	82
6.4.2 Domestic Energy Use	82
6.4.3 Impact of Domestic Energy Uses on Environment	85
Chapter Seven	89
Environmental Quality	89
7.0 Introduction.....	89
7.1 Air Quality	89
7.1.1 Review of Air Quality Data	90
7.2 Water Quality.....	96

7.2.1	Objectives of Water Quality Assessment	101
7.2.1.1	Single-objective Monitoring	101
7.2.1.2	Multi-objective Monitoring	101
7.3	Major Properties of Water	102
7.3.1	Physical Properties of Water.....	102
7.3.2	Chemical Properties of Water.....	102
7.3.3	Biological Components.....	103
7.4	Land Quality	107
7.5	Waste Management.....	108
7.6	Waste Composition.....	112
Chapter Eight.....		113
Environmental Protection.....		113
8.0	Introduction.....	113
8.1	National Parks.....	113
8.2	National Reserves	115
8.2.1	Game Reserves	117
8.2.2	Game Controlled Areas	118
8.2.3	Wildlife Management Areas (WMAs)	120
8.2.4	Forest Reserves	122
8.2.5	Marine Protection/Reserves	122
8.3	Environmental Impact Assessment (EIA)	127
8.3.1	EIA Certificates	127
8.3.2	Environmental Audit Certificates	129
8.3.3	Registration of Environmental Experts.....	130
8.4	Multilateral Environmental Agreements (MEAs)	132
Chapter Nine		135
Environmental Health and Sanitation		135
9.0	Introduction.....	135
9.1	Communicable Disease Outbreaks	136
9.2	Water Supply, Sanitation and Housing Conditions	140
9.2.1	Water Supply	140
9.2.2	Sanitation and Hygiene.....	141
9.2.2.1	Toilet Facility.....	142
9.2.2.2	Disposal of Household Garbage	143
9.2.3	Housing Conditions	143
Chapter Ten		145
Population Growth and Environment		145
10.0	Introduction.....	145
10.1	Potential Implication of Population Change.....	147
10.2	Trends in Population Distribution and Percent Change from 1967, 1978, 1988, 2002 and 2012 Censuses.....	147
Appendices.....		149

LIST OF TABLES

Table 1.1: Percentage Distribution of Population (aged 10+) by selected the Occupations, Tanzania Mainland, 2012	7
Table 1.2: Percentage Distribution of Employed Population (aged 10+) by selected the Main Industries, Tanzania Mainland, 2012.....	7
Table 1.3: Mountain Summits with Their Altitudes and Rank, Tanzania Mainland	10
Table 1.4: Road Network by Type and Condition, Tanzania Mainland, 2014.....	11
Table 2.1: Types of Soil Texture by Zone, Tanzania Mainland	16
Table 2.2: Main Features and Agro-Ecological Zones of Tanzania Mainland.....	17
Table 2.3: Detailed Features of Agro-Ecological Zones inTanzania Mainland, 2014	19
Table 2.6: Irrigation Development Areas by Type and Region up to 2017, Tanzania Mainland...	29
Table 2.7: Cumulative Irrigated Area (hectares) under Paddy and the Quantity Produced in Tonnes	30
Table 2.6a: Small Scale Farming; The Area (000 ha) Planted with Selected Crops by Crop-Year Tanzania Mainland, 2005/06 – 2012/13	31
Table 2.6 b: Small Scale Farming: The Area (000 ha) Planted with Selected Cereal Crops during the 2007/08 Crop Year by Region and Type of Cereal, Tanzania Mainland	32
Table 2.6 c: Small Scale Farming: The Area (000 ha) Planted with Selected Oil Seed Crops, Pulses, Banana, Roots and Tubers during the 2007/08 Crop Year by Region and Type of Crop, Tanzania Mainland	33
Table 2.6 d: Small Scale Farming: The Area (000 ha) Planted with Selected Oil Seed Crops, Pulses, Bananas, Roots and Tubers during the 2011/12 Crop Year by Region and Type of Crop, Tanzania Mainland	34
Table 2.7: Estimated Demand for Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13	35
Table 2.8: Availability of Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13 .	35
Table 2.9: Consumption of Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13	36
Table 2.10: Imported Fertilizers (kg) by Type, Tanzania Mainland, 2010 – 2014.....	37
Table 2.11: The Livestock Grazing Area by Region, Tanzania Mainland, 2005	39
Table 2.12: Small Holder Agriculture; the Estimated Carrying Capacity of Livestock by Region, Tanzania Mainland, 2008	40
Table 2.13: Small Holder Agriculture; Distribution of Livestock by Type and by Region, Tanzania Mainland, 2008	41
Table 2.14a: Small Holder Agriculture; Distribution of Cattle Population by Type and by Region, Tanzania Mainland, 2008	43
Table 2.14 b: Small Holder Agriculture; Distribution of Goats Population by Type and by Region, Tanzania Mainland, 2008.....	44
Table 2.14 c: Small Holder Agriculture; Distribution of Sheep Population by Type and by Region, Tanzania Mainland, 2008.....	46

Table 3.1: Distribution of Forest Area by Category, Tanzania Mainland, 2013/14	48
Table 3.2: Tree Planting – Seedlings Planted by Region, Tanzania Mainland, 2006/07 - 2013/14	50
Table 3.3: Area Planted with Trees – Industrial Plantation Forests, Tanzania Mainland, 2013.....	51
Table 3.4: Exported Forest Products and the Revenue Collected, Tanzania Mainland, 2006/07 - 2010/11	53
Table 3.5: Supply of Wood and Non-Wood Products by Station and Type of Product, Tanzania Mainland, 2001/02 – 2003/04	55
Table 3.6: Number of Hunting Companies and Tourist Hunters by Year, Tanzania Mainland, 2000/01 – 2012/13	59
Table 3.7: Exports of Government Trophies by Type of Specie, Tanzania Mainland, 2005 – 2013	59
Table 3.8: Earnings from Hunting Tourism and Export of Live Animals by Activity, Tanzania Mainland, 2008/09– 2013/14	60
Table 3.9: Trends in Earnings from Wildlife Subsector, Tanzania Mainland, 2006/2007 – 2010/2011	60
Table 3.10: Elephant Ivory Seizure, Tanzania Mainland, 2010 – 2014.....	61
Table 3.11: Bush Meat (kg) Poaching by Specie, Tanzania Mainland, 2010 – 2012.....	61
Table 4.1 a: Number of Fishers, Fishing Crafts and Fish Catches in Marine and Fresh Water, Tanzania Mainland, 2005 – 2014	64
Table 4.1 b: Number of Fishers, Fishing Crafts and Fish Catches in Marine Waters, Tanzania Mainland, 2005 – 2014	64
Table 4.1 c: Number of Fishers, Fishing Crafts and Fish Catches in Fresh Waters, Tanzania Mainland, 2005 – 2014	65
Table 4.2: Summary of Artisanal Fisheries Statistics by Water Body, Tanzania Mainland, 2014.	67
Table 4.3: Number of Fishers and Crafts, Weight and Value of Catches by Water Body, Tanzania Mainland, 2012 -2014.....	69
Table 4.4: Fish and Fishery Products Exported, Tanzania Mainland, 2005 – 2014	71
Table 4.5: Exports of Nile Perch, Tanzania Mainland, 2004 – 2014.....	71
Table 5.1: Production of Minerals by Type, Tanzania Mainland, 2010 - 2014.....	74
Table 5.2: Quantity of Minerals Exported, Tanzania Mainland, 2010 – 2014	75
Table 6.1: Installed Capacity and Total Units Generated by Type of Source, Tanzania Mainland, 2011 – 2014	78
Table 6.2: Quantity of Electricity Sold by Tanesco Region/Area, Tanzania, 2011 - 2014	79
Table 6.3: Quantity of Electricity Generated and Sold to Different Users, Tanzania, 2011 – 2014	79
Table 6.4: Number of Imported Vehicles by Type, Tanzania 2007 – 2014	80
Table 6.5: Imports of Petroleum and Petroleum Products (in kg), Tanzania, 2010 – 2014.....	81
Table 6.6: Percentage Distribution of Households by Source of Energy for Lighting, Tanzania Mainland, 2012.	83
Table 6.7: Percentage Distribution of Households by Source of Energy for Cooking, Tanzania Mainland, 2012.	83

Table 6.8: Percentage Distribution of Households by Source of Energy for Lighting and Cooking, Tanzania Mainland, 2000/01, 2007 and 2011/12	84
Table 7.1: Average Concentration of Air Pollutants Sampled in Dar es Salaam, Aug. 2005 – Dec. 2007	90
Table 7.2: Summary of Air Pollutants at Five Monitoring Stations during the 1992 Pilot Study..	91
Table 7.3: Nitrogen Dioxide Results from Monitoring Sites during the 1995 Study by NILU.....	91
Table 7.4: Summary of Air Pollutant Concentrations in DSM during the 1996 CEEST Study.....	92
Table 7.5a: Summary of Average Air Pollutants Concentrations at Sampled Bus Stations during the 2003 UCLAS Study	93
Table 7.6: Carbon Dioxide (CO ₂) Emissions by Sector, Tanzania, 1999.....	95
Table 7.7: Non – Carbon Dioxide (CO ₂) Air Pollution, (in 000 tonnes), 1995	96
Table 7.8: Water Supply Coverage in Urban and Rural Areas of Tanzania Mainland.....	97
Table 7.9: Water Supply to Selected Urban Areas, Tanzania Mainland, 2007	98
Table 7.10: Water Supply to Rural Areas by Region, Tanzania Mainland, 2005	98
Table 7.11: The Tanzania Standards of Quality of Domestic Water Use.....	99
Table 7.12: Discharge Data by Basin, Tanzania Mainland, 2005.....	100
Table 7.13: Percentage of Water Areas Owned by Tanzania, 2014	101
Table 7.14: Links Between Inland Freshwater Pollution and Other Assessment Media.....	104
Table 7.15: Pollution Load to Surface Water Resources (kg/day), Dar es Salaam, 1988	105
Table 7.16: Pollution Load to Groundwater Resources (kg/day), 1991 Projections	105
Table 7.17: Rapid Assessment of Industrial BOD ₅ Loads Penetration to Pangani River Up to Nyumba ya Mungu (Arusha Industrial Establishments), 2000.....	106
Table 7.18: Rapid Assessment of Industrial BOD ₅ Loads Penetration to Pangani River Up To Nyumba ya Mungu (Kilimanjaro Industrial Establishments), 2000.....	106
Table 7.19: Pollution Loads in Msimbazi River, 2011	107
Table 7.20: Pollution Load (kg/day) to Lake Victoria, 2007	107
Table 7.21: Water Quality in Msimbazi River during Wet and Dry Seasons, 2011.....	107
Table 7.22: Generation of Waste by Source in the City of Dar es Salaam, 2012 - 2014.....	109
Table 7.23: Generation and Recycling of Selected Waste Material, City of Dar es Salaam, 2012 - 2014	109
Table 7.24: Management of Municipal Wastes, City of Dar es Salaam, 2012 - 2014.....	110
Table 7.25: Management of Municipal Waste in Ilala, Kinondoni and Temeke Municipalities....	111
Table 7.26: Waste Treatment and Disposal Facilities, Dar es Salaam City, 2012 - 2014	112
Table 7.27: Percentage Composition of Municipal Wastes, Dar es Salaam City.....	112
Table 7.28: Overall Solid Waste Equipment Required and Owned by the Dar es Salaam City Council, 2011	112
Table 8.1: List of National Parks, by Bordering Districts and Size, Tanzania Mainland, 2014...	114
Table 8.2: Anti-poaching Activities from 2000 – 2014, Tanzania Mainland.....	115
Table 8.3: Protected Areas in Tanzania Mainland, 2011	116

Table 8.4: Game Reserves, Tanzania Mainland, 2014	118
Table 8.5: List of Game Controlled Areas (GCAs), Tanzania Mainland, 2014	119
Table 8.6: Wildlife Management Areas (WMAs), Tanzania Mainland, 2003 – June, 2013	121
Table 8.7: The Management of Marine Protected Areas, Tanzania, 2005	125
Table 8.8: Issued EIA and EA Certificates by Sector, Tanzania Mainland, 2010/2011.....	129
Table 8.9: Major Conventions on Environment to which Tanzania is a Party	132
Table 9.1: Infectious Diseases Report, Tanzania Mainland, 2012.....	137
Table 9.2: Environmentally Related Health Facility Attendances and OPD Diagnoses for Diseases of All Ages, Tanzania Mainland, 2010.....	138
Table 9.3: Proportion (percent) of Persons Reporting Environmentally Related Diseases by Age Group and Sex, Tanzania Mainland, 2007 and 2011/12.....	139
Table 9.4: Percentage Distribution of Households by Location and Main Source of Drinking Water, Tanzania Mainland, 2012	140
Table 9.5: Percentage Distribution of Households by Distance from Home to Water Source, Season and Area, Tanzania Mainland, 2011/12	141
Table 9.6: Sewerage System, Tanzania, 2012	142
Table 9.7: Percentage Distribution of Households by Type of Toilet Facility, Tanzania Mainland, 2012	142
Table 9.8: Percentage Distribution of Households by Type of Refuse Disposal, Tanzania Mainland, 2012	143
Table 9.9: Percentage Distribution of Households' by Construction Materials and Area, Tanzania Mainland, 2000/01, 2007 and 2011/12 HBS's	144

LIST OF FIGURES

Figure 1.1:	Status of Road Network by Type and Condition, Tanzania Mainland, 2014	12
Figure 1.2:	Distribution of Mean Rainfall by Month, Tanzania Mainland, 2010 - 2014	13
Figure 1.3:	Average Maximum Monthly Temperature, Tanzania Mainland, 2010- 2014.....	13
Figure 1.4:	Average Minimum Monthly Temperature, Tanzania Mainland, 2010 - 2014.....	14
Figure 2.1:	Distribution of Irrigation Development Potential Area (million ha.) by Quality, Tanzania Mainland, 2002.....	25
Figure 4.1:	Artisanal fishing gear in Tanzania Mainland, 2014	66
Figure 4.2:	Percentage Contribution to Production by Artisanal Fisher in Fresh and Marine Water, Tanzania Mainland, 2014	70
Figure 7.1:	The Interrelationship between Major Environmental Monitoring Systems.....	104
Figure 8.1:	Trend of EIA Certification, Tanzania Mainland, 2005 - 2014.....	128
Figure 8.2:	Trend of EIA Certification by Region, Tanzania Mainland, 2005/06 to 2013/14 ...	128
Figure 8.3:	Environmental Audit Certificates Issued, Tanzania Mainland, 2005/06 – 2009/10	130
Figure 8.4:	Registered Environmental Impact Assessment and Environmental Auditing Experts, Tanzania Mainland, 2009 - 2014	130
Figure 8.5:	Registered Environmental Impact Assessment and Environmental Auditing Firms, Tanzania Mainland, 2009-2014	131
Figure 8.6:	EIA Certificates issued by Sector from in the period of 2005 to 2014.....	131

LIST OF MAPS

Map 1:	Population Density by Region, Tanzania, 2012	6
Map 2:	Tanzania Rivers Network.....	9
Map 3:	Tanzania Mainland Showing Irrigation Potential Areas	23
Map 4:	Percentage of Households Using Electricity as their Main Source of Energy for Lighting by Region, Tanzania Mainland, 2012	87
Map 5:	Tanzania National Reserve Areas	117

ACRONYMS AND ABBREVIATIONS

ASC	-	Agriculture Sample Census
AQMCPB	-	Air Quality Monitoring Capacity Building Project
BOD	-	Biological Oxygen Demand
BRN	-	Big Results Now
CDM	-	Clean Development Mechanism
CEC	-	Conditional Environmental Clearance
CEEST	-	Center for Energy, Environmental Science and Technology
CEEPA	-	Center for Environmental and Economic Policy in Africa
COP	-	Conference of Parties
C&STWG	-	Censuses and Surveys Technical Working Group
DSM	-	Dar es Salaam
EDA	-	Economic Development of Africa
EEZ	-	Exclusive Economic Zone
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
EMA	-	Environmental Management Act
EPA	-	Environmental Protection Agency
ERB	-	Economic Research Bureau
FAO	-	Food and Agriculture Organization of the United Nations
HBS	-	Household Budget Survey
GEMS	-	Global Environment Monitoring System
GHG	-	Greenhouse Gas
HIV	-	Human Immunodeficiency Virus
IRA	-	Institute of Resource Assessment
ICM	-	Integrated Coastal Management
ISIC	-	International Standard Industrial Classification of All Economic Activities
IWRM	-	Integrated Water Resources Management
LPG	-	Liquified Petroleum Gas
MAFC	-	Ministry of Agriculture, Food Security and Cooperatives
MCS	-	Monitoring, Control and Surveillance
MDG	-	Millennium Development Goals
MEM	-	Ministry of Energy and Minerals
MPRU	-	Marine Parks and Reserves Unit
MIMCA	-	Mnemba Island Marine Conservation Area
MMC	-	Muhimbili Medical Centre
MNRT	-	Ministry of Natural Resources and Tourism
MPA	-	Marine Protected Area
MWI	-	Ministry of Water and Irrigation
NAFORMA	-	National Forest Resources Monitoring and Assessment
NAWAPO	-	National Water Policy
NBS	-	National Bureau of Statistics
NCSSD	-	National Conservation Strategy for Sustainable Development

NEAP	-	National Environment Action Plan
NEMC	-	National Environment Management Council
NEP	-	National Environment Policy
NGO	-	Non-Government Organisation
NFMS	-	National Forest Monitoring Systems
NIC	-	National Irrigation Commission
NILU	-	Norwegian Institute of Air Research
NOAA	-	National Oceanic and Atmospheric Administration
NSGRP	-	National Strategy for Growth and Reduction of Poverty
PEA	-	Preliminary Environmental Assessment
PHRDF	-	Policy and Human Resources Development Fund
PCBs	-	Polychlorinated biphenyls
POP	-	Persistent Organic Pollutants
POPP	-	President's Office Planning and Privatisation
PMO-RALG	-	Prime Minister's Office Regional Administration and Local Government
PMS	-	Poverty Monitoring System
PRS	-	Poverty Reduction Strategy
REDFD	-	Reducing Emission from Deforestation and Forest Degradation
SDP	-	Sustainable Dar es Salaam Project
SARDC	-	Southern African Research and Documentation Centre
SPM	-	Suspended Particulate Matter
SRI	-	System of Rice Intensification
SUA	-	Sokoine University of Agriculture
TAFIRI	-	Tanzania Fisheries Research Institute
TAFORI	-	Tanzania Forest Research Institute
TANESCO	-	Tanzania Electric Supply Company
TAWIRI	-	Tanzania Wildlife Research Institute
TBS	-	Tanzania Bureau of Standards
TFAP	-	Tanzania Forest Action Plan
TFC	-	Tanzania Fertilizer Company
TMA	-	Tanzania Meteorological Agency
TPDC	-	Tanzania Petroleum Development Corporation
UCLAS	-	University College of Lands and Architectural Studies
UDSM	-	University of Dar es Salaam
UK	-	United Kingdom
UN	-	United Nations
UNCCD	-	United Nations Convention to Combat Desertification
UNEP	-	United Nations Environment Programme
UNFCCC	-	United Nations Framework Convention on Climate Change
UNICEF	-	United Nations Children's Fund
UNESCO	-	United Nations Education Scientific and Cultural Organization
URT	-	United Republic of Tanzania
USA	-	United States of America

USGS	-	United States Geological Survey
VPO	-	Vice President's Office
VPO-DOE	-	Vice President's Office – Division of Environment
WB	-	World Bank
WHO	-	World Health Organisation
WMAs	-	Wildlife Management Areas

UNIT OF MEASUREMENT AND SYMBOLS

kg	-	kilogram
ha	-	hectares
m	-	metres
mg	-	milligrams
km	-	kilometres
t	-	tonnes
km ²	-	square kilometre
%	-	percentage
L	-	litre
m ³	-	cubic metre
ppb	-	parts per billion
Wh	-	watt-hours
MW	-	Megawatt
GWH	-	Gigawatt-Hour = Million KWH
W	-	watts
USD	-	United States Dollars
TZS	-	Tanzanian Shillings
Inh	-	inhabitants
µg/m ³	-	microgram per cubic metre
µg/L	-	microgram per litre

n.a. means "not applicable"

0 means "negligible"

- means, "data not available"

n.e.c means, "not elsewhere classified"

n.e.s means, "not elsewhere stated"

p means, "provisional/estimate"

r means, "revised"

FOREWORD

This publication on environment statistics is produced by the National Bureau of Statistics (NBS). I feel heartened to produce this third publication of “ENVIRONMENT STATISTICS IN TANZANIA MAINLAND”. Indeed, publishing the environment statistics of Tanzania marks yet another milestone in NBS documentary. The publication has come at the right time as challenges posed by the environment are a major concern both nationally and internationally. This situation has prompted the NBS to see environment statistics as an essential tool in facilitating decision making and policy formulation.

Since its inception, the NBS has, in one way or another, been involved in producing statistics that environment related. This is in essence possible due to the nature of the data that constitute environment statistics are of cross-cutting nature. Compiling of environment statistics as an embedded subject does not reflect the influence it would command if compiled separately. To do this effectively the statistics have been dealt with under specified subjects.

This publication is divided into ten chapters. Background information pertaining to human population, animal population and climate is discussed in Chapter One. Chapter Two presents components of agriculture while Chapter Three describes forestry and wildlife. The remaining chapters examine fisheries; mining; energy; environmental quality; environmental protection; environmental health and sanitation; and population growth and environment.

I would like to draw the attention of the reader to the adequacy and relevance of the itemised variables and their use, though further disaggregation of the subject-matter chapters is advisable and desirable. Nevertheless, I would like to extend my sincere gratitude to all those who strived to make this initiative a success.

I extend my sincere thanks to all government Ministries, Departments and Agencies that contributed generously to these manuscripts and enabled NBS to come up with chapters relating to their sectors. Furthermore, I would like to express my special gratitude to the Vice President’s Office, Division of Environment, the National Environment Management Council (NEMC), as well as other institutions and individuals for providing information and technical advice on specialized studies they had undertaken at different times.

I also take this opportunity to commend the Department of Environment Statistics and Statistical Analysis at NBS for the publication of this statistical report.

Lastly, I urge all users of this publication to assist the NBS by providing their views and comments that will improve the report of Environment Statistics for Tanzania in the near future.

Dr. Albina Chuwa

Director General

National Bureau of Statistics

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CHAPTER ONE

BACKGROUND INFORMATION

1.0 Introduction

Environmental awareness and movement of the 1960s and 1970s facilitated the enactment of laws aimed at protecting the environment globally. In Tanzania, the National Environmental Management Council (NEMC) was established as an agency to enforce these laws. NEMC was established by Act of Parliament Number 19 of 1983 to oversee the integrity of Tanzania's environment toward the achievement of the national goal of sustainable development as set out in the National Development Vision 2025. The environment portfolio was given more weight by being moved from the Ministry of Natural Resources, Environment and Tourism in 1995 to become a division under the Vice President's Office with a Minister responsible for environment.

Furthermore, the NEMC and the Division of the Environment were strengthened through the passing of the Environmental Management Act (EMA) of 2004, which was assented by the President of the United Republic of Tanzania on 8 February 2005. However, the environmental policy for Tanzania was formulated in 1997 with particular attention paid to the establishment and strengthening of institutions responsible for systematic monitoring of the state of the environment to cover the environmental information gaps.

In order to monitor this process over time, there is a need for ensuring that adequate environment statistics are produced regularly. Similarly the use of statistical techniques in monitoring and forecasting environmental changes require such statistics.

1.1 Collection of Environment Statistics

Environment is a cross cutting issue that involves all sectors of the economy under the mainstream ministries. Some of these ministries are Natural Resources and Tourism, Agriculture Food Security and Cooperatives, Education and Vocational Training, Energy and Minerals, Fisheries and Livestock Development as well as Water and Irrigation. In the various sectors, the environment is impacted by deliberate human activities carried out in the pursuit of livelihood, while some impacts occur naturally. These impacts can be either positive or negative.

Environment statistics describe the state and trend of the environment, in the media of the natural environment, air/climate, water, land/soil, the biota within the media and human settlements. Environment statistics are integrative in nature, measuring human activities and natural events that affect the environment, themselves as well as the social responses and the quality and availability of natural assets.

Environmental data includes data on direct and indirect values, some of which are captured within the market setting while others are not, since they are not traded but are very important and need to be monitored and analyzed. Again, environmental data could be in the form of stocks and flows such as forest cover at a point in time or amounts cut down or grown. Others are stocks and flows such as pollution of air and water among others. Accordingly, the collection of environmental statistics is made in different sectors and by various organizations or institutions.

In the USA the Environmental Protection Agency (EPA) collects data and monitors the quality of air, drinking as well as surface and ground water, ecosystem status and the introduction of toxic or hazardous substances into the environment while the National Aeronautics and Space Administration collects remote sensing data to support climatic research. The National Oceanic and Atmospheric Administration (NOAA) gathers worldwide environmental information about the ocean, earth, air, space and sun and their interactions in order to describe and predict the state of physical environment. The United States Geological Survey (USGS) through its Water Resources Division collects and maintains data on the quality, availability and use of the national water, which include stream flow data for hydro plants, groundwater subsistence, erosion, backwater, flooding, water contamination and sedimentation.

Environmental statistics in the United Kingdom comprise of data on air quality, coastal and marine waters, environmental protection expenditures by industry, global atmosphere as well as inland water quality and use, land use and land cover, noise, radioactivity, waste and recycling, wildlife and public attitudes to quality of life and the environment among others.

In Tanzania environmental statistics include most of the variables collected in USA and UK but some are not readily available due to technological and resource constraints. It is, however, envisaged that in the long run most of the data will be collected. Therefore, a complete set of environmental quality data will, in the future, involve quite a number of sectors and institutions falling under the Ministry of Water and Irrigation (MWI) for water quality and quantity, while NEMC will supply data on air quality, noise levels and other areas. The ministries of Agriculture Food Security and Cooperatives and Energy and Minerals will supply data on land use and its quality.

Efforts to streamline the collection of environmental statistics are underway including the initiative of Poverty Reduction Strategy (PRS) and currently the National Strategy for Growth and Reduction of Poverty (NSGRP) which is popularly known as MKUKUTA. Collaboration with the Economic Research Bureau (ERB) at University of Dar es Salaam (UDSM), Sokoine University of Agriculture (SUA), University College of Lands and Architectural Studies (UCLAS), National Environmental Management Council (NEMC) and other environmental related institutions will ultimately, lead to a systematic collection of environmental statistics that will facilitate planning and informed decision making for sustainable development.

1.2 Historical Background of Environment Statistics in Tanzania

The growing pressures on environment issues and increased environment 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.

Despite the fact that the environment in which humans live has been existed for decades: it was not until the mid nineties, that, with the assistance of Statistics Sweden the NBS managed to compiled a subject matter pamphlet called “Environment Statistics on Tanzania Mainland, 1994”. However, the publication has not been updated since then due to, among other things, lack of a formal section within NBS that dealt entirely with the issue. However, in order to address this shortfall and fulfill global commitments, the NBS established a Department for Environment Statistics in 2004. This publication is an update of the Environment Statistics 2012, Tanzania Mainland.

1.3 Policy Framework of Environment in Tanzania

The major area that the Government of Tanzania aims at addressing in both the Millennium Development Goals (MDGs) and the development vision (Vision 2025) is the reduction of poverty. To realize this vision, the Government developed and implemented a Poverty Reduction Strategy (PRS) from 2001/02 to 2004/05. It was followed by a five-year National Strategy for Growth and Reduction for Poverty I (NSGRP I), commonly known as MKUKUTA which started being implemented in July 2005. Currently NSGRP II is being implemented.

One of the major areas of concern for MKUKUTA is the growth and reduction of poverty whereby the anticipated broad outcome is the achievement and sustainability of a broad based and equitable growth. Unlike the previous PRS, MKUKUTA explicitly addresses, the poverty-environment linkages. Some of the environment related targets include: reduced negative impacts on environment and peoples’ livelihood; reduced land degradation and less loss of bio-diversity; and provision of reliable and affordable energy to consumers.

In order to monitor progress towards the achievement of these targets, there is need for data from various sources to feed into the Poverty Monitoring System (PMS). The National Bureau of Statistics is one of the institutions that play a major role in the production of statistical data in the country and it has been serving as both chair and secretariat for the Censuses and Surveys Technical Working Group (C&STWG) of the PMS.

1.4 Definitions of Common Terms and Concepts in Environment

Some terms and concepts in environment are technical and therefore, need to be defined. This section gives some definitions relating to environment, while others can be found in Appendix 11.

1.4.1 Environment

The totality of the external conditions affecting the life development and survival of an organism.

1.4.2 Environmental Audit

An independent and objective oriented examination of whether a practice complies with expected standards. Broadly, environmental audit means a check on some aspects of environmental management, and implies some kind of testing and verification.

1.4.3 Environmental Degradation

Deterioration of environmental quality from ambient concentration of pollutants and other activities including processes such as improper land use and natural disasters.

1.4.4 Environmental Disease

A disease that is, at least in part, caused or aggravated by living conditions, climate, water supply or other environmental conditions. Environmental factors that may affect health include psychological, biological, physical and accident related factors. Environmental diseases include in particular communicable diseases such as respiratory and vector-borne diseases such as malaria, schistosomiasis and onchocerciasis.

1.4.5 Environmental Impact

Direct effect of socio-economic activities and natural events on the components of the environment.

1.4.6 Environmental Impact Assessment (EIA):

A systematic examination conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment.

1.4.7 Environmental Indicator

Parameter or volume derived from parameters that provide information about and/or describes the state of the environment and has a significance extending beyond that directly associated with any given parametric value.

1.4.8 Environmental Quality

State of environmental conditions in environmental media, expressed in terms of indicators or indices related to environmental quality standards.

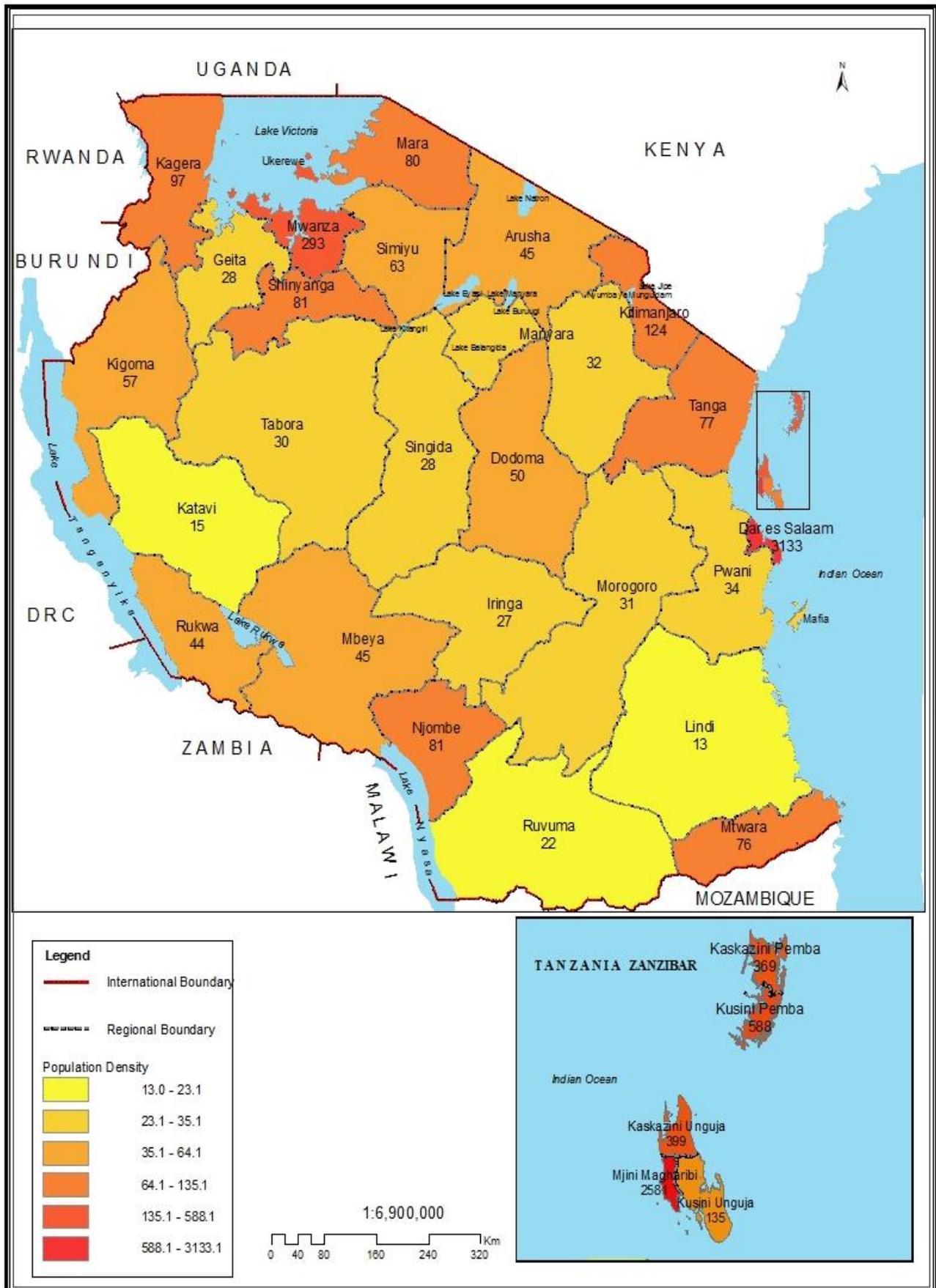
1.5 Profile of Tanzania Mainland

1.5.1 Population

Environment related studies collect information on various characteristics and subsequently relate them to how they affect the human beings nearby. The presence of humans in different areas gives rise to pressures on, not only the means of subsistence in the area but also on how to combat problems brought about by pollution, water shortage, excessive temperature and heavy rainfalls, to mention but a few. Therefore climate and quality of soils are important in estimating the potential carrying capacity of an area. In a place with a dry climate, annual precipitation is the most important factor for biological productivity, i.e., for the production of forests, food, livestock, wild plants and animals.

Population data for all regions and districts as per the 2012 Population and Housing Census are presented in this section. The map of Tanzania below shows population density by region. More regional and district statistics are given as Appendix 1.

Map 1: Population Density by Region, Tanzania, 2012



1.5.2 Population and Livelihood

Table 1.1 shows the percentage distribution of population by selected occupations from the 2012 Population and Housing Census. From the table it can be observed that 62.8 percent of the population of age 10 years or above are farmers. It can be further noted that 76.2 percent of the rural areas population and 26.7 percent of the urban areas population of the same age are farmers. The results revealed that about three-quarters of Tanzania Mainland's economically active population rely directly on the environment to earn their livelihoods.

Table 1.1: Percentage Distribution of Population (aged 10+) by selected the Occupations, Tanzania Mainland, 2012

Occupation	Tanzania Mainland	Rural	Urban
Farmers	62.8	76.2	26.7
Livestock keepers	2.4	2.9	0.9
Fishermen	0.9	0.8	1.0
Elementery	6.2	5.2	8.8
Sreet Vendors and Related	3.0	0.9	8.8

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB

The same applies when we look at the distribution of population employed by industry; about 62.7 percent of the population is employed in agriculture, commercial, food crops and forestry (Table 1.2). In rural areas, more than three quarters (75.7 percent) of the population are engaged in the same industry.

Table 1.2: Percentage Distribution of Employed Population (aged 10+) by selected the Main Industries, Tanzania Mainland, 2012

Industry	Tanzania Mainland	Rural	Urban
Agriculture, Commercial, Food Crops and Forestry	62.7	75.7	27.6
Fishing, Hunting, Livestock and Other related	3.5	3.8	2.5
Mining and Quarrying	2.6	2.3	3.5
Manufacturing	3.1	1.1	8.5
Construction	2.4	1.1	5.8
Raw Food Sales (Uncooked)	3.3	1.1	8.9
Trade and Commerce	6.3	4.8	10.1
Haulage and Storage	1.3	0.5	3.5
Service for food Hotels and Lodges	1.7	0.7	4.6

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB

Industries generally produce substantial amounts of polluting substances and discharge them to the air, water and land. Knowledge of the numbers and location of establishments carrying out various industrial activities is vital for measuring various types of emissions. The number of industrial establishments is presented in Appendix 2 as a measure of potential pollution sources. The information on industrial establishments is compiled by NBS through Annual Surveys of Industrial

Production. Appendix 2 shows the distribution of establishments by activity and by region for the year 2010.

1.5.3 Tanzania's Location and Physical Features

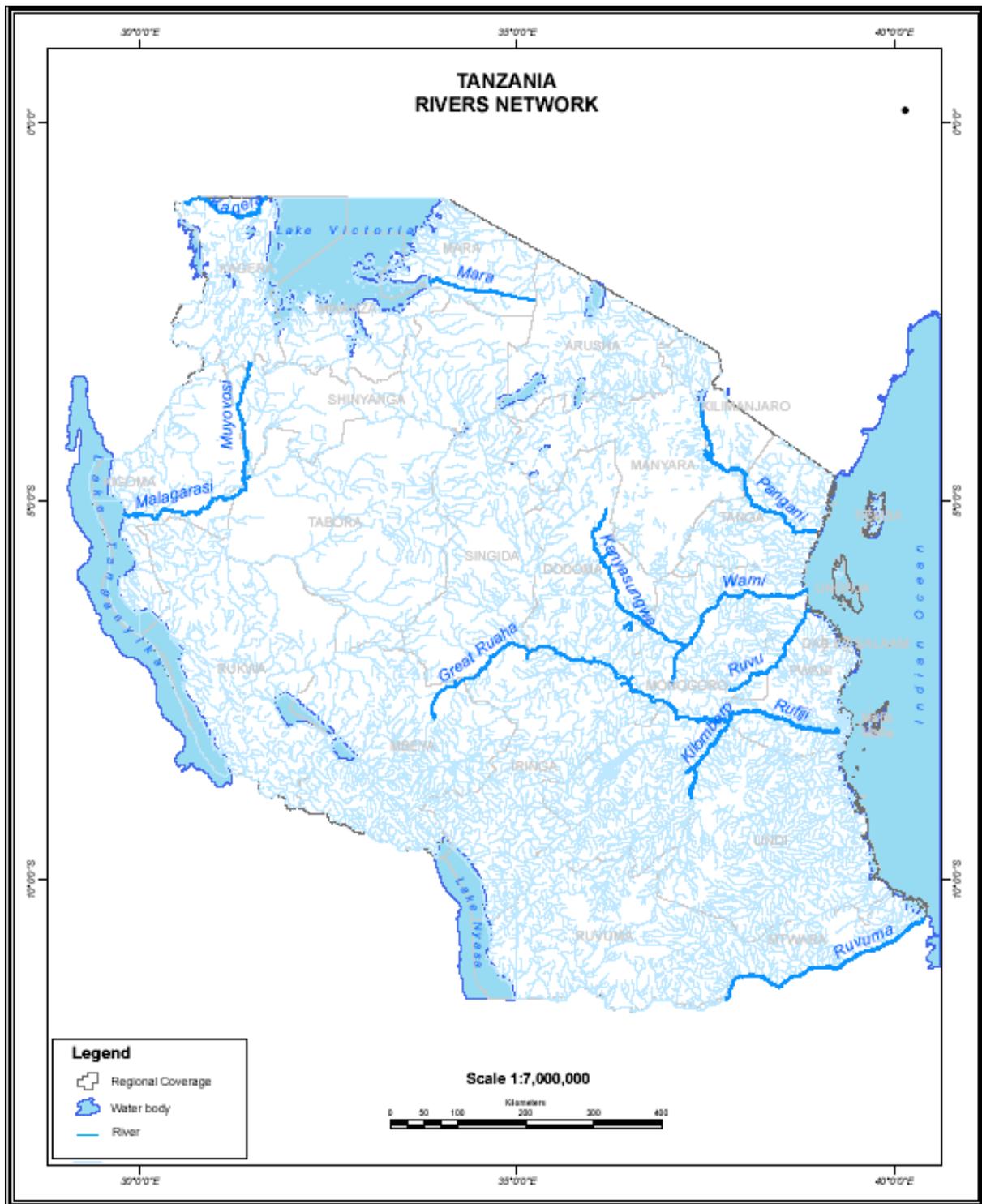
Tanzania lies just south of the Equator between latitudes 1⁰ and 12⁰ South of the Equator, and longitudes 29⁰ and 41⁰ East of Greenwich Meridian. Mainland Tanzania has borders with the following countries:- Democratic Republic of Congo, Rwanda, Burundi to the West; Uganda and Kenya to the North; Mozambique to the South; Malawi and Zambia to the South West. On the Eastern side it shares a border with the Indian Ocean. It covers an area of 943,000 square kilometres. This includes an estimated inland water area of 62,000 square kilometres. Except for the 900 kilometre coast line most of its land lies above 200 metres altitude; and much of the country is higher than 1,000 metres above sea level.

In the north, Mount Kilimanjaro, with a permanent ice cap rises to over 5,500 metres above sea level, with the highest peak Kibo reaching 5,895 metres. While this is the highest point in Africa, the lowest point is to be found somewhere on the bed of Lake Tanganyika, the deepest lake in Africa. A distinctive feature is the Rift Valley whose form is marked in parts by long, narrow and deep depressions often filled with lakes. The Great Rift Valley runs from near the mouth of the Zambezi River northwards through Tanzania, Kenya, and Ethiopia and across the Red Sea to Israel. Lake Tanganyika lies in the western rift that continues northwards through Lake Kivu.

Although there are no data to establish individual rivers in Tanzania Mainland, there is a map depicting their location. The area covered by inland water bodies account for about seven percent of the total Mainland area. Rivers flow into the Indian Ocean or the Great Lakes which are, Victoria, Tanganyika and Nyasa. Many of the rivers are seasonal, ceasing flowing in the dry season, and only Rufiji, pouring its waters in the Indian Ocean opposite Mafia Island and the Kagera into Lake Victoria are navigable up stream by anything larger than a canoe. The map below shows Tanzania's river network.

Lake Tanganyika drains into the Congo River system thereafter into the Atlantic Ocean. Lake Nyasa waters reach the Zambezi River, thence the Indian Ocean. Lake Victoria which differs from other major lakes of Tanzania in that it has been formed by a gentle down-warping of the earth's crust in a shallow subsidence, drains into the Nile, thence into the Mediterranean Sea. This makes Tanzania one of the few countries in the world that drains its water to three different oceans.

Map 2: Tanzania Rivers Network



Source: Cartographic Unit, National Bureau of Statistics, 2005

(a) Mountain Summits in Tanzania Mainland



Kilimanjaro Mountain is nicknamed as the “Roof of Africa”, since it has the highest summit in Africa, namely, Kibo with a height of 5,895 metres above sea level.

Tanzania Mainland has a number of mountain ranges. The Usambara mountain ranges, Livingstone mountain ranges and Udzungwa mountain ranges are few examples that are found in the northern and southern parts of Tanzania Mainland. The highest summit is Kibo at 5,895 metres above sea level, followed by Meru summit (4,566 m.) and Lool Malasin summit (3,648 m) (Table 1.3).

Table 1.3: Mountain Summits with Their Altitudes and Rank, Tanzania Mainland

Mountain Summit	Metres above sea level	Rank	Mountain Summit	Metres above sea level	Rank
Kilimanjaro (Kibo)	5,895	1	Longido	2,629	17
Mount Meru	4,566	2	Ngozi	2,620	18
Lool Malasin	3,648	3	Luhombero	2,576	19
Oldeani	3,188	4	Rubeho	2,576	20
Lemagruti	3,132	5	Olosha	2,526	21
Monduli	3,000	6	Likongowe	2,524	22
Mtorwi	2,961	7	Livingstone	2,521	23
Rungwe	2,960	8	Nyاملanga	2,488	24
Gelar Peak	2,942	9	Shengena	2,462	25
Chaluhangi	2,933	10	Mbogo	2,457	26
Tembolin	2,872	11	Selegu	2,454	27
Kitumbeine	2,858	12	Kisiba	2,421	28
Mbeya	2,826	13	Malonje	2,418	29
Salala	2,688	14	Mbizi	2,418	30
Uluguru	2,648	15	Mahari	2,373	31
Kimhando	2,629	16	Usambara	2,300	32

Source: Ministry of Land Development and Housing

(b) Roads

Most of the road networks in Tanzania Mainland are gravel types which are not passable in the wet season.

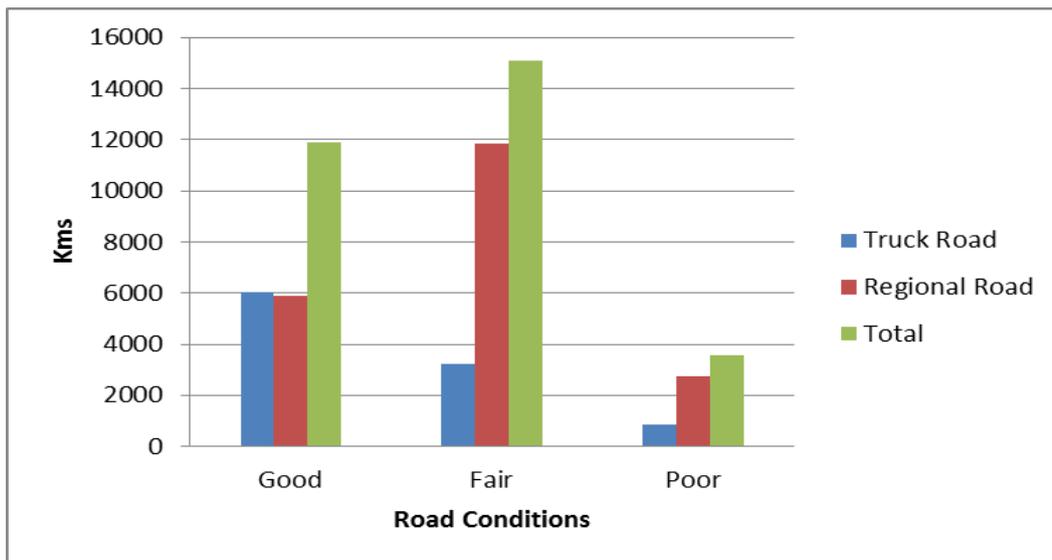
Tanzania Mainland is well connected by road networks, and 74 percent of the paved trunk roads are in good condition, 19 percent are fairly good while 7 percent are in poor condition. Moreover, 57 percent of regional roads are passable throughout the year, 33 percent are fairly good and 10 percent are in poor condition throughout the year. The data also give levels of quality among the unpaved trunk and regional roads (Table 1.4).

Table 1.4: Road Network by Type and Condition, Tanzania Mainland, 2014

Road Type	Good		Fair		Poor		Total	
	km	Percent	km	Percent	km	Percent	km	Percent
TRUNK ROADS								
Paved	4,731	74	1,215	19	444	7	6,390	21
Unpaved	1,307	35	2,028	54	405	11	3,740	12
Sub Total	6,038	60	3,243	32	849	8	10,130	33
REGIONAL ROADS								
Paved	577	57	333	33	102	10	1,012	3
Unpaved	5,299	27	11,530	59	2,621	13	19,450	64
Sub Total	5,876	29	11,863	58	2,723	13	20,462	67
Total	11,914	39	15,106	49	3,572	12	30,592	100

Source: Tanzania Road Agency - TANROADS, Ministry of Works

Figure 1.1: Status of Road Network by Type and Condition, Tanzania Mainland, 2014



Source: Tanzania Road Agency - TANROADS Ministry of Works,

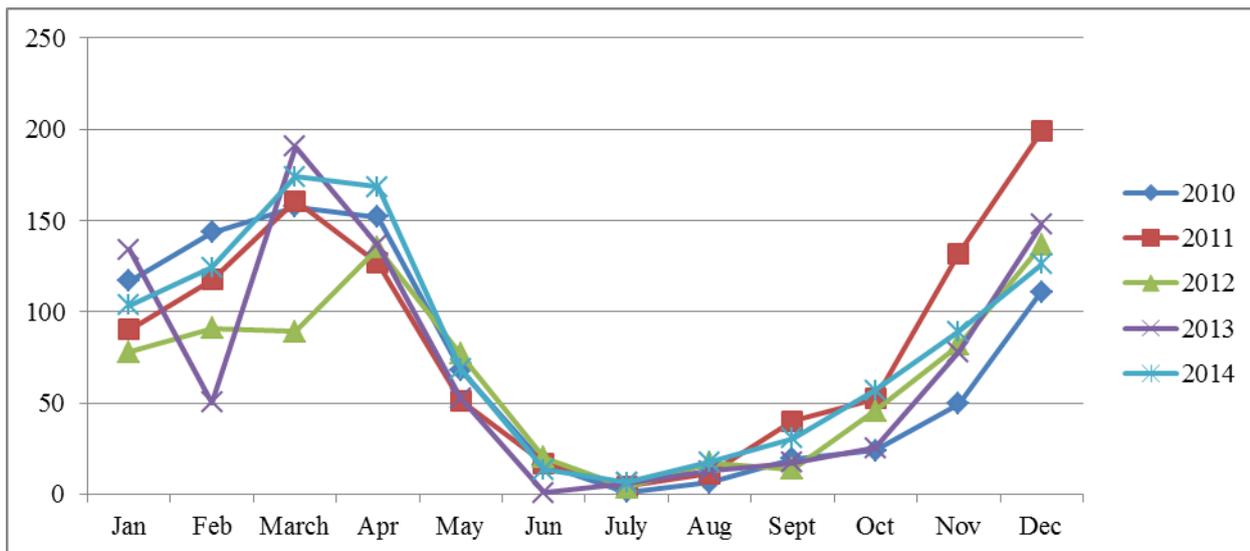
1.5.4 Climate

Different climatic conditions in the country lead to different rainfall patterns. However, these patterns are classified into two categories; namely unimodal and bimodal. Unimodal refers to areas with one rainy season and bimodal refers to those with two rainy seasons. In bimodal areas, one season is the short rainy season and the other is the long rainy season. The unimodal season occurs between November and April and is common to southern, south-western, central and western areas of the country. In bimodal areas the long rainy season is experienced between March and May and the short rains occur between October and November. Bimodal rains are common over the coast north of Mafia with its hinter-land, North-Eastern Highlands, areas around Lake Victoria and the Islands of Unguja and Pemba.

Precipitation information is supplied by the Tanzania Meteorological Agency (TMA) - presented monthly for selected locations in millimetres. Also obtained from the same agency, are monthly average minimum and maximum temperatures.

Figure 1.2 shows that the main rainy season in Tanzania Mainland is between January and May. In this period commonly known as Masika, Tanzania Mainland receives rains averaging above 1000 mm. It is followed by a dry season which begins in June and ends in September. The dry spell is followed by short term rains known as Vuli which occur from October to December.

Figure 1.2: Distribution of Mean Rainfall by Month, Tanzania Mainland, 2010 - 2014

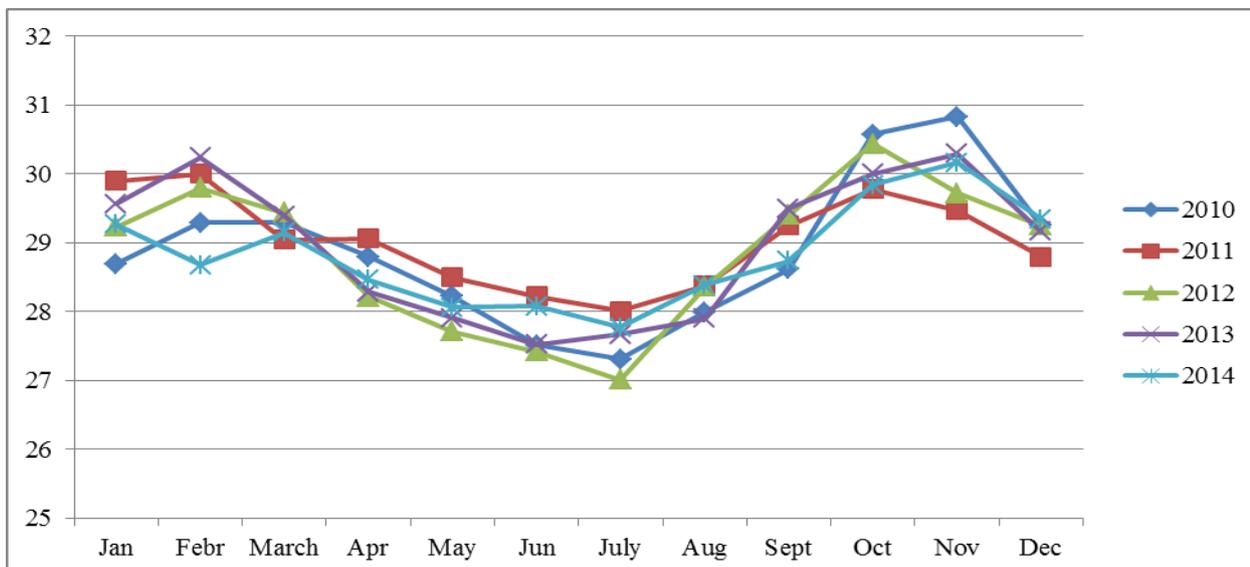


Source: Tanzania Meteorological Agency

According to the meteorological data from 2010 to 2014, the year 2010 received more masika rains than the others, and the year 2011 recorded the maximum amount of vuli rainfall compared to other years. Details on rainfall received during the five-year period (2010 – 2014) are given in Appendix 3.

Figures 1.3 and 1.4 show average monthly temperatures classified into two categories derived from daily maximum and minimum temperatures. Tanzania being a tropical country, experiences generally high temperature during the period between September and April, when the average maximum monthly temperature ranges between 27° centigrade and 32° centigrade and minimum temperatures during this season range between 22° centigrade and 26° centigrade.

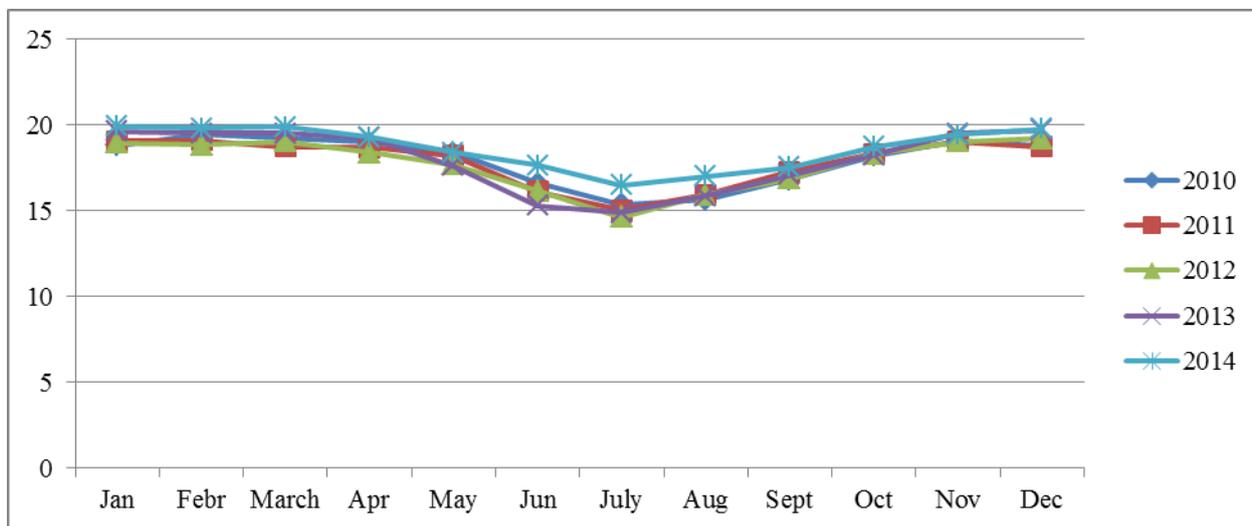
Figure 1.3: Average Maximum Monthly Temperature, Tanzania Mainland, 2010- 2014



Source: Tanzania Meteorological Agency

The low temperature season is experienced from May to August when the average monthly maximum temperature is between 19° centigrade and 22° centigrade; and the average monthly minimum temperature is between 15° centigrade and 19° centigrade. Details of average maximum and minimum temperatures for the period of 2010 – 2014 are given in Appendix 4.

Figure 1.4: Average Minimum Monthly Temperature, Tanzania Mainland, 2010 - 2014



Source: Tanzania Meteorological Agency

CHAPTER TWO

AGRICULTURE

2.0 Introduction

Most of Tanzania Mainland's population economically depends on agriculture and related activities which are farming, fishing and livestock keeping. These activities not only affect the environment, but also are affected in a cause and effect relationship. Thus, agriculture suffers from the effects of environmental impacts and at the same time creates some of the environment problems. The impacts vary with the type and scale of production. For example, the use of fertilizers is more common in large-scale farming than in small-scale farming and the types of pesticides applied are different between livestock holders and crop producers. Shifting cultivation is not a problem from an environmental point of view as long as the clearing activities do not use practice burning of forest areas. However, when agricultural activities creep up the mountain areas, thus replacing large forest areas, the environmental impact can be disastrous.

2.1 Soils

Tanzania Mainland has typical tropical soils with generally low nutrient content, particularly with respect to nitrogen and phosphorus. Although Tanzania possesses a great variety of soils, the most suitable for agriculture occur in few areas, like Arusha, Kilimanjaro, Morogoro and Mbeya. The coastal zone is mainly covered with deep, sandy to heavy textured soils with moderate to high water content. Sandy loams of low nutrient content and a low water holding capacity mantle occupy most of the central and western plateau areas. Drought prone areas cover most of the central and northern parts of the country, including the Masai steppes and the southern eastern plateau. Eroded land and deeply weathered soils, susceptible to erosion, occur on hill and mountain slopes in the central highlands (de Paw, 1984)

Well-drained volcanic soils of high ash content are found in the northern rift zone and the northern highlands. Generally these are of heavy texture, moderate to well drained, with moderate to high moisture holding properties. The western highlands soils are developed on basaltic or argillaceous rocks, and are well drained with good moisture holding properties. By international standards, only 9 percent of Tanzanian soils are of medium high fertility, 23 percent of low – medium fertility and the remainders are generally of lower quality (FAO – UNESCO, 1977).

A total of 128 land units were distinguished. Most land units contain more than one soil type. The soil patterns may either be an association or complex with or without, inclusions. In trying to avoid the soil scientist's vernacular, some of the terminologies used to name and describe the physiographic units and soils are those that can be understood by most stakeholders. These include the following:

Table 2.1: Types of Soil Texture by Zone, Tanzania Mainland

Zone Code	Name of Zone	Soil Texture	Remarks
Zone I	The Coast Zone	Deep, sandy and heavy soils with low nutrient content and low water holding capacity	Occupy most of the central and eastern plateau
Zone II	The Central Highlands Zone	Deeply weathered soils susceptible to erosion	Occupy most of the central highlands
Zone III	Northern and Southern Highlands Zone	Well-drained, volcanic soils of high ash content	Occupy most of northern and southern highlands such as Arusha, Kilimanjaro, Iringa, Mbeya and Ruvuma
Zone IV	Western Highlands Zone	Well-drained with good water holding properties. There are also sandy to loamy soils with low fertility	Occupy most of north-western and western highlands such as Kagera, Kigoma and part of Mwanza Region

Source: Ministry of Agriculture, Food Security and Cooperatives

2.2 Agro-Ecological Zones

The physical features of Tanzania consist of diverse ecological and climatic zones that accommodate different agricultural patterns. Consequently, the country is divided into four main features of agroecological zones and about seven which are more detailed that as shown in Table 2.2 and Table 2.3 respectively.

According to Table 2.2, the country is divided into four main agro-ecological zones that receive different levels of rainfall. Therefore, in some areas where there is shortage of rain but abundance of water from other physical features such as rivers, lakes and dams, irrigation becomes a suitable alternative.

Table 2.2: Main Features and Agro-Ecological Zones of Tanzania Mainland

Feature Zone	General Characteristic Feature	Rainfall	Specific Dominant Food Crops	Characteristic Main Activity	Features/ Representative Areas
I	Semi Arid and Central Area of Tanzania	Less than 500mm	Sorghum, Maize	Livestock rearing	Lowland area in Dodoma, Singida, Arusha and Iringa Regions
II	Mostly Coastal Area	500 – 1000mm	Paddy, Composite Maize, Cassava and Groundnuts	Agriculture, Fishing, Intensive poultry keeping	Mtwara, Lindi, Coast, Dar es Salaam, Morogoro, Tanga and Ruvuma regions
III	Mostly Western part of Tanzania	1000 – 1500mm	Cassava, Composite Maize, Peas and Sweet Potatoes	Intensive agriculture, keeping of cattle, goats, sheep and poultry	Mwanza, Mara, Shinyanga, Tabora, Kigoma and Rukwa regions
IV	Mostly Highland Area	Above 1500mm	Plantains, Hybrid maize, Beans and Irish Potatoes	Agriculture, Dairy cattle keeping pigs, goats, sheep and cattle	Mostly all the highlands around Kilimanjaro, Arusha, Tanga and Mbeya regions

Source: Ministry of Agriculture, Food Security and Cooperatives

Tanzania has about 88.6 million hectares of land suitable for agricultural production, including 60 million hectares of rangelands suitable for livestock grazing. Based on altitude, precipitation pattern, dependable growing seasons and average water holding capacity of the soils and physiographic features, as mentioned earlier, Tanzania has seven detailed agro-ecological zones (Table 2.3).

Studies undertaken during Initial National Communication (INC) indicate that increase in temperature by 2° C to 4° C would alter the distribution of the agro ecological zones. Consequently, areas that used to grow perennial crops would be suitable for annual crops. In addition, global warming would tend to accelerate plant growth and hence reduce the length of growing seasons.

The vulnerabilities in the agricultural sector include decreased crop production of different crops exacerbated by climatic variability and unpredictability of seasonality, erosion of natural resource base and environmental degradation. The following list shows the percentage decrease of two selected crops; maize and coffee:-

Maize: with an increase in temperature and a reduction in rainfall as well as changes in rainfall patterns, average yield will decrease by 33 percent country wide. Furthermore, yield of the same crop will decrease by up to 84 percent in the central regions, 22 percent in Northeastern high lands, 17 percent in the Lake Victoria region and 10 – 15 percent in the Southern highlands;

Coffee and Cotton as a result of a temperature increase of 2 - 4°C, coffee production is projected to increase by 18 percent in bimodal rainfall areas and 16 percent in unimodal rainfall areas. Furthermore, climate change is expected to further shrink the rangelands which are important for livestock keeping communities in Tanzania. This shrinkage will be more aggravated by the fact that about 60 percent of the total rangeland will be infested by tsetse flies making it unsuitable for livestock pastures and human settlements. Shrinkage of rangelands is likely to exacerbate conflicts between livestock keepers and farmers in many areas.

Table 2.3: Detailed Features of Agro-Ecological Zones in Tanzania Mainland, 2014

Zone	Sub-Zone and Areas	Soils and Topography	Altitude	Rainfall (mm/yr)	Growing Season
1. COAST	North: Tanga (except Lushoto), Coast and Dar es Salaam South: Eastern Lindi and Mtwara (except Makonde Plateau)	Infertile sands on gently rolling uplands Alluvial soils in Rufiji Sand and infertile soils Fertile clays on uplands and river flood plains	Under 3000m	North: Bimodal, 750- 1200mm South: Unimodal, 800- 1200mm	North: October- December and March - June
2. ARID LANDS	North: Serengeti, Ngorogoro Parks, Part of Masailand Masai Steppe, Tarangire Park, Mkomazi Reserve, Pangani and Eastern Dodoma	North: Volcanic ash and sediments. Soils variable in texture and very susceptible to water erosion South: Rolling plains of low fertility. Susceptible to water erosion. Pangani river flood plain with saline, alkaline soil	North: 1300-1800m South 500-1500m	North: Unimodal, unreliable, 500- 600mm South: Unimodal and Unreliable, 400- 600mm	March - May
3. SEMI-ARID LANDS	Central Dodoma, Singida, Northern Iringa, some of Arusha, Shinyanga Southern: Morogoro (except Kilombero and Wami Basins and Uluguru Mts). Also Lindi and Southwest Mtwara	Central: Undulating plains with rocky hills and low scarps. Well drained soils with low fertility. Alluvial hardpan and saline soils in Eastern Rift Valley and lake Eyasi. Black cracking soils in Shinyanga. Southern: Flat or undulating plains with rocky hills, moderate fertile loams and clays in South (Morogoro), infertile sand soils in center	Central: 1000-1500m Southeastern 200- 600m	Central: Unimodal and unreliable: 500- 800mm Southeastern: Unimodal 600-800mm	December- March

Table 2.3 ctd: Detailed Features of Agro-Ecological Zones in Tanzania Mainland, 2014

4. PLATEAUX	<p>Western: Tabora, Rukwa (North and Center), Mbeya North: Kigoma, Part of Mara Southern: Ruvuma and Southern Morogoro</p>	<p>Western: Wide sandy plains and Rift Valley scarps Flooded swamps of Mala garasi and Ugalla rivers have clay soil with high fertility Southern: upland plains with rock hills. Clay soils of low to moderate fertility in south, infertile sands in North.</p>	800-1500m	<p>Western: unimodal, 800-1000mm Southeastern: Unimodal 600-800mm</p>	November- April
5. SOUTHERN AND WESTERN HIGHLANDS	<p>Southern: A broad ridge of from N. Morogoro to N. Lake Nyasa, covering part of Iringa, Mbeya Southwestern: Ufipa plateau in Sumbawanga Western: Along the shore of Lake Tanganyika in Kigoma and Kagera</p>	<p>Southern: Undulating plains to dissected hills and mountains. Moderately fertile clay soils with volcanic soils in Mbeya Southwestern: Undulating plateau above Rift Valleys and sand soils of low fertility Western: North-south ridges separated by swampy valleys, loam and clay soils of low fertility in hills, with alluvium and pounded clays in the valleys</p>	<p>Southern: 1200-1500m Southwestern: 1400-2300m Western: 100-1800m</p>	<p>Southern: unimodal, reliable, local rain shadows, 800-1400mm Southern: unimodal, reliable, 800-1000mm Western: bimodal, 1000-2000mm</p>	<p>Northern: December –April Southwestern: November- April Western: October- December and February- May</p>
6. NORTHERN HIGHLANDS	<p>Northern: foot of Mt. Kilimanjaro and Mt. Meru. Eastern Rift Valley to Eyasi</p>	<p>Northern: Volcanic uplands, volcanic soils from lavas and ash. Deep fertile loams. Soils in dry areas prone to water erosion. Granite steep Mountain side to highland plateaux. Soils are deep, arable and moderately fertile on upper slopes, shallow and stony on steep slopes</p>	<p>Northern: 1000-2500m Granitic Mts: 1000-2000m</p>	<p>Northern: Bimodal, varies widely 1000-2000mm Granitic mts. Bimodal and very reliable 1000-2000m</p>	<p>Northern: November- January and March- Jun Granitic Mts. October- December and March-June</p>

Table 2.3 ctd: Detailed Features of Agro-Ecological Zones in Tanzania Mainland, 2014

7. ALLUVIAL PLAINS	K- Kilombero (Morogoro) R- Rufiji (Coast) U- Usangu (Mbeya) W- Wami (Morogoro)	K- Cental clay plain with alluvial fans east and west R- Wide mangrove swamp delta, alluvial soils, sandy upstream, loamy down steam in floodplain U- Seasonally flooded clay soils in North, alluvial fans in South W- Moderately alkaline black soils in East, alluvial fans with well drained black loam in West		K-Unimodal, very reliable, 900-1300mm R-Unimodal, often inadequate 800-1200mm U-Unimodal, 500-800mm W-Unimodal, 600-1800m	K-November-April R- December-April U-December-March W-December-March
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Source: Ministry of Agriculture, Food Security and Cooperatives

2.3 Farming

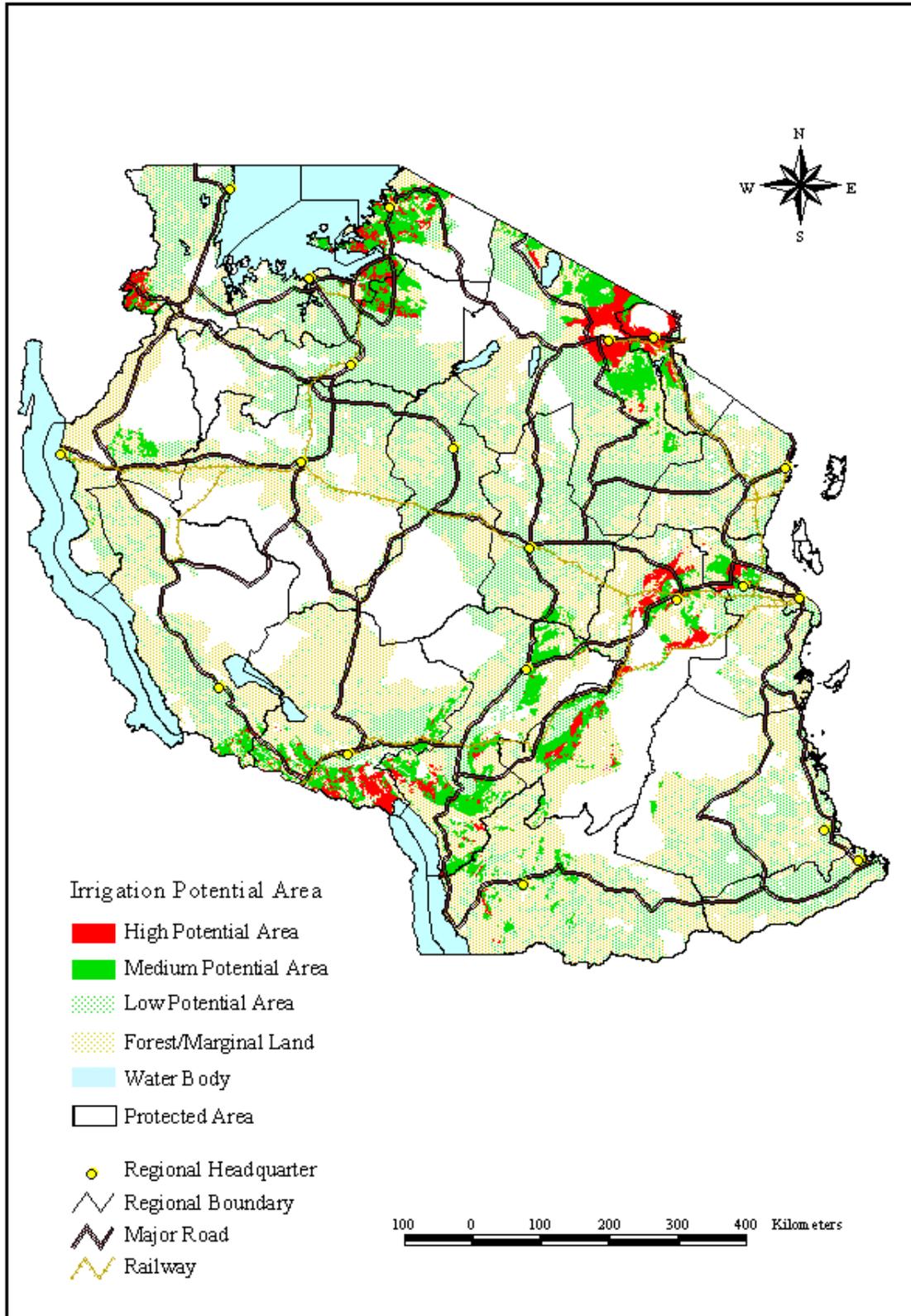
Although there are few areas in Tanzania in which cultivation is not practiced, the areas designated as cultivated are those in which most of the original vegetation has been replaced by cultivation.

Most agricultural areas in Tanzania are very much dependent on rainfall. There are others where traditional irrigation is the main source for watering agricultural produce and rearing.

2.3.1 Area under Irrigation

Despite abundance of water from lakes and rivers, the area under irrigation is still small in the country. Irrigation, both traditional and modern, has been tried in almost all regions in Tanzania Mainland. The map below shows the geographic distribution of the irrigation potential areas.

Map 3: Tanzania Mainland Showing Potential Areas for Irrigation, 2014



Distribution of Potential Areas for Irrigation

Improvement of traditional irrigation schemes started during the pre-independence period and continued during the post independence period, but at a slower pace of development. As most of the irrigation schemes did not receive improvement support, their performance gradually deteriorated due to inappropriate system design, ineffective management, low irrigation efficiencies and poor operations and maintenance, which resulted into their abandonment.

The performance of irrigated agriculture in the country from the 1960s to the 1980s was in developmental and operational context; however, it was reported to be inadequate. In the 1960s, targets of developing an irrigated area of 10,000 ha by 1970 and a further 10,000 ha, spread over the entire country were set. This period was characterized by unrealistic and uncoordinated planning resulting in slow development of new irrigation schemes and the irrigation of only 2,600 ha by 1970. The rate of development after 1970 lagged behind the set targets, because of low impetus by the Government until 1974/75 when the country was faced with a serious drought that resulted in a major food crisis. During the same period, the Government was implementing the decentralization reforms which created a vacuum in institutional capability for irrigation development. capacity



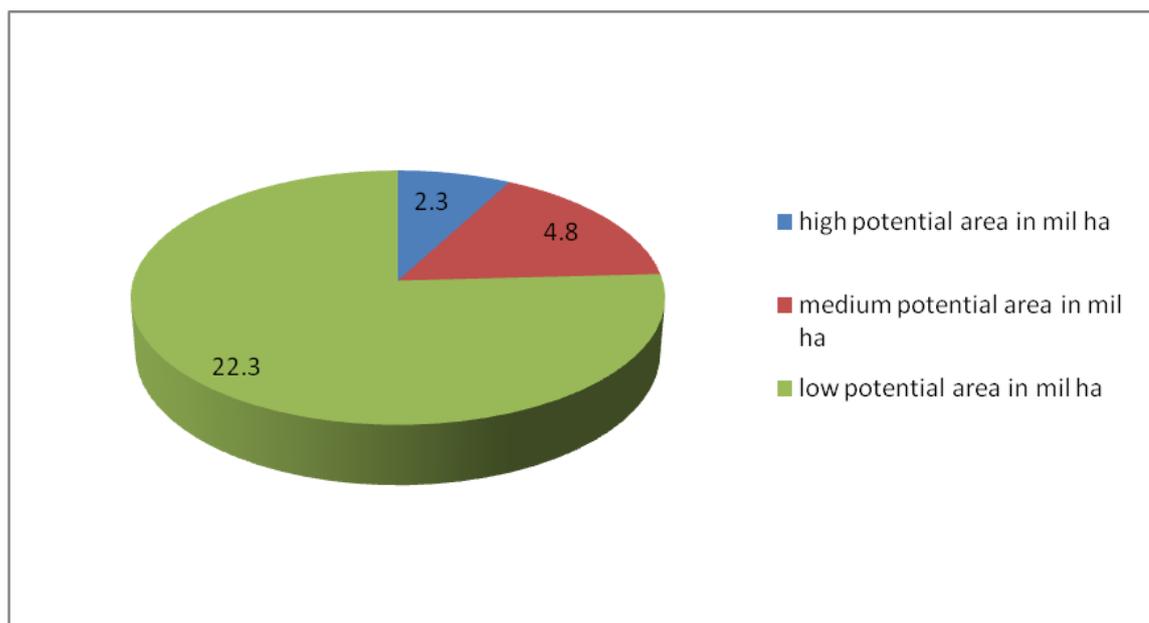
Irrigation Scheme Infrastructures in one of the schemes in Mbulu District

The strategy in the 1980s, of full rehabilitation of traditional irrigation schemes and the construction of new high input/output modern schemes for both the parastatals and smallholders proved expensive and unsuccessful with respect to the country's policy objectives. The rate of development of new irrigation schemes began to pick up in 1985 with the start of several other irrigation schemes development projects through external support. However, despite the increased activities, the performance of these schemes fell below expectations. The following were among the reasons for this low performance:

- absence of irrigation policy;
- unavailability of vital irrigation data for planning purposes;
- inadequate resources on the part of the Government, e.g. funds and trained irrigation personnel;
- absence of national irrigation investment criteria;
- insufficiency of a national coordination for irrigation development;
- reliance on sophisticated irrigation techniques, which demand heavy investment, highly trained manpower and a big component of foreign exchange; and
- inappropriate planning of irrigation projects, particularly smallholder traditional irrigation schemes.

Tanzania launched the National Irrigation Master Plan in 2002 which identified a total irrigation development potential of 29.4 million ha, of which 2.3 million ha were classified as high potential; 4.8 million ha as medium potential; and 22.3 million ha as low potential indicated in Figure 2.1.

Figure 2.1: Distribution of Irrigation Development Potential Area by Quality, Tanzania Mainland, 2002



Source: National Irrigation Master Plan, 2002

For the period starting from 2000/2001 to 2004/2005, 75 irrigation schemes with an area of 27,470 hectares and 6 dams commanding 860 hectares were implemented. The cumulative area under irrigation by 2001/2002 was 191,900 hectares, in which the dominant crop produced was paddy with production of 767,600 tonnes; in 2002/2003 the area planted was 200,895 hectares producing 803,580 tonnes of paddy; in 2003/2004 area planted was 227,486 hectares with the production of 909,944 tonnes of paddy (Table 2.5).

In 2004/2005 the target was to achieve a cumulative developed area of 254,610 hectares. However, the achievement was only 249,992 hectares and a production of 1,018,440 tonnes of paddy. In 2005/2006, the aim was to develop a further 18,000 hectares, but the achievement was only 14,396 hectares making a cumulative area of 264,388 hectares. During the year 2006/2007, the target was to develop 10,000 hectares of which the achievement was 9,557 raising the cumulative developed area to 273,945 hectares but only 289,245 hectares were under irrigation by June 2008. The targets were not achieved due to inadequate resources. Currently the Government has made several initiatives towards the improvement of irrigated agriculture in the country. Among these initiatives is the KILIMO KWANZA strategy launched in 2009. The Government of Tanzania has given high priority to irrigation development, particularly through accelerating small scale irrigation to boost crop production and agricultural productivity of the country. The area under irrigation reached 380,888 hectares by June 2011 and the developed area under irrigation was 345,690 hectares. In the total developed area 290,461 hectares were under small-holder farmer managed schemes while 55,229 hectares were under large business investors. During the year 2012 the developed area under irrigation reached 363,514 hectares by December 2012.

In the year 2013/2014 the Government started to implement the Big Results Now (BRN) Programme. The Ministry of Agriculture Food Security and Cooperative through the National Irrigation Commission has started rehabilitating 78 irrigation schemes under BRN programme. During this period the area under irrigation reached 450,392 hectares, the developed area remains the same as of December 2012. As during this period the emphasis was on rehabilitation or improvement of existing irrigation schemes in order to improve water use efficiency and increase productivity in irrigation schemes. In the total area under irrigation (450,392 hectares), 389,529 hectares were under small-holder farmer managed schemes while 60,863 hectares were under large business investors.

Challenges Facing Irrigation Development in Tanzania

In developing the irrigation sector, the National Irrigation Commission is facing some challenges such as:

- Shortage of funds for investment and development of irrigation infrastructure;
- Inadequate technical personnel and facilities in all aspects especially at the district council level;
- Unpredicted climate change leading to drought hence the need of infrastructure such as dams and the use of ground water;
- Little use of ground water for irrigated agriculture;
- Insufficient participation of the private sector in investing in development of irrigation projects;
- Poor accountability of farmers on maintenance and management of irrigation infrastructure in the schemes;
- Weak irrigation associations/cooperatives in operation and management of their irrigation infrastructure.

Irrigated agriculture ensures production that is three times greater than rain-fed agriculture therefore it helps in poverty reduction which is a serious problem in villages.

Paddy is the dominant irrigated crop in Tanzania, but sugar cane, tea and coffee are the most important commercial crops.



Paddy field at Mombo Irrigation Scheme- Korogwe District

The bulk of rice produced is locally consumed although a considerable amount is exported to neighbouring countries. Rice yields have increased from an average of 1.8 – 2.0 tonnes per hectare to as high as 4.0 – 5.0 tonnes per hectare and in improved irrigation schemes and new smallholder irrigation schemes, under very good agronomical practices yields have reached 10 tonnes per hectare. Water use efficiency increased from 15 percent to 30 percent. Despite the increase in water use efficiency, improvement is needed for better performance of the irrigation schemes.

Irrigation has an important role to play in the realization of the primary objectives of re-energized agriculture and water sectors. Sound irrigation development has the potential to transform the predominantly traditional subsistence rain-fed systems into profitable, mixed scales (small, medium and large) and commercial operations.

However, irrigation development can have negative environmental impacts if not planned properly. These may occur right from the initial stage of construction and rehabilitation activities to crop cultivation and irrigation practices. They can affect water quality, sanitation and erosion and create water use conflicts through reduction in downstream water flows.

Inappropriate water use practices and the resulting degradation can threaten the sustainability of ecosystem, human health, food security and productivity; and constrain investment in various social and economic sectors.

Another fundamental problem is inappropriate land use practices which can result into accelerated run-off, reduced groundwater recharge, soil erosion and increased sediment transport by rivers and their accumulation in reservoirs and irrigation systems. These are some of the environmentally related issues that need to be addressed well in irrigation schemes.

To address the effect of soil erosion and other environmental impacts in irrigation schemes the Ministry through the National Irrigation Commission in collaboration with Environmental Management Unit is conducting Environmental Impact Assessment (EIA) and Environmental Auditing (EA) to ensure all environmental interventions are addressed accordingly.

Effect of Climate Change in Irrigation Development

Climate change results in various effects in agriculture as well as in irrigation development. Indeed drought is among the possible effects of climate change.

Addressing Drought in Irrigation Development

In order to address the effect of climate change especially with respect to drought conditions in affected regions during the period of 2012/2013 the Ministry of Agriculture Food Security and Cooperatives through the National Irrigation Commission started constructing seven dams for water storage namely Inala (Tabora Manicipal Council), Kasuga (Kakonko District Council), Mahiga (Kwimba District Council), Masega (Serengeti District Council), Lwanyo (Mbarali District Council), Dongobesh (Mbulu District Council) and Itagata (Manyoni District Council). The construction process of these dams is ongoing and some have been completed; in addition feasibility studies for constructing other dams in drought regions such as Dodoma, Singida, Tabora, Shinyanga, Geita and Simiyu will be done.

The Ministry of Agriculture Food Security and Cooperatives through the National Irrigation Commission has continued to address the drought conditions in certain regions such as Dodoma through drilling wells and introducing drip irrigation. The Ministry has managed to construct irrigation schemes which use irrigation water from wells and dams in Chinangali Irrigation Scheme and Buigiri. Main crops produced are grapes in Chinagali and horticultural crops in Buigiri Irrigation Schemes.

Moreover the Ministry has continued to emphasize on water management practices, through the National Irrigation Commission under the Japanese Policy and Human Resources Development Fund (PHRD) project and Big Result Now (BRN) programme, it has managed to introduce technology which utilizes little water and increases yield called the System of Rice Intensification (SRI). SRI is one of the adaptation measures to combat the effects of climate change; it is now being practiced in some areas of the country such as Mbeya at Mbuyuni, Kimani and Madibira irrigation schemes, Morogoro at Mkindo and Dakawa irrigation schemes, Iringa at Magozi and

Pawaga irrigation schemes. There is also a plan of introducing this technology in drought regions such as Dodoma, Singida, Shinyanga and others but this will only be achieved by constructing wells and dams. The Ministry through the National Irrigation Commission is now planning on introducing, drought resistant varieties of paddy in irrigation schemes, such as Nerica variety which is mostly grown upland.

2.3.2 Irrigation Development Programme at Regional Level

Tanzania Mainland has potential areas in which irrigation can be utilized to improve crop production in the country. The Government of Tanzania through the ministry responsible for irrigation has so far identified potential irrigation areas in all rural regions (Table 2.4). Kilimanjaro Region has the largest potential area for irrigation, followed by Arusha, Mbeya and Morogoro. Kagera Region has the smallest potential area for irrigation followed by Mara and Mtwara.

Table 2.4: Irrigation Development Areas by Type and Region up to 2017, Tanzania Mainland

Region	Rehabilitation of Traditional Irrigation Schemes (hectares)	Rehabilitation/New Construction of Water Harvesting Schemes (hectares)	New Construction of Smallholder Irrigation Schemes (hectares)	Total
Dodoma	1,800	11,400	200	13,400
Arusha*	62,200	800	1,100	64,100
Kilimanjaro	68,600	0	13,400	82,000
Tanga	17,500	400	300	18,200
Morogoro	25,800	3,800	24,500	54,100
Pwani	900	400	6,900	8,200
Dar es Salaam	0	0	0	0
Lindi	6,200	1,200	1,900	9,300
Mtwara	2,100	2,700	0	4,800
Ruvuma	2,100	1,600	1,200	4,900
Iringa	13,200	0	800	14,000
Mbeya	52,100	0	7,100	59,200
Singida	0	8,500	0	8,500
Tabora	2,200	8,800	1,500	12,500
Rukwa	7,000	400	1,200	8,600
Kigoma	11,000	1,600	0	12,600
Shinyanga	900	10,900	100	11,900
Kagera	600	0	0	600
Mwanza	400	12,900	2,300	15,600
Mara	0	2,800	100	2,900
Total	274,600	68,200	62,600	405,400

*Includes Manyara Region.

Source: Ministry of Water and Irrigation, National Irrigation Master Plan (2002)

2.3.3 Temporary Crops

Compared to other crops, paddy is the most popular crop in irrigation schemes of rural regions. Looking at cumulative area under irrigation and paddy production, Table 2.5 shows positive improvement. The irrigation area increased from 191,900 hectares in 2001/2002 to 249,992 hectares in 2004/05. Paddy production increased significantly from 767,600 tonnes in 2001/02 to 1,018,440 tonnes in 2004/05.

Table 2.5: Cumulative Irrigated Area (hectares) under Paddy and the Quantity Produced in Tonnes

Year	Cumulative Area (hectares)	Paddy Production (tonnes)
2001/2002	191,900	767,600
2002/2003	200,895	803,580
2003/2004	227,486	909,944
2004/2005	249,992	1,018,440
2005/2006	264,388	-
2006/2007	273,945	-
2007/June 2008	289,245	-
2010/2011 June	380,888	-
2013/2014	450,392	-

Source: Ministry of Water and Irrigation

2.3.4 Planted Area Used by Small-Scale Farms



Sorghum is the second most grain crop produced by small – scale farms in Tanzania

In Tanzania, like in other Sub-Saharan countries, most of the crops are produced on small-scale farms owned by peasants. Maize is the most dominant crop with a planted area that is three times

that of any crops, followed by cassava and sorghum the three of which are the most important staple foods in the country. With the adoption of irrigation schemes, the planted area for paddy has increased in recent years (Table 2.6a). Table 2.6a gives routine figures and Table 2.6b are figures from Agriculture Sample Census, 2007/08.

Table 2.6a: Small Scale Farming; The Area (000 ha) Planted with Selected Crops by Crop-Year Tanzania Mainland, 2005/06 – 2012/13

Crop/Year	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Maize	2,570.99	2,600.35	3,980.97	2,961.33	3,050.71	3,287.85	4,118.12	4,120.27
Paddy	633.77	557.98	887.66	805.63	1,136.29	1,119.33	799.36	928.27
Sorghum	715.87	817.95	566.76	874.22	618.37	811.16	839.42	711.39
Millet	275.97	213.61	170.93	318.48	280.29	261.18	191.67	230.58
Wheat	53.22	75.37	43.16	149.20	54.57	108.28	109.82	107.19
Beans	646.09	845.96	749.54	868.31	1,208.69	737.66	1,265.40	1,151.38
Cassava	993.17	779.07	-	1,081.38	872.99	739.79	954.51	863.68
Sweet Potatoes	590.47	511.02	204.50	651.94	576.22	699.07	651.22	788.60
Groundnuts	309.43	378.01	470.67	428.55	482.31	675.23	839.63	943.68
Simsim	101.60	118.99	139.89	153.27	203.42	510.47	651.74	859.95
Sunflower	174.14	277.67	347.69	388.83	431.54	753.76	1,077.62	1,629.70

Source: Statistics Unit, Ministry of Agriculture Food Security and Cooperatives

Table 2.6b shows the distribution of planted area for each selected crop by region. Shinyanga, Dodoma, Tabora, Manyara, Iringa, and Mbeya regions were the regions with the largest planted areas for maize while paddy was mostly planted in Shinyanga, Tabora, Morogoro and Mbeya. Wheat was mainly grown in Iringa, Manyara, Mbeya and Arusha regions. The regions with the largest planted areas of sorghum were Shinyanga, Singida and Dodoma.

Table 2.6 b: Small Scale Farming: The Area (000 ha) Planted with Selected Cereal Crops during the 2007/08 Crop Year by Region and Type of Cereal, Tanzania Mainland

Region	Maize	Paddy	Sorghum	Bulrush Millet	Finger Millet	Wheat
Dodoma	337.4	2.8	95.0	80.5	9.7	0.0
Arusha	105.9	0.6	1.7	0.0	0.5	4.0
Kilimanjaro	63.3	0.8	0.1	0.0	1.7	0.0
Tanga	187.2	5.6	0.5	0.0	0.0	0.0
Morogoro	111.9	82.0	7.5	0.0	0.0	0.0
Pwani	43.6	19.5	3.7	0.0	0.0	0.0
Dar es Salaam	3.6	4.3	0.0	0.0	0.0	0.0
Lindi	75.5	18.3	38.0	0.3	0.0	0.0
Mtwara	77.5	21.4	19.6	0.0	0.3	0.0
Ruvuma	149.1	48.1	2.1	0.1	7.3	2.7
Iringa	245.7	6.5	4.4	0.0	6.1	17.5
Mbeya	229.2	81.1	18.2	1.5	7.3	5.4
Singida	149.9	13.0	97.4	48.9	6.8	0.1
Tabora	291.0	99.2	45.8	1.2	0.8	0.3
Rukwa	223.2	45.7	8.7	0.0	10.6	1.9
Kigoma	14.7	0.7	1.7	0.6	0.0	0.0
Shinyanga	514.1	170.3	97.7	14.6	0.8	0.0
Kagera	11.7	6.0	9.2	0.0	0.6	0.0
Mwanza	36.3	48.8	2.5	1.7	0.0	0.0
Mara	64.6	2.7	32.9	0.3	5.7	0.0
Manyara	255.9	2.2	8.2	1.0	1.9	10.2
Total Area Planted	3,191.4	679.7	494.8	150.8	60.1	42.2

Source: Ministry of Agriculture Food Security and Cooperatives, Agriculture Sample Census 2007/08

Table 2.6c shows the planted area for selected oil seeds pulses, roots and tubers, and bananas by region. In regard to groundnuts, Shinyanga, Tabora and Dodoma regions had the largest planted areas, while Mbeya, Iringa and Manyara regions had largest planted areas of beans. The regions with the largest planted areas of sunflower were Singida, Dodoma and Manyara regions (Table 2.6c).

Table 2.6 c: Small Scale Farming: The Area (000 ha) Planted with Selected Oil Seed Crops, Pulses, Banana, Roots and Tubers during the 2007/08 Crop Year by Region and Type of Crop, Tanzania Mainland

Region	Groundnut	Sunflower	Simsim	Beans	Banana	Sweet Potato	Irish Potatoes	Cassava
Dodoma	78.4	82.9	26.6	9.6	0.5	0.9	0.0	14.9
Arusha	0.0	2.2	0.4	40.0	8.9	0.4	0.5	0.0
Kilimanjaro	0.9	3.9	0.0	25.5	51.4	0.1	0.5	4.9
Tanga	1.0	0.7	3.9	47.4	11.4	0.4	3.6	69.4
Morogoro	0.6	2.4	12.7	8.2	10.8	13.6	0.6	33.4
Pwani	0.1	0.1	8.3	0.2	4.5	2.7	0.0	49.1
Dar es Salaam	0.2	0.0	0.1	0.0	1.1	6.6	0.0	3.9
Lindi	2.4	0.1	23.2	0.9	2.5	0.1	0.0	56.6
Mtwara	28.2	0.0	9.5	1.3	0.6	1.1	0.1	137.3
Ruvuma	11.2	4.4	11.8	38.4	8.1	7.5	0.3	55.2
Iringa	7.7	32.2	1.0	55.9	2.9	3.0	17.4	9.3
Mbeya	30.2	15.0	18.5	82.2	32.5	9.0	4.4	13.1
Singida	15.4	99.0	5.5	6.4	1.5	9.6	0.0	10.7
Tabora	96.9	15.3	1.4	9.8	0.4	33.3	0.2	25.8
Rukwa	34.2	36.6	6.6	37.6	2.7	13.5	0.4	42.0
Kigoma	2.9	0.1	0.0	18.8	9.9	2.7	0.0	50.9
Shinyanga	105.1	5.1	1.5	19.7	0.7	118.8	0.2	84.5
Kagera	4.6	0.0	0.0	38.0	118.1	16.5	0.2	62.3
Mwanza	2.4	0.8	0.0	2.6	3.6	28.9	0.3	72.7
Mara	0.5	0.1	0.1	5.2	1.3	17.9	0.1	76.7
Manyara	1.2	39.0	1.8	50.0	0.3	0.9	0.0	0.5
Total Area Planted	424.1	339.8	132.9	497.9	273.6	287.4	28.8	873.0

Source: Ministry of Agriculture Food Security and Cooperatives, Agriculture Sample Census 2007/08

Estimated planted area for selected oil seeds pulses, roots and tubers, and bananas by region from routine data are shown in Table 2.6d. In regard to groundnuts, Shinyanga, Tabora, Dodoma and Mbeya regions had the largest planted areas, while Tanga, Kagera, Kigoma and Manyara regions had the largest planted areas of beans. The regions with the largest planted areas of sunflower were Singida, Iringa, Dodoma and Rukwa regions (Table 2.6d). As stated above, cassava being the second staple food, utilised almost a quarter of the area planted with maize. Though almost all regions planted cassava, Mtwara, Mwanza, Kagera and Mara are the regions that had the largest planted areas of cassava.

Table 2.6 d: Small Scale Farming: The Area (000 ha) Planted with Selected Oil Seed Crops, Pulses, Bananas, Roots and Tubers during the 2011/12 Crop Year by Region and Type of Crop, Tanzania Mainland

Region	Ground nut	Sunflower	Simsim	Beans	Banana	Sweet Potato	Irish Potatoes	Cassava
Dodoma	99.31	174.69	110.76	33.99	-	42.84	3.37	35.06
Arusha		13.05	-	56.17	34.38	0.98	0.13	1.45
Kilimanjaro	5.34	6.98	-	50.65	76.38	19.65	3.50	3.42
Tanga	9.81	16.91	23.10	198.91	8.72	7.16	61.66	31.288
Morogoro	8.01	39.69	110.31	40.42	23.80	110.79	0.46	83.74
Pwani	-	-	62.56	-	-	39.53	-	83.74
Dar es Salaam	-	-	-	-	0.49	4.43	-	4.09
Lindi	28.09	-	172.85	0.03	-	3.36		42.84
Mtwara	64.97	-	27.84	0.66	0.33	2.74	-	173.23
Ruvuma	27.57	6.59	-	36.98	0.79	20.44	0.75	71.27
Iringa	18.19	212.83	0.87	34.62	0.40	10.26	52.12	0.93
Mbeya	91.59	46.08	59.48	87.48	29.22	31.22	38.16	7.86
Singida	43.89	278.52	17.62	79.85	-	74.87	-	48.34
Tabora	112.69	38.23	5.35	23.08	-	69.57	-	41.63
Rukwa	55.62	102.42	22.68	79.95	8.50	16.93	4.23	14.17
Kigoma	59.33	-	-	148.41	116.26	20.47	1.83	18.36
Shinyanga	169.55	37.63	2.57	31.71	0.06	163.12	-	62.64
Kagera	13.97	0.13	-	184.91	128.60	-	0.21	90.78
Mwanza	29.30	1.21	-	40.37	5.10	101.72	-	102.69
Mara	0.93	1.94	-	31.58	5.01	23.78	1.36	84.53
Manyara	1.48	95.48	6.54	105.61	4.14	2.28	0.67	0.22
Total Area Planted	839.63	1,077.62	622.53	1,265.40	442.19	766.13	168.45	1,002.28

Source: Statistics Unit, Ministry of Agriculture Food Security and Cooperatives

2.3.5 Fertilizers

Information on fertilizers which is presented in Tables 2.7, Table 2.8 and Table 2.9 shows the amount of various fertilizers demanded, their availability and actual consumption in specified years. Comparing the estimated demand and availability of fertilizers, Tables 2.7 and Table 2.8 show that the demand is usually higher than the supply. However, in the case of S/A there was surplus in 2009/10. These variations are largely due to the use and delay in the distribution of fertilizers in the rural areas. It has not been possible to show the regional distributions because the Tanzania Fertilizer Company which used to compile such information has ceased operations.

Table 2.7: Estimated Demand for Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13

Item	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2011/12	2012/2013
S/A	6,500	11,690	11,690	11,690	11,690	11,690	11,690	11,690	8,771
CAN	10,000	34,400	33,400	33,400	33,400	23,400	23,400	23,400	74,612
UREA	80,000	202,640	204,640	204,640	204,640	204,640	204,640	204,640	189,706
TSP	20,000	16,700	16,700	16,700	16,700	10,000	10,000	10,000	24,258
DAP	30,000	51,000	50,100	50,100	50,100	50,100	50,100	50,100	80,780
MOP/OTHERS	1,000	1,670	1,670	1,670	1,670	1,670	1,670	1,670	2,700
NPK 6:20:18/10:18:24	30,000	48,739	48,739	48,739	48,739	40,439	40,439	40,439	29,568
NPK 6:10:18	3,550	7,482	7,482	7,482	7,482	7,482	7,482	7,482	4,062
NPK 20:10:10	4,500	10,579	10,579	10,579	10,579	10,579	10,579	10,579	15,234
NPK 6:20:18/10:18:2	-	-	-	-	-	25,000	25,000	25,000	55,309
Total	185,550	384,900	385,000	385,000	385,000	385,000	385,000	385,000	485,000

Source: Inputs Unit, Ministry of Agriculture, Food Security and Cooperatives

Table 2.8: Availability of Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13

Item	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
S/A	7,408	7,000	5,320	11,660	8,760	6,157	15,346	4,002	10,314	7,946
CAN	29,145	32,782	28,951	38,553	28,228	31,933	26,940	35,898	32,020	24,632
UREA	51,576	85,850	122,037	125,597	95,075	91,029	104,427	90,491	81,664	92,982
TSP	2,487	7,117	4,700	6,273	2,361	1,427	769	1,962	1,436	1,821
DAP	5,666	12,345	44,829	34,670	36,219	30,121	47,858	42,909	69,918	33,318
NPK 6:20:18	18,515	-	-	-	4,522	11,494	12,778	7,171	9,540	6,041
NPK 25:5:5	1,795	3,576	3,208	16,000	7,227	9,033	9,257	238	4,658	-
NPK 20:10:10	6,803	7908	6,154	9,946	10,000	24,593	27,340	51,005	35,198	32,917
NPK 6:20:18/10:18:24	n.a	32,176	22,501	24,290	8,323	3,070	13,432	7,258	4,767	553
MOP/SOP	1,758	5,944	1,350	6,596	5,658	4,160	2,192	3,952	3,297	2,236
NPK 17:17:17	n.a	n.a	n.a	10,357	196	58,500	39,564	30,806	25,423	63,648
OTHERS	500	364	2,703	3,713	4,445	3,703	2,844	3,424	24,218	23,701
Total	125,653	195,062	241,753	287,655	211,014	275,219	302,748	279,115	302,453	289,795

na; not available

Source: Inputs Unit, Ministry of Agriculture Food Security and Cooperatives

The level of consumption of the available fertilizers shows that the use of industrial fertilizers in the country is very low. This is attributed to the availability of the composite and livestock dung fertilizers in some regions especially, Shinyanga, Mwanza, Mara, Tabora, Dodoma and Singida. Another reason is the delay in the distribution of fertilizers during the farming seasons in rural regions particularly Rukwa, Ruvuma, Mtwara, Kigoma and other periphery regions. Table 2.9 shows the consumption of fertilizers from 2003/04 to 2012/13.

Table 2.9: Consumption of Fertilizers (tonnes) by Type, Tanzania Mainland, 2003/04 – 2012/13

Item	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
S/A	7,408	7,000	5,320	11,660	8,760	6,157	15,346	4,002	10,314	7,946
CAN	29,145	32,782	28,951	38,553	28,228	31,933	26,940	35,898	32,020	24,632
UREA	51,576	85,850	122,037	125,597	95,075	91,029	104,427	90,491	81,664	92,982
TSP	2,487	7,117	4,700	6,273	2,361	1,427	769	1,962	1,436	1,821
DAP	5,666	12,345	44,829	34,670	36,219	30,121	47,858	42,909	69,918	33,318
NPK 6:20:18	18,515	-	-	-	4,522	11,494	12,778	7,171	9,540	6,041
NPK 25:5:5	1,795	3,576	3,208	16,000	7,227	9,033	9,257	238	4,658	-
NPK 20:10:10	6,803	7908	6,154	9,946	10,000	24,593	27,340	51,005	35,198	32,917
NPK 6:20:18/10:18:24	n.a	32,176	22,501	24,290	8,323	3,070	13,432	7,258	4,767	553
MOP/SOP	1,758	5,944	1,350	6,596	5,658	4,160	2,192	3,952	3,297	2,236
NPK 17:17:17	n.a	n.a	n.a	10,357	196	58,500	39,564	30,806	25,423	63,648
OTHERS	500	364	2,703	3,713	4,445	3,703	2,844	3,424	24,218	23,701
Total	125,653	195,062	241,753	287,655	211,014	275,219	302,748	279,115	302,453	289,795

Source: Inputs Unit, Ministry of Agriculture Food Security and Cooperatives

Currently, Tanzania imports fertilizers to cover the ever growing demand by both large scale farmers and peasants. Imports of fertilizers are shown in Table 2.10.

Table 2.10: Imported Fertilizers (kg) by Type, Tanzania Mainland, 2010 – 2014

Commodity Description	2010	2011	2012	2013	2014
Animal or vegetable fertilizers	757,565	772,762	469,784	458,054	1,078,100
Urea	104,104,069	72,816,834	88,281,948	155,533,349	104,644,161
Ammonium sulphate	12,577,249	7,558,513	20,909,392	28,061,915	16,333,250
Double salts and mixtures of ammonium sulphate and ammonium nitrate	27,327	21,155	384,331	270,457	36,899
Ammonium nitrate	25,298,141	26,284,094	28,671,469	16,353,971	28,303,726
Mixtures of ammonium nitrate with inorganic non-fertilizing substances	30,585,026	19,962,298	14,000,420	16,499,051	4,805,802
Sodium nitrate	24,321	23,004	6,819	47	5,150
Double salts and mixtures of calcium nitrate and ammonium nitrate	1,677,896	8,476,137	22,972,591	40,715,681	19,332,604
Mixtures of urea and ammonium nitrate in aqueous or ammoniacal solution	100	1,950	807	84,230	158
Mineral or chemical fertilizers, nitrogenous, nes	7,019,395	2,525,802	92,585	4,405,708	11,025,203
Superphosphates	814,450	3,130,885	2,124,673	975	1,548,439
Mineral or chemical fertilizers, phosphatic, nes	13,249	17,707,211	165,094	583,013	115,149
Carnallite, sylvite and other crude natural potassium salts	0	0	0	0	0
Potassium chloride	3,607,271	235,475	3,427,671	2,046,931	15,061
Potassium sulphate	52,969	7,918	39,442	903,154	209,413
Mineral or chemical fertilizers, potassic, nes	68,402	1,631,851	1,848,105	6,122,210	1,967,804
Fertilizers... in packages of a gross weight ≤10kg	21,107	1,038,376	11,038	20,660	42,582
Mineral or chemical fertilizers with nitrogen, phosphorus and potassium	51,024,647	101,954,998	58,681,618	0	64,166,577
Diammonium hydrogenorthophosphate (diammonium phosphate)	27,644,161	51,130,992	10,314,535	38,822,604	30,616,290
Ammonium dihydrogenorthophosphate (monoammonium phosphate)	207,552	109,057	980,673	995,754	5,142,518
Mineral or chemical fertilizers containing nitrates and phosphates	75,390	0	24	37,413	8,296
Mineral or chemical fertilizers with nitrogen and phosphorus, nes	356,061	16,981	36,617	534,525	420,403
Mineral or chemical fertilizers with phosphorus and potassium, nes	5,525,135	11,809	170,000	780	2
Other fertilizers, nes	2,826,891	2,641,440	8,818,615	2,074,691	1,326,440
Total	274,308,374	318,059,542	262,408,251	314,525,173	291,144,028

Source: Ministry of Finance, Customs Department

2.3.6 Pesticides

The Tropical Pesticides Research Institute is the source of statistics on pesticides and insecticides. Normally the amounts and types of pesticides and insecticides are based on the mandatory registration of these products before use within the country. These products have not been tabulated by region due to lack of necessary information. However, the list of pesticides and insecticides that were registered includes herbicides, acaricides, nematicides, rodenticides, plant growth regulators and avicides.

However, about 50,000 tonnes of obsolete pesticides are stockpiled throughout Africa, in rotting, rusting containers or bags that have been stored for up to 40 years. Tens of thousands of tonnes of soils have also been contaminated by toxic chemicals, including Persistent Organic Pollutants (POPs) banned internationally by the Stockholm Convention on POPs. As these chemicals spill and leak from their containers, they threaten rural and urban populations and contribute to land degradation, air and water pollution affecting some of the poorest communities across the continent.

2.4 Livestock

As already pointed out, livestock keeping is one of the major economic occupations commonly practiced among the rural population in Tanzania (refer to Table 1.1). In Tanzania it mainly involves the keeping of cattle, goats, sheep and chickens (Table 2.13)

2.4.1 Grazing Area

The grazing area is defined as the land that is available for rearing livestock. It excludes all tsetse fly infested areas, wildlife and forest reserves as well as tree plantation but includes game controlled areas and overlapping arable land.



Grazing area is available for both indigenous and improved cattle in Tanzania Mainland

Table 2.11 shows that 52.3 percent of land fit for grazing on Tanzania Mainland was being utilized.

Table 2.11: The Livestock Grazing Area by Region, Tanzania Mainland, 2005

Region	Land Fit for Grazing (ha)	Land Used for Grazing (ha)	Percent of Land Used for Grazing	Tsetse-fly Infested Area (ha)
Dodoma	3,133,601	1,921,999	61.3	933,600
Arusha*	12,225,284	11,000,084	90.0	1,802,834
Kilimanjaro	418,252	376,955	90.1	64,710
Tanga	1,588,935	488,493	30.7	1,183,987
Morogoro	1,643,590	302,508	18.4	2,305,228
Pwani	566,540	144,380	25.5	302,180
Lindi	2,322,466	82,410	3.5	1,009,051
Mtwara	398,375	370,000	92.9	174,875
Ruvuma	1,800,800	240,172	13.3	187,100
Iringa	3,688,700	2,459,134	66.7	0
Mbeya	2,043,660	1,246,400	61.0	889,400
Singida	2,326,790	1,415,800	60.8	1,775,675
Tabora	27,800	3,027	10.9	187,730
Rukwa	2,622,164	151,554	5.8	337,000
Kigoma	1,504,800	305,000	20.3	603,000
Shinyanga	3,990,551	1,385,709	34.7	1,053,595
Kagera	628,400	323,962	51.6	177,295
Mwanza	413,000	380,161	92.0	108,276
Mara	8,636,167	3,544,900	41.0	31,750
Total	49,979,875	26,142,648	52.3	13,127,286

* It includes Manyara region

Source: Ministry of Water and Livestock Development, Statistical Year Book, January 2005

2.4.2 Carrying Capacity of Livestock

The pressure of livestock can be assessed through the carrying capacity, which is the number of livestock per unit of arable land. Table 2.12 shows carrying capacity by region, of the three main livestock (cattle, goats and sheep). The concentration of these livestock is in the regions of Arusha, Kilimanjaro, Manyara, Mara, Singida and Dar es Salaam. The carrying capacity of main livestock (cattle, goat and sheep) for Tanzania Mainland was 3.4 in 2008.

Table 2.12: Small Holder Agriculture; the Estimated Carrying Capacity of Livestock by Region, Tanzania Mainland, 2008

Region	No. of Livestock	Arable Land (ha)	Carrying Capacity	Region	No. of Livestock	Arable Land (ha)	Carrying Capacity
(1)	(2)	(3)	(4)=(2)/(3)	(1)	(2)	(3)	(4)=(2)/(3)
Dodoma	2,392,958	924,280	2.6	Mbeya	1,603,651	751,270	2.1
Arusha	5,106,173	266,387	19.2	Singida	2,990,238	613,144	4.9
Kilimanjaro	1,580,582	161,321	9.8	Tabora	3,515,388	1,135,906	3.1
Tanga	1,668,555	571,822	2.9	Rukwa	1,294,821	749,616	1.7
Morogoro	1,136,128	597,221	1.9	Kigoma	894,025	348,238	2.6
Pwani	490,305	203,001	2.4	Shinyanga	6,468,844	2,160,577	3.0
D'Salaam	110,667	26,798	4.1	Kagera	1,757,250	407,037	4.0
Lindi	194,522	189,611	1.0	Mwanza	3,132,954	879,205	3.6
Mtwara	269,473	275,884	1.0	Mara	3,106,510	479,605	6.5
Ruvuma	485,645	537,658	0.9	Manyara	3,875,809	556,238	7.0
Iringa	833,875	726,866	1.1	Total	42,908,373	12,561,685	3.4

Note: Number of Livestock includes cattle, goats and sheep only

Source: National Sample Census Survey of Agriculture, 2007/2008

2.4.3 Livestock Population

Table 2.13 shows that sheep accounted for 14.9 percent of the main livestock (cattle, goats and sheep) population of Tanzania Mainland. It is followed by goats (35.4 percent) while cattle had the largest share of 49.7 percent. The regional distribution of these livestock shows that the region with the largest share was Shinyanga (15.1 percent). The region with the smallest share was Dar es Salaam (0.3 percent).

Table 2.13: Small Holder Agriculture; Distribution of Livestock by Type and by Region, Tanzania Mainland, 2008

Region	Number of Livestock				Percent			Percent Share
	Cattle	Goats	Sheep	Total	Cattle	Goats	Sheep	
Dodoma	1,193,850	915,356	283,752	2,392,958	49.9	38.3	11.9	5.6
Arusha	1,826,640	1,823,303	145,623	5,106,173	35.8	35.7	28.5	11.9
Kilimanjaro	538,306	653,511	388,765	1,580,582	34.1	41.3	24.6	3.7
Tanga	732,947	718,625	216,983	1,668,555	43.9	43.1	13.0	3.9
Morogoro	639,764	377,572	118,792	1,136,128	56.3	33.2	10.5	2.6
Pwani	256,284	190,880	43,141	490,305	52.3	38.9	8.8	1.1
Dar es Salaam	33,040	56,739	20,888	110,667	29.9	51.3	18.9	0.3
Lindi	30,198	159,322	5,002	194,522	15.5	81.9	2.6	0.5
Mtwara	18,115	234,564	16,794	269,473	6.7	87.0	6.2	0.6
Ruvuma	116,086	349,024	20,535	485,645	23.9	71.9	4.2	1.1
Iringa	477,893	299,534	56,448	833,875	57.3	35.9	6.8	1.9
Mbeya	874,005	544,872	184,774	1,603,651	54.5	34.0	11.5	3.7
Singida	1,595,068	842,461	552,709	2,990,238	53.3	28.2	18.5	7.0
Tabora	2,140,186	943,659	431,543	3,515,388	60.9	26.8	12.3	8.2
Rukwa	814,893	436,351	43,577	1,294,821	62.9	33.7	3.4	3.0
Kigoma	159,454	511,859	222,712	894,025	17.8	57.3	24.9	2.1
Shinyanga	3,668,643	1,968,841	831,360	6,468,844	56.7	30.4	12.9	15.1
Kagera	844,187	823,989	89,074	1,757,250	48.0	46.9	5.1	4.1
Mwanza	1,980,996	927,427	224,531	3,132,954	63.2	29.6	7.2	7.3
Mara	1,724,061	913,778	468,671	3,106,510	55.5	29.4	15.1	7.2
Manyara	1,674,349	1,481,729	719,731	3,875,809	43.2	38.2	18.6	9.0
Total	21,338,964	15,173,396	6,396,012	42,908,372	49.7	35.4	14.9	100

Source: National Sample Census Survey of Agriculture, 2007/2008

Though the country has a number of livestock research centres and ranches, which are used to improve the indigenous livestock, there are still no significant numbers of improved livestock for sheep, goats and cattle (Table 2.14a, Table 2.14b and 2.14c).

(i) Cattle



Indigenous cattle are the most common livestock found in Tanzania Mainland

Table 2.14a shows that in 2008, most of the cattle population (96.2 percent) consisted of indigenous cattle. They were followed by dairy cattle (2.9 percent) and then improved beef cattle (0.9 percent).

Traditional livestock keeping has the disadvantages of causing environmental degradation; as well as conflicts between farmers and livestock keepers in areas such as Kilosa, Usangu plain, Kilombero, Shinyanga, Dodoma, Singida and other areas in the country. Modern livestock keeping would greatly reduce the observed shortcomings.

Table 2.14a: Small Holder Agriculture; Distribution of Cattle Population by Type and by Region, Tanzania Mainland, 2008

Region	Number of Cattle				Percent			Percent Share
	Indigenous	Improved for meat	Improved for Dairy	Total	Indigenous	Improved for meat	Improved for Dairy	
Dodoma	1,174,305	16,072	3,473	1,193,850	98.4	1.3	0.3	5.6
Arusha	1,720,406	20,639	85,595	1,826,640	94.2	1.1	4.7	8.6
Kilimanjaro	321,063	54,179	163,065	538,306	59.6	10.1	30.3	2.5
Tanga	688,114	2,830	42,003	732,947	93.9	0.4	5.7	3.4
Morogoro	628,475	1,874	9,414	639,764	98.2	0.3	1.5	3.0
Pwani	225,494	1,141	29,650	256,284	88.0	0.4	11.6	1.2
D'Salaam	6,108	1,919	25,014	33,040	18.5	5.8	75.7	0.2
Lindi	25,458	135	4,605	30,198	84.3	0.4	15.2	0.1
Mtwara	17,415	305	394	18,115	96.1	1.7	2.2	0.1
Ruvuma	61,768	1,420	52,897	116,086	53.2	1.2	45.6	0.5
Iringa	460,229	1,498	16,166	477,893	96.3	0.3	3.4	2.2
Mbeya	787,686	10,259	76,059	874,005	90.1	1.2	8.7	4.1
Singida	1,587,649	2,066	5,353	1,595,068	99.5	0.1	0.3	7.5
Tabora	2,122,343	12,323	5,520	2,140,186	99.2	0.6	0.3	10.0
Rukwa	799,700	4,609	10,584	814,893	98.1	0.6	1.3	3.8
Kigoma	154,115	736	4,602	159,454	96.7	0.5	2.9	0.7
Shinyanga	3,632,826	20,066	15,750	3,668,643	99.0	0.5	0.4	17.2
Kagera	813,212	129	30,846	844,187	96.3	0.0	3.7	4.0
Mwanza	1,970,901	3,198	6,898	1,980,996	99.5	0.2	0.3	9.3
Mara	1,684,117	33,155	6,789	1,724,061	97.7	1.9	0.4	8.1
Manyara	1,648,290	4,930	21,129	1,674,349	98.4	0.3	1.3	7.8
Total	20,529,676	193,484	615,805	21,338,964	96.2	0.9	2.9	100.0

Source: National Sample Census Survey of Agriculture, 2007/2008

(ii) Goats

Table 2.14b shows that most of the goats in Tanzania Mainland are indigenous. In 2008, indigenous goats comprised 96.5 percent of the total goat population followed by dairy goats (2.8 percent and improved goats for meat (0.7 percent). The regions with the largest numbers of improved goats were Kilimanjaro and Morogoro.

Table 2.14 b: Small Holder Agriculture; Distribution of Goats Population by Type and by Region, Tanzania Mainland, 2008

Region	Number of Goats				Percent			Percent Share
	Indigenous	Improved for Meat	Improved for Diary	Total	Indigenous improved for Meat	Improved for Diary		
Dodoma	906,466	5,546	3,343	915,356	99.0	0.6	0.4	6.0
Arusha	1,764,226	5,902	53,176	1,823,303	96.8	0.3	2.9	12.0
Kilimanjaro	581,840	10,919	60,753	653,511	89.0	1.7	9.3	4.3
Tanga	705,706	0	12,919	718,625	98.2	0.0	1.8	4.7
Morogoro	322,614	0	54,958	377,572	85.4	0.0	14.6	2.5
Pwani	161,652	17,698	11,530	190,880	84.7	9.3	6.0	1.3
D'Salaam	50,701	3,784	2,254	56,739	89.4	6.7	4.0	0.4
Lindi	154,247	94	4,981	159,322	96.8	0.1	3.1	1.1
Mtwara	233,965	560	40	234,564	99.7	0.2	0.0	1.5
Ruvuma	338,561	5,632	4,832	349,024	97.0	1.6	1.4	2.3
Iringa	290,497	1,515	7,522	299,534	97.0	0.5	2.5	2.0
Mbeya	520,284	1,553	23,035	544,872	95.5	0.3	4.2	3.6
Singida	835,257	3,498	3,705	842,461	99.1	0.4	0.4	5.6
Tabora	942,887	773	0	943,659	99.9	0.1	0.0	6.2
Rukwa	410,480	9,181	16,690	436,351	94.1	2.1	3.8	2.9
Kigoma	488,165	11,840	11,854	511,859	95.4	2.3	2.3	3.4
Shinyanga	1,910,098	6,832	51,911	1,968,841	97.0	0.3	2.6	13.0
Kagera	785,391	9,078	29,520	823,989	95.3	1.1	3.6	5.4
Mwanza	904,695	7,727	15,005	927,427	97.5	0.8	1.6	6.1
Mara	902,362	254	11,163	913,778	98.8	0.0	1.2	6.0
Manyara	1,436,057	2,977	42,696	1,481,729	96.9	0.2	2.9	9.8
Total	14,646,150	105,361	421,885	15,173,396	96.5	0.7	2.8	100

Source: National Sample Census Survey of Agriculture, 2007/2008

(iii) Sheep

Sheep rearing is very prominent in Arusha Region

Table 2.14c shows that, out of an estimated 6,396,012 sheep in the country, only 10.8 percent were improved while the remaining 89.2 percent were indigenous. This indicates that most of the small scale farmers still practice the traditional methods of rearing their livestock. The distribution of improved sheep by region shows that the regions with large share of improved sheep were Kigoma (15.4 percent), Shinyanga (13.6 percent), Mbeya (12.6 percent), Tabora (11.6 percent) and Manyara (11.5 percent). The regions that reported having no improved sheep were Tanga, Morogoro, Pwani, Dar es Salaam, Ruvuma, Iringa and Rukwa (Table 2.14c).

Table 2.14 c: Small Holder Agriculture; Distribution of Sheep Population by Type and by Region, Tanzania Mainland, 2008

Region	Number of Sheep			Percent		Percent Share
	Indigenous	Improved for Mutton	Total	Indigenous	Improved for Mutton	
Dodoma	270,299	13,453	283,752	95.3	4.7	4.4
Arusha	1,401,093	55,137	1,456,230	96.2	3.8	22.8
Kilimanjaro	352,824	35,941	388,765	90.8	9.2	6.1
Tanga	216,983	0	216,983	100.0	0.0	3.4
Morogoro	118,792	0	118,792	100.0	0.0	1.9
Pwani	43,141	0	43,141	100.0	0.0	0.7
Dar es Salaam	20,888	0	20,888	100.0	0.0	0.3
Lindi	4,908	94	5,002	98.1	1.9	0.1
Mtwara	16,590	204	16,794	98.8	1.2	0.3
Ruvuma	20,535	0	20,535	100.0	0.0	0.3
Iringa	56,448	0	56,448	100.0	0.0	0.9
Mbeya	97,938	86,836	184,774	53.0	47.0	2.9
Singida	475,666	77,043	552,709	86.1	13.9	8.6
Tabora	351,565	79,978	431,543	81.5	18.5	6.7
Rukwa	43,577	0	43,577	100.0	0.0	0.7
Kigoma	116,388	106,324	222,712	52.3	47.7	3.5
Shinyanga	737,565	93,795	831,360	88.7	11.3	13.0
Kagera	76,481	12,594	89,074	85.9	14.1	1.4
Mwanza	224,403	128	224,531	99.9	0.1	3.5
Mara	418,077	50,593	468,671	89.2	10.8	7.3
Manyara	640,091	79,641	719,731	88.9	11.1	11.3
Total	5,704,253	691,759	6,396,012	89.2	10.8	100.0

Source: National Sample Census Survey of Agriculture, 2007/2008

CHAPTER THREE

FORESTRY AND WILDLIFE

3.0 Introduction

Chapter Three presents information about the prevailing forestry and environmental degradation caused by deforestation and major steps taken to improve the situation. It also elaborates on the wildlife and related activities in Tanzania Mainland.

3.1 Forest Area

According to the National Forest Resources Monitoring and Assessment (NAFORMA) project of 2009 - 2014, which assessed forest resources and land cover and land uses for Tanzania Mainland through field work and satellite, imagery reveals that forests cover 48.1 million hectares (55 percent) of the total land area of Tanzania Mainland. Before the assessment the forest area was estimated at 33.6 million hectares or 40 percent of the Mainland's land area. It seems that the forest area was previously under estimated due to the fact that the previous assessments were based on satellite imagery supported by very little ground true thing sites while NAFORMA was based on intensive fieldwork. However, the deforestation rate stands at about 372,000 hectares per year, still causing negative effects on environment.

Forests resources are categorized by type, usage and legal status. In regard to type of vegetation cover, 93 percent of the total forest area was covered by woodlands. This was followed by Lowland forests (3.4 percent), Humid Montane forest (2.0 percent), Plantation Forest (1.2 percent) and Mangroves (0.3 percent), which are very important to aquatic life. In terms of usage, the productive forest area comprised 60.3 percent of the total forest area while 39.7 percent of the forest area was accounted for as protected forest areas most of which are catchment areas and natural reserves. Furthermore, under legal status about 23.3 percent of the forest area is under wildlife-protected areas.

Table 3.1: Distribution of Forest Area by Category, Tanzania Mainland, 2013/14

Category	Area ('000 ha)	Percent
Type		
Forests (Montane, Lowland and Plantation)	3,206	6.7.
Mangrove forests	158	0.3
Woodlands	44,736	93.0
Total	48,100	100.0
Use of forest land		
Production forest area	29,004,	60.3
Protection forest area (mostly catchments areas)	19, 096	39.7.
Total	48100	100.0
Legal status		
Forest reserves	18,711	38.9
Forest/woodlands in national parks, etc.	11,207 ,	23.3.
Non-reserved forest land	18,182	37.8
Total	48100	100.0

Source: Forestry and Beekeeping Department, Ministry of Natural Resources and Tourism

3.2 Vegetation and Afforestation



Afforestation has become a prominent activity in most rural areas of Tanzania Mainland

In Tanzania, vegetation resources comprise forests, woodlands, grasslands or savanna, permanent swamps and desert/semi-arid areas. As it can be seen from Table 3.1, forests and woodlands cover 48.1 million hectares representing about 55 percent of the total land area.

The responsibility for the improvement of vegetation through afforestation, and reforestation programmes involves several actors such as ministries of Agriculture, Food Security and Cooperatives, Water and Irrigation, Livestock and Fisheries Development, and Natural Resources and Tourism, as well as non-governmental organizations and individuals. Apart from specialised work being done through specific programmes in the regions, there is the National Tree Planting Programme while villages have their own tree-planting programmes. Unfortunately, statistics pertaining to such afforestation and reforestation are limited to the acreage of planted areas in each region (Table 3.2).

Table 3.2 shows that the Government has been putting effort into afforestation by encouraging planting of trees. Although this exercise is sustainable tree-planting seedlings have been fluctuating. For example from Table 3.2 it can be seen that there was a decline in 2009/10 and 2010/11 and then an increase from 2011/12 to 2013/14. Data for year 2011/12, 2012/13 and from Geita region were not available. The regions of Njombe, Katavi, Simiyu and Geita did not exist before 2012. This might be the reason for the drop of seedling planted in the region of Shinyanga due to the fact that the region was splintered to create the region of Simiyu and part of Geita region.

Table 3.2: Tree Planting – Seedlings Planted by Region, Tanzania Mainland, 2006/07 - 2013/14

Region	Number					
	2006/07	2007/08	2008/09	2009/10	2010/11	2013/14
Dodoma	3,859,176	3,859,180	4,100,000	4,330,000	5,288,000	4,256,925
Arusha	4,141,250	4,312,043	6,968,417	5,163,791	3,768,491	-
Kilimanjaro	6,000,000	4,817,061	3,432,106	5,900,000	7,004,164	8,413,160
Tanga	5,596,002	3,238,550	5,250,010	7,520,316	2,834,000	-
Morogoro	-	5,950,835	10,902,351	11,268,387	11,609,727	7,836,950
Pwani	-	5,084,184	5,309,775	2,690,646	6,250,461	2,283,435
Dar es Salaam	1,668,801	1,668,800	2,763,392	2,867,313	3,333,545	3,486,100
Lindi	6,000,000	3,773,313	2,010,000	5,157,600	5,203,325	4,589,074
Mtwara	3,186,400	5,862,747	7,411,000	5,928,503	5,678,686	2,241,138
Ruvuma	-	3,392,395	6,427,855	642,855	4,099,613	12,339,350
Iringa	20,000,000	17,486,732	58,200,000	84,979,626	1,227,262	57,939,180
Mbeya	11,953,129	5,297,968	6,443,842	5,626,994	5,759,402	8,763,972
Singida	2,128,150	34,839,431	30,136,031	21,915,690	13,869,405	3,037,956
Tabora	-	1,830,458	1,498,289	2,033,533	1,953,074	8,747,180
Rukwa	-	5,423,241	8,374,066	2,981,630	11,681,036	-
Kigoma	2,013,451	2,013,452	1,971,790	1,346,643	2,157,320	-
Shinyanga	19,910,981	4,750,000	7,800,000	9,100,000	9,100,000	1,484,193
Kagera	-	5,293,435	13,298,266	12,168,342	5,195,702	-
Mwanza	7,730,189	1,713,806	3,678,734	3,565,908	4,867,812	7,787,753
Mara	5,094,200	4,154,855	4,614,004	4,499,801	4,717,730	5,539,773
Manyara	3,606,308	11,314,395	13,228,156	6,152,785	16,598,429	-
Njombe	na	na	na	na	na	43,500,000
Katavi	na	na	na	na	na	1,867,778
Simiyu	na	na	na	n.a	n.a	5,144,709
Geita	na	na	na	na	na	-
Total	102,888,037	136,076,881	203,818,084	205,840,363	132,197,184	189,258,626

Note: Njombe, Katavi, Simiyu and Geita regions did not exist before 2012

Source: Tanzania Forest Service Agency (TFSA)

3.2.1 Forest Plantations

In Tanzania Mainland, forest resources are scattered throughout the country with varying forest areas at the regional level. The regions with the large share of the total forest area in 2013/14 were Tabora (15.8 percent), Rukwa (14.6 percent), Lindi (12.9 percent), Arusha (7.4 percent), Pwani (7.3 percent), and Dodoma (7.0 percent). The percentage shares of other regions are shown in Appendix 5.

Besides natural forests, Tanzania Mainland has a number of forest plantations as indicated in Table 3.3. Sao Hill which is located in Iringa Region has the largest forest plantation area accounted for 56.8 percent of the total plantation area. This is followed by Meru Plantation in Arusha Region, North Kilimanjaro in Kilimanjaro Region and Shume in Tanga Region.

Table 3.3: Area Planted with Trees – Industrial Plantation Forests, Tanzania Mainland, 2013

Name of Plantation	Region	Area (ha)	Percent
Sao Hill	Iringa	52,070	56.8
Buhindi	Mwanza	3,810	4.2
Rubya	Mwanza	1,771	1.9
Rubare	Kagera	1,227	1.3
Rondo	Lindi	864	0.9
Kiwira	Mbeya	2,784	3.0
Kawetire	Mbeya	2,131	2.3
Ukaguru	Morogoro	976	1.1
Shume	Tanga	4,227	4.6
West Kilimanjaro	Kilimanjaro	4,149	4.5
Wino	Ruvuma	1,380	1.5
North Kilimanjaro	Kilimanjaro	6,177	6.7
Meru	Arusha	6,110	6.8
Mtibwa	Morogoro	1,867	2.0
Longuza	Tanga	1,904	2.2
Mbizi	Rukwa	158	0.2
Total Coverage		91,605	100.0

Source: Department of Forestry and Beekeeping, Ministry of Natural Resources and Tourism

3.2.2 Impact of Forests

Environmental changes caused by other sectors have some influence on the growth of trees and forest resources; hence they affect the forestry sector development and its related uses. Although forestry may have negative impacts on the environment, trees and forests usually have many positive effects. Some positive effects of trees and forests are:-

- Trees serve as windbreaks hence reducing soil erosion from wind;
- Leaves and branches retard heavy impact of rains on the soil hence reducing soil erosion from water;
- Shading and transpiration reduce soil temperature;
- Absorption of nutrients through deep root systems and subsequently transport of the nutrients to leaves and flowers whose shedding supply nutrients to the soil surface thereby increasing its fertility;
- Diminishes the effect of the run-off water from the forests; and
- Many direct uses of trees and tree products within the human society include: production of fuel wood, building materials, industrial raw materials, fodder, edible fruits, etc

Some of the negative effects caused by forestry are:-

- Monoculture over large areas makes forests more susceptible to insect attacks and diseases. These types of forests also reduce the area for natural forest regeneration, diminishing biodiversity, the growth of medicinal plants and other species necessary for balance of the ecosystem;
- Over-exploitation especially of natural species, gradually changes the genetic composition and reduces the biodiversity of forests; and
- Clear cutting of forests gradually leads to heavy erosion thereby reducing the possibilities for regeneration or growth of new forests.

3.3 Forest Products

Exports of forest products provide a source of foreign exchange for the country. Table 3.4 shows exports of wood and non-wood forest products. The revenue collection reached its highest level in 2006/07, when a total of USD 381,359.07 thousand were collected before dropping to USD 344,055.77 thousands in 2010/11. This might be due to export restrictions on forest products that were imposed by the Government. A further fall in revenue is expected due to these restrictions.



Beekeeping is a growing subsector in Tanzania due to afforestation campaigns

Table 3.4: Exported Forest Products and the Revenue Collected, Tanzania Mainland, 2006/07 - 2010/11

	Unit	2006/2007		2007/2008		2008/2009		2009/2010		2010/2011	
		Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000
Teak logs	m ³	8,808.38	27,030.00	-	-	-	-	-	-	-	-
Rough sawn timber	m ³	310,641.21	129,708.85	22.05	71,854.22	6,895.14	27,161.66	90,827.00	288,737.83	43,090.63	230,972.42
Dalbergia Timber	m ³	802.50	5,268.17	4.59	7,952.12	113.88	2,720.00	75.39	2,389.66	88.15	2,183.33
Flooring strips	m ³	38.50	821.50	23.43	676.00	0.23	52.00	117.00	148.62	-	-
Carvings	kg	29,953.15	25,943.37	127,432.66	58,706.73	28,560.47	18,993.59	35,849.00	23,154.20	31,860.13	20,041.52
Sandal wood	m ³	90,270.30	3,142.50	-	-	-	-	-	-	20,000.00	233.33
Furniture	kg	23.00	4,313.68	573.00	9,164.12	1,333.00	3,298.00	1,297.00	3,655.29	8,645.00	5,561.75
Mimosa leaves	kg	444,000.00	2,780.00	1,534,000.00	16,777.60	458,000.00	2,532.00	194,025.00	979.31	209,000.00	761.47
Tree seeds	kg	10,665.00	137,300.00	-	-	-	-	-	-	-	-
Tree seedlings	kg	41,698.00	12,428.00	-	-	-	-	-	-	700.00	606.67
Gum arabica	kg	-	-	-	-	-	-	195,020.00	838.14	398,295.00	25,323.33
Tree backs	kg	245,235.00	2,203.00	20,000.00	1,064.00	628,200.67	4,120.00	138,502.05	934.48	87,000.00	680.00
Palm fibres	kg	1,000.00	140.00	16,089.00	2,192.00	4,000.00	232.08	4,147.00	504.38	1,444.00	983.93
Rattans	kg	2,400.00	2,540.00	-	-	-	-	-	-	8,230.00	4,000.55
Medicine leaves	kg	2.00	61.00	2.00	500.40	13.00	110.40	26.37	193.12	66.00	4,472.67

Table 3.4: (ctd) Exported Forest Products and the Revenue Collected, Tanzania Mainland, 2006/07 - 2010/11

	Unit	2006/2007		2007/2008		2008/2009		2009/2010		2010/2011	
		Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000	Quantity	Value USD'000
Dalbergia off cuts	m ³	5.22	100.00	-	-	15,000.00	116.00			-	-
Timber pallets	m ³	19.00	70.00	-	-	-	-			2,365.00	40,000.00
Poles	R/M	6,396.01	24,970.00	8,496.28	31,239.30	27.11	172.00	0.06	1,500.00	425.00	670.00
Palm fibres	kg	6,000.00	280.00	1,000.00	560.00	2,000.00	116.00			-	-
Bee hives	Pcs			25,500.00	116.00	-	-	-	-	-	-
Jatropha oil	kg	0	0	14,000.00	112.00			210.00	44.83	85.75	140.00
Sandal oil	kg	0	0	0	0	5,968.00	1,776.00	9,358.00	2,251.72	500.00	96.67
Carvings	kg	0	0	0	0	0	0	5,425.50	3,604.34	15,245.00	3,456.40
Rubber	kg							155,000.00	1,300.00		
Sandal dust	kg	0	0		0	0	0	82,288.79	29,063.45	96,511.25	626.67
Honey	tonnes	369.74	422.59	94.00	80.89	620.46	915.56	291.44	457.64	343.02	646.25
Bee wax	tonnes	413.77	1,836.41	428.68	1,891.77	296.50	1,379.83	329.90	1,427.68	534.00	2,598.83
Electricity poles	m ³	0	-	-	-	-	-	2,255.00	7,468.97	-	-
Total Revenue			381,359.07		202,887.15		63,643.12		368,653.66		344,055.77

Source: Tanzania Forest Service Agency

Table 3.5: Supply of Wood and Non-Wood Products by Station and Type of Product, Tanzania Mainland, 2001/02 – 2003/04

Station	Product	Units	2001/02	2002/03	2003/04
Tanzania Tree Seed Agency	Tree Seeds	(tonnes)	11.2	10.8	10.65
		TZS.	106,334,842	114,138,213,	88,040,157
Tanzania Forest Research Institute	Sawn-logs	(m ³).	919	9,784	767
		TZS	3,582,000	58,204,856	3,773,004
	Tree Seeds	(Kgs) &	2	3	4
		TZS	22,000	54,000	72,000
Sao Hill Forest Plantation	Sawn logs	(m ³)	116,677	229,247	207,822
		TZS.	293,309,752	882,644,038	664,718,393
	Poles, All sizes	(m ³)	6410	10,563	17,140
		TZS.	32,049,750	52,815,000	85,700,000
	Fuel-wood	(m ³)	107	73.6	-
		TZS.	106,800	73,600	-
Maize	tonnes	1215	578	-	
	TZS	18,225,000	11,556,000	-	
Morogoro	Sawn-logs	(m ³)	2,001.2	6,323.8	4,950.4
		TZS.	39,498,301	98,507,786	92,149,612
	Poles, All sizes	(No.)	743	733	1246
		TZS.	292,900	219,650	393,000
	Fuel-wood	(m ³)	1,464.1	257.8	242
		TZS.	1,424,080	841,660	766,600
	Charcoal	Bags	96,520	89,579	57,269
		TZS.	38,608,220	35,575,980	24,567,240
	Sawn Timber	Pcs	0	-	2,035
		TZS	0	8,147,303	13,924,393
	Raffia	kgs	0	-	26,308
		TZS	0	423,290	394,650
	Bamboo	Each	0	-	130
		TZS	0	242,500	13,000
Ecotourism	No	90	60	60	
	TZS	320,000	356,600	300,000	
Kiwira Forest Plantation	Sawn-logs	(m ³)	604.88	1,700	1,600
		TZS.	2,909,000	14,692,200	9,296,000
	Fuel-wood	(m ³)	0	7	7
		TZS.	0	3500	3500
	Potatoes	tonnes	800	272	272
		TZS	56,000,000	19,040,000	19,040,000
Maize	tonnes	204	204	204	
	TZS	24,480,000	24,480,000	24,480,000	

Table 3.5 (ctd): Supply of Wood and Non-Wood Products by Station and Type of Product, Tanzania Mainland, 2001/02 – 2003/04

Station	Product	Units	2001/02	2002/03	2003/04
Buhindi Forest Plantation	Trees	(m ³)	24,239.484	33059.881	29,545.238
		TZS.	160,410,000	210,362,515	188,450,425
	Poles, All sizes	(No.)	0	463	50
		TZS.	0	115,750	10,000
	Fuelwood	(m ³)	111	137	202
		TZS.	330,000	411,000	418,500
	Raffia	kgs	75	0	0
		TZS.	11,250	0	0
	Potatoes	tonnes			
		TZS	-	-	-
Maize	tonnes				
	TZS	-	-	-	
Murram (Building material)	tones	0.5	6	5	
	TZS	1500	18,000	15,000	

Source: Department of Forestry and Beekeeping

3.4 Deforestation



Encroachment has created adverse Environment impact in most part of Tanzania Mainland as captured in Makete District

Deforestation is a major environmental concern in Sub-Saharan Africa leading to its inclusion in the Lagos Plan of Action for Economic Development of Africa for the period 1980-2000. In adopting the plan at the national level, the environmental situation in Tanzania was reviewed and among the priority issues identified were desertification, degradation and depletion of natural resources including forest reserves.

In Tanzania deforestation is considered to be a man-made environmental problem resulting from a growing population, which exerts pressure on land to fulfill their socio-economic requirements. Deforestation results from land clearance for small-scale and commercial agriculture and felling of trees for domestic use in most cases for fuel wood.

In Tanzania, forest resources face increasing threats of deforestation and degradation but there are no reliable statistics on forest area to support this fact. According to the NAFORMA, it is estimated that about 372,000 hectares are lost annually through deforestation (URT, 2014). The major effect of deforestation is the deterioration of the ecological system with resulting negative impacts on soil fertility, water flows and biological diversity. Others are drought, symptoms of desertification, salination of watercourses and dams; land degradation, loss of soil fertility and soil erosion.

Statistics from the Government report for Agenda 21 reveal that more than 90 percent of the population depends on fuel wood for energy. Tanzanian forests supply about 97 percent of the total fuel wood consumed.¹ Other factors causing deforestation are timber for construction and for exports. It is also caused by the use of fuel wood in the curing of tobacco in Iringa, Tabora and Ruvuma regions.

3.4.1 National Actions to Reduce Deforestation and Forest Degradation

Recently, Tanzania embarked on the initiatives of Reducing Emissions from Deforestation and forest Degradation (REDD+) through UN REDD programme. The initiatives aim to support communities to conserve forests resources and get financial motivation (avoided deforestation) through carbon credit schemes. The scheme will be developed based on Kyoto Protocol through the Clean Development Mechanism (CDM). As part of international efforts to address climate change through the United Nations Framework Convention on Climate Change (UNFCCC) and through encouragement from the Cancun Agreements, developing countries, including Tanzania, are required to undertake REDD+ activities. REDD+ activities aimed at reducing emissions from deforestation and forest degradation, through the conservation of forest carbon stocks, the sustainable management of forests and the enhancement of forest carbon stocks. To do this, Tanzania already has in place National Forest Monitoring Systems (NFMS). NFMS were a topic in the recent climate negotiations in Doha in 2012, aiming (in the language of the negotiations) for a decision of the Conference of Parties (COP) on *modalities for national forest monitoring systems and measuring, reporting and verifying*. Hitherto the main guidance that the UNFCCC has provided in this area dates back to a decision in 2009 which specifies that NFMS should be transparent, robust, consistent and as accurate as possible. Countries should follow the most recent methodological recommendations by the Intergovernmental Panel on Climate Change as adopted by the COP. They should also use a combination of remote sensing and ground-based data, all as a basis for estimating the sources of anthropogenic greenhouse gas (GHG) emissions, their removal

¹ (Misana S.B. et al., 1997)

by sinks, and for measuring carbon stocks and changes in forest area.

The issue of addressing drivers of deforestation and degradation remains on the national and international agenda. No specific negotiation progress was achieved on this issue during the COP 18 in Doha in 2012, although side events presented new results. Agriculture was indicated as a driver of forest loss by many developing countries and that for REDD+ to work, different actors and sectors need to work together to make monitoring systems efficient and to understand better the interactions taking place. As many drivers of forest change are outside the forestry sector (e.g. arising from agriculture or fuel wood demand), other sectors also have a role in the statistical design, implementation and, in particular, the monitoring for REDD+ and its impacts.

3.5 Wildlife



A group of elephants in Serengeti National Park in Ngorongoro District

Wildlife embraces all living organisms occurring naturally in wild habitats. They include plants, animals, birds, reptiles, amphibians, fish and the invertebrates. The increasing demand for land, water, food and energy has reduced the wild plants and animal life. The use of land for agriculture has decreased the amount of space available to wildlife. Furthermore, clearing of forests for fuel and building materials has also threatened this sector. There is a direct relationship between increases in human population and loss of wildlife habitat, which call for an effort to control this situation.

3.5.1 Hunting

Wildlife statistics are compiled by the Wildlife Department of the Ministry of Natural Resources and Tourism. Information on hunting licenses is a source of the statistics included in this report. Table 3.6 shows that, hunting clients were increasing over the period 2000/01 – 2007/08 and then

dropped drastically from 2008/09 to 2012/2013 period. This might be due to more restrictions imposed by the Government on hunting.

Table 3.6: Number of Hunting Companies and Tourist Hunters by Year, Tanzania Mainland, 2000/01 – 2012/13

Year	Number of Tourists			Revenue accrued from trophy hunting (USD Million)
	Hunting Clients	Observers	Total	
2000/01	993	427	1,420	9.4
2001/02	982	321	1,303	9.0
2002/03	1,035	418	1,453	9.3
2003/04	1,018	359	1,377	8.8
2004/05	1,274	380	1,654	9.7
2005/06	1,440	241	1,681	11.6
2006/07	1,582	855	2,437	12.0
2007/08	1,508	700	2,208	14.7
2008/09	1,152	337	1,489	19.8
2009/10	851	203	1,054	18.4
2010/11	862	171	1,033	23.5
2011/12	680	128	808	15.7
2012/13	631	364	995	15.9

Source: Wildlife Department, Ministry of Natural Resources and Tourism

3.5.2 Government Trophies

Export of wildlife and wildlife products provide much needed foreign exchange for national development. However, this needs to be done in a careful manner so that the species are not endangered. Table 3.7 gives the number of wildlife exported by Tanzania Mainland between 2005 and 2013; data for 2012 could not be obtained. The data indicate that export of birds, increased over the period from 2006, while other exports show fluctuations.

Table 3.7: Exports of Government Trophies by Type of Specie, Tanzania Mainland, 2005 – 2013

Type of Species	2005	2006	2007	2008	2009	2010	2011	2012*	2013
Birds	90,869	6,236	15,347	15,347	18,798	25,742	68,964	na	42,909
Reptiles	54,221	101,467	112,630	114,171	110,056	56,988	57,221	na	47,733
Mammals other than primates	507	229	274	296	202	263	379	na	30
Primates	437	273	736	738	50	202	61	na	71
Amphibians	18,823	37,989	43,967	46,402	47,055	24,557	10,635	na	25,110
Insects	73,057	107,489	77,245	111,512	100,171	40,351	21,765	na	34,905

* The business of exports of Government trophies was prohibited during 2012

Source: Wildlife Department, Ministry of Natural Resources and Tourism

Exportation of wildlife and wildlife products as well as tourist hunting increased the government revenue (Table 3.8). Photographic and tourism activities show an improvement when compared to hunting tourism and export of live animals.

Table 3.8: Earnings from Hunting Tourism and Export of Live Animals by Activity, Tanzania Mainland, 2008/09– 2013/14

Activity	Unit	2008/2009	2009/2010	2010/2011	2011/2012	2012/20313	2013/2014
Trophy Hunting	USD	14,861,740	17,610,454	21,450,234	15,696,990	15,917,431	-
Export of live Animals	TZS	204,897,124	109,790,238	133,376,980	26,469,234	15,135,437	-
Photographic Tourism	TZS	261,639,400	128,704,850	408,873,272	32,075,365	27,533,000	158,809,000
	USD	2,706,603	2,576,677	7,975,452	2,854,370	4,566,708	1,952,865

Source: Wildlife Department, Ministry of Natural Resources and Tourism

Table 3.9 shows the trends of earnings from wildlife subsector where it may be noted that the photographic tourism sector still shows improvement.

Table 3.9: Trends in Earnings from Wildlife Subsector, Tanzania Mainland, 2006/2007 – 2010/2011

Description	Unit	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	(%) Change 2010/11
Hunting tourism	USD	14,704,370	19,760,812	18,444,881	14,443,417	13,375,780	-7.4
Photographic tourism	USD	1,332,385	2,387,728	2,706,603	2,576,677	7,975,453	209.5
	TZS	89,729,250	114,758,392	261,639,400	128,704,850	408,873,272	217.7
Trophy business licences	TZS	189,888,495	153,084,905	172,046,203	16,122,000	20,707,000	28.4
Permits for trophy exports	TZS	10,457,500	10,206,000	5,651,750	14,705,750	14,529,769	-1.2
Permits for catching wild animals	TZS	74,478,766	408,476,566	87,559,229	137,055,190	65,665,766	-52.1
Trophy property rights	TZS	2,885,400	2,353,400	1,462,000	2,231,840	1,752,330	-21.5
Other fees	TZS	84,703,267	111,453,174	7,361,669	15,174,066	7,228,219	-52.4
Total	USD	16,036,755	22,148,540	21,151,484	17,020,094	21,351,233	25.4
	TZS	452,142,678	800,332,437	535,720,251	313,993,696	518,756,356	65.2

Source: Wildlife Department, Ministry of Natural Resources and Tourism

Information on wildlife particularly on population of big game such as elephant as well as endangered species is necessary for planners to take appropriate measures to protect them. This is due to the fact that there have been reports of illegal hunting of elephants and some other animals. Table 3.10 shows the elephant ivory seizure in the country from 2010 to 2014.

Table 3.10: Elephant Ivory Seizure, Tanzania Mainland, 2010 – 2014

Year	Incidents	No. of Suspects Arrested	Raw Ivory		Worked Ivory	
			Pieces	kgs	Pieces	kgs
2010	22	25	497	2,036.00	5	0.73
2011	12	10	1,197	2,909.00	10	0.4
2012	98	142	1,177	2,798.58	7	2.85
2013	102	145	3,789	12,193.68	695	52.28
2014	65	87	402	1,631.11	312	0.51

Source: Wildlife Department, Ministry of Natural Resources and Tourism

Table 3.11 shows bush meat poaching in kilograms for various species between 2010 and 2012. The table however, shows that with the exception of elephant and hippopotamus the incidence decreases over time, an indication that the prevailing law has been effective.

Table 3.11: Bush Meat (kg) Poaching by Specie, Tanzania Mainland, 2010 – 2012

Specie	2010	2011	2012
Giraffe	14,000	0	323
Zebra	2,950	5,890	1,212
Buffalo	3,800	4,514	1,634
Wildebeest	3,225	5,010	110
Eland	1,650	3,250	1,812
Elephant	0	1,260	8,880
Hippopotamus	1,650	2,050	8,000
Impala	1,602	341	135
Topi	100	0	0
Puku	950	0	0
Hartebeest	174	785	120
Total	30,101	23,100	22,226

NB: Data from Tanzania National Park not included here

Source: Wildlife Department, Ministry of Natural Resources and Tourism

CHAPTER FOUR

FISHERIES

4.0 Introduction

Fishing, like agriculture and forestry, is an economic activity, which depends on and has impact on the environment. For instance, the destruction of areas such as mangroves or coral reefs has serious effects on the production of many aquatic species. The pollution of water caused by industrial discharges, sewage effluent, leaching of fertilizers and pesticides from agriculture activity also has serious effects. Illegal fishing methods such as the use of small nets, poison and dynamite have negative effects on fishing activities as they threaten aquatic biodiversity in general.



Large Scale Fishing is also practised in fresh water like Lake Victoria

Statistics on fisheries from the Ministry of Livestock and Fisheries Development provides trend on number of fishers and quantity of catches in both fresh water (lakes, rivers and ponds) and marine waters. It is indicated that, the average annual production (2000 – 2012) is estimated at 349,936.20 metric tons. The highest landings were recorded in 2005, when 375,535 metric tons were landed. In 2014 fish production was 365,974 metric tons valued at TZS. 1,494,898,413 (Table 4.1a).

Table 4.1 a: Number of Fishers, Fishing Crafts and Fish Catches in Marine and Fresh Water, Tanzania Mainland, 2005 – 2014

Year	No. of Fishers	No. of Crafts	Fish Catches	
			Weight (tonnes)	Value (TZS. 000')
2005	133,197	39,438	375,535	338,905,700
2006	156,544	51,552	341,109	336,152,589
2007	163,037	51,851	327,845	291,764,549
2008	170,038	52,327	324,821	371,395,387
2009	172,090	52,898	335,674	410,423,479
2010	163,601	50,001	347,157	774,483,954
2011	177,527	55,299	341,066	1,198,838,634
2012	182,741	56,985	365,023	1,307,131,724
2013	183,341	57,385	375,160	1,473,305,761
2014	183,800	57,291	365,974	1,494,898,413

Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

Table 4.1b shows fishing effort, i.e the number of fishers and crafts deployed to catch fish in marine waters and the value of the catch collected between 2005 and 2014. The table shows a decreasing trend of production from 54,969 metric tons in 2005 to 51,912 metric tons in 2014, however, the trend of value of fish has increased from 82.4 million TZS in 2005 to 207.6 million TZS. in 2014.

Table 4.1 b: Number of Fishers, Fishing Crafts and Fish Catches in Marine Waters, Tanzania Mainland, 2005 – 2014

Year	No. of Fishers	No. of Crafts	Fish Catches	
			Weight (tonnes)	Value in TZS. 000'
2005	29,754	7,190	54,969	82,452,900
2006	29,754	7,190	48,591	72,885,750
2007	36,247	7,342	43,499	39,239,352
2008	36,247	7,342	43,130	51,756,216
2009	36,321	7,664	47,616	67,930,600
2010	36,321	7,664	52,683	89,639,934
2011	36,321	7,664	50,592	166,954,953
2012	36,321	7,664	50,079	177,781,799
2013	36,321	7,664	52,846	195,529,127
2014	36,321	7,664	51,912	207,648,000

Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

Table 4.1c indicates the fishing efforts i.e the number of fishers and crafts used to catch fish in fresh waters, the table also illustrates the trend of estimated quantity of fish caught and its value from 2005 to 2014. Production decreased from 320,566 metric tons in 2004 to 314,062 metric tons in 2014. While the value of catches shows an increasing trend from 256.4 million TZS. in 2004 to 1.3 billion TZS. in 2014.

Table 4.1 c: Number of Fishers, Fishing Crafts and Fish Catches in Fresh Waters, Tanzania Mainland, 2005 – 2014

Year	No. of Fishers	No. of Crafts	Fish Catches	
			Weight (tonnes)	Value in TZS. 000'
2005	103,443	32,248	320,566	256,452,800
2006	126,790	44,362	292,519	263,266,839
2007	126,790	44,362	284,347	252,525,197
2008	133,791	44,832	281,691	319,639,171
2009	135,769	45,234	288,059	342,492,879
2010	141,206	47,635	294,474	684,844,020
2011	141,206	47,635	290,474	1,031,883,681
2012	146,420	49,321	314,944	1,129,349,925
2013	147,020	49,721	322,314	1,277,776,634
2014	147,479	49,627	314,062	1,287,250,413

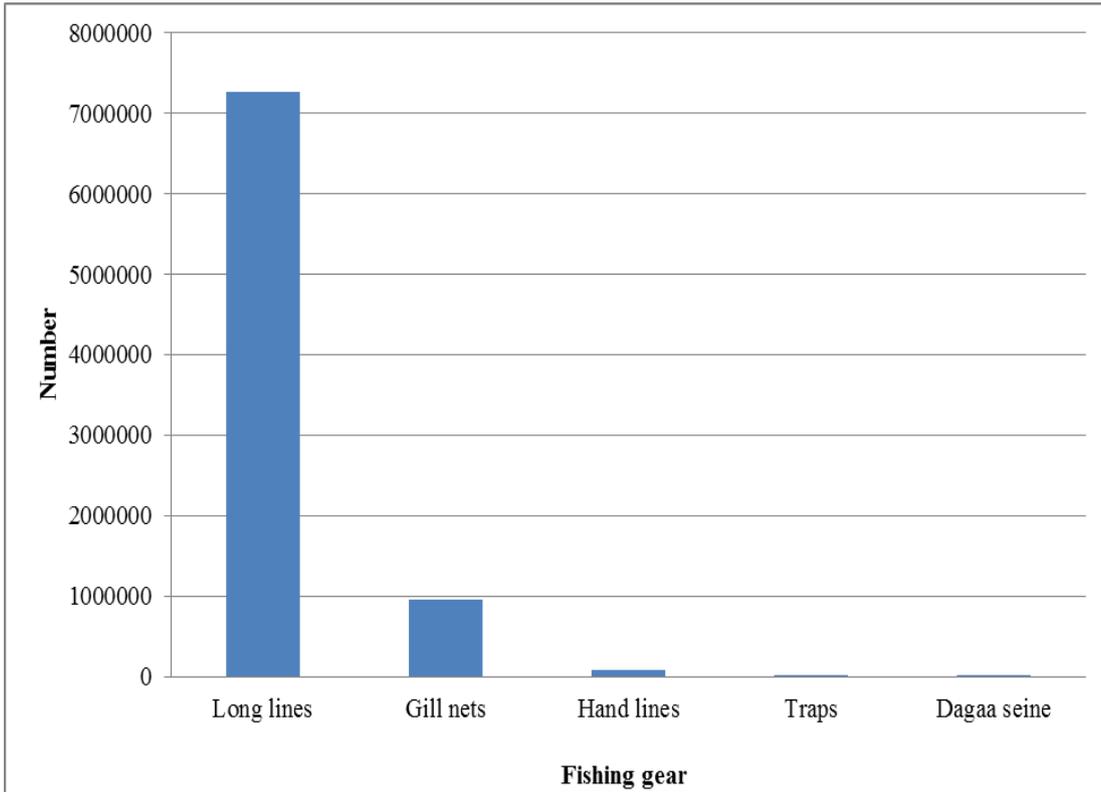
Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

The fisheries sector provides a source of employment and livelihood to a substantial number of people. According to frame surveys, 183,800 people were engaged in full-time fishing in 2014, with about 147,479 people were engaged in fresh water fishing while 36,321 were engaged in marine water fishing. The trend of number of fishers indicates that there is an increase in the number of fishers from 133,197 in 2005 to 183,800 in 2014 (Table 4.1). Also more than 4 million people make their livelihood through various fishery-related activities, such as; boat building, net making, fish processing and food marketing.

4.1 Fishing Gear

The common fishing gear employed by artisanal fishers according to 2014 frame survey were long lines (7,272,695), gill nets (954,853), hand lines (85,524), traps (14,427) and dagaa seine nets (9,171). Other gear used are appollo lift nets in Lake Tanganyika, purse seines, cast nets, spears, monofilament nets and scoop nets (Table. 4.2).

Figure 4.1: Artisanal fishing gear in Tanzania Mainland, 2014



4.1.1 Fish Sources in Tanzania Mainland

The main types of fish are:-

- (i) Fin fish and sardines from major lakes (Victoria, Tanganyika and Nyasa);
- (ii) Shellfish and Finfish from Marine Territorial Waters;
- (iii) Tuna and tuna-like species from Marine Exclusive Economic Zone.

Table 4.2 gives the summary of all the artisanal fisheries statistics by water body for the year 2014. From the table it can be noted that long lines and gill nets are the most common gear in use in all water bodies.

Table 4.2: Summary of Artisanal Fisheries Statistics by Water Body, Tanzania Mainland, 2014

Item	Lake		Lake	Lake	Lake	Nyumba	Mtera	Minor	Total
	Marine	Victoria	Tanganyika	Lake Nyasa	Rukwa	ya Mungu	Dam	Water	
Number of landing site	257	642	239	114	20	21	28	18	1,339
Number of fishers	36,321	103,540	26,612	5,550	3,428	1387	2,369	4,593	183,800
Number of fishing vessels	7,664	29,154	11,506	2,632	1,786	906	1,238	2,405	57,291
Weight in tonnes	51912.4	236,287.17	59,281.00	9,386.60	3,039.60	233.29	503.8	5,330.08	365,974
Value in '000' TZS.	207,648,000	980,591,752	237,123,929	35,669,080	11,550,480	873,759	1,812,687	19,627,126	1,494,898,413
Gear in use									
Number of gill nets	19,940	354,859	523,856	11,582	21,281	856	20,567	1912	954,853
Number of shark nets	3,733	-	-	-	-	-	-	-	3,733
Number of beach seines	768	1956	-	12	344	80	493	207	3,860
Number of scoop nets	40	474	82	-	-	-	-	-	596
Number of cast nets	229	165	-	4	-	2	-	5	405
Number of appolo lift nets	-	-	66	-	-	-	-	-	66
Number of lift nets	-	35	1,664	-	-	-	0	-	1,699
Number of lamps	-	-	11,929	-	-	-	-	-	11,929
Number of ring nets	1,241	-	185	1	-	-	438	-	1,865
Number of dagaa sein nets	-	8,443	-	728	-	-	-	-	9,171
Number of hand lines	13,955	15,647	13,048	284	15,000	5	22,578	5,007	85,524
Number of long lines	9,437	7,079,216	600	157,648	885	949	23,960	0	7,272,695
Number of traps	4,674	837	22	71	2,820	2,677	2881	445	14,427
Number of spears	1,315	-	-	-	-	-	0	-	1,315
Number of purse seines	-	-	-	1,120	-	-	-	-	1,120
Number of trawlers	3	-	-	-	-	-	-	-	3
Other gears (hand held nets and monofilaments)	-	22,064	-	-	-	-	-	-	22,064
Engines									
Number of outboard engines	737	9,416	1,002	15	12	-	8	-	11,190
Number of inboard engines	94	-	-	-	-	-	-	-	94

Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

Table 4.3 shows fishing activities in various water bodies in terms of the number of fishers and crafts and the amount of catches in tonnes and value in the period of 2012 to 2014. It may be observed that there was an increase in the number of craft as well as fishers over the period. This implies increased new entrants into the fishing activity for the purpose of sustaining their livelihood.

Table 4.3: Number of Fishers and Crafts, Weight and Value of Catches by Water Body, Tanzania Mainland, 2012 -2014

Water bodies	2012				2013				2014			
	Fishers (No.)	Crafts (No.)	Catches (tonnes)	Values (TZS)	Fishers (No.)	Crafts (No.)	Catches (tonnes)	Values (TZS)	Fishers (No.)	Crafts (No.)	Catches (tonnes)	Values (TZS)
Lake Victoria	101,250	28,470	238,366	876,855,291	101,250	28,470	234,530	938,119,720	103,540	29,154	236,287	980,591,752
Lake Tanganyika	26,612	11,506	59,395	190,062,720	26,612	11,506	59,912	233,276,569	26,612	11,506	59,281	237,123,929
Lake Nyasa	5,550	2,632	10,890	39,959,000	5,550	2,632	9,913	38,165,050	5,550	2,632	9,387	35,669,080
Lake Rukwa	3,428	1,786	3,965	12,687,168	3,428	1,786	3,661	13,911,800	3,428	1,786	3,040	11,550,480
Mtera Dam (FS 2014)	2,487	1,586	990	6,091,301	2,369	1,238	913	3,285,000	2,369	1,238	504	1,812,687
Nyumba ya Mungu Dam	786	502	251	251,000	786	502	246	921,375	1,387	906	233	873,759
Lake Kitangiri	1,700	825	317	666,540	1,700	825	295	1,033,900	1,700	825	213	850,000
Lake Singidani	62	19	143	429,000	62	19	136	462,094	62	19	117	479,123
Lake Kindai	46	15	73	226,300	46	15	69	234,260	46	15	59	243,267
Lake Burunge	195	110	45	133,800	195	110	41	141,795	38	17	6	21,914
Minor waters (Lake Babati, Lake Eyasi,	4,304	1,870	510	1,987,804	3,680	1,471	390	1,460,625	1,523	730	194	724,851
River Kilombero	-	-	-	-	1,224	799	4,902	17,891,205	1,224	799	4,742	17,307,971
Small scale Marine	36,321	7,664	50,079	177,781,799	36,321	7,664	52,846	195,529,127	36,321	7,664	51,912	207,649,600
Total	182,741	56,985	365,023	1,307,131,724	183,223	57,037	367,854	1,444,432,520	183,800	57,291	365,974	1,494,898,413

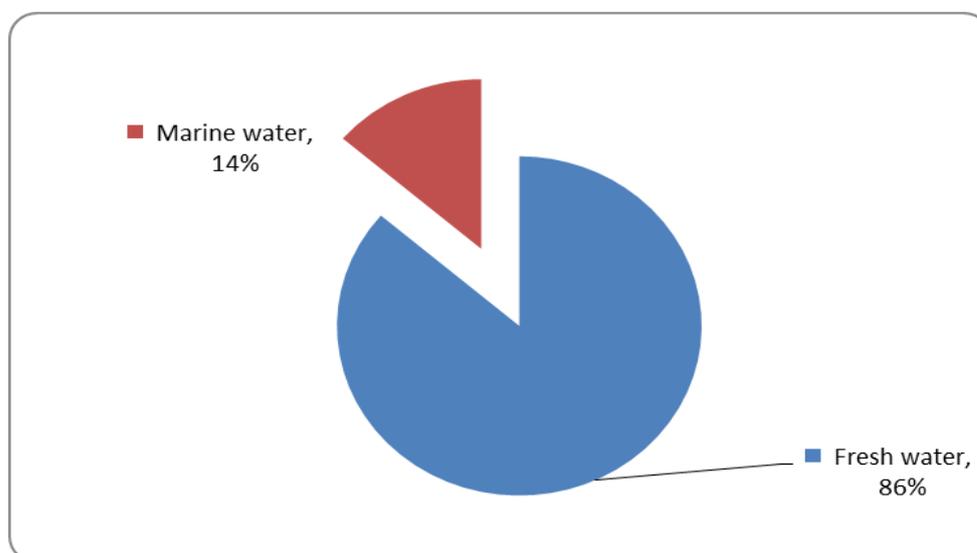
Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

4.2 Artisanal Fishing

The artisanal fishing in Tanzania is the most important type of fishery as it lands most of the inland and the marine catches and contributes to creating employment; providing food, foreign exchange earnings and recreation. This type of fishing is dominated by small scale fishers who use traditional vessels like wind driven dhows, dugout canoes (3 – 5 metres long), motorized outboard engines and few have inboard engines for the craft length ranging from 7 to 11metres.

The artisanal fishing in Tanzania is divided into two components namely fresh water and marine water. Fishing in freshwater is carried out in major lakes of Victoria, Tanganyika and Nyasa, minor lakes, dams and rivers. It contributes about 86 percent of production while the remaining 14 percent are produced from marine water (Fig 4.2).

Figure 4.2: Percentage Contribution to Production by Artisanal Fisher in Fresh and Marine Water, Tanzania Mainland, 2014



4.3 Export of Fish and Fish Products

Fish resources are a vital source of food and make valuable economic contributions to the local communities and foreign exchange earnings to the Government. Table 4.4 indicates the trends of weight and value of exported the fish and fish products, from 2005 to 2014.

Table 4.4: Fish and Fishery Products Exported, Tanzania Mainland, 2005 – 2014

Years	Aquarium fish		Value (USD)	Value (TZS)	Royalty (TZS)
	Weight (kgs)	in pieces			
2005	57,289	21,025	141,597,362	162,619,492.9	9,142,768,084
2006	44,496	21,741	138,120,145	170,184,661	6,236,615,179
2007	57,796	25,502	173,272,670	213,211,259	7,589,576,914
2008	51,426	33,066	174,409,214	205,054,093	6,629,846,700
2009	41,148	53,188	161,053,646	207,447,120	6,047,528,427
2010	39,772	40,552	187,427,054	263,131,442	5,876,103,557
2011	37,996	61,215	152,973,357	233,714,590	6,153,278,023
2012	41,394	45,550	163,299,366	254,901,017	6,819,926,007
2013	38,574	44,260	147,659,779	234,884,629	6,117,769,194
2014	43,354	42,100	832,085,311	1,406,120,001,304	7,490,632,355

Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

Table 4.5 shows the exports of Nile perch and their value in Tanzanian Shillings and in US dollars. It also shows that exports of Nile perch have been unsteady, resulting in fluctuating revenue and royalties.

Table 4.5: Exports of Nile Perch, Tanzania Mainland, 2004 – 2014

Year	Weight (kg)	Value		Royalty TZS
		USD	TZS.	
2004	30,312,898.3	76,261,406.4	82,356,866,789.0	5,171,324,343.4
2005	53,675,473.7	129,184,492.6	148,785,948,008.6	8,419,301,970.4
2006	39,472,977.7	126,829,665.7	156,160,190,326.6	5,491,786,878.8
2007	50,078,575.6	158,442,058.5	195,242,463,549.7	6,660,034,977.0
2008	38,721,422.2	153,740,723.3	180,366,779,818.2	5,412,912,979.2
2009	28,721,577.0	130,644,300.1	168,368,910,379.9	4,628,409,654.5
2010	27,229,470.7	139,666,995.1	194,012,069,313.9	4,509,670,993.8
2011	25,426,157.2	127,601,694.3	197,899,741,508.3	4,299,987,312.2
2012	28,951,094.7	141,189,161.6	220,149,518,645.6	4,967,311,025.1
2013	26,290,404.8	117,761,244.4	187,060,112,187.9	4,620,066,664.3
2014	24,280,981.8	665,847,769.8	1,131,560,483,603.5	4,565,445,327.5

Source: Fisheries Development Division, Ministry of Livestock and Fisheries Development

4.4 Fisheries Management

Fisheries resource management involves conservation and protection of fish habitats; data gathering, processing, analysis and dissemination of fisheries information; stakeholders participation and their empowerment. Despite ongoing efforts in fisheries resources management, there has been a decline in fish stocks due to an increase in environmental degradation.

The challenges of fisheries management in Tanzania are: unregulated access to fisheries resources; use of illegal fishing gears and practices; illegal, unreported and unregulated fishing (IUU) and illegal fishing trade; harvesting of endangered and rare aquatic species; environmental degradation; and poverty of the fishing communities which causes over dependence on fishery resources. Habitat degradation of coral reefs occurs through destructive fishing practices such as dynamite fishing and trawling, also through pollution, seawater temperature rise, sedimentation etc. Coral reefs are also being impacted by non-fishing activities, in particular the extraction of sand, gravel and limestone rock for construction purposes.

Management of the fisheries resources is decentralized; policies and regulations are implemented in collaboration with local government authorities. Collaborated fisheries management or Participatory fishing resource management have proved to be an effective approach for sustainable fisheries management in the country.

Management measures for the exploitation of fisheries resources by artisanal fishers include:

- Size restriction of mesh sizes of fishing gear in order to prevent catching immature size groups of fish stock including the spawning stock;
- Restrictions on the number and size of fishing vessels in the prawn fishery;
- Protecting the stocks and habitats through prohibiting inappropriate fishing practices, particularly the use of destructive fishing equipment and materials such as dynamite, poison, spear, drag nets and beach seine;
- Providing a mechanism for resolving conflicts over the use of fishing areas and resources;
- Some degree of access rights in the form of the fishing area applicable to a fishing license.

Enforcement of fisheries by-laws is implemented both at national and local levels where the local authorities are involved. Generally, the costs associated with implementation of this mechanism are too high to be met by the Government alone. The local authorities have developed by-laws, which are relevant in fisheries management targeting the improvement of Monitoring, Control and Surveillance (MCS) activities. In the process, fisheries patrols have been organized and conducted in Lake Zone and near and offshore marine waters.

CHAPTER FIVE

MINING



Gold is among major minerals produced in Tanzania

5.0 Introduction

Although mining contributes significantly to the national economy, it also leads to environmental degradation. The environmental effects of mining depend on the type of ore, method of extraction, waste disposal and prevailing climatic conditions. Mining destroys original soils and damages the ecosystem through the removal of topsoil. Some of the ores contain elements that destroy the environment at the stages of processing or use of final products.

5.1 How Mining Affects the Environment

In Tanzania coal is an example of such minerals as its sulphur content ranges from 0.4 percent to 6.6 percent and when burnt, it emits sulphur dioxide which is harmful to the environment.

Another example is gold which is associated with sulphides which interact with water to form sulphuric acid. Open cast mining involves excavation of wide and deep pits which after mining may have an impact on the environment. In underground mining ore is brought from the underground to the surface leaving holes in the ground. Trucks or conveyor belts are used to transport ore from mining site to crushing plants and such activities and others, like drilling and blasting, are associated with noise and dust emissions.

Application of different chemicals in the processing of minerals, such as cyanide and mercury in extracting gold, generate tailings and chemicals that have a negative impact on the environment.

Hence, disposal of these end products has to be done with care so as to avoid environmental degradation such as the contamination of surface and ground water.

During mine closure, the resultant structures are either be turned into useful features or restored in to the original environmental status according to the law.



Open Gold Mining Pit at Nyankanga Geita demonstrates the Environment Impact of Mining

Tables 5.1 and 5.2 show the minerals produced and exported from 2010 to 2014. Table 5.1 shows that the production of minerals was mainly inconsistent.

Table 5.1: Production of Minerals by Type, Tanzania Mainland, 2010 - 2014

Mineral	Unit	2010	2011	2012	2013	2014p
Diamonds	carats	80,498	28,378	127,124	179,633	252,875
Gold	kgs	39,448	37,085	39,012	42,534	4048
Gemstones	kgs	2,646,109	-	1,237,625	1,692,436	3,083,765
Salt	tonnes	34,455	4,108	34,016	36,032	54,757
Phosphate	tonnes	17,180	-	570,626	397,020	738,000
Limestone	tonnes ('000)	1,437	202	1,224	35,529	873
Tin Ore	tonnes	3	-	-	2	79
Gypsum	tonnes	26,918	9,288	91,610	171,567	200,179
Coal	tonnes	179	-	78,672	84,772	246,128
Pozolana	tonnes	60320	-	75,193	79,452	68,925
Kaolin	tonnes	58	178	1,422	907	3,809
Silver ore	kgs	12,470	10,399	11,227	12,159	14493
Copper	pound	11,741,898	7,531,164	12,426,025	12,749,548	14,027,008
Bauxite	tonnes	39,326,000	29,520,000	28,433,930	39,977,300	25,641,201

Carat = 0.205 gms

Source: Ministry of Energy and Minerals, Mineral Department

Table 5.2 shows that gemstones and bauxite are leading in terms of quantity of minerals exported. However, on the other hand, in terms of value, gold leads other minerals in foreign earnings.

Table 5.2: Quantity of Minerals Exported, Tanzania Mainland, 2010 – 2014

Type of Mineral	Unit	Quantity Exported					Value('000 USD)				
		2010	2011	2012	2013	2014p	2010	2011	2012	2013	2014p
Diamond (Rough)	'000 carats	181	80	127	179633	252875	16294	7480	33826	46013	82053
Diamond (Cut)	'000 carats	-	-	-	-	-	-	-	-	-	-
Diamond (Construct goods)	'000 carats	-	-	-	-	-	-	-	-	-	-
Gold	'000 gram	39112	37085	39012	42534	40481	1436233	1879622	2161520	1735708	1640072
Gemstones	'000 gram	1068481	1058580	-	1058580	3083765	6119	6309	32570	62453	49146
Salt	tonnes	18430	32298	32004	33210	54757	4038	3699	3408	3785	5275
Phosphate	tonnes	752	848512	570626	397020	738000	470	425	277	225	140
Tin	tonnes	-	-	48	-	78725	na	-	732	-	907
Gypsum	tonnes	9498	11820	71610	-	200179	126	99	215	231	2518
Graphite	tonnes	-	-	-	-	25000	na	-	-	-	3
Silver	000 grams	12040	10399	11227	11013	14493	7673	11615	12682	17214	10283
Copper	0001b	11742	7531	12426	12654045	14027008	36710	30202	44816	42134	43675
Industrial mineral	tonnes	-	-	-	-	98	-	-	-	-	9
Bauxite	tonnes	39326000	37700000	28433930	39977300	25647201	1050	1385	12479	35827	2001
Tottal ('000 USD)							1508713	1940836	2302525	1943590	1836082

Source: Ministry of Energy and Mineral, Mineral Department

CHAPTER SIX

ENERGY

6.0 Introduction

Most types of energy used for domestic activities and industrial production cause environmental pollution or land degradation. The use of energy involves burning of wood or fossil fuels such as coal or oil, which cause air pollution. Although electricity, fuelwood and petroleum products are the main sources of energy used by most people in Tanzania Mainland, studies have revealed that the country is heavily endowed with other natural sources of energy. These include the coalfields in the Southern Highlands belt of the Rukwa, Mbeya, Iringa and Ruvuma regions; and also natural gas from the Lindi and Mtwara regions where Songosongo gas fields are found.

6.1 Electricity

Information on electricity production, sales and consumption may be regarded as an important source of calculations and measurements of actual emission of pollutants. However, if the source of electric energy is hydropower, wind energy, solar radiation or other sources which do not involve the burning of fossil fuels, there is no direct release of air pollutants through the use of electric energy. On the other hand, the production of hydropower generally means construction of water reservoirs that cause other environmental problems, such as the drenching of large land areas, promoting water-borne diseases such as malaria or schistosomiasis as well as influencing the transportation of silt by rivers. Information on electricity was obtained from the Tanzania Electric Supply Company (TANESCO).

Table 6.1 shows the capacity and the amount of electricity produced in Tanzania Mainland by source from 2011 to 2014.

The table shows that more than 50 percent of the electricity produced by TANESCO over the same period was hydro electricity. The table further shows that there was a decline in production of hydro-electricity in 2011 towards 2013. This decline might be due to low levels of water and siltation at the water dams like Mtera as a result of drought and soil erosion. However, as expected the production of thermal electricity showed a consistent increase over the period between 2011 and 2013.

Table 6.1: Installed Capacity and Total Units Generated by Type of Source, Tanzania Mainland, 2011 – 2014

Source	2011		2012		2013		2014	
	Capacity MW	Generated GWH	Capacity MW	Generated GWH	Capacity MW	Generated GWH	Capacity MW	Generated GWH
Hydro	561.8	1,992.58	561.8	1,766.51	561.8	1,717.33	561.8	2,590.70
Thermal	227.97	956.99	259.4	1,203.81	322.4	1,374.70	322.4	1,290.81
Total Grid	789.81	2,949.57	821.2	2,970.32	884.24	3,092.03	884.24	3,881.51
Isolated	77.60	131.71	70.98	159.68	82.30	178.51	101.3	251.4
Grand Total								
- TANESCO	867.41	3,081.28	892.22	3,110.00	966.54	3,270.54		
Other Sources*		2,074.89		2,725.71		2,726.71	637.7	2,152.46
Total Electricity Generated		5,156.17		5,855.71		5,997.25	1,623.24	6,285.01

* Other sources include (Uganda, TANWAT, Zambia, GTS Songas, IPTL, Kiwira Coal Mine, Kilombero – Ilovo, Symbion, etc)

MW - Megawatt

GWH – Gigawatt-Hour = Million KWH

Source: Tanzania Electric Supply Company Ltd. (TANESCO)

Table 6.2 shows the quantity of electricity sold by TANESCO region and Zanzibar from 2011 to 2014. It may be noted that the Dar es Salaam Region, which consists of Ilala, Kinondoni and Temeke; consumes about half of all electricity sold in the country. This might be due to the fact that, Dar es Salaam, being an urban region, has most of the large industries, commercial enterprises, offices and a large population. Total sales of electricity show a consistent increase from year to year.

Table 6.2: Quantity of Electricity Sold by Tanesco Region/Area, Tanzania, 2011 – 2014

Region/Area	Electricity Sold (GWh)			
	2011	2012	2013	2014
Dodoma	86.2	93.8	104.9	110.6
Arusha	239.8	285.4	315.8	325.6
Kilimanjaro	117.9	134.3	144.1	153.6
Tanga	218.7	244.4	264.2	265.6
Morogoro	163.3	206.5	221.0	232.2
Pwani	115.5	141.2	170.7	199.1
Ilala	595.9	629.6	730.9	754.6
Kinondoni Kaskazini	511.6	580.2	770.0	672.5
Kinondoni Kusini	233.0	238.5	257.2	269.0
Temeke	323.6	364.1	392.1	421.5
Lindi	14.4	14.5	18.2	22.6
Mtwara	29.6	34.0	35.0	8.5
Ruvuma	21.2	23.3	26.8	27.6
Iringa	91.7	102.0	105.3	106.5
Mbeya	131.6	149.6	153.2	169.9
Singida	23.4	29.2	32.0	35.8
Tabora	94.8	103.1	108.7	60.8
Rukwa	18.7	18.1	20.1	22.2
Kigoma	17.9	20.4	23.1	24.9
Shinyanga	309.8	279.3	280.4	359.1
Kagera	29.2	54.8	52.7	54.2
Mwanza	200.5	223.7	231.1	241.3
Mara	109.3	110.2	125.0	134.0
Manyara	19.9	22.9	24.2	25.2
Tanzania Mainland	3717.5	4102.8	4606.4	4703.0
Zanzibar	277.2	298.5	218.6	348.5
Total	3994.7	4401.4	4825.1	5051.5

Note: Kinondoni, Ilala and Temeke are districts in Dar es Salaam region but in TANESCO they are treated as regions

Source: Tanzania Electric Supply Company Ltd.

Table 6.3 shows electricity generated and sold to different users from 2011 to 2014. The customers are categorized into small, medium and large.

Table 6.3: Quantity of Electricity Generated and Sold to Different Users, Tanzania, 2011 – 2014

Year	Tanzania Mainland			Zanzibar	Total	Power Transmission Loss	Total Power Generated
	Small Customers	Medium Customers	Large Customers				
2011	329	1,271	2,118	277	3,995	1,159	5,153
2012	321	1,480	2,302	299	4,401	1,048	5,450
2013	281	1,747	2,560	219	4,807	1,140	5,947
2014	217	1,891	2,595	348	5,051.5	367.7	6,285.0

Source: Tanzania Electric Supply Company Limited (TANESCO)

Not all electricity consumed in Tanzania Mainland is produced by TANESCO or its hydro stations. There are other sources of electricity within the country and from neighbouring countries that can be seen in greater detail in Appendix 8.

6.2 Motor Vehicles

Motor vehicles are among the principal sources of air pollution in major cities like Dar es Salaam, Mwanza and Arusha. The number of imported motor vehicles is used as an indirect measure of the stress on the environment and human health. The actual amount of polluting gases may be calculated using special emission coefficients, for the different types of vehicles and for different qualities of fuel. The information on the number of imported vehicles by type and year is compiled using data from the Ministry of Finance, Customs Department as indicated in Table 6.4.

Table 6.4: Number of Imported Vehicles by Type, Tanzania 2007 – 2014

HS Code	Type of Vehicle	2007	2008	2009	2010	2011	2012	2013	2014
8701	Tractors	4,147	4,266	7,049	10,935	9,787	3,503	18,980	21,059
8702	Buses	3,616	9,166	11,724	5,776	4,522	3,666	4,421	5,585
8703	Passenger cars	34,608	39,600	88,761	43,597	42,316	54,454	68,200	83,764
8704	Lorries, trucks, etc.	19,851	15,197	18,390	13,999	16,067	17,475	28,270	26,315
	Special purpose								
8705	lorries	306	373	525	498	398	327	239	1,098
8711	Motor cycles	51,471	87,774	240,197	421,181	428,584	247,626	210,903	39,335,444

Source: Customs Department, Ministry of Finance

6.3 Petroleum Products

The distribution and use of petroleum and petroleum products are another indirect measures of pollution. However, it has not been possible to get the information on distribution of these products by region. Until now, there has been no significant move to minimize air pollution through vehicles' exhaust fumes. At the moment, there are only a few fuel companies that distribute unleaded petrol. Table 6.5 shows the importation of petroleum products for the years 2010 to 2014 more detail see appendix 7.

Table 6.5: Imports of Petroleum and Petroleum Products (in kg), Tanzania, 2010 – 2014

HS Code	Description	2010	2011	2012	2013	2014
27101120	Motor Spirit (gasoline) regular	698,100,662	804,431,525	477,666,969	1,029,914,281	671,273,184
27101130	Aviation Spirit	929,396	2,062,893	450,556	582,962	0
27101140	Spirit type Jet Fuel	22,401	30,165	11,976,376	14	208,657,596
27101922	Illuminating Kerosene (IK)	612,396,247	246,821,553	46,071,412	84,192,196	31,035,913
27101931	Gas oil (automotive, light, amber for high speed engines)	1,805,578,945	1,984,976,905	2,000,123,059	2,783,510,409	1,220,701,565
27101932	Diesel oil (industrial heavy, black, for low speed marine and statio	328,640	28,568	22,028	12	0
27101941	Residual fuel oils(marine, furnace and similar fuel oils) of a Kine	134,597,525	273,346,943	189,000,219	236,583,453	167,294,317
27111100	Natural gas, liquefied	14,100	585	1,085,070	225	8,190
27111200	Propane, liquefied	0	0	1,184	0	19,861
27111300	Butanes, liquefied	277,256	446,941	11,193,807	73,910,973	3,830,750
27111900	Petroleum gases and other gaseous hydrocarbons, liquefied, nes	2,008,230	2,869,982	2,201,425,367	28,143,455	8,697,537
27112100	Natural gas in gaseous state	0	818	0	421	124
27112900	Petroleum gases and other gaseous hydrocarbons in gaseous state, nes	1,983	7,528	1,867	803	26,353

Nes – Not elsewhere stated

Source: Customs Department, Ministry of Finance

6.4 Domestic Energy

As reported in surveys and studies carried out by various developing countries, the main sources of energy used for cooking and lighting in households are firewood, charcoal, fossil fuels (kerosene and gas), electricity, solar power, as well as animal and plant residuals. However, in Tanzania, fuel wood and charcoal are the main sources of energy used by households' for lighting, cooking and other purposes. Activities such as cooking, boiling and house warming use firewood and charcoal both in people's homes and commercial centers such as restaurants. Also, economic activities such as salt making, brick making, fish smoking and tobacco curing use firewood. On the other hand, the major source of energy for lighting is kerosene due to the fact that electrification is still low with only about 18 percent of all households having grid electricity connection (HBS 2011/12) and most of these are in urban areas.

6.4.1 Round Wood, Fuel Wood and Charcoal

Until now, some of the facts presented by the Government of the United Republic of Tanzania on sustainable development on wood as a source of energy in Tanzania are:

- Wood accounts for 90 percent of the total energy used in rural areas in Tanzania;
- More than 90 percent of the population depends on wood fuel energy;
- Charcoal is widely consumed in urban centres (about 62.1 percent of households);
- In 1993, fuel wood consumption was estimated at 45 million cubic metres, with a per capital wood consumption of 2.0 cubic metres of round wood per annum;
- Rural areas consumed about 43.8 million cubic metres of firewood in 1993;
- By the year 2000, fuel wood demand was expected to exceed 60 million cubic metres;
- It was estimated that an average of 45,000 trees of 0.2 cubic metres size were cut daily for fuel wood in the 1980s;

6.4.2 Domestic Energy Use

During the 2012 Population and Housing Census, information was collected on the sources of energy used for cooking and lighting. The following two tables show the percentage distribution of the households by source of energy use at the time of the census.

Table 6.6: Percentage Distribution of Households by Source of Energy for Lighting, Tanzania Mainland, 2012.

Source of Energy for Lighting	Tanzania Mainland (percent)	Rural (percent)	Urban (percent)
Electricity (TANESCO)	18.9	5.4	46.2
Kerosene (Wick Lamps)	40.6	50.7	20.1
Kerosene (lantern/Chimney)	17.8	15.3	22.7
Firewood	2.0	2.8	0.3
Solar	1.4	1.7	1.0
Candles	1.3	1.0	2.1
Acetylene	2.7	2.8	2.3
Generator/Private Source	0.3	0.3	0.4
Torch/Rechargeable Lamps	14.9	19.9	4.8
Number of Households	9,026,785	6,054,641	2,972,144

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB

Table 6.6 shows that about 58.4 percent of households use kerosene lamps as a source of energy for lighting. In rural areas, about 66.0 percent of households use kerosene lamps as a source of energy for lighting. The situation is not much better in urban areas where about 42.8 percent of households also use kerosene types of lamps. Smoke coming from such lamps is one of the main factors of indoor pollution in many households, which in turn affect people's health in terms of respiratory, skin and eye diseases.

Table 6.7: Percentage Distribution of Households by Source of Energy for Cooking, Tanzania Mainland, 2012.

Energy for Cooking	Tanzania Mainland (percent)	Rural (percent)	Urban (percent)
Electricity (TANESCO)	1.5	0.2	4.2
Charcoal	25.6	7.7	62.1
Gas (Industrial)	0.9	0.1	2.4
Firewood	68.6	90.2	24.5
Solar	0.1	0.1	0.1
Coal	0.1	0.1	0.3
Paraffin	2.4	1.0	5.3
Generator/Private Source	0.1	0.0	0.1
Wood/Farm Residuals	0.2	0.3	0.1
Animal Residuals	0.1	0.1	0.0
Not stated	0.4	0.1	0.9
Number of Households	9,026,785	6,054,641	2,972,144

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB.

In Tanzania Mainland, the main source of energy for cooking comes from wood (firewood and charcoals) (Table 6.7). In rural areas, almost all households (90.2 percent) use energy from fire

wood for cooking. In urban areas, about 62.1 percent of the households use energy from charcoal whereas 24.5 percent of them use firewood. Thus, besides the effect of such energy use on deforestation, there are also health hazards for those engaged in cooking as well as for the other household members.

Another source of survey information, besides the population census, on energy sources for lighting and cooking, is the Household Budget Survey. This survey has been conducted three times since the 1990s. Table 6.8 shows the trend in the use of different sources of energy for lighting/cooking based on the Household Budget Surveys of 2000/01, 2007 and 2011/12.

Table 6.8: Percentage Distribution of Households by Source of Energy for Lighting and Cooking, Tanzania Mainland, 2000/01, 2007 and 2011/12

Item	Dar es Salaam			Other Urban Areas			Rural Areas			Tanzania Mainland		
	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12
Lighting												
Electricity	57.3	54.3	68.1	29.1	26.5	34.7	2.0	2.7	3.8	9.8	12.5	18.2
Gas - biogas	0.1	0.0	0.0	0.1	0.0	0.3	0.2	0.1	0.5	0.2	0.1	0.4
Paraffin /Kerosene	40.4	42.4	23.3	69.6	72.0	55.2	90.4	91.2	69.9	83.9	83.0	61.0
Candles	1.8	2.6	4.2	0.3	0.8	3.1	0.3	0.8	1.2	0.4	1.0	2.0
Firewood	na	na	-	na	na	0.4	na	na	2.3	na	na	1.6
Other source	na	na	3.4	na	na	5.4	na	na	20.3	na	na	15.2
Wood/farm residuals	0.5	0.3	-	0.7	0.7	-	7.1	5.2	-	5.7	3.6	-
Solar	na	na	1.0	na	na	0.9	na	na	1.8	na	na	1.6
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
Cooking												
Electricity	4.8	2.2	1.2	3.2	1.5	0.4	1.3	0.2	0.1	1.8	0.5	0.3
Gas – industrial	0.4	0.9	4.8	0.1	0.2	0.8	0.3	0.1	0.1	0.3	0.2	0.8
Gas – biogas	0.2	0.1	-	0.1	-	0.1	0.1	-	-	0.1	-	-
Paraffin or Kerosene	43.0	12.4	9.4	8.9	6.0	3.3	1.0	0.7	0.9	5.0	3.0	2.5
Coal	0.6	0.4	0.5	0.3	0.1	0.5	-	0.2	0.1	0.1	0.2	0.2
Charcoal	46.2	74.9	76.5	53.3	53.9	61.7	3.9	7.0	9.1	14.2	22.7	28.2
Firewood	4.6	8.0	2.5	33.8	37.7	30.4	93.4	91.8	89.1	78.5	73.1	66.3
Wood/farm residuals	-	-	-	-	0.2	0.2	-	0.1	-	-	0.1	-
Solar	na	na	0.1	na	na	-	na	na	0.2	na	na	0.1
Generator or Private	na	na	-	na	na	-	na	na	0.3	na	na	0.2
Other	0.3	1.1	5.0	0.2	0.2	2.7	-	-	0.2	0.1	0.1	1.3
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

Note: In source of energy for lighting, option, 'Firewood' and 'Other source' were combined in 2000/01 and 2007; 'Solar' not asked in 2000/01 and 2007

Note: In source of energy for cooking, 'Solar' and 'Generator/private' were not asked on 2000/01 and 2007,

Source: 2011/12 Household Budget Survey, National Bureau of Statistics

The proportion of households in Tanzania that reported using electricity as source of light increased slightly, from 12.5 per cent in 2007 to 18.2 per cent in 2011/12. This might be due to increased urbanization and a small increase in coverage in rural areas. Nevertheless, electricity is mainly used by the urban population. In Dar es Salaam, the most common source of energy for lighting is electricity, whereas kerosene/paraffin is most prevalent in other urban and rural areas. Although firewood remains the most common source of energy for cooking in rural areas, the use of charcoal seemed to be used mostly in Dar es Salaam and other urban areas. In the population as a whole, the use of charcoal has increased substantially since 2000/01. This might reflect changes in prices, particularly the rise in oil prices in 2007.

6.4.3 Impact of Domestic Energy Uses on Environment

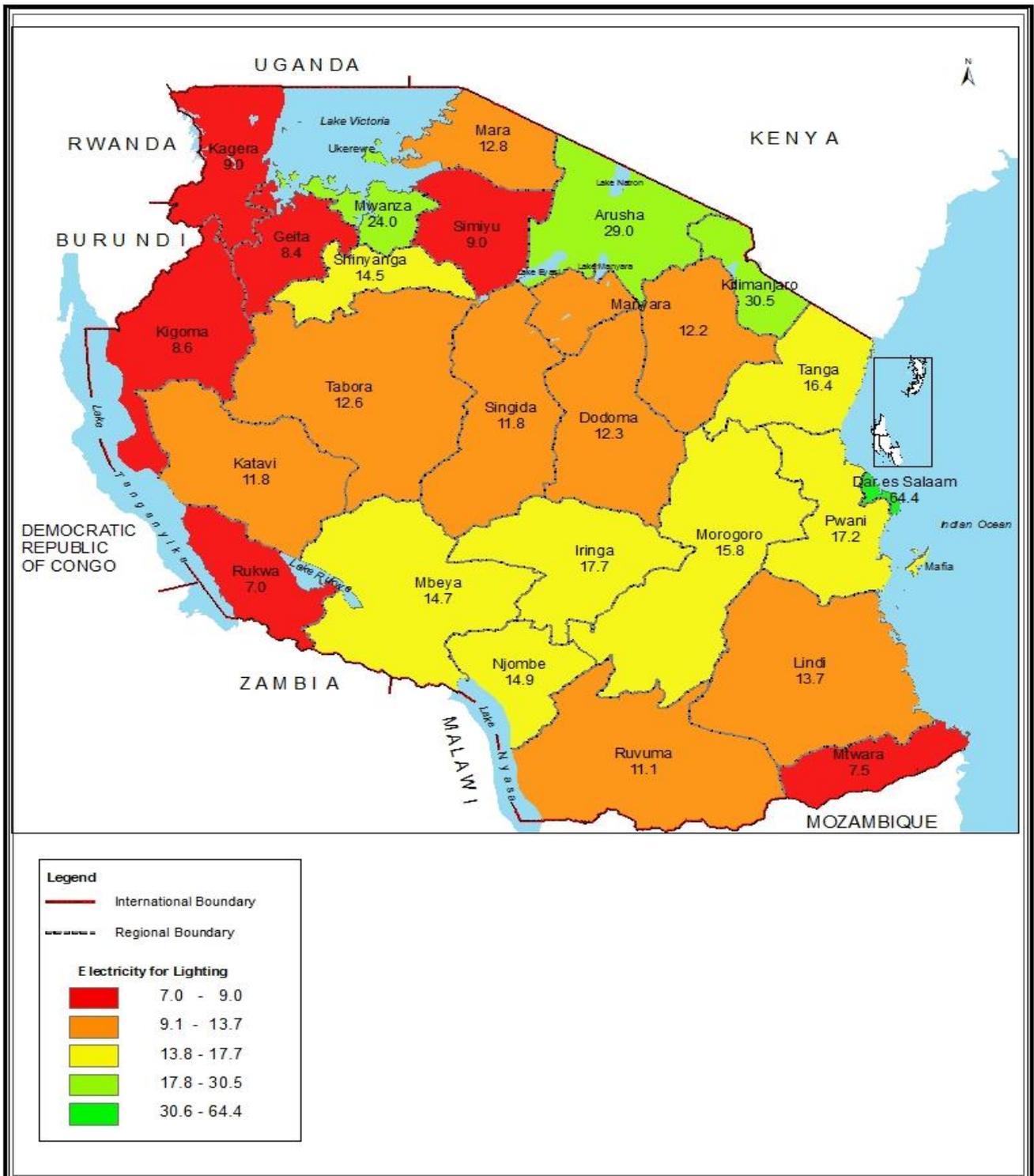
Given the rapid growing population and the absence of alternative cheap sources of energy, the demand for fuel wood supplies will outstrip the rate of forest regeneration. The World Bank (1991) argues that, fuel wood accounts for about 80 percent of energy needs in Sub-Saharan Africa, and it is in very short supply.

In the absence of reliable indicators on the rate of deforestation, we can use survey data to reflect the scarcity of fuel wood. In Tanzania, some of the indicators of fuel wood shortage include increased distances and time to sources resulting into high prices of firewood and charcoal. According to Misana and Nyaki (1993), ten years before 1993, women were able to collect firewood within a radius of one or two kilometres from their villages but in 1993 they had to walk ten kilometres or more hence consuming much of their time and energy. They further argue that, in Shinyanga and Mwanza, where sources of wood supplies no longer exist, cooking is done over fires of cow dung and crop residues such as maize cobs, maize stalks and cotton wastes.

The forests that were once found along the main roads from Dar es Salaam to Tunduma and to Arusha are no longer there due to firewood and charcoal production. Even the smaller trees that are regenerating along those areas are cut down, such that, the size of firewood pieces has decreased and the quality of charcoal has gone down. This situation has called the attention of environmentalists, the government and the public at large inciting the government take various measures to ameliorate the situation. Strict control measures that ensure sustainable harvesting of trees and forest products in general have been implemented since 2006 and we can observe from the tables above that the use of Industrial gas as energy for cooking is picking-up especially in urban areas of Tanzania Mainland. Even though the use of charcoal and firewood is still leading, it is likely to fall in the future as the price of charcoal has increased tremendously from TZS 10,000/- per bag of approximately 40kg in 2005 to at least TZS 23,000/- in 2007 and about Tsh. 30,000/- in 2012. More efforts need to be directed at encouraging more people to use industrial gas for cooking instead of charcoal or firewood, as industrial gas is more environmentally friendly.

The regional distribution of the percentage of households using electricity as their main source of energy for lighting is shown in the map below. It can be seen that, the regions with low percentages are Rukwa (7.0 percent), Mtwara (7.5 percent), Geita (8.4 percent), Kigoma (8.6 percent), Simiyu (9.0 percent) and Kagera (9.0 percent)

Map 4: Percentage of Households Using Electricity as their Main Source of Energy for Lighting by Region, Tanzania Mainland, 2012



CHAPTER SEVEN

ENVIRONMENTAL QUALITY

7.0 Introduction

Environment consists of all living and non-living things which surround us. Therefore, the basic components of the environment are the atmosphere or the air, the hydrosphere or the water; the lithosphere or the rocks and soil.

Environmental quality is therefore a general term which can refer to varied characteristics that relate to the natural environment as well as the built environment, such as air, water, land or soil as well as the potential effects which such characteristics may have on physical and mental health. This chapter presents information on quality of air, water and soil.

7.1 Air Quality

Air quality may be monitored by observing the quantities of pollutants such as smoke, carbon dioxide, carbon monoxide, hydrogen sulphide, sulphur dioxide, lead, nitrogen dioxide etc. in the air. Table 7.1 shows indicative information for air quality at sampled stations in the Dar es Salaam region. These data were collected during the Air Quality Monitoring Capacity Building Project (AQMCBP). This project was implemented in the three municipalities of the city of Dar es Salaam with the aim of establishing baseline data and information on the concentration of selected impurities in ambient air.

The AQMCBP was implemented through the National Environment Management Council (NEMC) in collaboration with other stakeholders, which included Dar es Salaam City Council, Tanzania Bureau of Standards (TBS), Government Chemist Laboratory Agency, Tanzania Meteorological Agency (TMA) and University College of Lands and Architectural Studies (UCLAS).

The major project activities included monitoring of air quality through sampling and establishing an information database on ambient air quality.

Table 7.1: Average Concentration of Air Pollutants Sampled in Dar es Salaam, Aug. 2005 – Dec. 2007

Pollutant (unit)	Station				Urafiki Post Office
	Mwenge	Tandika	Kariakoo	Fire	
Particulate Matter (PM ₁₀ ($\mu\text{g}/\text{m}^3$))	276.82	9.75*	282.59	1430.19	392.95
Sulphur dioxide (SO ₂ (ppb))	1.6	0.8	1.5	4.3	4.4
Nitrogen dioxide (NO ₂ (ppb))	7.8	10.1	13.7	13.9	8.2
Ozone (O ₃ (ppb))	21.7	14.4	27.2	21.2	32.9

Source: NEMC, 2008.

7.1.1 Review of Air Quality Data

Ambient air monitoring programs have been conducted over the past few years in Tanzania. The US Environmental Protection Agency (EPA) is currently involved in two complementary activities now being conducted in Sub-Saharan Africa focusing on short-term air pollution monitoring. The activities include the Air Quality Monitoring Project in Dar es Salaam and an equivalent project, taking place in Accra, Ghana.

In 1992, the Chemistry Department of the University of Dar es Salaam was commissioned by the National Environmental Management Council (NEMC) to begin a pilot study on air quality in Dar es Salaam. Five areas, all in the city, were chosen as monitoring stations. Those stations were in Kariakoo, Gerezani, Askari Monument, Muhimbili Medical Center (MMC), and Bahari Beach Hotel. The air pollutants monitored were CO, SO₂, suspended particulate matter (SPM), hydrocarbons, and lead (Pb). The study does not give information regarding methods used for collecting samples or length of sampling time.

The results displayed in Table 7.2 are the average concentrations of pollutants during the peak hours in the dry season in 1992. Compared to the World Health Organization (WHO) air quality standards, the results show that there was indeed a significant degradation of the air quality with regard to CO, SO₂, SPM, and HCs concentration levels at the Kariakoo, Gerezani, and Askari Monument monitoring stations. The SO₂, SPM, and HCs concentration levels were higher than the WHO standards at Muhimbili Medical Center, but the CO concentration levels were satisfactory. At Bahari Beach, the SO₂ concentration levels were above WHO standards, but CO, SPM, and HCs concentration levels were below WHO standards.

Table 7.2: Summary of Air Pollutants at Five Monitoring Stations during the 1992 Pilot Study

Pollutants $\mu\text{g}/\text{m}^3$	Monitoring Stations					WHO Standard
	Bahari Beach	Muhimbili Medical Centre	Kariakoo	Gerezani	Askari Monument	
Carbon monoxide (CO)	15	32	60 – 94	94	60 – 94	60
Sulphur dioxide (SO ₂)	1.23	3.29 – 3.36	3.29 – 3.36	3.29 – 3.36	3.29 – 3.36	0.365
Suspended Particulate Matter	0.09	0.61 - 0.76	0.61 – 0.76	0.61 – 0.76	0.19	0.12
Hydro carbons (CHCs)	0.11	0.31	0.28 – 0.45	0.28 – 0.45	0.28 – 0.45	0.16
Lead (Pb)	0.02	0.02 – 0.08	0.08	0.02 – 0.08	0.02 – 0.08	-

Source: National Environment Management Council.

During 1995, the Sustainable Dar es Salaam Project (SDP) and the Norwegian Institute of Air Research (NILU) measured SO₂ and NO₂ at nine sites throughout the city. The chosen sites were SDP offices, Arnautoglu Hall, Gerezani, Manzese, Tanzania Bureau of Standards, Ardhi Institute (Mwenge), Radio Tanzania, Airport, and Kivukoni Ferry. The passive samplers were supplied by NILU and the analysis was conducted in Norway. The study does not give the sampling time, thus, making it rather difficult to interpret the measured results against WHO standards. The results of the 1995 study are presented in Table 7.3. The WHO standard for NO₂ for a 1- and 8-hr. sampling period is 200 $\mu\text{g}/\text{m}^3$ and 120 $\mu\text{g}/\text{m}^3$, respectively. Based on the report, the SO₂ values were rather low. The highest recorded value was 2 $\mu\text{g SO}_2/\text{m}^3$.

Table 7.3: Nitrogen Dioxide Results from Monitoring Sites during the 1995 Study by NILU

Sample Site	Name of Site	Type of Major Land Use	Measured Values $\mu\text{gNO}_2/\text{m}^3$
1	SDP Offices (CBD)	Commercial	28
2	Anoutoglo Hall (CBD)	Commercial	17
3	Gerezani	Commercial	20
4	Manzese	Residential	-
5	Tanzania Bureau of Standards - Ubungo	Industrial	23
6	Ardhi Institute – Mwenge	Institutional	10
7	Radio Tanzania – Dar es Salaam	Industrial	8
8	Airport	Industrial	3
9	Kivukoni Ferry	Commercial	12

Source: National Environment Management Council.

In 1996, the Center for Energy, Environmental Science and Technology (CEEST) was commissioned by the NEMC to study concentrations of CO, CO₂, SO₂, and suspended particulate matter (SPM) in Dar es Salaam. The locations chosen for sampling were Ubungo, Kariakoo, Samora/Morogoro, Oyster Bay and Dar es Salaam International Airport. The results displayed in Table 7.4 are the average concentrations of pollutants during an 8-hour sampling period. When comparing the results to the WHO air quality guidelines, SO₂ concentrations at Ubungo, Kariakoo, and Samora/Morogoro exceed the 1-hour regulation (350 µg/m³) and the 24-hour limit (125 µg/m³). The SPM concentrations at all the monitoring stations substantially exceed the WHO limit. Concentrations of CO were within the WHO guidelines.

Table 7.4: Summary of Air Pollutant Concentrations in DSM during the 1996 CEEST Study

Monitoring Stations	Pollutants (µg/m ³)			
	CO (µg/m ³) (8 hr. Average)	CO ₂ (µg/m ³) (8 hr. Average)	SO ₂ (µg/m ³) (8 hr. Average)	SPM (µg/m ³)
Ubungo	2.473	3221.7	256.33	56156
Kariakoo	5.790	5277.57	213.00	42600
Samora/Morogoro	7.236	5286.23	288.00	45350
Oyster Bay	2.620	5264.93	Below detectable limit	60350
DSM Airport	Trace	5238.50	Below detectable limit	1320
WHO Guidelines	10 (8 - hr)	No guidelines	125 (24 - hr)	100-150 (8-hr)

Source: National Environment Management Council.

In 2003, the University College of Lands and Architectural Studies (UCLAS) conducted a study at eight bus stations to ascertain the contribution from the bus emission to the air pollution problem in Dar es Salaam. The air pollutants collected and analyzed were SO₂, NO₂, and particulate matter (PM). The bus locations chosen for this study were Mwenge, Ubungo, Posta, Mnazi Mmoja, Kariakoo Market, Uhuru, Tandika, and Buguruni. The methods used for collecting the samples were bubblers and the sampling time was one hour. The methods of analysis were Pararosaniline Method for SO₂, Saltzman's Method for NO₂ and Filtration Method for PM.

The results displayed in Table 7.5a are the average hourly concentrations of pollutants at the eight bus stations. Compared to WHO 1-hr guidelines (350 µg/m³ for SO₂, 200 µg/m³ for NO₂, and 230 µg/m³ for PM), all bus stations exceeded the limit for SO₂ except Tandika. In addition, Mwenge, Ubungo, Posta, Uhuru, and Buguruni exceeded the limit for NO₂, and all bus stations exceeded the PM limit.

Table 7.5a: Summary of Average Air Pollutants Concentrations at Sampled Bus Stations during the 2003 UCLAS Study

Bus Station	Pollutants ($\mu\text{g}/\text{m}^3$) for 1 hr Sampling Time		
	SO ₂	NO ₂	PM
Mwenge	1,297.7	208.2	1,211.3
Ubungo	1,740.3	240.0	1,143.6
Posta	1,410.8	297.5	794.6
Mnazi Mmoja	1,331.3	184.5	782.1
Kariakoo Market	1,829.9	119.8	592.3
Uhuru	2,483.8	257.0	892.3
Tandika	128.7	88.2	648.7
Buguruni	1,797.7	228.5	1,008.8

Source: UCLAS

A committee composed of Tanzania Bureau of Standards (TBS), NEMC and other stakeholders set up a national standard on air quality for Sulphur Dioxide (SO₂), Carbon monoxide (CO), Nitrous oxide (NO), Lead (Pb), Nitrogen dioxide (NO₂), Suspended Particulate Matter (SPM), and black smoke. In addition, TBS was also checked the quality of imported vehicles for emissions and roadworthiness². Further to this, Tanzania also embarked on environment and sustainable development planning through the President's Office Planning and Privatization (PO-PP) and the Regional Administration and Local Governments. Moreover, Dar es Salaam City has joined the Global Environment Monitoring System (GEMS/Air Programme)³.

All in all the mentioned pollutants have serious health effects on human beings and other living organisms and hence need to be monitored and minimized as much as possible. The (WHO) has set limits or standards for various pollutants, above which the air pollution could produce harmful effects to human beings and other living organisms. In most areas of Tanzania, air pollution is not yet a major problem although there are some hot spots where pollution limits are exceeded particularly in the major industrial urban centre of Dar es Salaam as explained above. The major likely problems caused by the various air pollutants are given in Table 7.5b:-

² APINA (2003) Tanzania: Country Fact Sheet. <http://www.sei-international.org/rapid/pdf/Tanzania.pdf>

³ *ibid.*

Table 7.5b: The likely Major Problems Caused by Varius Air Pollutants, Tanzania Mainland

Serial Number	Type of Pollutant	Source of Pollutant	Type of Effect/ Impact
1	Sulphur dioxide (SO ₂)	Forms when fuel containing sulphur, e.g. coal and petroleum, is burned. Main sources include, motor vehicles exhaust emissions, petroleum refineries, cement manufacturing, metal processing as well as locomotives, large ships, non road diesel equipment	Causes respiratory problems, acidification of rain water (as a result of acid rain), causing soil acidification and corrosion of materials.
2	Carbon dioxide (CO ₂)	Combustion of all fuels including motor vehicles, industrial processes, forest fires, wood fuel burning etc.	Causes global warming and climate change. Climate change effects include change in weather patterns and therefore weather related catastrophies.
3	Carbon monoxide (CO)	Motor vehicles, industrial processes (metal processing and chemical manufacturing), residential wood burning, stoves and forest fires	Causes respiratory problems, when in the blood, CO reduces the delivery of oxygen to the body's organic tissues causing impairment of visual perception, manual dexterity, learning ability and performance of complex tasks.
4	Nitrous oxide (NO)	Motor vehicles, electric utilities and other industrial, commercial and residential sources that burn fuel.	Causes bronchitis, pneumonia and respiratory infection, acid rain and nutrient enrichment in plants.
5	Lead (Pb)	Motor vehicle combustion, industrial processes. Products such as batteries, ammunition, metal products (solder and pipes) old paint products, leaded petrol, some ceramics and plastics.	Causes brain damage to children, interferes with cardio - vascular and reproductive systems.
6	Nitrogen dioxide (NO ₂)	Motor vehicles, electric utilities and other industrial, commercial and residential sources that burn fuel.	Causes respiratory problems, contributes to acid rain and global warming.
7	Suspended Particulate Matter (SPM)	Cement manufacturing, construction activity, earth moving activities, land tilling or ploughing, livestock movement, mining, wind, fires, etc,	Causes loss of lung function and respiratory problems, reduces visibility and aesthetic value of environmental amenities among others.

Table 7.5b ctd: The likely Major Problems Caused by Various Air Pollutants, Tanzania Mainland

8	Black smoke	Burning of wood, forest fires, industrial processes, motor vehicle combustion.	Reduces visibility and aesthetic value of environmental amenities among others and may cause loss of lung function and respiratory problems
9	Chlorofluorocarbons (CFCs)	Industrial processes (manufacture of cooling equipment such as refrigeration)	Causes ozone depletion, which in turn affects the respiratory system, dermatological complications e.g. skin cancer and also affects crop yields.
10	Non-Methane VOCs (Volatile Organic Compounds)	Housekeeping and maintenance products and building and furnishing materials e.g. solvents, paint and glues.	Causes adverse health effects on humans including respiratory problems and cancer.

Table 7.6 shows emission of carbon dioxide (CO₂) by sector whereby it can be observed that transport sector was leading in emission of this gas followed by manufacturing and construction.

Table 7.6: Carbon Dioxide (CO₂) Emissions by Sector, Tanzania, 1999

Serial Number	Sector	Percentage Emission
1	Transport	50
2	Manufacturing and Construction	26
3	Domestic	16
4	Electricity and Heat production	5
5	Other Energy Industries	3
Total		100

Source: Earth Trends (2003) Climate and Atmosphere; Tanzania.⁴

Table 7.7 shows some type of air pollution in Tanzania and Sub-Sahara Africa with their proportion of global emissions.

⁴ <http://www.sei.international.org/rapidic/pdfs/tanzania.pdf>, WRI

Table 7.7: Non – Carbon Dioxide (CO₂) Air Pollution, (in 000 tonnes), 1995

Serial Number	Type of Pollutant	Tanzania Emissions	Proportion of Global Emissions	Sub-Sahara Africa Emissions	Proportion of Global Emissions	Global Emissions
1	Sulphur dioxide	105	0.07	5,345	3.8	141,875
2	Nitrogen oxide	604	0.6	9,309	9.4	99,271
3	Carbon monoxide	12,947	1.5	177,302	20.8	852,415
4	Non-methane VOC	1,182	0.7	17,375	10.9	159,634

Source: Earth trends (2003) Climate and Atmosphere; Tanzania.⁵

Note: Total CO₂ emissions include the mass of CO₂ produced during the combustion of solid, liquid and gaseous fuels, from gas flaring and manufacture of cement. These estimates do not include bunker fuels used in international transport due to the difficulty of apportioning these fuels among the countries benefiting from that transport. The above estimates are presented here for illustrative purposes using available but not yet vetted information from Earth Trends who have permitted fair use of their data on their website.

7.2 Water Quality

Water quality may be defined as the degree of usefulness of water for a particular purpose. This includes its appearance, its smell, its chemical composition and its taste. This definition takes into account the fact that even when water is contaminated with foreign agents such as organic or inorganic pollutants, depending on the level of the contaminant, the water can still be used for other purposes such as washing of cars or irrigation of crops but may not be suitable for cooking or drinking. Thus the quality of water is a measure of the substances contained in it with respect to what the water is used for.

The quality of the water is influenced by its immediate surrounding environment, such as the water body it is contained in, the air around it, the soil and surrounding activities. Soils of various types have different chemical properties and water stored between the pores of soil will absorb some minerals thus changing its chemical properties. Similarly, when water mixes with gases emitted from industry, such as oxides of nitrogen or sulphur, the resultant precipitation is acidic to the level that it can destroy crops or vegetation. Industrial including mining and municipal effluents discharged in water bodies such as streams, rivers or lakes without being treated, introduces organic and inorganic nutrients into the water. Water pollution at the domestic level is mainly due to sanitary conditions of containers and other utensils used.

⁵ <http://www.sei.international.org/rapidic/pdfs/tanzania.pdf>, WRI

In Tanzania, water resources management and development is under the Ministry of Water. The major issues addressed by the National Water Policy (NAWAPO) include water conservation, water quality management and pollution control. In water quality management and pollution control, one of the objectives is to maintain water resources at an acceptable quality. Table 7.8 shows water supply coverage in urban and rural areas of Tanzania Mainland.

Table 7.8: Water Supply Coverage in Urban and Rural Areas of Tanzania Mainland

Region	Percentage of Rural Population Supplied with Water	Percentage of Urban Population Supplied with Water
Dodoma	50.04	89
Arusha	58.53	97
Kilimanjaro	73.07	95
Tanga	59.81	92
Morogoro	61.89	94
Dar es Salaam and Pwani	64.6	67
Lindi	41.38	70
Mtwara	49.4	82
Ruvuma	59.91	81
Iringa	65.82	96
Mbeya	60.04	95
Singida	50.44	86
Tabora	43.36	87
Rukwa	54.67	85
Kigoma	60.19	88
Shinyanga	50.07	78
Kagera	56.01	76
Mwanza	58.28	93
Mara	51.04	60
Manyara	63.01	88

Source: State of Environment, URT, 2012

Table 7.9 shows water supply in urban areas of Tanzania Mainland, 2007. The table reveals that the estimated demand of water is higher than production. More than 30,000,000 cubic meters is needed to satisfy the demand of water in urban areas.

Table 7.9: Water Supply to Selected Urban Areas, Tanzania Mainland, 2007

Authority	Estimated Water Demand (m ³)	Total Water Production (m ³)
Dodoma	7,560,000	6,662,000
Arusha	17,225,000	15,840,000
Moshi	8,395,000	8,496,000
Tanga	9,036,000	8,946,000
Morogoro	10,800,000	9,033,000
Lindi	1,800,000	512,000
Mtwara	4,380,000	1,721,000
Songea	2,970,370	2,047,000
Iringa	5,110,000	4,198,000
Mbeya	10,950,000	8,669,000
Singida	2,502,000	1,082,000
Tabora	8,212,000	5,648,000
Sumbawanga	2,912,000	1,576,000
Kigoma	9,490,000	3,604,000
Shinyanga	5,308,000	2,892,000
Bukoba	2,562,000	2,295,000
Mwanza	18,875,000	12,403,000
Musoma	8,640,000	3,727,000
Babati	1,148,800	906,000
Total	137,876,170	100,257,000

Source: Ministry of Water and Irrigation

Table 7.10: Water Supply to Rural Areas by Region, Tanzania Mainland, 2005

Region	Total Population Receiving Water Services	Percentage of Water Services Received
Dodoma	1,195,175	87.1
Arusha	564,697	49.9
Kilimanjaro	798,045	61.7
Tanga	939,310	60.8
Morogoro	884,760	57.8
Pwani	583,766	67.8
Lindi	300,108	61.7
Mtwara	460,826	46.8
Ruvuma	509,235	54.1
Iringa	816,684	57.4
Mbeya	997,240	56.4
Singida	423,080	42.5
Tabora	736,991	42.1
Rukwa	482,106	46.0
Kigoma	682,759	42.1
Shinyanga	1,167,283	44.2
Kagera	805,749	48.6
Mwanza	1,707,640	57.2
Mara	673,401	53.9
Manyara	472,267	43.5
Total	15,201,122	

Source: National Economic Survey, 2006, Ministry of Water and Irrigation

Unfortunately, Tanzania’s waters have deteriorated over the years due to point and non point sources of pollution thus making water unusable and its treatment costly. In order to remedy the situation, water shall be protected from pollution and harmful depletion through, among others water quality monitoring and assessment, polluter pays principal and public awareness programmes.

Water quality monitoring in Tanzania is currently done in accordance with the 1974 Temporary Standards of Quality of Domestic Water as stipulated by the Water Utilization (Control and Regulation) Act amended in 1981. Table 7.11 shows the standards.

Table 7.11: The Tanzania Standards of Quality of Domestic Water Use

Group	Parameter	Unit	Allowable Value	Upper Limit
Toxic	1. Lead Pb	µg/l	0.05	0.1
	2. Arsenic AS	µg/l	0.05	0.05
	3. Selenium Se	µg/l	0.01	0.05
	4. Chromium (6+) Cr	µg/l	0.05	0.05
	5. Cyanide CN	µg/l	0.10	0.20
	6. Cadmium Cd	µg/l	0.01	0.05
	7. Barium Ba	µg/l	1.00	1.0
	8. Mercury Hg	µg/l	n.m	n.m
	9. Silver Ag	µg/l	n.m	n.m
Affecting Human Health	1. Flouride F	µg/l	1.50	8.0
	2. Nitrate NO ₃	µg/l	30.0	100
Organoleptic	1. Colour	TCU	15	50
	2. Turbidity	NTU	15	30
	3. Taste	-	n.o	n.o
	4. Odour	-	n.o	n.o
Salinity and Hardness	1. pH	-	6.5-8.5	6.5-9.2
	2. Total Filterable Residue	µg/l	1500	2000
	3. Total Hardness (CaCO ₃)	µg/l	500	600
	4. Calcium Ca	µg/l	200	300
	5. Magnesium Mg	µg/l	150	100
	6. Magnesium + Sodium SO ₄	µg/l	1000	1000
	7. Sulphate SO ₄	µg/l	400	600
	8. Chloride Cl	µg/l	250	800
Less Toxic Metals	1. Iron Fe	µg/l	0.3	1.0
	2. Manganese Mn	µg/l	0.1	0.5
	3. Copper Cu	µg/l	1.5	3.0
	4. Zinc Zn	µg/l	5.0	15.0

Table 7.11 ctd: The Tanzania Standards of Quality of Domestic Water Use

Group	Parameter	Unit	Allowable Value	Upper Limit
Organic Pollution of natural Origin	1. BOD (5 days at 30 ⁰ C)	µg/l	6.0	6.0
	2. PV (Oxygen abs KMNO ₄)	µg/l	10.0	20
	3. Ammonium (NH ₃ + NH ₄)	µg/l	0.5	2.0
	4. Total Nitrogen (Excluding NO ₃)	µg/l	0.1	1.0
Organic Pollution Introduced Artificially	1. Surfactants (Alkly Benzyl Suphonates)	µg/l	1.0	1.0
	2. Organic Matter (As carbon in Chloroform extract)	µg/l	0.5	0.5
	3. Phenolic Substances (As Phenol)	µg/l	0.002	0.002

n.o – not objectionable

n.m – not mentioned

Source: Ministry of Water and Irrigation

The management modality of water resources adopted by the new Water Policy is the river basin approach and Integrated Water Resources Management (IWRM). It is through this management approach that water quality and quantity will be monitored. Tanzania was divided into several basins in order to facilitate water resources management. These include:

1. Pangani Basin
2. Wami and Ruvu Basin
3. Rufiji Basin
4. Ruvuma and the Southern Coast Basin
5. Lake Nyasa Basin
6. Internal Drainage – Lake Eyasi
7. Lake Rukwa Basin
8. Lake Tanganyika Basin
9. Lake Victoria Basin

Table 7.12: Discharge Data by Basin, Tanzania Mainland, 2005

Basin Name	Name of River	Measurement Taken (place)	Maximum Flow	Minimum Flow	Average Daily Flow
Rufiji Basin	Rufiji	Stiegler's Gorge	5754	48.53	1053.89
Pangani Basin	Pangani	Korogwe	821	1.04	24.26
Wami/Ruvu Basin	Ruvu	Moro Road Bridge	1177	0.00	20.81
Lake Nyasa Basin	Ruhuhu	Masigira	3062	8.68	11.02
Rufiji Basin	Kilombero	Swero	3042	25.7	63.89
Lake Nyasa Basin	Kiwira	Ipyana	361	6.27	10.01
Lake Tanganyika Basin	Malagarasi	Taragi	489	0.08	88.49
Lake Victoria Basin	Mara	Mara Mines	8900	479	32.97

Source: Ministry of Water and Irrigation

Three important lakes in Africa which include Lake Victoria, Lake Tanganyika and Lake Nyasa cover about 5.7 percent of the total area of the country. Lake Victoria, the second largest freshwater lake in the world shared with Tanzania, Kenya and Uganda. Lake Tanganyika, the second deepest lake in the world is also shared by Tanzania, Burundi, Democratic Republic of Congo and Zambia; and Lake Nyasa is shared by Tanzania, Malawi and Mozambique. The percentage of the area owned by Tanzania is indicated in Table 7.13. The country has a territorial sea of 64,000 km² (6.4 million ha), an Exclusive Economic Zone (EEZ) covering an area of about 223,000 km² (22.3 million ha) and a coastline of about 800 km stretching from Mtwara region in the south to Tanga region in the North.

Table 7.13: Percentage of Water Areas Owned by Tanzania, 2014

Water Body	Total Area (km ²)	Tanzania Share (area in km ²)	Percent
Lake Victoria	68,800	35,088	51
Lake Tanganyika	32,900	13,489	41
Lake Nyasa	30,800	5,760	19
Marine (Territorial sea)	64,000	64,000	100
EEZ	223,000	223,000	100

Source: State of the Environment Report, URT

7.2.1 Objectives of Water Quality Assessment

According to the WHO water quality assessment guidelines, no assessment programme should be started without critically scrutinizing the real need for water quality information (i.e. the “need to know” as opposed to “it would be nice to know”). Since water resources are usually put to several competing beneficial uses, the monitoring used to acquire necessary information should reflect the data needs of the various users involved. Consequently, there are two different types of monitoring programmes depending on how many assessment objectives have to be met.

7.2.1.1 Single-objective Monitoring

This may be set up to address one problem area only. This involves a simple set of variables, such as: pH, alkalinity and some cautions for acid rain; nutrients and chlorophyll pigments for eutrophication; various nitrogenous compounds for nitrate pollution; or sodium, calcium, chloride and a few other elements for irrigation.

7.2.1.2 Multi-objective Monitoring

This may cover various water uses and provide data for more than one assessment programme, such as drinking water supply, industrial manufacturing, fisheries or aquatic life, thereby involving a large set of variables. The Commission of the European Communities has a list in excess of 100 micro pollutants to be considered in drinking water alone.

Data requested for by NBS for water quality assessment is both single-objective and multi-objective monitoring.

7.3 Major Properties of Water

Water has three major properties namely physical, chemical and biological. All the three properties can be measured in order to provide important information on quality of water as discussed below⁶.

7.3.1 Physical Properties of Water

Basic physical parameters of water properties, that can be measured, include temperature, taste, turbidity, hardness, and smell. These parameters for water in natural waterways depend on climate and on geology. Water discharged from industrial works may have higher temperature, and it is therefore important that it be cooled before allowing its flow into rivers and lakes. Plant and animal aquatic life cannot do well in hot water, as oxygen levels for respiration and metabolism can be compromised. Odour in water is a result of decaying organic materials or solutions, presence of microorganisms, or the presence of human wastes. Smelling water suggests that some undesirable elements are in the water but tests are necessary before one can say if these elements are harmful or not.

7.3.2 Chemical Properties of Water

Chemical properties of water can be measured separately both directly and indirectly using conductivity method. While pure water is a poor conductor of electricity, polluted water may contain chemicals that may 'encourage' it to conduct electricity better. Conductivity of water is important in that it reflects the amount of dissolved salts (free ions) in the water.

Water in its pure form is neutral, that is, it is neither acidic nor alkaline, and has a pH value of 7. The pH scale measures the acid balance of water. It ranges from zero to 14, with zero as pure acid, seven as neutral and 14 as pure alkaline. The pH of a water sample may vary with time depending on biotic life present, or its chemical composition.

Hardness in water is caused by the presence of magnesium and calcium salts. When hard water is boiled, these salts coagulate and precipitate, and if the water is allowed to evaporate, the precipitate remains in the container.

Oxygen is important in water for aquatic life to 'breathe' and for photosynthesis. It is important for almost all natural processes occurring in the water. In general, the more dissolved oxygen there is in water the better, but pollution, high temperature, salinity and biological activity can drastically reduce oxygen levels.

⁶SARDC: <http://www.sardc.net/imercsa/zambezi/zfsheet/zfsheet04.html> or <http://www.sardc.net/waterbook/Summary.pdf>

Nitrogen is found naturally and accounts for nearly 80 percent of the gas in the atmosphere. It is important for living organisms as an important constituent of proteins and genetic material. A common source of nitrogen compounds in water is run off from agricultural fields in the form of fertilizers. Nitrogen compounds in water usually take the form of nitrates, nitrites, ammonia and nitrogen. High levels of ammonia indicate organic pollution usually from domestic sewerage, industry or agriculture.

Another common component of water is sulphur and its compounds. In industrialised areas, sulphur dioxide is released to the atmosphere and when sulphur combines with rainwater, it forms an acid (commonly called acid rain) that is corrosive. This phenomenon is yet to afflict Tanzania in a notable way.

Eutrophication is the process where water becomes rich in compounds causing an excessive growth of plants such as algae and has general negative effects on other life forms that live in water because dissolved oxygen is used up. This problem is persistent in agricultural lands where fertilizers leach into waterways, and in areas where industrial effluent rich in nitrogen and sulphur compounds enter water bodies.

Most metals are found in water as trace elements. The most common include iron, magnesium, copper and zinc. Metals such as aluminium (especially their sulphates) are believed to cause cancer, while heavy metals such as lead, mercury and manganese are toxic. Organic compounds are a set of compounds centred on carbon, the element commonest in living tissues. The most common organic compounds in water include oils, agro-chemicals especially pesticides, polychlorinated biphenyl (PCBs) and human and animal waste.

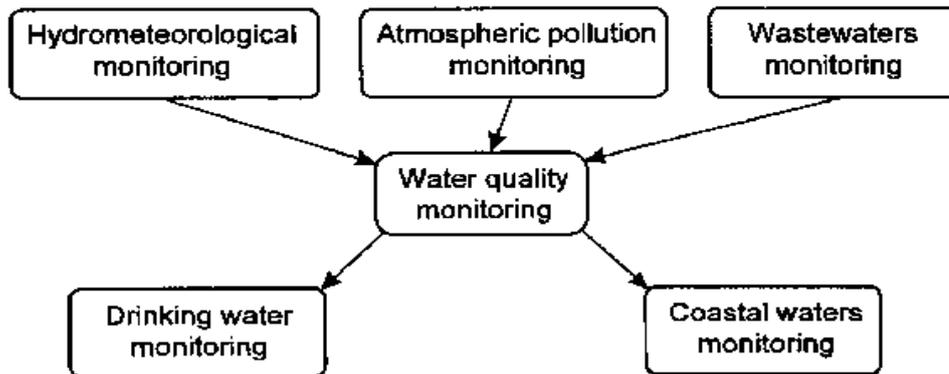
7.3.3 Biological Components

According to SARDC⁷, water from natural waterways carries two types of micro-organisms: bacteria/fungi/protozoa and algae (which form a class of organisms that can photosynthesise). Water contaminated with micro-organisms can be toxic, or cause diseases depending on their nature. Water pollution by such organisms occurs especially when human excreta are allowed into the water and may result in waterborne diseases such as dysentery, cholera and typhoid. Common bacterial pathogens (such as *Salmonella*, *Shigella*, and *Escherichia coli*) are responsible for typhoid, paratyphoid, gastro-enteritis, and food poisoning, and can be passed into the water by an apparently healthy person, and be further spread by birds and animals. Bacteria passed out from the stomach are called *coli-forms*, and are common in running water from populated settlements. In an effort to safeguard human health, strict guidelines on *coli-forms* in drinking and wastewater are suggested, and some coli forms such as faecal coli forms have to be totally absent in water for domestic purposes. In Tanzania, outbreaks of waterborne diseases such as cholera and typhoid are common in both urban and rural areas.

⁷ Ibid.

Parameters to be measured in order to determine the quality of water may use the following framework drawn up in 1992 by the collaborative tripartite effort of UNESCO/WHO/UNEP for assessing biota, sediments and water environmental monitoring in order to link up the various parts contributing to water pollution. These measures are compared to WHO standards for water quality. Water quality standards and guidelines are a set of limits or levels of chemical and biological contaminants permissible in water. Most countries adopted WHO guidelines, while some countries set their own which are based on the WHO guidelines shown below.

Figure 7.1: The Interrelationship between Major Environmental Monitoring Systems



Source: UNESCO/WHO/UNEP, Second Edition, (1992)

Out of the above framework, the parameters, which may be monitored to determine water quality over time, are presented in Table 7.14 below.

Table 7.14: Links Between Inland Freshwater Pollution and Other Assessment Media

Issue	Pathways / Links				
	Air to Water	Water to Soil	Water to Tap water	Water to Food	Water to Coastal Marine Waters
Pathogens	x	x	xxx	xxx	xxx
Organic matter	0	x	x	na	xxx
Eutrophication ¹	x	x	0	0	xxx
Nitrate pollution	0	0	xx	xxx	xxx
Salinisation	0	xxx	x	0	na
Trace elements	xx	xx	xx	xxx	xxx
Organic micropollutants	xx	xx	xxx	xxx	xxx
Acidification	xxx	xx	xx	0	na
Suspended solids	0	na	x	na	xx

Note:

- xxx - Severe effects or impairments
- x - Some effects or impairments
- na - not applicable
- xx - Important effects or impairments
- 0 - No effects or impairments
- 1 - Excluding nitrate

Source: UNESCO/WHO/UNEP (1992)⁸ Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition, © UNESO/WHO/UNEP, 1992

⁸UNESCO/WHO/UNEP, Second Edition, (1992) Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring.

Data available on water pollution in Tanzania is presented in Table 7.15. Data obtained from a water quality study conducted in 1988 in Dar es Salaam identified extensive surface water pollution as indicated by high conductivity, low dissolved oxygen and high bacteriological contamination through evidence of pathogens with human excreta among others.

Table 7.15: Pollution Load to Surface Water Resources (kg/day), Dar es Salaam, 1988

Type	Industrial Effluent	Pit latrines	Septic tanks	Without facilities
BOD	28,330	15,282	3,275	9,897
COD	29,904	16,131	3,457	10,447
Suspended solids	47,216	25,470	5,458	16,495
Dissolved solids	83,940	45,280	9,830	29,325
Total Nitrogen	4,145	2,236	479	1,448
Total Phosphorus	787	425	91	275

Source: Managing sustainable growth and development of DSM by Sustainable Dar es Salaam Project (SDP)

Similarly, a survey of groundwater quality from a number of boreholes drilled in 1980 concluded that its high salinity excluded it from being considered as a potable resource. The majority of groundwater resources within the built up area are also contaminated as a result of poor sanitary arrangements, with more than 118,822 tonnes of polluted water discharged to the ground daily. Projected 1991 pollution loads from land sources included 68 tonnes BOD, 7 tonnes COD, 147 tonnes suspended solids, and 219 tonnes dissolved solids, 21 tonnes of total nitrogen and 33 tonnes of total phosphorus. This results in high nutrients and suspended solid loads, as well as occurrences of pathogens at places where fresh excreta are released.

Table 7.16: Pollution Load to Groundwater Resources (kg/day), 1991 Projections

Type	No Facility	Pit Latrines	Septic Tanks	Sewer Domestic	Industry Losses
BOD	1,100	15,282	7,641	1,221	1,899
COD	1,161	16,131	8,068	1,289	11,994
Suspended solids	1,833	6,116	3,832	2,035	3,148
Dissolved solids	3,258	97,857	61,128	3,618	5,596
Total Nitrogen	120	4,829	3,018	3,618	5,596
Total Phosphorus	23	915	572	34	52

Source: Managing sustainable growth and development of DSM by SDP

Table 7.17: Rapid Assessment of Industrial BOD₅ Loads Penetration to Pangani River Up to Nyumba ya Mungu (Arusha Industrial Establishments), 2000

Serial Number.	Industrial Establishment (Arusha Region)	Generated load (t/yr) BOD ₅	Nyumba ya Mungu Pollution (t/year) BOD ₅
1	Breweries	634	174
2	Pharmaceuticals	232	42
3	Abattoirs	120	26
4	Fibre Boards	53	16
5	Soap Factory	20	6
6	Pepsi Bottlers	152	46
7	General Tyres	3	1
8	ATZ Textiles	146	44
9	Sunflag	249	76
10	Arusha Urban	273	83
11	Arusha Rural	1232	40
12	Livestock/Poultry	360	11
Total		3474	565

Source: Mwanuzi (2000)⁹**Table 7.18: Rapid Assessment of Industrial BOD₅ Loads Penetration to Pangani River Up To Nyumba ya Mungu (Kilimanjaro Industrial Establishments), 2000**

Serial Number	Industrial Establishment (Kilimanjaro Region)	Generated Load (t/yr) BOD ₅	Nyumba ya Mungu Pollution (t/year) BOD ₅
1	Moshi Breweries	42	11
2	TPC	90	27
3	Bonite Bottlers	174	52
4	Pesticides	-	-
5	Kibo Paper	17	5
6	Tannery	115	34
7	Moshi Textiles	125	37
8	Kibo Match	20	4
9	Moshi Urban	1,477	266
10	Moshi Rural	5,796	811
11	Livestock/Poultry	1,973	197
Total		9,829	1,444

Source: Mwanuzi (2000)

Rivers in urban centres, for example Msimbazi in Dar es Salaam, have been abused by different sectors as dumping sites for waste from various sources and as a consequence of the high levels of pollution the water quality of these rivers and streams, has sharply decreased, thus rendering the water not safe for domestic consumption or irrigation purposes. Pollution loads from various sources to Msimbazi River and Lake Victoria are presented in Table 7.19 and Table 7.20 respectively. Table 7.19 shows the seasonal variation in the water quality of Msimbazi River.

⁹ Mwanuzi, F.L (2000) Assessment of water quality for Pangani River in Tanzania. Paper presented at the 1st WARFSA/Water Net symposium. November, Maputo Mozambique.

Table 7.19: Pollution Loads in Msimbazi River, 2011

Descriptions of diffuse pollution sources	Pollution loads estimates (t/yr)	
	Minimum	Maximum
On-site sanitation system	20.32	101.57
Industrial areas that have no sewers	17.70	141.56
Informal sector activities premises	16.12	80.61
Storm water from low-lying areas	8.57	42.83
Farm and animal grazing lands	19.75	80.57
Illegal solid waste disposal sites	11.17	55.86
Total pollution load	93.62	503.01

Source: State of the Environment Report, URT, 2011

Table 7.20: Pollution Load (kg/day) to Lake Victoria, 2007

Type	Industrial effluents	Municipal effluents	Total
BOD	5,201	9,998	15,199
COD	-	-	-
Total Suspended Solids	4,934	6,664	11,598
Faecal Coliform (FC) (No/day)	1.1×10^{14}	6.3×10^{14}	7.4×10^{14}
Total N	653	1,778	2,431
Total F	185	711	896

Source: Ministry of Water and Irrigation, Lake Victoria Environment Management Project (Water Quality and Ecosystem Management Component)

Table 7.21: Water Quality in Msimbazi River during Wet and Dry Seasons, 2011

Parameter	Season	
	Wet	Dry
Iron (mg/ltr)	0.68 – 1.39	0.66 – 0.87
Suspended solids (mg/ltr)	59 – 131	28 – 50
Faecal Coliform count $\times 10^4 / 100\text{ml}$	2.7 – 58	3.69 – 11.7
Turbidity (NTU)	62 – 70	30 – 41
Colour	214 – 316	194 – 247
Chloride (mg/ltr)	402 – 413	372 – 450
Electric conductivity (mS/cm)	8.7 – 9.7	8.9 – 10.4
Sulphates (mg/ltr)	32 – 60.4	61 – 456

Source: State of the Environment Report, URT, 2011

With future data availability water quality or pollution data may be presented by water basin or body as classified above.

7.4 Land Quality

Land quality is a complex attribute which acts in a distinct manner in its influence on the suitability of land for a specific use. Land qualities may be expressed in a positive or negative way. Examples are moisture availability, erosion resistance, flooding hazard, nutritive value of pastures,

accessibility, land cover, etc. Where data are available, aggregate land qualities may also be employed, e.g. crop yields, mean annual increments of timber species, etc.

As opposed to water and air surfaces land is a solid part of earth surface. It is the material that forms the top layer of the surface of the earth in which plants can grow. Land quality therefore refers to the condition of land relative to the requirements of land use, including agricultural production, forestry, conservation, and environmental management. Land quality needs to be assessed with respect to specific functions and types of land use.

7.5 Waste Management

Waste management includes collection, transportation, processing, recycling or disposal of waste material and is undertaken to reduce waste effect on health, the environment, aesthetics (aspects of beauty) or to recover resources from it.

Waste management is a growing problem in the country. Increasing urbanization, (rural to urban migration), and rapid development associated with population growth have resulted in increased solid and liquid waste generation mainly by industrial and domestic activities. The increase in waste generation has not been accompanied by an equivalent increase in the capacity of the relevant urban authorities to deal with this problem. The proper management of waste has thus become one of the most pressing and challenging environmental problems in the the country.

Currently there is limited waste management data available for the country. Tables below show some of the available data for solid, liquid and hazardous waste for the city of Dar es Salaam.

Table 7.22 shows the generation of waste by source in the city of Dar es Salaam. From the table it can be seen that most of the wastes are generated from manufacturing followed by households.

Table 7.22: Generation of Waste by Source in the City of Dar es Salaam, 2012 - 2014

Source	Unit	2012	2013	2014
Agriculture, forestry and fishing	tonnes	111,164.40	138,681.75	125,592.12
Mining and quarrying	tonnes	71,407.69	57,104.25	80,675.49
Manufacturing	tonnes	540,382.50	432,360.75	610,517.25
Energy supply	tonnes	63,687.94	89,735.25	71,953.82
Construction	tonnes	57,126.15	73,419.75	64,540.40
Other economic activities	tonnes	185,274.00	244,732.50	209,320.20
Households	tonnes	524,943.00	595,515.75	593,073.90
Total waste generation	tonnes	1553985.7	1631550	1755673.178

Source: Dar es Salaam City Council

Table 7.23 shows the generation and recycling of selected waste material in the city of Dar es Salaam. The table depicted that so far recycling is concentrated on plastics waste. Others are, used tyres and electric and electronic scrap.

Table 7.23: Generation and Recycling of Selected Waste Material, City of Dar es Salaam, 2012 - 2014

Material	Category	Unit	2012	2013	2014
Paper, paperboard and paper products	Wastes generated	tonnes	133,520.04	136,663.30	141,620.00
	Wastes collected for recycling	tonnes	-	-	-
Glass	Wastes generated	tonnes	166,900.06	170,829.13	177,025.00
	Wastes collected for recycling	tonnes	-	-	-
Aluminium	Wastes generated	tonnes	33,380.01	34,165.83	35,405.00
	Wastes collected for recycling	tonnes	-	-	-
Ferrous metal (including stainless steel)	Wastes generated	tonnes	50,070.02	51,248.74	53,107.50
	Wastes collected for recycling	tonnes	-	-	-
Plastic	Wastes generated	tonnes	267,040.09	273,326.60	283,240.00
	Wastes collected for recycling	tonnes	216,970.07	222,077.86	230,132.50
Generation of other selected waste materials	Construction/Demolition waste	tonnes	83,450.03	85,414.56	88,512.50
	Sewage sludge (dry weight)	tonnes	16,690.01	17,082.91	17,702.50
	End-of life vehicles	tonnes	-	-	-
	Used tyres	tonnes	33,380.01	34,165.83	35,405.00
	Electric and electronic scrap	tonnes	50,070.02	51,248.74	53,107.50
	Other	tonnes	83,450.03	85,414.56	88,512.50

Source: Dar es Salaam City Council

Table 7.24 shows the management/collection of municipal wastes in the city of Dar es Salaam. Much of the waste is collected from household sources.

Table 7.24: Management of Municipal Wastes, City of Dar es Salaam, 2012 - 2014

Category	Unit	2012	2013	2014
Municipal waste collected from households	tonnes	395,021.25	463,491.60	579,364.50
Municipal waste collected from other origins	tonnes	118,506.38	185,396.64	210,678.00
Total amount of municipal waste collected	tonnes	513,527.63	648,888.24	790,042.50
Municipal waste managed in the city	tonnes	-	-	
<i>Amounts going to:</i>				
Recycling	tonnes	-	-	
Composting	tonnes	23,622.27	29,848.86	36,341.96
Incineration	tonnes	5,135.28	6,488.88	7,900.43
<i>of which: with energy recovery</i>	tonnes	3,081.17	3,893.33	4,740.26
Landfill	tonnes	188,978.17	238,790.87	290,735.64
<i>of which: controlled landfill</i>	tonnes	30,811.66	38,933.29	47,402.55
Percentage of total population served by municipal waste collection	%	36.75	43.12	49
Percentage of urban population served by municipal waste collection	%	26	29	32
Percentage of rural population served by municipal waste collection	%	-	-	-

Source: Dar es Salaam City Council

Table 7.25 shows the management of municipal waste in three municipalities in Dar es Salaam; Ilala, Kinondoni and Temeke. The table depicts that, of all three municipalities, the Kinondoni Municipal was leads on the percentage of population being served by municipal waste collection. It was further revealed that much of municipal waste collection comes from households in all three municipalities. With respect to proportion, recycling of the wastes is being performed mostly in Kinondoni followed by Ilala and least of all in Temeke Municipality.

Table 7.25: Management of Municipal Waste in Ilala, Kinondoni and Temeke Municipalities

Category	Unit	2012	2013	2014
Ilala				
Total population of the municipality	persons	1,220,611	1,358,056	1,424,242
Percentage of city population served by municipal waste collection	%	36.75	43.12	45.00
Municipal waste collected from households	tonnes	208,050.00	213,525.00	219,000.00
Municipal waste collected from other origins	tonnes	71,284.50	73,967.25	76,650.00
Total amount of municipal waste collected	tonnes	279,334.50	287,492.25	295,650.00
<i>Amounts going to:</i>				
Recycling	tonnes	2,960.95	3,047.42	3,133.89
Composting	tonnes	12,849.39	13,224.64	13,599.90
Incineration	tonnes	1,396.67	1,437.46	1,478.25
<i>of which: with energy recovery</i>	tonnes	111.73	115.00	118.26
Landfill	tonnes	102,795.10	105,797.15	108,799.20
<i>of which: controlled landfill</i>	tonnes	16,760.07	17,249.54	17,739.00
Kinondoni				
Total population of the municipal	number	1,775,049	1,978,915	2,083,348
Percentage of city population served by municipal waste collection	%	41.4	42.9	49.0
Municipal waste collected from households	tonnes	263,159.50	270,084.75	277,010.00
Municipal waste collected from other origins	tonnes	69,985.76	72,619.63	75,253.50
Total amount of municipal waste collected	tonnes	333,145.26	342,704.38	352,263.50
<i>Amounts going to:</i>				
Recycling	tonnes	3,531.34	3,632.67	3,733.99
Composting	tonnes	15,324.68	15,764.40	16,204.12
Incineration	tonnes	1,665.73	1,713.52	1,761.32
<i>of which: with energy recovery</i>	tonnes	133.26	137.08	140.91
Landfill	tonnes	122,597.45	126,115.21	129,632.97
<i>of which: controlled landfill</i>	tonnes	19,988.72	20,562.26	21,135.81
Temeke				
Total population of the municipal	number	1,368,881	1,522,117	1,598,770
Percentage of city population served by municipal waste collection	%	39	42	47
Municipal waste collected from households	tonnes	91,452.70	93,859.35	96,266.00
Municipal waste collected from other origins	tonnes	34,589.58	35,891.34	37,193.10
Total amount of municipal waste collected	tonnes	126,042.28	129,750.69	133,459.10
<i>Amounts going to:</i>				
Recycling	tonnes	1,336.05	1,375.36	1,414.67
Composting	tonnes	5,797.95	5,968.53	6,139.12
Incineration	tonnes	630.21	648.75	667.30
<i>of which: with energy recovery</i>	tonnes	50.42	51.90	53.38
Landfill	tonnes	46,383.56	47,748.25	49,112.95
<i>of which: controlled landfill</i>	tonnes	7,562.54	7,785.04	8,007.55

Source: Dar es Salaam City Council

The waste treatments and disposal facilities in the city of Dar es Salaam are shown in Table 7.26.

Table 7.26: Waste Treatment and Disposal Facilities, Dar es Salaam City, 2012 - 2014

Category	Unit	2012	2013	2014
Landfill sites:	number			
annual inputs	1000 tonnes	1	1	1
<i>of which: controlled landfill</i>	number	1	1	1
annual inputs	1000 tonnes	7,828.33	8,055.44	8,282.55
<i>of which: uncontrolled landfill</i>	number	-	-	-
annual inputs	1000 tonnes			
Incineration plants:	number			
annual capacity	1000 tonnes	3,692.61	3,799.74	3,906.86
<i>of which: with energy recovery</i>	number			
annual capacity	1000 tonnes	295.41	303.98	312.55
Composting plants:	number			
annual capacity	1000 tonnes	33,972.01	34,957.58	35,943.14

Source: Dar es Salaam City Council

7.6 Waste Composition

Information on the composition of the solid waste is important in evaluating equipment needs, collection system, disposal methods, and management plans. Table 7.27 shows the composition of waste by category in Dar es Salaam City. As expected based on organic materials from food and garden wastes (31.5 percent), plastic wastes (22 percent) accounted for most of the wastes.

Table 7.27: Percentage Composition of Municipal Wastes, Dar es Salaam City

Category	2012	2013	2014
Paper, paperboard	20.6	15.0	12.0
Textiles	1.0	3.0	5.0
Plastics	16.0	21.0	22.0
Glass	15.0	8.0	9.0
Metals	6.5	4.0	0.5
Organic material	26.0	28.0	31.5
<i>of which: food and garden waste</i>	7.9	11.0	13.0
Other inorganic material	7.0	10.0	7.0
TOTAL	100	100	100

Source: Dar es Salaam City Council

Table 7.28 shows the overall solid waste equipment owned by the Dar es Salaam City Councils with their status in 2011.

Table 7.28: Overall Solid Waste Equipment Required and Owned by the Dar es Salaam City Council, 2011

Equipment required	Compactor trucks	Skip master	Skip container	Dump trucks
Equipment required	42	62	651	103
Equipment available	0	5	42	22
Deficit (Percent)	100	92	94	79

Source: Dar es Salaam City Council

CHAPTER EIGHT

ENVIRONMENTAL PROTECTION

8.0 Introduction

Environmental protection is the practice of protecting the natural environment at individual, organizational or governmental levels, for the benefit of the natural environment and humans. Due to the pressures of population and technological advancement, the biophysical environment is being degraded, sometimes permanently. This has been recognized, and governments have begun placing restraints on activities that cause environmental degradation.

The scarcity of information on environmental protection in the country does not mean that no efforts are being made to improve the situation. The only information presented here is on protected land areas (in the form of national parks, game reserves, game controlled areas, forest reserves and marine parks) as well as data on environmental impact assessment (EIA). This information could also be used as baseline information when more data about the number of threatened species and size of populations of such species are made available.

8.1 National Parks

National parks are protected areas managed mainly for ecosystem conservation and recreation (Table 8.1). They are natural areas of land and/or sea, designated to:

- Protect the ecological integrity of ecosystems for the present and future generations;
- Prevent exploration or occupation contrary to the purpose of designation of the area; and
- Provide foundation for spiritual, scientific, educational, and recreational development as well as tourism opportunities, all of which must be environmentally compatible.

Table 8.1: List of National Parks, by Bordering Districts and Size, Tanzania Mainland, 2014

Serial Number	Name of National Park	Bordering District(s)	Area (km ²)	Year Established
1	Gombe Stream	Kasulu, Kigoma Urban (Kigoma Region)	52	1968
2	Rubondo	Muleba (Kagera Region), Sengerema (Mwanza Region), Geita, Chato (Geita Region)	456	1977
3	Kitulo	Makete(Iringa Region), Mbeya rural, Rungwe (Mbeya Region)	465	2004
4	Arusha	Arumeru (Arusha Region)	552	1960
5	Lake Manyara	Babati, Mbulu (Manyara Region), Karatu, Monduli (Arusha Region)	648	1959
6	Saadani	Bagamoyo (Pwani Region), Pangani, Handeni (Tanga Region)	1,062	2004
7	Mahale Mts.	Kigoma Rural (Kigoma Region), Mpanda (Rukwa Region)	1,613	1980
8	Kilimanjaro	Siha, Hai, Moshi Rural (Kilimanjaro Region), Longido (Arusha Region).	1,668	1973
9	Udzungwa	Kilombero, Kilosa (Morogoro Region), Kilolo (Iringa Region)	1,990	1992
10	Tarangire	Babati, Kiteto, Simanjiro (Manyara Region), Monduli (Arusha Region), Kondoa (Dodoma Region)	2,850	1970
11	Mikumi	Kilosa, Morogoro, Mvomero (Morogoro Region)	3,230	1964
12	Mkomazi	Same, Mwanga (Kilimanjaro Region), Lushoto, Korogwe, Mkinga (Tanga Region)	3,245	2007
13	Katavi	Mpanda (Rukwa Region)	4,471	1974
14	Serengeti	Meatu, Bariadi (Shinyanga Region), Magu (Mwanza Region), Bunda, Serengeti, Tarime (Mara Region), Ngorongoro (Arusha Region)	14,763	1951
15	Ruaha	Iringa Rural (Iringa Region), Mbarali, Chunya (Mbeya Region), Chamwino (Dodoma Region)	20,300	1964
16	Saa Nane Island	Nyamagana District (Mwanza Region)	50	2012
Total			57,415	

However, despite efforts made by government to protect these areas, there exists poaching (illegal hunting practices) among the communities surrounding the national parks and game reserves. Therefore, Government has established protection policy, measures and by laws to curb such practices. These protection measures are intended to discourage illegal hunting in national parks. Table 8.2 shows anti-poaching activities for the period from 2000 to 2014.

Table 8.2: Anti-poaching Activities from 2000 – 2014, Tanzania Mainland

Year	Patrol Man-days	Poachers Arrested	Man-days/Poacher
2000	17,798	2,515	7.08
2001	42,431	1,468	28.90
2002	27,674	1,333	20.76
2003	40,964	1,540	26.60
2004	41,498	2,107	19.70
2005	61,152	2,302	26.56
2006	66,137	1,318	50.18
2007	68,864	2,096	32.85
2008	72,783	3,052	23.85
2009	72,783	1,738	41.88
2010	77,446	1,310	59.12
2011	62,832	972	64.64
2012	73,619	1,784	41.27
2013	120,791	1,445	83.59
2014	120,825	1,364	88.58
Total:	967,597	26,344	36.73

Source: Wildlife Department, Ministry of Natural Resources and Tourism

8.2 National Reserves

These are areas of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species available primarily for scientific research and/or environmental monitoring, which are protected and managed by government (or any other appointed authority) so as to preserve their natural conditions. They could be game, forest or even sea reserves depending upon the type of the species intended to be preserved. The distribution and location of the existing protected areas in Tanzania Mainland are shown in Table 8.3 and on Map 5.

Table 8.3: Protected Areas in Tanzania Mainland, 2011

Serial Number.	Name Area (km ²)	Year Established	Location/Altitude	Principal Features
1.	Serengeti (14,763)	1951	1°28' – 3°17'S 35°00' – 35°50'E 920 – 1,850m above sea level	Central area Acacia savanna. Short and long grass plains South. North hilly more densely wooded in Western Corridor.
2.	Ruaha (20,300)	1964	7°45'S 35°40'E at the center 750 – 1,900m above sea level	Rivers, escarpment, springs, hills, Miombo woodland.
3.	Mikumi (3,230)	1964	7°00' – 7°50'S 37°00' – 37°30'E 549m above sea level	Swamps and Miombo woodlands and Mkata river flood plains.
4.	Tarangire (2,850)	1970	3°50'S 36°00'E at the center 1,200m above sea level	Nine vegetational zones, swamps, rock outcrops and the Tarangire river
5.	Katavi (4,471)	1974	6°40' – 7°05'S 35°50' – 56°50'E 900m above sea level	River, Lakes, swamps and Miombo woodlands
6.	Udzungwa Mountains (1,990)	1992	7°45'S 36°36'E at the center 1,200m above sea level	Forest reserve
7.	Mount Kilimanjaro (1,668)	1973	2°50' – 3°10'S 37°20' – 37°40'E 900m above sea level	Shira Plateau, Mawenzi and Kibo peak
8.	Rubondo Island (456)	1977	2°30'S 31°45'E at center 1,150m above sea level	Lake Victoria, about a dozen smalts belonging to the park and forest
9.	Mahale mountain (1,613)	1980	6°00' – 6°28'S 29°43' – 30°07'E 2,000 – 2,462m above sea level	Mountain range, Rift Valley and forests, Lake Tanganyika
10.	Lake Manyara (648)	1959	3°20'S 30°40'E at centre 945m above sea level	Lake Manyara Great Rift Valley and ground water forest
11.	Arusha (552)	1960	3°15'S 35°55'E at centre 1,524 – 1,572m above sea level	Craters, lakes, rugged Mount Meru and forest
12.	Gombe Stream (52)	1968	4°40'S 29°38'E at center 681 – 1,524m above sea level	Mountains, Rift Valley, Lake Tanganyika valleys with stream
13.	Saadani (1,062)	2004	na	na
14.	Kitulo (465)	2004	na	na
15.	Mkomazi (3,245)	2007	na	na
16.	Saa Nane National (50)	2012	na	na
Conservation Area Authority				
1	Ngorongoro Conservation Area (8,292)	1959	2°44' – 3°26'S 35°00' – 35°55'E 1,350 – 3,600m above sea level	Scenic craters, good forest, volcanic mount, extensive plains, highland plateau

Source: Wildlife Department, Ministry of Natural Resources and Tourism

Table 8.4: Game Reserves, Tanzania Mainland, 2014

Serial Number	Name of Game Reserve	Area (km ²)	Bordering Region	Year Gazzetted
1	Biharamulo	1,300.00	Kagera	1959
2	Burigi	2,200.00	Kagera	1972
3	Grumeti	2,000.00	Mara	1993
4	Ibanda	200.00	Kagera	1972
5	Ikorongo	3,000.00	Mara	1993
6	Kigosi	7,000.00	Shinyanga/Tabora	1983
7	Kijereshi	300.00	Mwanza	1994
8	Kimisi	1,026.23	Kagera	2005
9	Kizigo	4,000.00	Singida	1972
10	Liparamba	570.99	Ruvuma	1959
11	Lwafi	2,228.00	Rukwa	1993
12	Lukwati	3,146.00	Rukwa/Katavi	1997
13	Lukwika-Lumesule	444.00	Mtwara	1995
14	Maswa	2,200.00	Shinyanga/Simiyu	1969
15	Mkungunero	700.00	Dodoma/Manyara	1996
16	Moyowosi	6,000.00	Kigoma	1981
17	Mpanga-Kipengele	1,574.25	Iringa	2003
18	Msanjesi	210.00	Mtwara	1995
19	Muhesi	2,000.00	Singida	1994
20	Pande	12.00	Dar es Salaam	1994
21	Rukwa	4,000.00	Rukwa/Katavi	1995
22	Rumanyika	800.00	Kagera	1965
23	Rungwa	9,000.00	Singida/Tabora/Mbeya	1951
24	Selous	50,000.00	Pwani/Morogoro/Lindi/Ruvuma	1920
25	Swagaswaga	871.00	Dodoma	1996
26	Ugalla	5,000.00	Tabora	1965
27	Uwanda	5,000.00	Rukwa	1959
28	Piti	2,972.93	Mbeya	2013
Total		117,755.40		

Source: Wildlife Department, Ministry of Natural Resources and Tourism

8.2.2 Game Controlled Areas

In addition to game reserves, there is a sizeable number of game controlled areas. These are areas managed mainly for the sustainable use of natural ecosystems. They contain predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological biodiversity, while at the same time, providing a sustainable flow of natural products and services to meet community needs. There are about forty two game controlled areas covering more than 50,000 square kilometres in Tanzania (Table 8.5).

Table 8.5: List of Game Controlled Areas (GCAs), Tanzania Mainland, 2014

Serial Number	Name of GCA	Area (km ²)	Year Gazzettment	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)	Tanga - 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 - Sumbawanga
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	Lolkisale	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	Lunda Mkwambi	1,000	1985 (GN 38)	Iringa – Iringa rural
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 Diamond Mine	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 - Njiro Dam	30	1974 (GN 269)	Arusha – Arusha Urban
32	Inyonga	3,500	1974 (GN 269)	Rukwa and Tabora - (Mpanda and Tabora)
33	Rau Forest	100	1974 (GN 269)	Kilimanjaro - Moshi
34	Rungwa River	1500	1974 (GN 269)	Rukwa – Mlele
35	Ruvu Masai	1,500	1974 (GN 269)	Arusha – Simanjiro

Table 8.6 (Ctd): List of Game Controlled Areas (GCAs), Tanzania Mainland, 2014

Serial Number	Name of GCA	Area (km ²)	Year Gazzettment	Region; District
36	Ruvu Same	1,000	1974 (GN 269)	Kilimanjaro – Same
37	Sanya - Lelatema	800	1974 (GN 269)	^Kilimanjaro 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
Total		55,565		

Source: Wildlife Department, Ministry of Natural Resources and Tourism

8.2.3 Wildlife Management Areas (WMAs)

The Wildlife Policy calls for the creation of Wildlife Management Areas (WMAs) which give local communities some control over wildlife resources utilization on their lands and enable them to benefit directly from these resources. Currently there are 38 WMAs which cover a total land area of about 29,000 km² within 334 villages in the country.

The aim of involving the local communities in wildlife conservation and management are:

- Promoting conservation of wildlife outside protected areas by creating WMAs
- Enabling local communities to manage WMAs.
- Creating an enabling environment which ensures that legal and sustainable wildlife schemes directly benefit local communities.

Table 8.6: Wildlife Management Areas (WMAs), Tanzania Mainland, 2003 – June, 2013

Serial Number	Name of WMA	District	Year of establishment	Area (km ²)	Number of Villages
1	Jukumu (UKUTU)	Morogoro	2003	639	21
2	Wami Mbiki Society (WMS)	Morogoro Bagamoyo Mvomero	2003	2,400	24
3	Twatwatwa	Kilosa	2003	1,000	4
4	Mbarang'andu (MBARANG'ANDU)	Namtumbo	2003	2,471	7
5	Tunduru (NALIKA)	Tunduru	2003	1,391	9
6	Liwale (MAGINGO)	Liwale	2003	4,515	9
7	Ngarambe/Tapika (MUNGATA)	Rufiji	2003	767	2
8	Burunge (JUHIBU)	Babati	2003	617	10
9	Makame (INDEMA)	Kiteto	2003	5,372	4
10	Enduimeti (ENDUIMETI)	Longido	2003	751	9
11	Ikona (JUHIWAIKO)	Serengeti Tarime	2003	242	5
12	Loliondo (GCA)	Ngorongoro	2003	1,000	6
13	Tarime	Tarime	2003	-	2
14	Uyumbu (UWIMA)	Urambo	2003	839	4
15	Ipole (JUHIWAI)	Sikonge	2003	2,406	4
16	Pawaga-Idodi (MBOMIPA)	Iringa	2003	777	21
17	Makao (JUHIWAPOMA)	Meatu	2007	769	7
18	Mpanda (UBENDE)	Tabora (Mpanda)	2006	-	10
19	Mpanda (MPIMBWE)	Tabora (Mpanda)	2006	-	5
20	Mpanda (KAMSISI)	Tabora (Mpanda)	2009	-	5
21	Igombe/Sagara (ISAWIMA)	Urambo	2007	315	11
22	Malagarasi (MAWIMA)	Kigoma	2007	305	9
23	Natron North	Longido Ngorongoro	2008	-	32
24	Natron South	Longido	2008	-	8
25	Mpanga/Kipengere (WAGA)	Mufindi, Iringa Mbarali	2006	-	20
26	Mpanga/Kipengera (UMEMARUWA)	Mbarali Njombe	2006	-	22
27	Rufiji (JUHIWANGUMWA)	Rufiji	2008	-	13
28	MBOMAMINJIKA	Kilwa	2008	-	9

Table 8.6 ctd: Wildlife Management Areas (WMAs), Tanzania Mainland, 2003 – June, 2013

Serial Number	Name of WMA	District	Year of establishment	Area (km ²)	Number of Villages
29	KIMBANDA	Namtumbo	2008	2,150	5
30	CHINGOLI	Tunduru	2008	938	4
31	KISUNGULE	Namtumbo	2008	1,345	3
32	KILINDI	Kilindi	2009		5
33	YAEDACHINI	Mbulu	2009	-	
34	MCHIMALU	Nanyumbu	2011	-	6
		Nachingwea			
35	NDONDA	Nanyumbu,	2011	-	7
	RANDILEN				
36	(Lolkisale)	Monduli	2011	-	4
37	ILUMA	Kilombero, Mahenge	2011	509	14
38	KIDOMA	Kilosa, Mvomero	2011	-	7
		Total			337

Source: Ministry of Natural Resources and Tourism, Wildlife Department

8.2.4 Forest Reserves

Land and forest resources are the main natural endowments of Tanzania. However, it has been observed that the country's forest area has been declining. Causes of this decline are mainly heavy pressure from agricultural expansion, livestock grazing, wildfire, over-exploitation of wood resources for various purposes and other human activities.

Tanzania has initiated actions towards the incorporation of environmental concerns in forestry and other sectors. These initiatives include the review of sector policies (forestry, agriculture, land, water) and other related policies; and adoption of the Tanzania Forest Action Plan (TFAP), the National Conservation Strategy for Sustainable Development (NCSSD), the National Environment Action Plan (NEAP) and the National Environmental Policy (NEP).

The Forest Ordinance was extended to cover the establishment of institutions other than state forest reserves, such as village forest reserves, controlled areas and pastoral areas for pastoralists. In this case key areas are reserved for biological conservation as strict natural resources. A list of the forest reserves in Tanzania Mainland, which was obtained from the Department of Forestry and Beekeeping of the Ministry of Natural Resources and Tourism, is given in Appendix 6.

8.2.5 Marine Protection/Reserves

The Tanzania coast line runs approximately north-south and is dominated by three large offshore islands: those of Pemba, Unguja, and Mafia. Among the countries of Eastern Africa, Tanzania has the largest reef area (3,580 km²). There are fringing and patch reefs along much of the mainland coast and the offshore islands.

Misali Island, just west of Pemba, has some of the country's oldest historically recorded coral cover and high species diversity. Mafia Island has extensive reefs, particularly in the south, many of which remain in good condition. Likewise there are many reefs around the Songo Songo Archipelago in good condition, especially those furthest from the Mainland.

There are mangrove forests in most river mouths and sea grass ecosystems are widespread, particularly in the shallow waters around the Mafia Island and Songo Songo Archipelagos. The Rufiji Delta supports the largest single mangrove forest in Eastern Africa, covering 53,000 hectares. Mangroves and shallow coral reefs represent highly diverse and productive systems, which provide important resources for poor people living in coastal areas. On the other hand, protecting these resources meaningfully is a considerable challenge. In order to deal with this challenge, ecological criteria have been identified that can assist in designing local networks or larger systems. These are:

- **Representativeness:** This ensures that all types of biodiversity (both species and habitats) receive protection.
- **Comprehensiveness:** This recognizes the full range of species and ecosystems to be included.
- **Adequacy:** This ensures that the individual components are of sufficient size and appropriate spatial distribution to ensure the ecological viability and integrity of populations and species. In reality, the total amount of ocean gazetted as marine protected area (MPA) is less important than whether appropriate amounts of each effectively managed habitat type are included that is, whether the network is representative.
- **Connectivity:** This recognizes the linkages between individual components. Connectivity among MPAs, and between MPAs and other areas, is very important given the reproductive characteristics of marine environment.
- **Resilience:** This ensures that the network can survive natural catastrophies and major impacts, by replicating sites that have particularly vulnerable species and ecosystems such as coral reefs.

Although it is often stated that protected areas have been created in the past on an *ad hoc* basis, there is in fact a good correspondence between the existing MPAs and the core priority areas for biodiversity conservation in URT. The current system of MPAs (Table 8.7) is thus a good start towards fulfilling these criteria. Only one MPA (Dar es Salaam Marine Reserve System) does not fall in a seascape, but was established largely for tourism and recreation, rather than biodiversity protection, as it is adjacent to a major urban development. This does not mean that there are enough

MPAs, or that they are large enough to ensure adequate representation, but it does indicate that existing MPAs form a sound baseline for the development of a representative system.

Other facts about marine environment in Tanzania are given below as extracted from a book “Blue Print 2050”:

Territorial seas 37,000 km² area

Coastal line 1,424 km long

Protected area 1,380 km² at mid 2004, which is about 4 percent of territorial seas

Table 8.7: The Management of Marine Protected Areas, Tanzania, 2005

Area	Date Established*	Sub-tidal Area (km ²)
Tanzania Mainland (870 km²)		
Dar es Salaam Marine Reserve System – comprises 4 islands and placed under the mandate of Marine Parks and Reserves Unit (MPRU) in 1998	1975	26.0
Maziwe Island Marine Reserve	1975	2.6
Mafia Island Marine Park (total of 822 km ²) - multiple use marine park with zoning	1995	615.0
Tanga Collaborative Fishery Management Area (1,603 km ² , of which 29 km ² is no-take) - covers coastal areas of Muheza, Tanga and Pangani districts, set up as joint initiatives between local communities and districts; area includes closed reefs and Maziwe Island Marine Reserve	1996-2000	26.4
Mnazi Bay-Ruvuma Estuary Marine Park (total area 650 km ²)	2000	221
Saadani National Park: a new protected area, up-grading the previous Game Reserve, and potentially extending protection into the sea	2004	na
Kinondoni Integrated a Coastal Area Management Program	2000	na
Rufiji Environmental Management Program – a large program covering the entire delta, but with a Coastal component.	1998	na
Zanzibar (510 km²)		
Chumbe Island Coral Sanctuary (all no-take) -management delegated to a private company	1994	0.3
Menai Bay Conservation Area - a community-managed MPA	1997	470.0
Misali Island Marine Conservation Area (total area 23 km ² includes terrestrial; no-take is 1.4 km ²) -an NGO and community-managed MPA	1998	21.6
Mnemba Island Marine Conservation Area** (no-take zone) -as part of MIMCA, a privately managed MPA on Mnemba Island is supported through Conservation Corporation Africa	2002	0.15
Kiwengwa Controlled Area -established in 2000 but never managed	2000	17.5
Ngezi Forest Reserve (14.4 km ²) -proposed for re-designation as a Nature Reserve; includes mangroves and beach	1959	na
Jozan National Park -a pilot ICM site and protected forest area, Zanzibar's first national park	2004	na

Na – not available

Source: Ministry of Natural Resource and Tourism

**The date established normally shows the date that the sub-tidal area was included; some sites that include land were designated as terrestrial protected areas earlier. For Saadani National Park, which was established as a Game Reserve in 1964, no sub-tidal area has yet been declared. Dates for ICM programs in Kinondoni and Rufiji are the start date of the programs.*

***Mnemba Island Marine Conservation Area beyond the no-take zone now includes the Kiwengwa Controlled Area and Chwaka Bay. It extends from Nungwi (north of Unguja) to Chwaka Bay, through Mnemba, Kiwengwa, Marumbi, Charawe, Michamvi and Ukongoroni villages, and is co-managed by community and government.*

Tanzania continental shelf covers an estimated 17,900 km² underlying all waters up to 200 m depth. It is generally narrow (narrowest point 2 km, widest 80 km) and drops sharply after 60 m depth.

Exclusive Economic Zone (EEZ): This maritime claim was by Tanzania in Territorial Sea and EEZ Act of 1989. It extends to a maximum of 200 nautical mile limit from the low water line, or to an equidistant line with neighbouring state as defined under the United Nations Convention on the law of the sea. The EEZ covers a consultant area of approximately 200,000 km².

Territorial Sea: This maritime claim extends 12 nautical miles from the low waterline, and covers a resultant 37,000 km². It has the same baseline as the EEZ and is thus wholly contained within the EEZ. Among the countries of Eastern Africa, Tanzania has the greatest roof area (3,580 km²) concentrated at Tanga, Pemba, Unguja, Mafia, the Songosongo Archipelago and Mtwara.

The Rufiji Delta supports the largest single mangrove forest in Eastern Africa covering 53,000 ha. Mangrove shallow water reefs represent highly diverse and productive systems. Mainland mangroves cover about 108,000 ha.

Important ecosystems in United Republic of Tanzania include mangrove forests, estuaries, coral reef, sea grass beds and inter-tidal flats. These ecosystems support a very high diversity of plant and animal species including marine mammals, marine turtles, coastal and sea birds, fish, plankton, sponges, crustaceans, molluscs, echinoderms and a variety of other organisms. The ecosystems and species affect the livelihoods of the people who depend on this environment. An estimated 40,000 artisan fishermen land about 50,000 tonnes of fish annually. Current annual production of marine invertebrates (lobsters, crab, octopus, squids, seashells and sea cucumbers) is about 1,400 tonnes. In URT there are several areas closed to fishing covering some 66 km² along Dar es Salaam, Maziwe, Mafia, Tanga and Zanzibar.

8.3 Environmental Impact Assessment (EIA)

Environmental impact assessment means a systematic examination conducted to determine whether or not a programme, activity or project will have any adverse impacts on the environment. While addressing an obligation to undertake EIA, EMA No.20 of 2004 directs that any person, being a proponent or a developer of a project shall undertake or cause to be undertaken, at his own cost, an environmental impact assessment study and that EIA study shall be carried out prior to the commencement of financing of a project or undertaking. The process of EIA undergoes several stages such as application for registration at the National Environment Management Council (NEMC), screening of application forms, scoping if deemed necessary during screening, conducting EIA study and preliminary environmental assessment (PEA), submission of environmental impact statement (EIS) i.e. the EIA/PEA report to NEMC, review of EIS, approval of EIS by NEMC, monitoring, auditing and decommissioning.

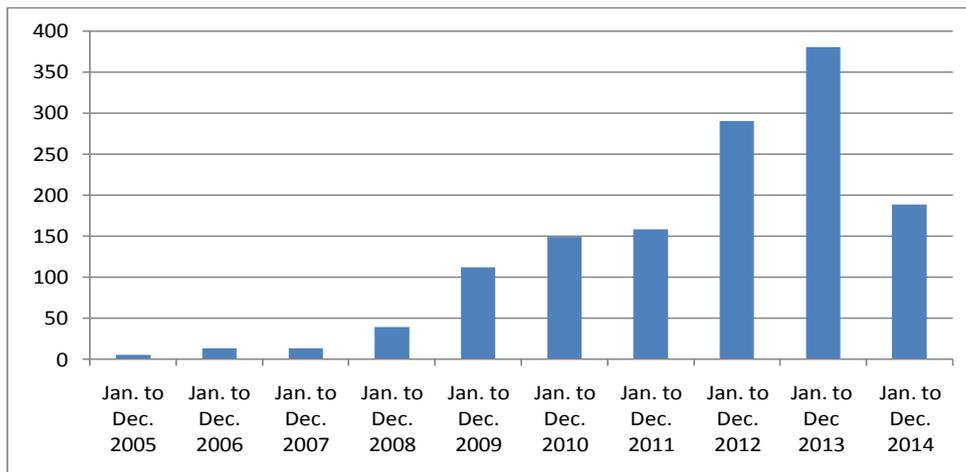


Photo: Mining activities can be destructive to the environment if EIA is not done at the onset of such activities

8.3.1 EIA Certificates

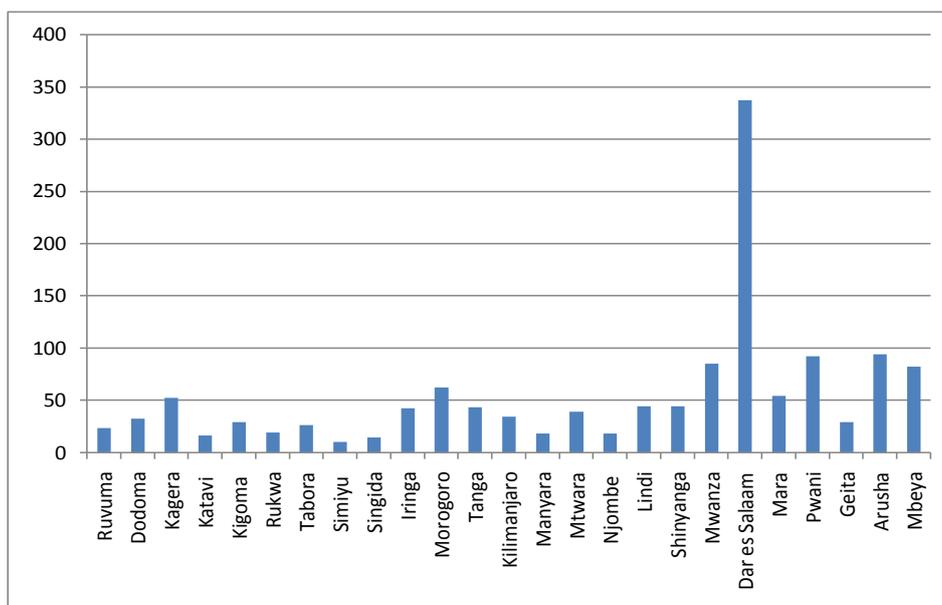
At the end of review of EIS, NEMC may recommend and make a formal request to the Minister responsible for Environment to consider issuing of environmental impact assessment certificate for the project concerned. Until year 2004, NEMC was issuing Conditional Environmental Clearance (CEC) upon approval of development projects. From year 2005, NEMC is charged with recommending and preparing terms and conditions for issuance of the EIA Certificate by the Minister, as stipulated in EMA 2004 Section 92 (1). Approval/disapproval of the EIA Certificate is done by the Minister responsible for Environment. Figures 8.1 and 8.2 below show the overall trend of EIA and Environmental Audit (EA) certification by year and region respectively.

Figure 8.1: Trend of EIA Certification, Tanzania Mainland, 2005 - 2014



Source: NEMC Environment and Development Series: Release 2014

Figure 8.2: Trend of EIA Certification by Region, Tanzania Mainland, 2005/06 to 2013/14



Source: NEMC Environment and Development Series: Release 2014

In the year 2010/11, a total of 166 projects were issued with EIA and Environmental Audit (EA) certificates. These projects are grouped into different sectors whereby communication seemed to be high with 26.5 percent followed by construction and processing industries with 22.9 percent (Table 8.8).

Table 8.8: Issued EIA and EA Certificates by Sector, Tanzania Mainland, 2010/2011

Projects by Sector	Certificates issued	Percent
Infrastructure (Housing estate, roads)	17	10.24
Mining	8	4.82
Tourism	16	9.64
Communication	44	26.51
Energy	28	16.87
Construction and Processing Industries	38	22.89
Water supply	12	7.23
Agricultural/Forest	3	1.81
Total	166	100

Source: NEMC

8.3.2 Environmental Audit Certificates

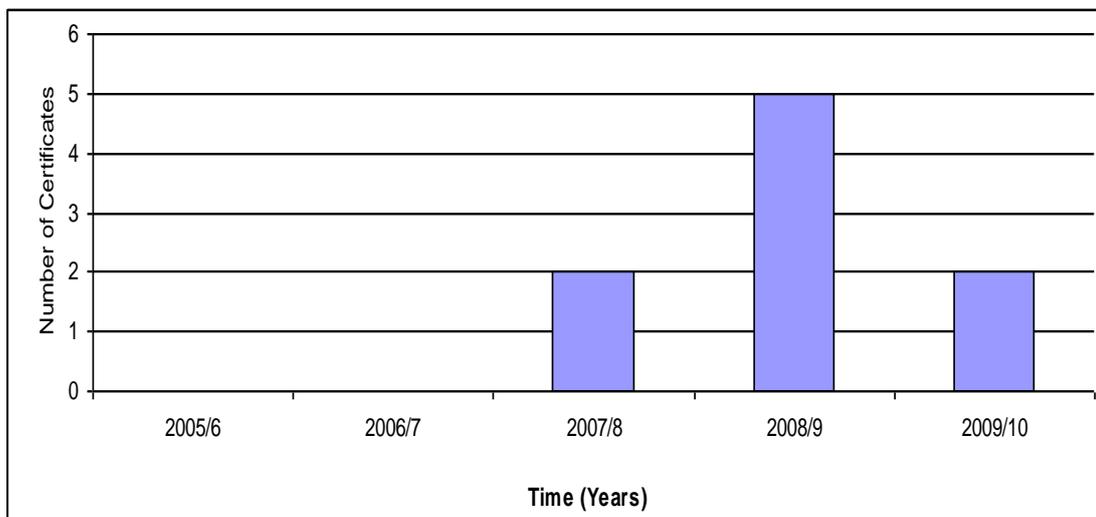
An environmental audit is an independent and objective oriented examination of whether the practice complies with set standards. Broadly, environmental audit means a check on some aspects of environmental management, and implies some kind of testing and verification. It is normally done to a project after operating for a sufficiently long time for impacts to have emerged and towards the end of a project. The main objective of this audit is to establish new baseline information which can be used for conducting future monitoring and audits to establish the adequacy of mitigation measures and accuracy of impacts prediction during the EIA study.



Environmental audit exercise

Figure 8.3 gives the trend of Environmental Audit Certificate issued from year 2005/6 to 2009/10.

Figure 8.3: Environmental Audit Certificates Issued, Tanzania Mainland, 2005/06 – 2009/10



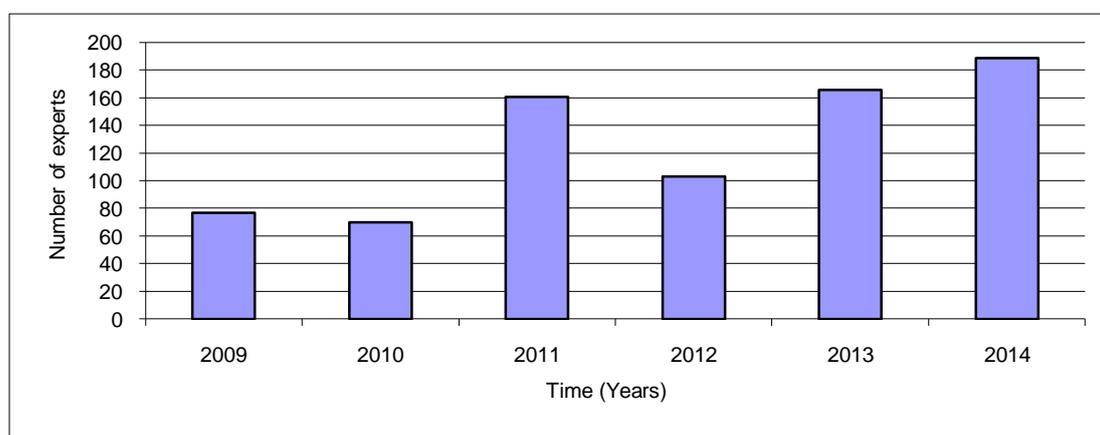
Source: NEMC Environment and Development Series: Release 2010

8.3.3 Registration of Environmental Experts

According to Environmental Impact Assessment and Audit Regulations 2005, the Environmental Impact Assessment shall be conducted by experts or firms of experts whose names have been duly certified and registered in accordance with the provisions of the environment.

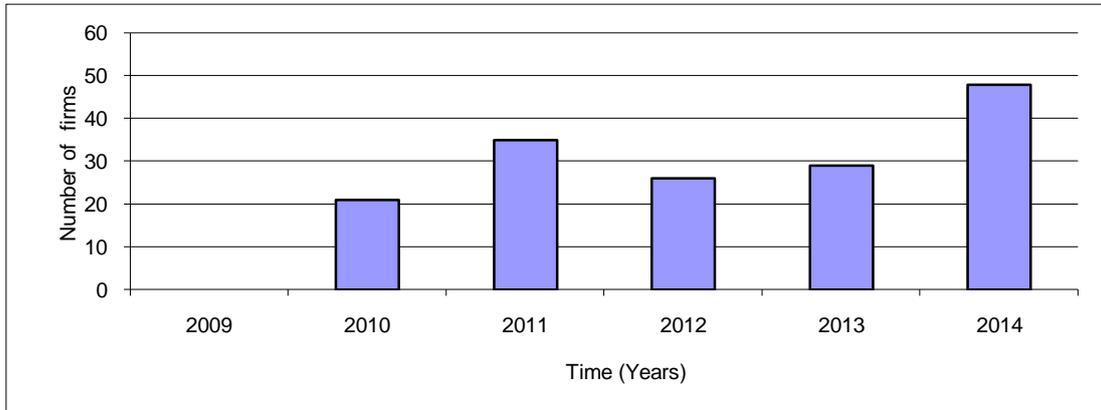
Regulation 31 of GN No. 349/2005 directs the Registrar of Environmental Experts to publish each year in the Gazette and the media the list of name and firms certified and registered as environmental experts. NEMC started registering environmental auditing experts and environment auditing firms since 2009, with the trend as shown figures 8.4 and 8.5 below.

Figure 8.4: Registered Environmental Impact Assessment and Environmental Auditing Experts, Tanzania Mainland, 2009 - 2014



Source: NEMC Environment and Development Series: Release 2014

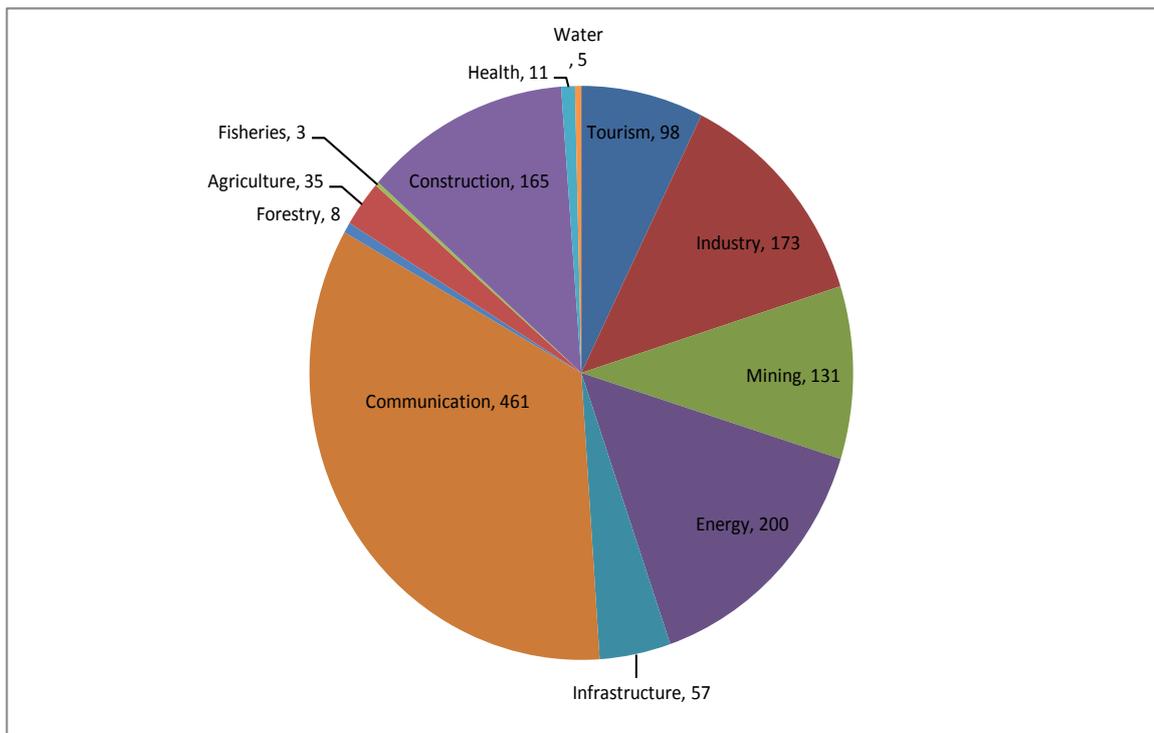
Figure 8.5: Registered Environmental Impact Assessment and Environmental Auditing Firms, Tanzania Mainland, 2009-2014



Source: NEMC Environment and Development Series: Release 2014

A total of 1,347 projects were issued with Environment Impact Assessment (EIA) and Environmental Audit (EA) certificates from 2005 to 2014. In 2014, a total of 188 certificates were issued Figure 8.4. These projects are grouped in different sectors as shown in Figure 8.6.

Figure 8.6: EIA Certificates issued by Sector in the period of 2005 to 2014



8.4 Multilateral Environmental Agreements

Tanzania cooperates with other states in managing the global environment. In this regard, Tanzania is a Party to various international treaties aiming at the protection of the environment. (Table 8.9).

Table 8.9: Major Conventions on Environment to which Tanzania is a Party

Serial Number	Convention	Objective
1	Convention on Biological Diversity (CBD) – Ratified 1996	To promote conservation of biological diversity; sustainable use of its components; and fair and equitable sharing of benefits arising out of the utilization of genetic resources.
2	United Nations Framework Convention on Climate Change (UNFCCC) – Ratified 1996	To mitigate and adapt to climate change to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner
3	The United Nations Convention to Combat Desertification (UNCCD) – Ratified 1996	To combat desertification and reduce effects of drought in countries experiencing various drought and/or desertification, particularly in Africa.
4	Ramsar Convention on Wetlands – Ratified in 1975	Provides the framework for national action and international cooperation for the conservation and wise use of wet lands and their resources.
5	UNESCO World Heritage Convention, Convention for Protection of World Cultural and Natural Heritage – Ratified 1975	To establish an effective system for the collective protection of cultural and natural heritage of outstanding universal value.
6	Convention on International Trade in Endangered Species of Wild Fauna and Flora – Ratified 1975	To ensure that international trade in specimens of wild animals and plants do not threaten the species' survival.
7	Convention on the Protection and use of Transboundary Water Courses and International Lakes – Ratified 1996	Promotes protection and management of transboundary waters, surface water and ground water, as well related ecosystems, including the marine environment.
8	Basel Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal – Ratified 1992	Set up framework for controlling movements of hazardous wastes across international borders
9	Rotterdam Convention of the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade – Ratified 2004	Promotes shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals in order to protect human health and the environment
10	Stockholm Convention on Persistent Organic Pollutants POPs – Ratified 2004	Protect human health and the environment from persistent organic pollutants, mainly by addressing the use and emission of POPs and the management of POP waste in developing countries.

Table 8.9 (Ctd): Major Conventions on Environment to which Tanzania is a Party

Serial Number	Convention	Objective
11	The Convention on Conservation on Fauna and Flora in their Natural state, London – Ratified 1993	To preserve the natural fauna and flora of certain parts of the world, particularly of Africa, by means of national parks and reserves, and by regulation of hunting and collection of species.
12	The Convention of the Africa Migratory Locust, Kano – Ratified 1962	Preventive control of the African Migratory Locust undertaken in Africa.
13	The Convention on the Prevention of Marine Pollution by Dumping of the Wastes and other matters, London – Ratified 1972	International control and prevention of marine pollution by prohibiting the dumping of the certain hazardous materials
14	The Convention on the Prevention of Marine Pollution from ships (MARPOL) – Ratified 1973	Prevention and minimizing pollution from ships – both accidental pollution and that from routine operations
15	The United Nations Convention on Law of the Sea, Montego Bay – Ratified 1982	Convention provides for an equitable relationship among States in their use of the oceans based on their respective geographical characteristic, economic circumstances, political imperatives and global responsibilities.
16	The Montreal Protocol on substances that deplete the Ozone layer, Montreal – Ratified 1987	Protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer.
17	Bamako Convention on the Ban of the Import into Africa and the Control of the Transboundary Movement of Hazardous Waste within Africa – Ratified 1990	Protect human health of the Africa population and the environment against the adverse effects which may result from the generation of hazardous wastes.
18	Amended Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean (WIO) Region – Ratified 1996	Protect, manage and develop their coastal and marine environment sustainability. Inter-governmental discussions that lead to better understanding of regional environmental problems and the strategies needed to address them; and promote sharing of information and experiences in the Western Indian Ocean region and with the rest of the world.
19	Convention on Sustainable Management of Lake Tanganyika – Ratified 2004	To ensure the protection and conservation of the biological diversity and the sustainable use of the natural resources of Lake Tanganyika and its environment by the Contracting States on the basis of integrated and co-operative management.

CHAPTER NINE

ENVIRONMENTAL HEALTH AND SANITATION

9.0 Introduction

Environmental factors are a significant root cause of the disease burden in Tanzania. Some of the most mentioned issues include unsafe water, poor sanitation and hygiene that are causes of diarrhoeal diseases. The relationship between human health and the environment is a recognized fact. Analysis of the epidemiology of most communicable diseases such as tuberculosis, bilharzias and cholera; or vector-borne diseases such as malaria reveals that they are usually associated with changes occurring to environmental conditions. Hence, continued mismanagement of the earth's natural resources can only lead to greater land degradation and human suffering.

Evidence based on statistics from routine administrative records, sample surveys and population censuses reveal that the majority of diseases found in developing countries, including Tanzania, are caused by poor environmental health conditions. Diseases such as malaria, diarrhoea, tuberculosis, worm infections and skin diseases which rank high among the top ten diseases are directly linked to poor environmental health. The main objective of environmental health is to contribute to the attainment of significant reduction in morbidity and mortality of environmental health related diseases.

The Annual Health Statistics Abstract (2008/2009) indicates that malaria, acute respiratory infections, pneumonia and diarrhoeal diseases are the major causes of the outpatient and inpatient attendances for both populations under 5 years of age and those aged 5 years and above. These diseases are mainly due to poor environmental health, hygiene and sanitation.

The magnitude and severity of the diseases differ across regions. Furthermore, over 70 per cent of the burden of diseases in Tanzania is caused by communicable diseases. HIV, malaria, tuberculosis, diarrhoea and respiratory infections are significant contributors to the huge burden caused by communicable cases, while 23 per cent is contributed by non communicable disease and 7 per cent caused by injuries (WHO 2010). This chapter highlights and discusses in detail the major environmental health issues and the country status. It intends to show the relationship between the environment and human health.

9.1 Communicable Disease Outbreaks

Communicable diseases and non-communicable diseases are on the increase. Disease epidemics, communicable diseases and poor living environment have for many years affected the performance of the income generating population and consequently led to poor quality of life and poverty at large. There is thus a need to improve the environmental conditions since there are health benefits to be obtained for instance, improving the water supply leads to the reduction of biological organisms, chemicals and physical contamination from faecal matter. These are best controlled through improved sanitation, hygiene promotion and health education at community level.

The burden of diseases in Tanzania could be attributed to communicable diseases, Malaria, cholera, pneumonia, rabies, dysentery, typhoid, measles, HIV/AIDS, and tuberculosis are among the most infectious diseases in Tanzania. These diseases have been the main preoccupation of health sector planning and implementation in the country. As a result, resource allocation in the health sector is skewed towards infectious diseases with a lot of effort being made in controlling and combating these diseases by using various approaches such as provision of health education and health advocacy among the community, strengthening vaccination, health promotion campaigns, educating health personnel, strengthening diagnosis and curative services and follow-up of patients.

Environmentally related diseases may be classified into four categories namely:

- Air-borne such as tuberculosis and meningitis;
- Water-borne diseases like diarrhoea and bilharzias/schistosomiasis;
- Vector-borne diseases such as malaria.
- Food materials can be a route of transmission of diseases such as cholera, typhoid, dysentery, salmonellosis and helminthiasis.

Other diseases and health problems may be transmitted by consumption of unsafe food resulting in increase of the prevalence of food borne diseases including food poisoning, chemical poisoning and mycotoxin in various foods and anthrax among others.

The association of some important diseases by the regions in Tanzania Mainland is presented in the Table 9.1. The table shows that pneumonia in under-fives is the cause of most cases of hospital attendance and the leading cause of mortality in most regions in Tanzania Mainland.

Table 9.1: Infectious Diseases Report, Tanzania Mainland, 2012

Regions	Cholera		Pneumonia<5		Dysentery		Diarrhoea<5		Typhoid	Measles	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Cases	Deaths
Dodoma	0	0	39,784	171	7,232	2	39,852	26	2,010	209	0
Arusha	0	0	38,659	36	2,828	0	11,032	1	11,703	631	11
K' manjaro	36	0	29,847	14	551	0	4529	1	271	56	0
Tanga	84	2	47,133	63	2,765	13	20,922	32	1,260	89	0
Morogoro	18	1	65,588	26	10,366	12	38,159	13	4,971	381	0
Pwani	30	2	28,632	19	3,872	2	12,439	5	209	315	1
Dar es`Salaam	0	0	14,281	186	3,610	0	13,450	70	1,364	1509	17
Lindi	485	15	17,259	10	4,509	1	19,230	6	2,778	38	2
Mtwara	3	0	19,557	9	2,867	0	12,370	8	79	82	0
Ruvuma	0	0	26,746	139	1,928	11	18,402	67	102	182	2
Iringa	0	0	30,741	66	5,895	4	22,543	18	2,591	197	1
Mbeya	84	1	41,480	65	5,053	3	58,439	29	1,804	196	0
Singida	0	0	6,243	0	1,100	14	6,262	22	583	0	0
Tabora	1	0	38,107	139	1,220	2	35,054	68	746	367	7
Rukwa	61	1	15,026	59	3,224	17	33,849	67	5,158	119	2
Kigoma	108	0	9,759	20	2,646	0	14,079	0	102	26	0
Shinyanga	239	10	76,570	42	4,076	0	51,443	14	3,077	93	2
Kagera	0	0	26,686	65	1,594	1	58,754	8	547	130	1
Mwanza	0	0	3,028	10	1,030	0	11,362	9	324	94	0
Mara	0	0	24,382	26	3,243	1	28,243	8	1,025	42	0
Manyara	0	0	54,615	92	8,039	143	18,896	16	787	35	0
Total	1149	32	654,123	1257	77,648	226	529,309	488	41,491	4791	46
CFR %		2.79		0.19		0.29		0.09			0.96

CFR - Case Fatality Rate

Source: Ministry of Health and Social Welfare

Table 9.2 shows the prevalence of environmentally related diseases and health problems which are among the leading causes of outpatient diagnoses, as compiled by the Ministry of Health and Social Welfare in Tanzania Mainland. From the table it can be concluded that, of the three most prevalent diseases, malaria came first followed by acute respiratory infections and diarrhoeal diseases. Other health problems are shown in tables 9.2 and 9.3.

Table 9.2: Environmentally Related Health Facility Attendances and OPD Diagnoses for Diseases of All Ages, Tanzania Mainland, 2010

Region/ Diagnosis	Chole ra	Dysent ery	Diarrho ea Diseases	Menin gitis	Typh oid Disea ses	Malaria	Schisto somi as is	Tuber culosis	ARI	Intestin al Worms	Poiso ning
Dodoma	0	6,568	86,440	88	163	555,754	1,533	39	240,543	50,154	420
Arusha	0	782	99,749	0	336	395,946	94	2,311	282,028	52,835	469
Kilimanjaro	0	0	61,075	88	41	368,843	738	55	289,757	91,199	206
Tanga	172	2,168	101,197	86	1,029	885,667	723	102	372,150	79,338	5,726
Morogoro	0	0	90,174	0	0	797,465	1,681	99	273,773	90,443	4,223
Pwani	0	0	53,617	0	0	443,268	1,055	96	199,160	42,718	85
Dar es Salaam	0	0	273,552	0	0	1,904,102	626	407	598,648	181,125	1,526
Lindi	0	2	41,631	0	24	277,827	1,188	56	84,717	18,680	157
Mtwara	0	1,374	35,024	4	272	299,453	753	168	132,922	18,751	520
Ruvuma	0	418	60,132	58	20	579,757	1,742	66	192,523	36,526	371
Iringa	16	5,574	87,220	2	272	219,132	135	79	331,974	55,756	364
Mbeya	6	2,112	178,171	4	107	812,971	1,772	72	584,018	55,297	947
Singida	4	1,282	65,919	68	296	451,728	319	1,125	176,552	27,394	140
Tabora	0	844	69,279	160	439	525,590	214	27	183,754	50,966	121
Rukwa	100	1,696	251,309	42	878	372,119	341	12	187,531	30,262	70
Kigoma	282	1,000	95,325	68	136	513,695	1,706	54	207,914	99,317	335
Shinyanga	1,538	0	152,861	0	15	992,648	937	69	418,791	77,767	229
Kagera:	0	2,086	71,824	144	14	434,603	79	200	255,102	90,431	547
Mwanza	0	1,922	297,144	518	2,297	1,111,625	6,148	207	325,658	151,111	395
Mara	0	1,914	201,744	518	1,886	781,487	1,891	53	179,837	146,939	521
Manyara	4	2,992	55,842	36	200	203,834	21	187	156,175	59,971	118

Source: Ministry of Health and Social Welfare; Annual Health Statistical Tables and Figure, 2011

A similar trend of environmentally related diseases is revealed in Table 9.3 which is based on the 2007 and 2011/12 Household Budget Survey. It may be observed from the table that in 2011/12, fever had the largest share of diagnoses for children under 15 years at 43.3 percent followed by malaria at 37.2 percent. Likewise, in 2011/12 among persons aged 15 years and above, fever had the highest share of 35.9 percent followed by malaria (29.0 percent) and chronic illnesses (7.1 percent).

Table 9.3: Proportion (percent) of Persons Reporting Environmentally Related Diseases by Age Group and Sex, Tanzania Mainland, 2007 and 2011/12

Age Group and Illness or Injury	Male		Female		Total	
	2007	2011/12	2007	2011/12	2007	2011/12
Children (under 15 years):						
Fever/Malaria	76.7	-	77.5	-	77.1	-
Fever	49.7	44.2	50.8	42.5	53.0	43.3
Malaria	39.7	37.6	39.2	36.7	39.5	37.2
Diarrhoea	12.4	9.3	12.0	10.7	12.2	10.0
Accident	2.8	2.3	2.2	1.4	2.5	1.8
Dental	1.2	1.3	0.9	1.1	1.0	1.2
Skin condition	4.2	2.8	4.1	3.7	4.1	3.3
Eye	2.4	2.8	2.6	2.3	2.5	2.6
Ear, nose or throat	6.8	4.1	7.7	6.6	7.3	5.4
Chronic illnesses	2.8	1.7	2.1	0.7	2.4	1.2
Other	8.0	6.4	8.5	6.2	8.3	6.3
Asthma	-	1.1	-	1.9	-	1.5
Headache	-	0.4	-	0.3	-	0.4
Coughing	-	1.0	-	1.8	-	1.5
Influenza	-	1.4	-	0.5	-	0.9
Intestinal	-	0.0	-	0.0	-	0.0
Stomach ache	-	1.2	-	1.8	-	1.5
Not stated	-	4.5	-	5.2	-	4.8
% who reported multiple complaints	16.4	-	16.5	-	16.5	-
Adults (15+ years):						
Fever/Malaria	61.0	-	63.1	-	62.2	-
Fever	39.5	35.5	41.5	36.2	40.6	35.9
Malaria	30.2	28.9	31.5	29.0	31.0	29.0
Diarrhoea	7.3	6.0	7.0	6.1	7.1	6.0
Accident	7.9	6.9	3.6	2.4	5.4	4.2
Dental	3.5	3.7	4.1	3.7	3.8	3.7
Skin condition	2.6	2.1	2.1	1.4	2.3	1.7
Eye	4.6	5.5	4.7	5.4	4.6	5.4
Ear, nose or throat	6.0	3.7	6.5	3.2	6.3	3.4
Chronic illnesses	13.2	5.7	13.5	8.1	13.4	7.1
Other	15.1	14.0	17.8	13.9	16.7	13.9
Asthma	-	2.6	-	2.4	-	2.5
Headache	-	0.8	-	1.3	-	1.1
Coughing	-	0.3	-	0.6	-	0.5
Influenza	-	0.3	-	0.4	-	0.3
Intestinal	-	0.3	-	0.4	-	0.4
Stomach ache	-	2.3	-	3.7	-	3.2
Not stated	-	6.9	-	8.2	-	7.7
% who reported multiple complaints	17.9	-	19.6	-	18.9	-

Source: Household Budget Survey 2011/12

9.2 Water Supply, Sanitation and Housing Conditions

9.2.1 Water Supply

The source of drinking water is important for human life; hence it is necessary for such sources to be free of waterborne diseases such as diarrhoeal diseases, cholera, and dysentery among others. The main uses of water for households include drinking, cooking, washing and general cleaning. Availability and accessibility of water in terms of quantity and quality is an important indicator of environmental health and sanitation. Sources of drinking water in Tanzania include tap water, rivers, wells and lakes. Table 9.4 indicates sources of drinking water as revealed by the data collected through the 2012 Population and Housing Census. The table reveals that most of the piped water are found in urban areas (22.2 percent) while most of unprotected dug well wee in rural areas (25.2 percent).

Table 9.4: Percentage Distribution of Households by Location and Main Source of Drinking Water, Tanzania Mainland, 2012

Source Type	Rural	Urban	Tanzania Mainland
Piped Water into Dwelling	5.7	22.2	11.1
Piped Water to yard/plot	3.1	16.9	7.7
Public Tap/stand pipe	16.1	18.8	17.0
Tube well/bore hale	7.0	10.0	8.0
Protected dug well	7.0	8.9	7.6
Unprotected dug well	25.2	7.2	19.3
Protected Spring	2.8	1.2	2.2
Unprotected Spring	14.3	2.4	10.4
Rain water collection	1.5	0.7	1.2
Bottled water	0.1	0.6	0.3
Cart with small tank/drum	1.5	4.9	2.6
Tanker truck	0.4	3.4	1.4
Surface water (river, dam, lake)	15.3	2.9	11.2
Total	100.0	100.0	100.0

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB

A supplementary indicator of accessibility of water is the distance and time taken to fetch water from the source. Information on those two measures was obtained from the Household Budget Survey. Table 9.5 gives the distance to the source of drinking water. The table shows the mean distance to drinking water in the dry and rainy season. Constraints of access to safe drinking water in the form of long travel distances continue to affect a large number of rural households.

Table 9.5: Percentage Distribution of Households by Distance from Home to Water Source, Season and Area, Tanzania Mainland, 2011/12

Distance	Dar es Salaam		Other Urban Areas		Rural Areas		Tanzania Mainland	
	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry
At home	15.8	6.3	25.6	8.3	16.9	2.5	18.1	3.8
Less than 500m	72.8	80.0	53.2	58.2	42.3	37.8	47.0	45.2
500m – 1km	9.8	11.4	15.9	21.8	20.9	24.0	19.0	22.4
Greater than 1 km	1.5	2.3	5.3	11.7	19.9	35.6	15.8	28.6
1-2 km	1.4	2.0	3.9	8.6	13.5	20.4	10.8	16.7
2-5 km	0.1	0.3	1.3	2.8	5.7	11.5	4.5	9.1
5-8 km	0.0	0.0	0.0	0.2	0.6	3.2	0.5	2.4
Greater than 8km	0.0	0.0	0.0	0.1	0.1	0.5	0.0	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Household Budget Survey 2011/12

9.2.2 Sanitation and Hygiene

Excreta management is an important task for reducing transmission of faecal oral route diseases. Any mismanagement may lead to spread of communicable diseases such as cholera, diarrhea and bacillary dysentery. Estimates show that 60 to 80 percent of the diseases requiring hospital attendance in Tanzania are caused by water and sanitation related aspects (Health Management Information System, 2007).

The management of human excreta is a big challenge in our communities. Currently, about five million people in Tanzania do not own any kind of sanitation facility while 90 percent of the total population have at least any form of sanitation option (MoHSW, 2012), most of which are rated as unimproved.

In Tanzania only 23 percent and 27 percent of the households have access to improved sanitation in rural and urban areas respectively. Moreover, some societies still practice open defecation (WHO/UNICEF, 2010). Efforts are underway to cut down number of people without access to improved sanitation in Tanzania. For example, MKUKUTA II strives to achieve 35 percent and 45 percent access to improved sanitation in rural and urban areas respectively by 2015.

Recent studies conducted by the Ministry of Health and Social Welfare have shown that only 3.3 percent of the households have hand washing points. The situation is even worse in schools where the majority do not have any facilities for hand washing after visiting latrines.

Table 9.6: Sewerage System, Tanzania, 2012

Name of the City/Municipality	Length in km	Percentage Coverage	Existing Wastewater Treatment System
Arusha	43	16.7	Waste Stabilization pond
Moshi	45.3	45	Waste Stabilization pond and
Tanga	33	16	Sea outfall
Morogoro	31	-	Waste Stabilization pond
Dar es Salaam	188	7	Waste Stabilization pond
Lindi	0	0	None
Mtwara	0	0	None
Songea	36.4	12	None
Iringa	27.5	13	None
Mbeya	47	10	Waste Stabilization pond
Singida	0	0	None
Tabora	18.9	8.2	None
Sumbawanga	0	0	None
Kigoma	0	0	None
Shinyanga	0	0	None
Kagera	0	0	None
Mwanza	28.2	9	Waste Stabilization pond
Musoma	0	0	None
Babati	0	0	None

Source: State of the Environment Report, URT, 2012

9.2.2.1 Toilet Facility

Another important aspect of environmental sanitation at household level is use of toilet facilities to dispose of human waste. Careless disposal of human waste may result into transmission of disease such as diarrhoea, cholera, typhoid, dysentery and worms. The 2012 Population and Housing Census results show that about 30.9 percent of households used pit latrines without washable and 7.5 percent of the households did not have toilets. In rural areas, 10.8 percent of the households did not have toilets (Table 9.7).

Table 9.7: Percentage Distribution of Households by Type of Toilet Facility, Tanzania Mainland, 2012

Main Type of Toilet	Rural	Urban	Tanzania Mainland
Flush/Pour to piped sewer system	0.2	4.4	1.6
Flush/Pour to Septic Tank	0.5	10.8	3.9
Flush/Pour to Covered Pit	2.0	16.6	6.8
Flush/Pour to somewhere else	0.4	2.9	1.2
Ventilated Improved Pit Latrine	0.7	2.9	1.4
Pit latrine with washable slab with lid	3.9	16.0	7.9
Pit latrine with washable slab without lid	6.4	20.4	11.0
Pit latrine without washable/soil slab	38.9	14.5	30.9
Pit latrine without slab/Open pit	35.9	10.5	27.5
Composting/Ecoson Latrine	0.2	0.1	0.2
Bucket	0.0	0.0	0.0
No Facility/bush/field/beach	10.8	0.9	7.5
Total	100	100	100

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB

9.2.2.2 Disposal of Household Garbage

Another indicator of environmental sanitation is the disposal of wastes/garbage resulting from domestic activities, especially in urban areas where most land is occupied by dwellings and commercial premises. The garbage include food remains and by products, waste packaging materials, worn out clothes and empty bottles. Uncontrolled disposal of such waste may cause environmental related health hazards such as cholera, malaria, respiratory diseases, skin diseases and physical injuries from sharp objects and chemicals. Information on garbage disposal was collected in the 2012 Population and Housing Census. Table 9.8 gives the distribution of households by means of garbage disposal.

Table 9.8: Percentage Distribution of Households by Type of Refuse Disposal, Tanzania Mainland, 2012

Main Means of Waste Disposal	Rural	Urban	Tanzania Mainland
Regularly collected	0.1	15.6	5.2
Irregularly collected	0.2	9.1	3.1
Burnt	22.9	22.3	22.7
Roadside dumping	1.1	1.6	1.2
Burying/Pit	38.0	35.0	37.0
Other Dumping	37.8	16.4	30.7
Total	100	100	100

Source: National Bureau of Statistics, Basic Demographic and Socio-Economic Profile Volume IIIB.

Table 9.8 shows that more than one-third of households in rural and urban areas disposed their garbage through burying. In Tanzania Mainland the proportion of households that used burying/pit was 37.0 percent. Most of the remaining solid waste was either disposed through the regularly and irregularly collected; burnt and roadside dumping. If the rubbish bins are not emptied and transported to the official dumping places on a daily basis, then most of the garbage is left within the vicinity of human settlements, thus increasing the chance of causing health hazards to the population, especially children and women who spend most of the time at home.

9.2.3 Housing Conditions

Housing conditions is another dimension of environmental health and sanitation. Construction materials used and the size of the living unit have health implications for the inhabitants. In surveys conducted by National Bureau of Statistics (NBS), the indicators are derived from questions on floor, wall and roofing materials. The following table shows the distribution of households by construction materials of the housing unit (Table 9.9). The information was collected during the 2000/01, 2007 and 2011/12 Household Budget Surveys.

Table 9.9: 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 Areas			Rural Areas			Tanzania Mainland		
	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12
House floor												
Non-Modern	7.6	9.7	3.5	38.8	38	31.6	87.5	84.4	80.1	74.8	68.2	60.6
Earth	6.7	8.7	3.2	38.3	37.1	30.8	86.6	83.1	77.3	74	67	58.5
Other	0.9	1	0.3	0.5	0.9	0.8	0.9	1.3	2.8	0.8	1.2	2.1
Modern	92.4	90.4	96.5	61.1	61.9	68.4	12.5	15.6	20	25.2	31.8	39.4
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
Total	100	100	100	100	100	100	100	100	100	100	100	100
House walls												
Non-Modern Walls	11.5	9.9	2.9	61.7	49.4	32.1	83.3	78.2	66.9	75.3	66.0	51.8
Poles, branches, grass Mud and poles or stones	0.9	1.5	0.0	5.3	4.6	0.2	19.3	16.9	1.0	16	13	0.7
Mud only	5.2	4.7	2.5	13.1	10.9	11.9	21.8	22	31.1	19.4	18.2	23.6
Mud bricks	2.2	1.9	-	12.1	10.3	-	18.1	12	-	16.1	10.7	-
Other	3.2	1.3	0.3	30.8	22.6	19	23.5	26.4	31	23.3	23.2	24.7
Modern Walls	88.5	89.9	97.1	38.3	50.6	67.8	16.7	21.9	33	24.7	34.1	48.2
Baked or burnt bricks	0	0.5	0.1	0.4	1	1	0.6	0.9	3.8	0.5	0.9	2.8
Concrete, cement, stone	1.3	1.6	0.2	15.9	29.9	42	13.7	18.8	28.1	13.2	19.3	27.3
Total	100	100	100	100	100	100	100	100	100	100.0	100.1	100.0
House Roof												
Non-Modern Roof	1.8	2.8	0.8	16.3	15.4	9.5	68.7	58	45.2	56.4	44.4	32.3
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 and 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
Other	0	0.3	0.0	0.5	0.5	0.3	0.5	0.6	0.9	0.5	0.5	0.6
Modern Roof	98.2	97.1	99.2	83.7	84.6	90.5	31.2	42	54.8	43.6	55.6	67.6
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
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Household Budget Survey, 2011/12

CHAPTER TEN

POPULATION GROWTH AND ENVIRONMENT

10.0 Introduction

The population of many developing countries has been growing at rapid rates often exceeding 2.0 percent per year. According to the 2012 Population and Housing Census, the annual rate of population growth in Tanzania Mainland was 2.7 percent per year. In most cases, the increase in population has occurred at the expense of resource conservation and their effective utilization. As a result, rapid deterioration of the environment is evident in many areas in the form of degradation, pollution and soil erosion. Both population growth and environmental degradation have become global problems. The link between population growth, distribution and resource utilization is well documented. Human beings have been identified to be major agents of resource depletion and the resultant environmental degradation. Their actions have degraded the land through misuse and overuse, as they seek essential requirements for their livelihood. It is therefore evident that the continuous rapid population growth leads to further environmental problems, the following are pictures on environmental degradation due to deforestation.

Environmental Degradation due to Deforestation



Water Pollution Caused by Human Activities



Source: National Bureau of Statistics, 2004

Oceans Final Destination for Human Wastes

POPULATION INCREASE

NO SWIMMING

Oceans - the final destination for our wastes

but for how long?

ENVIRONMENTAL DEGRADATION

World marine resource scientists warned at the start of 2001 that “microbiological contamination of the sea has precipitated a health crisis with massive global implications

It is evident from pictures on environmental degradation due to deforestation that with increase of population growth of 2.7 percent in Tanzania Mainland, the population will exert pressure to the available land for agriculture and other use for development. The 2012 Population and Housing Census reported that over 90 percent of the rural households use charcoal and fire wood as the main source of energy for cooking. Population increase and disposal of more solid and liquid waste have caused oceans to become the final destination for urban sewage and solid waste and other pollution from farm and households. The oceans' capacity to absorb waste is not infinite and there are significant consequences which have already been reported as a result of human activities which that take place on land. These activities have impacts that can affect human welfare.

10.1 Potential Implication of Population Change

The implication of population growth to environment in Tanzania is pronounced in Goal 3 of MKUKUTA Cluster 2, which is improvement of Quality of Life and Social Well Being. The goal is to have increased access to clean, affordable and safe water, sanitation, decent shelter and a safe and sustainable environment and thereby, reduced vulnerability from environment risks.

As stipulated in MKUKUTA Cluster 2, it will take a long time for Tanzania to control environmental degradation of the rural and urban population with increase of population growth rate of 2.9 percent per annum. There are many implications that emanate from the increase of the population growth rate. These include;

- Failure of development and environmental goals
- Additional resource demands and waste/pollution
- Biodiversity loss and environmental degradation
- Increasing demand for food, water, land, fuel wood from the natural resource pool.
- Increased pollution due to high consumption
- Intensified resource use conflicts
- Constrains on budgetary allocations (education, health, water, transport, housing, etc.).

10.2 Trends in Population Distribution and Percent Change from 1967, 1978, 1988, 2002 and 2012 Censuses

According to the 1967 Population and Housing Census the population of Tanzania was 12.3 million compared to 34.4 million as it was observed in 2002 census. From the period between 1967 and 2002 the population of Tanzania has almost tripled. It is likely that, Tanzania will continue to experience high rates of population growth at least till the end of the present century. The total population of Tanzania reached 44.9 million by the year 2012. While a slight decline in fertility rates is envisaged in the projections, this is likely to be offset by a reduction in mortality rates since

the rate of growth is expected to remain constant. The rapid growth rate of the population is mainly due to the high fertility rate and moderately declining mortality.

The rapid increase in population growth exerts pressure on available land suitable for agriculture, increase unemployment, reduces per capita income, increases rural-urban migration, affects the quality of education and reduces the country's ability to invest on development projects and create employment. To address the issue of rapid population growth there is an urgent need of promoting family planning policies to lower levels of fertility by increasing contraceptive use and woman's education. Likewise, all policies that govern environmental conservation in Tanzania should be implemented at all levels.

APPENDICES

Appendix 1: Area, Population, Population Density and Growth by Region and District, Tanzania Mainland, 2012

Region	District	Area (km ²)	2012 Population	Population Density (person/km ²)	Population Growth (%)
Dodoma	Bahi	5,612	221,645	39.5	2.1
	Chamwino	9,219	330,543	35.9	
	Chemba	7,225	235,711	32.6	
	Dodoma Urban	2,580	410,956	159.3	
	Kondoa	13,342	269,704	20.2	
	Kongwa	3,852	309,973	80.5	
	Mpwapwa	8,043	305,056	37.9	
Arusha	Arusha	1,461	323,198	221.1	2.7
	Arusha Municipality	128	416,442	3,253.5	
	Karatu	3,963	230,166	58.1	
	Longido	7,930	123,153	15.5	
	Meru	1,387	268,144	193.3	
	Monduli	15,534	158,929	10.2	
	Ngorongoro	14,498	174,278	12.0	
Kilimanjaro	Hai	954	210,533	220.7	1.8
	Moshi Rural	1,398	466,737	333.9	
	Moshi Urban	170	184,292	1,084.1	
	Mwanga	2,182	131,442	60.2	
	Rombo	1,489	260,963	175.3	
	Same	5,742	269,807	47.0	
	Siha	1,316	116,313	88.4	
Tanga	Handeni	7,497	276,646	36.9	2.2
	Kilindi	5,626	236,833	42.1	
	Korogwe	2,892	68,308	23.6	
	Lushoto	3,452	492,441	142.7	
	Mkinga	2,677	118,065	44.1	
	Pangani	1,425	54,025	37.9	
	Tanga	209	273,332	1,307.8	
	Muheza	1,530	204,461	133.7	
	Korogwe Urban	864	242,038	280.1	
Morogoro	Gairo	2,478	193,011	77.9	2.4
	Kilombero	13,577	407,880	30.0	
	Kilosa	11,767	438,175	37.2	
	Morogoro	12,031	286,248	23.8	
	Morogoro Urban	534	315,866	591.2	
	Mvomero	6,555	312,109	47.6	
	Ulanga	23,682	265,203	11.2	

Appendix 1 (Ctd): Area, Population, Population Density and Growth by Region and District, Tanzania Mainland, 2012

Region	District	Area (km ²)	2012 Population	Population Density (person/km ²)	Population Growth (%)
Pwani	Kibaha	1,348	70,209	52.1	2.2
	Kisarawe	3,438	101,598	29.6	
	Mafia	518	46,438	89.6	
	Mkuranga	3,561	222,921	62.6	
	Rufiji	13,369	217,274	16.3	
	Bagamoyo	9,847	311,740	31.7	
	Kibaha Urban	488	128,488	263.5	
Dar-es-salaam	Ilala	208	1,220,611	5,868.3	5.6
	Kinondoni	501	1,775,049	3,543.0	
	Temeke	684	1,368,881	2,001.3	
Lindi	Kilwa	13,484	190,744	14.1	0.9
	Lindi Rural	6,184	194,143	31.4	
	Lindi Urban	791	78,841	99.7	
	Liwale	36,641	91,380	2.5	
	Nachingwea	6,120	178,464	29.2	
	Ruangwa	2,440	131,080	53.7	
Mtwara	Masasi	4,664	247,993	53.2	1.2
	Mtwara Rural	3,557	228,003	64.1	
	Mtwara urban	195	108,299	554.5	
	Nanyumbu	4,938	150,857	30.5	
	Newala	1,728	205,492	118.9	
	Tandahimba	2,155	227,514	105.6	
	Masasi Township	4,277	102,696	24.0	
Ruvuma	Mbinga	5,128	353,683	69.0	2.1
	Namtumbo	21,523	201,639	9.4	
	Nyasa	3,396	146,160	43.0	
	Songea Rural	14,531	173,821	12.0	
	Songea Urban	421	203,309	482.9	
	Tunduru	18,778	298,279	15.9	
Iringa	Iringa Rural	18,842	254,032	13.5	1.1
	Iringa Urban	147	151,345	1,030.4	
	Kilolo	8,998	218,130	24.2	
	Mufindi	6,669	265,829	39.9	
	Mafinga Town	464	51,902	112.0	
Mbeya	Chunya	27,065	290,478	10.7	2.7
	Ileje	1,935	124,451	64.3	
	Kyela	791	221,490	280.0	
	Mbarali	15,000	300,517	20.0	
	Mbeya Rural	2,810	305,319	108.6	
	Mbeya Urban	709	385,279	543.4	
	Mbozi	3,788	446,339	117.8	
	Momba	5,308	196,818	37.1	
	Rungwe	2,454	339,157	138.2	

Appendix 1 (Ctd): Area, Population, Population Density and Growth by Region and District, Tanzania Mainland, 2012

Region	District	Area (km ²)	2012 Population	Population Density (person/km ²)	Population Growth (%)
Singida	Ikungi	8,915	272,959	30.6	2.3
	Iramba	4,325	236,282	54.6	
	Manyoni	28,620	296,763	10.4	
	Mkalama	3,400	188,733	55.5	
	Singida	2,582	225,521	87.3	
	Singida Urban	638	150,379	235.7	
Tabora	Igunga	6,788	399,727	58.9	2.9
	Kaliua	14,909	393,358	26.4	
	Nzega	6,961	502,252	72.2	
	Sikonge	26,065	179,883	6.9	
	Tabora Urban	1,971	226,999	115.2	
	Urambo	6,350	192,781	30.4	
	Uyui	13,417	396,623	29.6	
Rukwa	Kalambo	6,011	207,700	34.6	3.2
	Nkasi	9,375	281,200	30.0	
	Sumbawanga Rural	4,758	305,846	64.3	
	Sumbawanga Urban	1,494	209,793	140.4	
Kigoma	Buhigwe	2,648	254,342	96.0	2.4
	Kakonko	2,323	167,555	72.1	
	Kasulu	9,320	425,794	45.7	
	Kibondo	16,055	261,331	16.3	
	Kigoma	1,219	211,566	173.5	
	Kigoma Urban	251	215,458	859.7	
	Uvinza	12,646	383,640	30.3	
Shinyanga	Kahama	8,731	523,802	60.0	2.1
	Kishapu	4,311	272,990	63.3	
	Shinyanga Rural	3,736	334,417	89.5	
	Shinyanga Urban	554	161,391	291.5	
	Kahama Township Authority	880	242,208	275.2	
Kagera	Biharamulo	9,477	323,486	34.1	3.2
	Bukoba Rural	2,129	289,697	136.1	
	Bukoba Urban	291	128,796	442.6	
	Karagwe	4,923	332,020	67.4	
	Kyerwa	2,070	321,026	155.1	
	Misenye	2,884	202,632	70.3	
	Muleba	3,557	540,310	151.9	
	Ngara	3,497	320,056	91.5	
Mwanza	Ilemela	601	343,001	570.7	3.0
	Kwimba	3,223	406,509	126.1	
	Magu	1,625	299,759	184.5	
	Missungwi	2,323	351,607	151.4	
	Nyamagana	385	363,452	944.0	
	Sengerema	3,028	663,034	219.0	
	Ukerewe	640	345,147	539.3	

Appendix 1 (Ctd): Area, Population, Population Density and Growth by Region and District, Tanzania Mainland, 2012

Region	District	Area (km ²)	2012 Population	Population Density (person/km ²)	Population Growth (%)
Mara	Butiama	2,365	241,732	102.2	2.5
	Bunda	2,875	335,061	116.6	
	Musoma Rural	1,434	178,356	124.4	
	Musoma Urban	75	134,327	1,779.7	
	Rorya	1,532	265,241	173.2	
	Serengeti	10,942	249,420	22.8	
	Tarime	1,938	339,693	175.3	
Manyara	Babati	4,509	312,392	69.3	3.2
	Hanang	2,681	275,990	102.9	
	Kiteto	12,276	244,669	19.9	
	Mbulu	3,054	320,279	104.9	
	Simanjiro	20,204	178,693	8.8	
	Babati Urban	1,798	93,108	51.8	
Njombe	Ludewa	6,325	133,218	21.1	0.8
	Makete	4,344	97,266	22.4	
	Njombe Rural	4,688	85,747	18.3	
	Njombe Urban	3,863	130,223	33.7	
	Wanging'ombe	3,651	161,816	44.3	
	Makambako Town	2,127	93,827	44.1	
Katavi	Mlele	25,639	282,568	11.0	3.2
	Mpanda Urban	701	102,900	146.8	
	Mpanda Rural	25,142	179,136	7.1	
Simiyu	Bariadi	5,546	422,916	76.3	1.8
	Busega	1,444	203,597	141.0	
	Itilima	4,709	313,900	66.7	
	Maswa	3,941	344,125	87.3	
	Meatu	7,024	299,619	42.7	
Geita	Bukombe	7,802	224,542	28.8	2.6
	Chato	3,242	365,127	112.6	
	Geita	4,743	807,619	170.3	
	Mbogwe	2,206	193,922	87.9	
	Nyang'hwale	1,556	148,320	95.3	

Appendix 2: Number of Establishments in the Industrial Sector by Activity and by Region – 2010

ISIC	Industrial Activity	D' Salaam	Arusha	Mwanza	Singida	Tanga	Kagera	Kilimanjaro	Pwani	Dodoma	Iringa
06	Extraction of crude petroleum and natural gas	1	0	0	0	0	0	0	0	0	0
07	Mining of metal ores	0	0	0	0	0	0	0	0	0	0
08	Other mining and quarrying	0	0	0	0	0	0	0	0	0	0
09	Mining support service activities	0	0	1	0	0	0	0	0	0	0
10	Manufacture of food products	106	20	10	13	5	5	3	0	7	4
11	Manufacture of beverages	12	8	3	0	1	0	2	0	3	0
12	Manufacture of tobacco products	1	0	0	0	0	0	0	0	0	0
13	Manufacture of textiles	8	2	0	0	1	0	0	0	0	0
14	Manufacture of wearing apparel	1	0	0	0	0	0	0	0	0	0
15	Manufacture of leather and related products	9	0	3	0	0	0	0	0	0	0
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	16	1	2	0	0	0	0	0	0	0
17	Manufacture of paper and paper products	5	0	0	0	0	0	2	0	0	1
18	Printing and reproduction of recorded media	32	3	1	0	2	0	1	0	0	0
20	Manufacture of chemicals and chemical products	26	4	1	0	0	0	0	0	0	0
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	4	1	0	0	0	0	0	0	0	0
22	Manufacture of rubber and plastics products	34	1	0	0	0	0	0	0	0	0
23	Manufacture of other non-metallic mineral products	45	4	0	0	2	0	1	1	0	0
24	Manufacture of basic metals	8	1	1	0	0	0	0	0	0	0
25	Manufacture of fabricated metal products, except machinery and equipment	20	9	1	0	0	0	0	0	0	0
26	Manufacture of computer, electronic and optical products	0	1	0	0	0	0	0	0	0	0

Appendix 2 (Ctd): Number of Establishments in the Industrial Sector by Activity and by Region – 2010

ISIC	Industrial Activity	D' Salaam	Arusha	Mwanza	Singida	Tanga	Kagera	Kilimanjaro	Pwani	Dodoma	Iringa
27	Manufacture of electrical equipment	5	0	0	0	0	0	0	0	0	0
28	Manufacture of machinery and equipment n.e.c.	4	0	0	0	0	0	2	0	0	0
29	Manufacture of motor vehicles, trailers and semi-trailers	7	1	0	0	0	0	0	0	0	0
30	Manufacture of other transport equipment	1	0	1	0	0	0	0	0	0	0
31	Manufacture of furniture	72	0	2	3	1	2	3	0	0	0
32	Other manufacturing	83	7	6	0	5	0	1	1	1	1
33	Repair and installation of machinery and equipment	4	0	1	0	1	0	0	0	0	0
35	Electricity, gas, steam and air conditioning supply	2	3	1	1	1	1	1	1	1	1
36	Water collection, treatment and supply	1	0	0	0	0	1	0	0	1	2
	Total Industry	507	66	34	17	19	9	16	3	13	9

Appendix 2 (Ctd): Number of Establishments in the Industrial Sector by Activity and by Region – 2010

ISI	Industrial Activity	Kigoma	Lindi	Manyara	Mara	Mbeya	Morogoro	Mtwara	Rukwa	Ruvuma	Shinyanga	Tabora
06	Extraction of crude petroleum and natural gas	0	0	0	0	0	0	0	0	0	0	0
07	Mining of metal ores	0	0	1	0	0	0	0	0	0	0	0
08	Other mining and quarrying	1	0	1	0	0	0	0	0	0	1	1
09	Mining support service activities	0	0	0	0	0	0	0	0	0	0	0
10	Manufacture of food products	5	0	9	3	4	3	0	2	3	4	0
11	Manufacture of beverages	0	0	0	0	1	0	0	0	1	0	0
12	Manufacture of tobacco products	0	0	0	0	0	3	0	0	0	0	0
13	Manufacture of textiles	0	0	0	0	0	1	0	0	0	1	0
14	Manufacture of wearing apparel	0	0	0	0	0	0	0	0	0	0	0
15	Manufacture of leather and related products	0	0	0	0	0	1	0	0	0	0	0
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0	1	0	0	1	0	0	0	2	1	1
17	Manufacture of paper and paper products	0	0	0	0	0	0	0	0	0	0	0
18	Printing and reproduction of recorded media	0	0	0	1	0	1	1	0	1	0	1
20	Manufacture of chemicals and chemical products	4	0	0	0	0	0	0	0	0	0	0
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	0	0	0	0	0	0	0	0	0	0	0
22	Manufacture of rubber and plastics products	0	0	0	0	0	1	0	0	0	0	0
23	Manufacture of other non-metallic mineral products	0	0	0	0	2	1	0	0	0	0	0
24	Manufacture of basic metals	0	0	0	0	0	1	0	0	1	0	0
25	Manufacture of fabricated metal products, except machinery and equipment	0	0	0	0	0	0	0	0	0	0	0
26	Manufacture of computer, electronic and optical products	0	0	0	0	0	0	0	0	0	0	0
27	Manufacture of electrical equipment	0	0	0	0	1	0	0	0	0	0	0

Appendix 2 (Ctd): Number of Establishments in the Industrial Sector by Activity and by Region – 2010

ISI	Industrial Activity	Kigoma	Lindi	Manyara	Mara	Mbeya	Morogoro	Mtwara	Rukwa	Ruvuma	Shinyanga	Tabora
28	Manufacture of machinery and equipment n.e.c.	0	0	0	0	1	1	0	0	0	0	0
29	Manufacture of motor vehicles, trailers and semi-trailers	0	0	0	0	0	0	1	0	0	0	0
30	Manufacture of other transport equipment	0	0	0	0	0	0	0	1	0	0	0
31	Manufacture of furniture	0	0	0	0	1	3	0	0	1	0	0
32	Other manufacturing	0	0	0	0	1	1	0	0	0	0	0
33	Repair and installation of machinery and equipment	0	0	0	0	0	0	0	0	0	0	0
35	Electricity, gas, steam and air conditioning supply	1	1	1	1	1	1	1	1	1	1	1
36	Water collection, treatment and supply	1	1	0	0	1	1	1	1	0	0	2
	Total Industry	12	3	12	5	14	19	4	5	10	8	6

Source: National Bureau of Statistics (NBS)

Appendix 3: Monthly Rainfall in millimetres for various stations (2010 – 2014)**Appendix 3 (i): Monthly Rainfall for the year 2010**

Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Dodoma	104.0	122.5	39.4	4.9	0.2	0.0	0.0	0.0	0.0	0.0	6.2	117.4
Arusha	86.1	106.7	95.9	322.4	49.7	1.3	0	0.8	1.3	1.2	98.9	29.1
Kilimanjaro	90.7	10.3	169.0	106.9	64.9	2.2	0.0	0.1	1.7	0.0	12.5	54.3
Tanga	126.6	40.6	105.5	321.7	200.9	62.2	3.1	84.6	82.0	46.7	79.4	2.6
Morogoro	87.3	80.6	87.3	207.1	79.7	m	0.0	1.0	0.0	4.2	22.2	181.6
Dar es Salaam	14.0	83.2	167.7	362.2	119.0	14.6	7.1	15.8	46.2	0.4	48.7	85.3
Mtwara	168.2	310.1	203.3	339.0	95.6	12.3	1.8	2.0	0.9	4.5	6.9	86.2
Songea	326.1	230.9	151.1	67.0	15.4	2.3	0.0	1.4	0.0	2.1	0.3	159.0
Iringa	108.5	114.4	64.9	19.3	0.0	0.0	0.0	0.0	0.0	0.0	5.4	105.4
Mbeya	151.1	123.9	239.1	37.8	14.7	1.0	0.0	0.0	0.0	0.0	17.6	93.1
Singida	94.3	130.7	64.0	5.8	3.7	0.0	0.0	0.0	0.0	0.0	29.6	132.0
Tabora	119.9	158.6	248.2	41.3	60.3	0.0	0.0	0.0	6.7	1.6	58.9	154.9
Sumbawanga	179.2	154.6	162.2	8.2	23.0	0.0	0.0	0.0	0.0	0.0	17.1	261.3
Kigoma	75.4	56.1	198.4	82.9	111.9	5.6	0.5	0.0	16.0	60.2	100.5	158.1
Shinyanga	25.3	137.6	122.1	70.4	32.3	1.2	m	0.0	1.1	5.7	123.4	82.4
Bukoba	134.9	385.9	173.6	425.1	243.4	111.7	7.0	9.5	129.9	73.5	118.8	176.3
Mwanza	125.5	216.8	239.4	108.8	45.0	51.7	0.6	1.4	11.8	156.9	75.4	111.4
Musoma	90.6	122.1	305.6	205.5	68.0	7.5	4.1	0.0	52.6	76.0	70.0	4.2
Zanzibar	46.6	21.1	223.3	252.7	193.8	48.1	0.3	20.0	43.4	86.6	169.1	102.4

m - missing values

Source: Tanzania Meteorological Agency

Appendix 3 (ii): Monthly Rainfall for the year 2011

Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Dodoma	115.5	63.2	115.8	27.9	0.1	0.0	0.0	0.0	0.0	0.9	28.5	291.2
Arusha	11.2	51.1	118.4	51.1	57.1	1.2	0.0	0.0	3.3	90.6	38.7	69.7
Kilimanjaro	2.4	84.2	92.0	41.6	84.4	1.7	0.0	0.0	10.5	74.6	32.3	68.3
Tanga	155.7	66.5	213.5	28.4	2.4	0.5	0.0	0.0	68.3	25.5	124.1	216.4
Morogoro	117.5	103.7	117.5	196.3	58.8	5.3	0.4	5.8	45.1	23.2	47.0	191.1
Pwani	20.0	25.6	203.6	244.2	74.6	7.4	0.0	5.0	41.1	28.5	139.3	247.7
Dar es Salaam	4.1	103.8	26.3	224.4	106.7	29.7	11.9	26.3	54.4	31.6	316.5	377.2
Lindi	1.7	224.8	91.0	358.2	98.9	17.5	0.2	0.0	2.2	21.7	47.5	163.1
Mtwara	35.2	371.6	187.8	194.6	98.4	34.6	2.7	0.8	38.6	13.8	91.9	153.5
Ruvuma	223.4	339.0	243.6	97.7	11.2	0.5	0.0	0.5	8.8	40.0	52.2	141.8
Iringa	99.5	103.3	80.7	102.2	0.0	0.0	0.0	0.0	0.0	0.0	28.2	303.8
Mbeya	134.6	167.4	167.4	118.3	9.0	0.0	0.0	0.0	14.5	43.1	62.3	357.6
Singida	117.6	41.2	97.5	7.8	0.2	0.2	0.0	0.0	0.8	2.8	116.5	204.0
Tabora	155.7	66.5	213.5	28.4	2.4	0.5	0.0	0.0	68.3	25.5	124.1	216.4
Rukwa	161.0	79.3	168.4	81.1	21.8	0.0	0.0	0.0	2.1	9.7	187.5	239.4
Kigoma	74.9	148.0	230.0	81.2	19.6	0.0	10.6	2.6	91.6	89.8	175.5	154.4
Shinyanga	123.4	49.0	135.0	35.0	11.9	28.6	0.0	16.5	10.5	118.3	210.6	183.5
Kagera	127.6	135.5	325.8	319.5	267.2	110.0	33.3	65.0	217.4	255.4	232.9	150.5
Mwanza	95.6	68.0	86.1	132.9	75.8	58.1	0.0	40.5	24.4	104.9	226.4	219.1
Mara	28.0	60.6	299.8	167.4	27.1	46.9	29.5	67.3	100.6	52.1	361.1	31.0

Source: Tanzania Meteorological Agency

Appendix 3 (iii): Monthly Rainfall for the year 2012

Region	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Dodoma	124.0	103.4	124.4	81.9	1.2	0.0	0.0	0.0	0.0	0.0	15.8	154.4
Arusha	23.1	59.9	18.6	233.0	47.9	1.8	0.6	18.3	0.5	7.8	211.2	165.1
Kilimanjaro	1.5	22.6	33.4	46.5	0.7	0.0	24.1	24.1	0.0	0.0	112.0	31.3
Tanga	0.0	1.9	28.2	116.7	92.4	53.3	17.8	79.3	70.2	43.9	101.5	38.7
Morogoro	70.3	71.7	59.9	124.9	134.6	23.1	0.0	9.7	0.0	0.0	76.5	76.0
Pwani	7.5	30.7	121.7	210.1	103.3	7.4	1.1	11.1	5.3	3.9	37.1	98.7
Dar es Salaam	3.2	36.4	49.9	263.5	109.6	9.7	3.7	19.2	15.8	0.8	124.0	66.8
Mtwara	179.5	103.9	165.8	105.1	54.9	6.3	15.4	6.6	1.2	15.1	10.0	44.1
Ruvuma	286.7	111.4	172.2	58.6	12.3	0.0	0.0	0.0	0.0	0.0	82.7	171.9
Iringa	76.1	73.9	80.7	79.3	2.7	8.8	0.0	0.0	0.0	24.1	38.3	173.5
Mbeya	149.9	153.0	105.7	24.4	5.8	0.0	0.0	0.0	0.0	47.2	37.7	114.6
Singida	107.1	52.6	97.6	38.3	4.8	0.0	0.0	1.5	0.0	6.3	36.4	201.9
Tabora	122.3	135.8	98.9	116.3	38.0	0.8	0.0	13.9	10.3	32.8	29.9	228.9
Rukwa	150.7	249.9	84.1	34.6	1.0	0.0	0.0	0.0	0.0	4.5	70.8	233.4
Kigoma	33.0	43.3	100.3	69.1	41.7	15.7	0.0	36.3	8.6	60.7	190.7	135.9
Shinyanga	37.8	138.3	98.1	96.0	18.9	5.7	0.0	20.9	0.0	27.3	66.9	191.0
Kagera	94.8	246.1	170.7	451.5	533.2	140.8	8.7	68.1	37.4	167.7	142.0	219.2
Mwanza	2.1	36.8	36.4	322.6	158.2	60.2	0.0	11.4	65.6	336.4	105.8	172.1
Mara	11.5	54.2	50.0	94.4	104.3	52.7	0.0	13.0	47.6	93.3	66.5	77.4

Source: Tanzania Meteorological Agency

Appendix 3 (iv): Monthly Rainfall for the year 2013

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	132.1	32.1	36.5	105.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	87.7
Arusha	39.9	54.8	158.3	115.6	63.5	0.0	1.6	1.2	1.4	0.9	48.7	171.5
Kilimanjaro	72.7	1.1	140.6	90.0	61.3	1.0	0.9	5.9	0.8	0.2	34.3	83.8
Tanga	6.5	0.0	256.8	168.6	166.5	13.1	20.4	98.5	28.0	111.0	203.3	75.6
Morogoro	136.8	38.0	86.6	121.4	22.5	0.1	1.7	4.1	0.8	70.5	47.3	22.0
Kibaha	119.5	0.2	282.3	140.2	36.6	3.2	1.6	2.0	0.1	53.0	77.9	61.1
DIA	67.4	1.6	190.2	179.0	85.8	1.2	2.3	9.1	19.7	37.0	69.3	69.6
Kilwa	206.0	16.2	235.2	109.8	18.1	0.0	0.0	6.1	4.4	28.2	48.9	33.3
Mtwara	505.5	60.6	327.1	45.5	15.9	0.6	1.7	0.0	36.2	4.4	22.6	137.0
Songea	281.5	76.3	252.8	114.4	7.1	0.0	0.0	0.0	0.0	18.4	106.6	147.3
Iringa	163.3	67.7	112.6	39.5	0.0	0.0	0.0	0.0	0.0	0.0	5.3	99.0
Mbeya	124.5	159.2	144.1	53.2	72.2	0.0	0.0	0.0	0.0	0.0	34.9	193.3
Singida	235.9	51.1	140.2	266.7	3.1	0.0	0.0	0.0	0.0	0.0	46.1	116.0
Tabora	121.5	145.0	218.7	105.6	0.5	0.0	0.0	0.0	18.2	0.0	69.2	321.2
Sumbawanga	97.3	69.7	140.5	5.7	5.5	0.0	0.0	0.0	0.0	2.2	25.6	232.8
Kigoma	134.8	72.3	225.0	83.5	28.5	0.0	0.0	0.0	35.0	33.4	217.6	207.3
Bukoba	93.1	110.5	378.9	347.8	282.3	0.0	90.0	103.9	125.1	105.9	183.0	225.8
Mwanza	105.4	26.1	146.9	162.8	74.5	0.0	0.0	39.6	0.0	54.4	208.5	169.4
Musoma	27.2	3.9	144.5	278.4	103.5	1.5	10.0	1.2	60.8	9.1	96.1	62.3
Manyara (Babati)	99.5	40.8	229.7	206.1	34.5	0.0	0.0	0.0	0.0	0.0	17.3	333.6
Simiyu (Shinyanga)	48.8	33.3	151.7	131.2	24.2	0.0	0.0	0.0	37.4	3.5	73.4	250.2

Source: Tanzania Meteorological Agency

Appendix 3 (v): Monthly Rainfall for the year 2014

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	162.4	28	91.5	20.5	0.0	0.0	0.0	0.0	1.8	3.9	59.5	122.1
Arusha	14.3	182.4	160.3	364.9	85.6	9.8	0.0	0.0	50	8.7	150.6	161.9
Kilimanjaro	1.0	81.7	109.2	102.9	72.5	6.6	0.0	0.1	13.2	3.3	60.7	50.5
Tanga	0.7	59.6	130.8	144.1	286.8	56.1	59.5	94.3	21.5	104.4	142.9	64.6
Morogoro	56.0	65	185.7	231	113.0	24.0	13	10.8	9.1	87.4	43.6	155.2
Kibaha	10.2	178.7	266.6	432.3	91.7	5.9	0.8	6.7	32.7	4.6	40.0	105.3
Dar es Salaam	0.9	80.6	426.3	449.2	154.5	4.2	7.9	0.5	60.8	20.1	33.9	40.0
Kilwa	59.1	187.1	181.0	236.3	140.4	1.1	6.1	0.0	18.8	0.3	22.4	52.6
Mtwara	65.9	304.6	239.7	194.7	3.2	13.2	0.4	3.3	4.9	0.5	80.5	113.0
Songea	384.8	172.7	196.6	141.8	2.8	0.6	0.0	4.0	3.3	24.0	130.2	132.7
Iringa	194.3	157.7	157.1	79.7	0.0	3.1	0.0	0.0	0.0	16.1	70.3	223.3
Mbeya	258.3	363.9	135.8	127.1	5.3	0.0	0.0	0.0	0.0	26.0	51.6	180.3
Singida	210.6	109.1	93.9	17.7	1.0	0.0	0.0	0.0	0.4	52.9	52.1	240.5
Tabora	112.6	133.6	140.1	36.9	2.9	8.1	0.0	0.0	2.5	65.7	109.0	215.1
Sumbawanga	99.0	92.6	112.5	60.0	2.4	0.0	0.8	5.0	0.0	35.7	102.2	51.2
Kigoma	43.8	70.1	152.3	147.3	0.0	0.0	0.0	21.7	73.1	157.4	150.7	60.1
Bukoba	115.5	72.5	310.1	419.4	268.2	133.4	28.9	71.3	227	167.9	223.2	189.8
Mwanza	137.7	74.1	90.0	95.7	17.3	0.6	11.6	38.7	64.5	167.8	153.1	120.3
Musoma	8.2	18.8	178.8	79.5	158.7	12.6	4.6	107.8	10.1	97.8	54.1	71.7
Manyara(Babati)	116.9	94.7	152.3	57.9	40.9	1.7	0.0	1.6	9.8	5.4	75.7	242.0
Shinyanga	122.3	79.7	145.3	96.4	0.0	0.0	1.4	7.7	39.8	147.7	70.6	57.2

Source: Tanzania Meteorological Agency

Appendix 4: Average Monthly Maximum and Minimum Temperatures for 2010 – 2014**Appendix. 4 (i): Average Monthly Maximum Temperatures for the year 2010**

Stations	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Dodoma	29.2	29.8	30.6	30.2	29.4	28.0	26.9	27.7	29.1	m	32.0	30.4
Arusha	27.6	27.9	28.2	25.3	23.9	22.6	22.4	23.5	25.0	28.7	28.2	27.6
Kilimanjaro	32.0	33.7	33.1	29.2	27.6	26.7	26.6	27.6	29.3	32.4	33.0	32.6
Tanga	31.5	33.0	33.4	31.8	30.7	30.1	30.0	29.4	29.5	31.7	32.4	33.5
Morogoro	31.4	32.5	32.7	30.5	29.6	29.0	28.6	29.0	30.5	33.3	33.8	32.4
Dar es Salaam	32.6	33.7	32.6	31.4	31.0	30.4	30.2	30.5	30.7	32.5	32.5	32.7
Mtwara	30.7	31.3	31.7	30.8	30.9	29.4	29.3	30.4	25.1	31.5	31.9	31.7
Songea	28.8	28.0	27.9	27.2	26.5	24.6	24.3	25.4	28.4	31.1	31.6	29.2
Iringa	26.3	27.3	27.9	28.0	27.2	25.6	m	26.0	27.6	30.0	30.3	28.1
Mbeya	24.6	24.2	24.7	24.5	23.8	22.3	22.0	23.4	25.6	28.1	27.9	25.2
Singida	27.2	28.1	28.1	27.9	27.1	26.5	25.7	26.8	28.3	30.4	30.3	28.1
Tabora	28.7	29.2	29.5	30.0	30.2	29.9	29.5	30.9	32.1	33.5	32.8	29.1
Sumbawanga	24.0	24.0	24.6	24.8	25.4	24.6	24.1	25.8	26.9	28.4	27.0	24.0
Kigoma	28.5	29.4	28.7	30.1	30.3	30.1	30.3	30.8	31.0	30.5	m	27.8
Shinyanga	30.1	30.6	30.1	31.0	30.4	30.7	30.2	31.3	32.3	33.4	32.9	30.1
Bukoba	26.9	26.8	26.8	26.9	26.4	26.3	25.8	26.7	26.2	27.0	27.0	25.9
Mwanza	28.3	29.3	28.5	29.5	28.9	29.3	29.3	29.2	29.0	28.3	m	m
Musoma	28.1	28.4	28.4	29.3	28.8	29.2	29.0	29.5	28.5	29.0	29.7	28.8
Zanzibar	32.3	33.7	33.3	31.0	30.6	29.9	29.9	m	30.4	31.6	31.1	32.1

m = missing values

Source: Tanzania Meteorological Agency

Appendix 4 (ii): Average Monthly Minimum Temperatures for the year 2010

Stations	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Dodoma	19.2	19.3	19.4	18.8	17.7	15.5	14.4	14.6	15.4	m	18.7	18.8
Arusha	14.6	16.1	16.2	17.4	16.4	15.0	13.2	13.6	13.7	14.6	15.7	14.2
Kilimanjaro	19.1	20.1	20.2	20.6	18.7	17.2	15.3	15.0	15.7	17.5	19.4	18.9
Tanga	24.5	25.0	25.5	24.6	23.7	22.6	21.3	21.2	21.5	22.4	24.0	24.5
Morogoro	22.4	22.4	23.0	21.5	20.3	17.9	16.3	16.9	17.6	19.0	20.6	21.7
Dar es Salaam	25.6	25.4	25.0	m	22.5	20.9	m	19.4	19.9	21.2	23.3	24.5
Mtwara	m	m	m	23.1	22.5	20.6	19.7	18.9	18.8	20.5	22.3	23.8
Songea	m	m	m	m	m	m	m	m	17.7	19.8	20.2	18.3
Iringa	16.6	16.7	16.2	16.3	15.8	13.9	m	13.7	14.1	15.5	16.2	16.4
Mbeya	15.1	15.6	15.2	13.0	11.1	8.1	7.8	6.5	9.4	12.2	14.2	13.9
Singida	17.2	17.7	17.8	17.6	16.8	15.0	13.8	14.1	14.9	17.0	18.0	17.3
Tabora	18.5	19.0	18.9	17.7	17.3	15.4	15.2	16.2	18.4	20.2	20.1	18.2
Sumbawanga	13.1	15.2	13.8	14.5	13.4	10.4	9.7	9.8	12.6	14.0	15.6	14.4
Kigoma	20.4	21.3	20.2	20.4	20.1	17.7	16.8	16.5	18.8	19.8	m	19.6
Shinyanga	19.1	20.2	19.7	20.0	19.2	17.9	16.6	17.3	19.7	20.9	21.1	19.8
Bukoba	18.3	18.6	19.0	19.3	19.3	18.5	17.8	17.7	17.9	18.2	18.0	17.4
Mwanza	18.4	19.7	18.8	19.7	19.0	17.6	15.8	16.8	18.3	18.2	18.7	17.9
Musoma	19.2	19.2	19.1	19.6	19.1	18.4	17.1	17.6	18.4	18.8	18.8	18.3
Zanzibar	24.4	24.6	25.1	24.9	24.6	23.9	22.5	m	21.4	21.8	23.2	23.8

m = missing values

Source: Tanzania Meteorological Agency

Appendix 4(iii) Average Monthly Maximum Temperatures for the year 2011

Stations	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Dodoma	29.9	29.9	20.3	29.0	28.4	28.1	27.6	27.6	29.4	30.7	31.6	29.5
Arusha	29.9	31.1	28.3	26.7	25.1	24.1	24.0	24.2	26.3	26.8	28.0	27.9
Kilimanjaro	34.1	33.9	32.7	31.2	28.6	27.9	27.5	28.2	29.9	30.5	32.3	33.1
Tanga	33.5	33.7	33.8	31.8	30.4	30.4	30.1	30.0	30.5	30.2	31.5	32.4
Morogoro	31.7	32.1	31.6	29.8	28.7	28.3	28.2	28.8	30.4	31.5	32.4	31.5
Kibaha	33.9	34.1	33.6	30.5	29.6	29.3	29.9	30.1	30.7	31.9	31.7	31.7
Dar es Salaam	33.5	33.7	33.8	31.3	30.7	30.4	30.1	30.4	31.6	32.1	32.0	32.2
Mtwara	31.8	30.8	31.0	31.0	30.5	29.2	29.0	30.2	30.7	30.6	32.2	m
Songea	28.4	26.8	27.2	26.7	25.9	25.6	24.3	25.6	27.8	29.8	31.1	29.0
Iringa	27.5	26.9	27.1	26.8	26.6	26.7	26.2	26.4	27.8	29.9	29.9	27.9
Singida	27.4	28.2	28.2	28.7	27.8	27.6	m	27.4	28.9	30.1	27.9	26.2
Tabora	28.5	28.8	29.2	29.5	30.4	30.5	30.4	31.0	31.4	31.3	28.8	27.7
Sumbawanga	23.8	24.3	24.0	24.5	25.3	25.6	25.6	26.3	26.7	27.1	25.1	23.8
Kogoma	m	28.1	27.8	29.6	30.3	30.1	29.4	30.3	30.7	28.1	27.6	28.0
Shinyanga	29.7	30.7	30.4	31.0	31.5	31.0	30.8	30.8	32.0	31.6	29.2	28.5
Bukoba	26.3	27.4	26.1	27.1	25.8	26.2	26.0	m	25.5	26.0	25.4	25.9
Mwanza	m	m	m	m	28.8	28.7	28.6	27.8	28.3	29.4	26.9	27.0
Musoma	28.5	29.5	28.6	28.9	28.5	28.4	28.5	27.3	27.9	28.5	26.9	27.3

m = missing values

Source: Tanzania Meteorological Agency

Appendix 4 (iv): Average Monthly Minimum Temperatures for the year 2011

Stations	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Dodoma	18.7	18.9	18.4	18.1	17.0	15.4	14.0	15.3	16.8	18.1	19.6	19.5
Arusha	13.9	14.4	15.6	17.5	16.5	14.5	14.0	14.1	15.3	15.7	16.8	15.5
Kilimanjaro	19.0	19.0	19.6	20.4	19.1	17.1	15.7	16.6	17.1	18.6	19.3	19.5
Tanga	24.9	24.9	25.0	24.4	23.4	22.4	21.4	21.4	22.0	22.8	23.7	24.2
Morogoro	21.4	21.6	21.3	21.1	20.2	17.8	15.4	16.6	18.1	19.7	21.3	21.5
Kibaha	23.9	24.8	m	m	m	m	m	m	m	m	m	m
Dar es Salaam	24.8	24.6	24.0	23.3	22.6	20.7	19.2	19.6	20.5	21.7	22.9	24.3
Mtwara	24.1	23.1	22.9	22.8	21.4	19.9	18.6	18.7	19.7	20.3	22.6	m
Songea	m	m	m	m	17.3	12.7	10.8	12.1	15.0	17.4	19.1	18.9
Iringa	16.5	17.0	15.7	15.8	14.8	13.4	12.6	14.0	15.0	16.0	17.3	17.0
Mbeya	13.7	14.3	13.7	12.9	11.0	7.2	5.6	7.0	10.0	13.5	13.9	14.1
Singida	17.0	16.9	17.1	16.9	16.2	14.9	m	14.4	15.8	17.0	17.4	17.3
Tabora	18.0	18.0	18.1	17.3	16.7	15.2	14.9	17.4	19.2	19.0	19.1	18.3
Sumbawanga	14.2	13.7	13.8	13.7	12.1	9.1	8.2	9.8	12.4	13.8	14.6	14.0
Kigoma	m	19.4	19.3	19.6	19.4	17.5	16.5	17.8	19.8	20.3	19.8	19.9
Shinyanga	19.3	19.4	19.3	19.3	19.9	18.7	17.3	18.6	20.5	20.4	19.7	19.3
Bukoba	17.1	17.6	18.1	18.2	18.2	18.4	17.9	18.5	18.0	m	18.2	18.2
Mwanza	m	17.8	18.3	18.4	23.7	16.9	16.0	17.2	18.2	19.0	18.7	18.8
Musoma	18.7	18.8	18.7	18.2	18.4	18.6	17.5	17.9	18.0	18.4	18.5	18.5

m = missing values

Source: Tanzania Meteorological Agency

Appendix 4 (v): Average Monthly Maximum Temperatures for the year 2012

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	29.2	30.6	29.0	28.4	27.5	27.2	27.0	28.1	29.8	31.4	31.3	30.6
Arusha	30.9	28.9	29.6	25.5	23.2	23.0	23.1	24.6	26.5	28.7	26.8	26.8
Kilimanjaro	35.1	34.9	33.8	29.9	27.6	27.2	25.7	28.2	30.3	31.0	31.4	32.0
Tanga	31.7	32.5	33.2	31.9	30.5	30.1	28.8	29.3	29.2	30.9	31.8	33.0
Morogoro	31.3	33.1	31.6	29.9	28.8	28.0	27.4	29.3	31.2	32.7	33.3	33.1
Pwani	31.0	33.4	32.3	31.2	29.9	30.1	30.1	30.7	31.4	32.5	32.3	33.2
Dar es Salaam	32.4	33.3	33.3	32.2	31.3	31.2	31.0	31.4	31.5	32.6	32.4	33.4
Mtwara	30.3	30.4	30.8	30.5	29.9	29.2	29.0	29.5	30.5	30.7	32.2	32.2
Ruvuma	27.9	27.6	27.7	26.4	25.8	25.2	23.3	26.6	28.9	30.4	29.4	28.3
Iringa	27.1	26.2	27.6	27.0	26.6	26.2	26.4	26.7	28.8	29.9	30.0	28.7
Mbeya	24.4	25.4	24.7	23.6	23.6	23.2	23.2	25.3	27.0	28.2	26.7	26.1
Singida	27.4	28.4	27.4	26.2	26.1	26.0	26.1	27.0	28.4	30.0	29.2	27.6
Tabora	29.0	29.7	29.2	29.0	29.6	29.3	29.0	31.0	32.5	33.2	31.6	29.4
Rukwa	22.9	24.4	24.9	24.8	25.3	23.4	23.4	26.1	27.4	27.8	24.8	23.6
Kigoma	29.2	28.9	30.3	29.6	28.6	30.0	28.5	30.4	30.6	30.6	27.6	27.4
Shinyanga	30.7	31.4	30.0	29.0	29.9	29.9	29.7	31.1	32.6	33.2	32.1	29.3
Kagera	27.4	27.6	27.2	24.9	25.8	25.7	25.4	26.2	25.3	26.5	25.6	26.4
Mwanza	28.6	29.4	28.3	27.8	28.6	28.2	28.3	28.6	28.5	28.3	27.5	26.9
Mara	29.0	30.0	28.5	28.3	28.0	27.9	27.8	28.8	28.3	29.7	28.7	27.8

Source: Tanzania Meteorological Agency

Appendix 4(vi): Average Monthly Minimum Temperatures for the year 2012

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	19.2	19.3	18.8	18.2	16.5	14.1	14.5	15.6	16.3	17.9	19.7	19.7
Arusha	14.4	14.0	16.1	17.0	16.0	14.9	13.4	13.0	13.7	15.4	15.5	16.3
Kilimanjaro	18.4	19.1	19.9	20.0	18.3	17.5	14.4	15.5	15.9	16.9	19.3	19.5
Tanga	24.2	24.3	24.4	23.8	23.2	22.0	20.1	21.3	21.7	22.7	23.9	24.6
Morogoro	21.5	21.5	21.3	17.4	19.3	17.0	15.8	19.9	17.6	19.1	20.6	21.5
Pwani	22.9	22.7	22.5	22.2	21.9	20.3	18.5	18.6	19.3	20.4	21.9	22.7
Dar es Salaam	25.4	24.7	27.0	22.8	21.2	19.1	18.0	18.1	18.5	21.4	23.1	22.9
Mtwara	23.2	23.1	23.7	22.3	20.8	19.1	18.5	18.3	18.5	19.4	22.2	22.8
Ruvuma	18.4	18.3	17.5	15.4	13.3	18.2	11.1	12.4	14.6	16.3	18.2	17.5
Iringa	16.6	16.7	16.2	16.3	15.8	13.9	13.1	13.7	14.1	15.5	16.2	16.4
Mbeya	14.7	13.5	15.1	12.5	12.3	7.1	5.7	8.8	12.3	15.4	17.5	17.6
Singida	16.9	16.9	16.9	16.6	15.7	14.5	13.6	14.2	15.1	17.1	17.9	17.5
Tabora	18.2	18.4	17.8	18.0	16.9	15.5	13.9	16.5	18.8	20.0	19.5	18.9
Rukwa	14.1	13.2	13.3	13.5	12.3	8.6	7.6	8.9	11.9	12.1	14.1	14.4
Kigoma	20.1	19.5	20.0	19.8	19.0	17.8	16.8	18.0	19.6	20.6	20.1	19.8
Shinyanga	19.1	19.5	19.3	19.1	18.7	17.7	14.9	17.9	19.9	21.3	20.3	19.7
Kagera	17.5	17.6	18.1	17.9	18.1	16.3	15.5	17.9	16.7	18.4	15.1	16.4
Mwanza	18.1	17.8	19.1	18.9	19.0	16.2	16.2	16.8	18.3	18.3	18.4	18.8
Mara	17.5	18.3	14.8	18.3	18.0	17.4	16.4	17.6	18.0	19.8	18.4	18.3

Source: Tanzania Meteorological Agency

Appendix 4(vii): Average Monthly Maximum Temperatures for the year 2013

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	30.1	30.6	29.9	29.3	28.5	27.1	27.3	27.5	30.2	30.9	32.3	31.5
Arusha	28.7	30.3	28.1	25.3	23.1	22.4	22.9	23.4	26.5	27.3	28.8	27.3
Kilimanjaro	33.0	34.9	33.0	29.2	27.1	26.2	26.5	27.2	30.0	32.3	32.6	31.8
Tanga	33.2	33.0	32.8	31.2	30.3	29.3	29.4	28.2	29.8	30.0	31.3	32.2
Morogoro	33.5	33.3	31.9	30.0	29.6	29.1	29.4	29.2	31.4	31.5	33.5	32.0
Kibaha	32.3	33.8	32.2	30.8	30.1	30.0	29.9	30.0	31.5	31.8	32.8	32.3
Dar es Salaam	32.7	33.9	32.4	32.2	31.1	30.9	30.7	31.4	32.1	32.2	32.8	32.9
Kilwa	31.5	32.1	31.1	30.8	30.0	29.3	28.7	28.6	29.4	30.0	31.3	31.9
Mtwara	30.7	30.7	31.8	31.4	30.9	29.6	30.7	29.9	30.3	31.1	32.2	31.9
Songea	28.3	28.5	27.4	26.7	25.7	24.5	24.1	25.7	28.7	28.9	30.6	28.7
Iringa	27.3	27.8	27.4	27.3	26.5	25.8	25.9	25.7	28.6	28.6	30.6	28.8
Mbeya	25.0	25.4	24.9	24.1	23.0	22.4	22.7	23.9	27.1	27.7	26.3	24.1
Singida	27.6	27.9	27.5	26.1	25.4	25.1	25.7	25.9	28.6	29.2	29.7	27.0
Tabora	29.1	30.1	29.6	28.2	29.5	29.2	29.8	30.5	32.4	33.1	32.0	28.4
Sumbawanga	24.0	24.8	24.3	24.0	24.3	24.9	25.3	25.3	27.0	27.1	26.7	24.6
Kigoma	28.4	29.3	28.4	28.6	29.9	29.6	29.6	30.8	30.9	29.9	27.5	27.8
Bukoba	27.8	27.6	26.6	26.1	26.0	26.7	26.4	25.9	26.0	26.6	26.0	26.0
Mwanza	28.8	28.9	28.6	27.6	27.9	30.0	29.5	29.0	28.7	28.6	27.9	26.8
Musoma	29.1	30.3	29.5	28.2	29.0	28.5	28.6	28.8	28.4	29.9	28.7	28.2
Simiyu (Shinyanga)	30.3	31.7	30.5	28.6	30.3	29.9	30.3	31.1	32.4	33.3	32.2	29.1

Source: Tanzania Meteorological Agency

Appendix 4(viii): Average Monthly Minimum Temperatures for the year 2013

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	19.9	19.5	19.6	18.9	17.1	14.7	14.6	15.2	16.6	17.5	19.4	20.2
Arusha	14.8	14.6	15.3	17.5	15.4	13.4	13.2	13.2	13.2	13.9	15.9	14.3
Kilimanjaro	18.8	19.0	20.9	20.1	17.6	14.9	14.4	15.4	15.2	16.6	19.2	19.0
Tanga	25.2	25.1	25.1	24.6	23.3	22.1	21.2	21.0	21.7	22.6	23.4	24.5
Morogoro	22.4	21.8	22.0	21.4	19.6	16.2	15.4	17.2	17.6	19.4	20.8	22.1
Kibaha	23.7	23.5	22.7	22.7	21.6	20.3	20.1	18.7	19.1	20.3	21.8	22.7
Dar es Salaam	25.1	25.8	24.2	23.4	22.0	19.7	19.0	19.3	19.9	21.4	23.2	24.9
Kilwa	25.5	25.8	24.7	24.6	23.3	21.7	21.0	21.5	22.4	24.0	25.4	25.6
Mtwara	23.5	23.0	22.9	22.2	20.9	18.9	18.7	17.9	18.8	19.9	21.7	22.8
Songea	17.6	16.6	16.3	14.5	12.0	9.1	9.0	11.5	13.5	15.8	17.2	16.7
Iringa	16.9	16.6	14.9	15.4	14.4	11.9	12.1	12.4	13.3	14.7	16.3	16.6
Mbeya	15.9	15.0	14.3	13.0	10.1	4.2	4.8	7.6	10.5	13.5	17.5	17.6
Singida	17.4	17.1	17.6	16.7	15.4	13.3	13.2	13.8	15.5	16.3	17.8	17.4
Tabora	18.8	18.5	18.7	18.4	16.4	13.6	13.9	15.9	18.7	19.8	19.5	18.9
Sumbawanga	11.8	13.8	13.9	13.4	11.2	8.6	7.6	8.9	11.9	13.7	14.4	14.4
Kigoma	20.6	20.5	20.7	20.6	19.4	16.3	15.9	18.1	20.1	20.1	20.1	20.3
Bukoba	17.8	17.3	18.3	18.7	18.5	18.5	17.4	17.8	17.7	18.0	18.5	18.5
Mwanza	19.1	18.2	19.0	19.2	17.8	15.9	14.7	16.3	17.5	18.3	18.7	19.1
Musoma	18.9	19.3	19.7	20.5	18.7	17.3	16.3	18.1	19.0	19.1	19.0	19.0
Simiyu (Shinyanga)	18.8	19.6	19.7	19.5	18.0	15.9	15.4	17.8	19.8	20.2	20.6	19.8

Source: Tanzania Meteorological Agency

Appendix 4(ix): Average Monthly Maximum Temperatures for the year 2014

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	29.6	29.1	29.6	28.5	28.0	27.4	27.1	28.3	28.7	31.3	31.9	30.1
Arusha	30.4	27.4	27.1	25.3	23.0	22.3	22.8	24.4	24.6	27.9	27.7	27.2
Kilimanjaro	34.4	31.5	31.7	29.9	26.7	26.9	26.9	29.0	29.0	32.3	33.1	32.5
Tanga	32.4	31.3	32.2	31.5	29.9	29.8	29.2	29.1	29.5	30.8	31.8	32.3
Morogoro	28.3	28.6	29.6	29.6	30.3	30.1	30.0	30.7	31.5	31.4	31.6	28.7
Kibaha	33.3	31.9	31.8	30.7	29.7	29.8	30.0	30.7	30.0	31.3	32.9	32.7
Dar es Salaam	33.4	32.5	32.3	31.4	30.6	31.1	30.4	31.8	30.6	32.6	33.6	33.6
Kilwa	31.9	30.8	30.9	30.5	30.1	29.7	29.2	30.4	29.2	30.3	30.0	31.8
Mtwara	30.7	30.0	30.8	30.7	30.3	29.9	30.0	30.7	30.6	31.7	32.2	31.2
Songea	27.8	27.5	27.2	26.0	25.4	24.6	24.4	26.2	27.4	29.4	30.1	30.0
Iringa	26.3	26.7	26.9	25.6	26.0	25.6	25.5	26.6	26.8	29.0	29.9	28.7
Mbeya	23.2	23.8	24.6	23.6	22.2	27.0	23.1	23.1	25.4	26.7	27.5	25.4
Singida	26.6	25.9	26.8	26.0	25.6	25.6	25.7	26.4	27.0	28.3	29.2	26.9
Tabora	28.3	28.6	29.6	29.6	30.3	30.1	30.0	30.7	31.5	31.4	31.6	28.7
Sumbawanga	24.0	24.0	24.7	24.2	25.4	25.2	25.2	25.1	26.2	26.9	26.4	24.4
Kigoma	28.4	28.5	28.7	29.5	31.1	30.1	29.9	30.4	30.1	29.4	28.7	28.1
Shinyanga	29.4	28.7	30.1	30.0	30.9	30.5	30.2	30.8	32.4	31.1	32.0	30.3
Bukoba	26.6	27.1	27.3	26.5	26.1	26.2	26.3	26.0	25.7	26.5	26.6	26.4
Mwanza	27.3	27.4	29.0	28.9	29.2	29.4	29.1	28.1	29.0	27.9	27.2	27.4
Musoma	28.5	28.4	29.4	29.1	29.0	28.7	28.8	28.1	28.6	29.1	28.1	27.8
Zanzibar	33.8	32.6	31.8	30.6	29.5	29.6	29.4	29.5	29.7	31.3	31.4	32.1

Source: Tanzania Meteorological Agency

Appendix 4(viii): Average Monthly Minimum Temperatures for the year 2014

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dodoma	19.5	19.6	19.3	18.7	16.8	15.9	15.0	16.0	16.2	18.2	19.4	19.6
Arusha	13.9	16.6	16.7	16.9	16.2	14.6	13.5	14.0	14.5	15.7	16.3	15.1
Kilimanjaro	18.9	19.1	21.7	19.7	18.4	16.8	16.2	15.9	16.2	18.0	18.5	18.3
Moshi	19.6	20.1	20.5	16.3	19.7	16.9	18.1	18.1	18.0	19.2	19.9	19.8
Same	20.1	20.1	20.7	19.9	18.5	17.1	16.3	16.3	16.7	18.5	19.7	20.5
Tanga	25.2	24.3	24.5	24.2	23.2	22.9	21.7	21.6	21.9	22.7	23.5	24.4
Morogoro	22.9	22.2	21.8	21.1	19.7	17.8	16.4	17.4	17.9	19.6	20.4	21.8
Dar es Salaam	25.9	24.4	23.7	23.5	22.4	20.9	19.5	20.0	20.2	21.7	23.1	25.1
Kilwa	16.6	16.3	15.6	15.2	11.5	9.9	9.1	10.5	11.8	14.2	15.5	15.8
Mtwara	23.1	22.7	22.8	22.1	21.1	19.7	18.8	19.3	19.1	20.8	21.7	23.3
Iringa	16.7	16.7	16.3	15.9	14.2	12.8	12.7	12.9	13.9	15.8	16.5	16.7
Mbeya	13.7	13.9	13.3	13.3	9.5	15.1	6.7	6.5	10.4	11.9	14.6	14.8
Singida	16.9	16.6	17.0	16.8	15.4	14.5	13.7	14.7	15.1	16.8	17.4	17.1
Tabora	18.7	18.4	18.1	17.2	16.6	16.4	14.4	17.6	18.6	17.7	18.0	17.7
Kigoma	20.6	20.6	20.5	20.3	19.7	18.5	17.6	19.3	19.9	20.7	20.3	20.5
Shinyanga	19.6	18.8	18.8	18.4	18.3	17.9	17.2	18.6	18.9	19.9	19.9	19.9
Bukoba	18.2	18.7	18.8	18.4	19.3	18.8	18.0	18.2	18.1	18.3	18.5	18.0
Mwanza	18.6	18.7	19.0	19.0	18.9	18.2	17.7	17.9	18.4	19.0	19.0	18.9
Musoma	19.1	18.7	19.1	18.9	18.9	18.3	17.9	18.0	18.2	18.6	18.2	18.2
Karume	25.6	24.8	25.2	24.8	24.1	24.1	23.2	23.3	23.5	23.7	24.0	24.9
Zanzibar	25.4	24.7	24.7	24.8	23.9	23.5	23.0	21.8	21.3	22.9	23.8	24.8

Source: Tanzania Meteorological Agency

Appendix 5: Regional Distribution of Forest Reserves (FR) in Tanzania

Region	District	Central Govt FR ha	Local Authority FR ha.	Public land Forest ha	Total Forests ha	Regional % to Total National Forests
Arusha	Arumeru	26,478	272	27,490	54,240	
	Babati	15,427	0	16,166	31,593	
	Hanang	5,698	60	103,146	108,904	
	Kiteto	466	0	884,364	884,830	
	Monduli	12,707	18,254	889,195	920,156	
	Mbulu	84,581	0	140,286	224,867	
	Ngorongoro	96,349	2,331	0	98,680	
	Simanjiro	0	0	147,850	147,850	
	Sub-total	241,706	20,917	2,208,497	2,471,120	7.36
Dar es Salaam	Dar es Salaam	2,238	0	369	2,607	0.01
	Bagamoyo	57,900	19,335	627,858	705,093	
	Kisarawe	67,559	0	332,122	399,681	
Pwani	Kibaha	31,930	0	22,273	54,203	
	Mafia	404	2,596	42,932	45,932	
	Rufiji	81,787	68,633	1,081,510	1,231,930	
	Sub-total	239,580	90,564	2,106,695	2,436,839	7.26
Dodoma	Dodoma	57,823	6,099	2,001,115	2,065,037	
	Kondoa	61,189	10,880	128,470	200,539	
	Mpwapwa	15,792	0	80,413	96,205	
	Sub-total	134,804	16,979	2,209,998	2,361,781	7.04
Iringa	Iringa	60,122	220,053	93,440	373,615	
	Ludewa	7,764	628	40,000	48,392	
	Makete	37,109	39	72,470	109,618	
	Mufindi	137,271	0	82,241	219,512	
	Njombe	2,325	6,369	67,000	75,694	
	Sub-total	244,591	227,089	355,151	826,831	2.46
Kagera	Biharamulo	168,763	0	0	168,763	
	Bukoba	42,696	0	0	42,696	
	Karagwe	0	0	0	0	
	Muleba	95,833	0	0	95,833	
	Ngara	0	2,522	0	2,522	
	Sub-total	307,292	2,522	0	309,814	0.92
Kigoma	Kasulu	235,541	635	71,624	307,800	
	Kibondo	401,450	113,183	57,667	572,300	
	Kigoma	84,907	6,044	734,949	825,900	
	Sub-total	721,898	119,862	864,240	1,706,000	5.08
Kilimanjaro	Hai	47,029	0	21,000	68,029	
	Moshi	23,419	0	0	23,419	
	Mwanga	4,543	376	7,420	12,339	
	Rombo	39,883	0	22,617	62,500	
	Same	23,266	5,155	14,416	42,837	
	Sub-total	138,140	5,531	65,453	209,124	0.62

Appendix 5 (Ctd): Regional distribution of Forest Reserves (FR) in Tanzania

Region	District	Central Govt FR ha	Local Authority FR ha	Public land Forest ha	Total Forests ha	Regional % to total national forests
Lindi	Kilwa	206,713	0	1,084,787	1,291,500	
	Lindi	46,522	2,218	727,230	775,970	
	Liwale	303,158	0	1,434,942	1,738,100	
	Nachingwea	28,491	0	506,209	534,700	
	Sub-total	584,884	2,218	3,753,168	4,340,270	12.93
Mara	Bunda	0	1,581	0	1,581	
	Musoma	2,940	0	0	2,940	
	Serengeti	0	0	0	0	
	Tarime	0	152	0	152	
	Sub-total	2,940	1,733	0	4,673	0.01
Mbeya	Chunya	205,880	76,126	84,260	366,266	
	Ileje	5,703	20,746	49,418	75,867	
	Mbeya	52,080	2,314	38,115	92,509	
	Mbozi	34,212	1,095	20,302	55,609	
	Rungwe	203,016	157,698	95,600	456,314	
	Sub-total	500,891	257,979	287,695	1,046,565	3.12
Morogoro	Kilombero	121,992	3,469	127,548	253,009	
	Kilosa	85,908	0	144,800	230,708	
	Morogoro	172,799	3,704	158,692	335,195	
	Ulanga	980,000	3,637	38,640	1,022,277	
	Sub-total	1,360,699	10,810	469,680	1,841,189	5.49
Mtwara	Masasi	40,922	3,311	499,597	543,830	
	Mtwara	8,402	668	261,263	270,333	
	Newala	9,534	4,567	28,879	42,980	
	Sub-total	58,858	8,546	789,739	857,143	2.55
Mwanza	Geita	64,251	24,734	0	88,985	
	Kimba	2,900	7,020	0	9,920	
	Magu	5,421	0	0	5,421	
	Mwanza	5,691	0	0	5,691	
	Sengerema	36,627	1,818	0	38,445	
	Ukerewe	4,355	1,171	3,870	9,396	
Sub-total	119,245	34,743	3,870	157,858	0.47	
Rukwa	Mpanda	2,514,356	176,757	359,217	3,050,330	
	Nkansi	47,191	0	0	47,191	
	Sumbawanga	64,000	4,923	1,736,139	1,805,062	
	Sub-total	2,625,547	181,680	2,095,356	4,902,583	14.61

Appendix 5 (Ctd): Regional distribution of Forest Reserves (FR) in Tanzania

Region	District	Central Govt FR ha	Local Authority FR ha	Public land Forest ha	Total Forests ha	Regional % to total national forests
Ruvuma	Mbinga	2,719	191	2,699	5,609	
	Songea	316,902	10,756	51,817	379,475	
	Tunduru	318,963	0	170,942	489,905	
	Sub-total	638,584	10,947	225,458	874,989	2.61
Shinyanga	Bariadi	0	237	23,810	24,047	
	Kahama	553,095	201,731	36,926	791,752	
	Maswa	98	1,059	19,600	20,757	
	Meatu	0	14,263	56,925	71,188	
	Shinyanga	2,705	30,171	17,855	50,731	
	Sub-total	555,898	247,461	155,116	958,475	2.86
Singida	Iramba	0	0	93,200	93,200	
	Manyoni	785,264	0	124,450	909,714	
	Singida	0	0	54,530	54,530	
	Sub-total	785,264	0	272,180	1,057,444	3.15
Tabora	Igunga	16,851	9,842	111,768	138,461	
	Nzega	76,610	102,388	135,016	314,014	
	Tabora	857,010	389,158	2,042,982	3,289,150	
	Urambo	637,412	239,841	685,560	1,562,813	
	Sub-total	1,587,883	741,229	2,975,326	5,304,438	15.81
Tanga	Handeni	50,272	1,503	1,217,210	1,268,985	
	Korogwe	11,222	5,199	30,251	46,672	
	Lushoto	31,560	2,775	262,646	296,981	
	Muheza	30,889	3,258	133,425	167,572	
	Pangani	5,202	0	82,823	88,025	
	Tanga	10,503	0	7,011	17,514	
Sub-total	139,648	12,735	1,733,366	1,885,749	5.62	
Grand Total		10,990,590	1,993,545	20,571,357	33,555,492	100.00

Source: Ministry of Natural Resources and Tourism, Department of Forestry and Beekeeping

Appendix 6: Forest reserves in Tanzania

District	Region	Name of Reserve	Area in hectare	
			Productive	Protected
Arumeru	Arusha	Meru		26,443.5
Mbulu	Arusha	Marang		35,399.0
Mbulu	Arusha	Nou		31,257.0
Ngorongoro	Arusha	Northern Highlands		89,152.0
Kisarawe	Owani	Ruvu South		35,500.0
Kibaha	Pwani	Bana/North Ruvu	31,930.0	
Rufiji	Pwani	Rufiji Delta Mangroves	67,612.0	
Rufiji	Pwani	Ruhoi River	68,639.0	
Dodoma	Dodoma	Chinyami		43,330.0
Dodoma	Dodoma	Kiborian Ranges		54,936.0
Dodoma	Dodoma	Chinene West		29,836.0
Kondoa	Dodoma	Songa		34,966.1
Kondoa	Dodoma	Swangaswanga		87,100.0
Kondoa	Dodoma	Mkungunero		74,395.0
Iringa	Iringa	Ukwama		25,900.8
Iringa	Iringa	W. Kilombero Scarp		195,260.0
Makete	Iringa	Kipengere Range	34,146.7	
Mufindi	Iringa	Mbalwe/Mfukulembwe		57,296.0
Mufindi	Iringa	Sao Hill	31,063.5	
Biharamulo	Kagera	Biharamulo	90,650.0	
Biharamulo	Kagera	Kasongeye		48,781.0
Biharamulo	Kagera	Nyantakara	29,332.0	
Biharamulo/ Muleba	Kagera	Ruiga River		95,832.9
Kasulu	Kigoma	Mkuti	57,498.0	
Kasulu	Kigoma	Makere North	78,995.1	
Kasulu	Kigoma	Makere South	99,682.7	
Kibondo	Kigoma	Buyungu	113,183.1	
Kibondo	Kigoma	Mwalye	401,450.4	
Kigoma	Kigoma	Mkuti	47,915.0	
Kigoma	Kigoma	Mtunda Hill	797,259.0	
Rombo	Kilimanjaro	Kilimanjaro F.R		39,883.4

Appendix 6 (Ctd): Forest reserves in Tanzania

District	Region	Name of Reserve	Area in hectare	
			Productive	Protected
Hai	Kilimanjaro	Kilimanjaro F.R		47,028.6
Kilwa	Lindi	Maleh	38,850.0	
Kilwa	Lindi	Mangroves	36,737.0	
Kilwa	Lindi	Mtarue	60,484.0	
Kilwa	Lindi	Ngarma North	39,628.0	
Lindi	Lindi	Mpigamiti		30,000.0
Liwale	Lindi	Lungoya	208,380.0	
Liwale	Lindi	Nyera/Kiperere	80,423.0	18,000.0
Nachingwea	Lindi	Lionja	28,490.8	
Chunya	Mbeya	Lukwati	199,430.2	
Chunya	Mbeya	Muipa	75,110.1	
Chunya	Mbeya	Mpiwe	49,147.0	
Mbozi	Mbeya	Isalalo-Lunga	35,340.0	
Rungwe	Mbeya	Livingstone		26,365.4
Rungwe	Mbeya	Karolo		159,937.0
Kilombero	Morogoro	Iyondo		27,979.5
Kilombero	Morogoro	Kilombero River		158,365.2
Kilosa	Morogoro	Ukwiva		54,634.5
Morogoro	Morogoro	Mkulazi	68,627.4	
Ulanga	Morogoro	Lohombero/Luwengu	296,645.1	
Ulanga	Morogoro	Ngindo	557,255.2	
Masasi	Mtwara	Mbagala	28,490.0	
Geita	Mwanza	Geita	48,305.5	
Mpanda	Rukwa	Msaganja	85,213.6	
Mpanda	Rukwa	Mulele hill	519,211.0	
Mpanda	Rukwa	Mpanda North-East	502,460.5	
Mpanda	Rukwa	Nyonga	578,623.8	
Mpanda	Rukwa	Rungwa river	401,462.4	
Mpanda	Rukwa	Tongwe	167,837.1	
Mpanda	Rukwa	Ugalla river	427,350.0	
Nkasi	Rukwa	Kisi	32,634.0	
Nkasi	Rukwa	Loasi river	33,468.0	
Sumbawanga	Rukwa	Kalambo river	41,958.0	
Mbinga	Ruvuma	Liparamba G.R		57,099.0
Songea	Ruvuma	N.E. Undendeule	305,539.4	
Songea	Ruvuma	Matogoro "B"		32,900.0
Songea	Ruvuma	Kipiki		63,850.0
Tunduru	Ruvuma	Muhuwesi	170,945.3	
Tunduru	Ruvuma	Mwambesi		104,052.0
Tunduru	Ruvuma	Sasawara		39,886.0
Manyoni	Singida	Rungwa	785,840.2	

Appendix 6 (Ctd): Forest reserves in Tanzania

District	Region	Name of Reserve	Area in hectare	
			Productive	Protected
Bukombe	Shinyanga	Biharamulo	44,030.0	
Bukombe	Shinyanga	Runzewe	32,375.0	
Kahama	Shinyanga	Nikonga river	492,100.5	
Kahama	Shinyanga	Ngongwa busangi	28,438.2	
Kahama	Shinyanga	Ushetu Ubagwe	52,318.1	
Kahama	Shinyanga	Usumbwa	38,073.0	
Shinyanga	Shinyanga	Nindo	27,768.1	
Nzega	Tabora	Igombe river	37,296.0	
Nzega	Tabora	Ilombero Hill	35,224.0	
Nzega	Tabora	Karitu	78,026.1	
Tabora	Tabora	Goweko	42,088.8	
Tabora	Tabora	Itulu Hill	388,512.4	
Tabora	Tabora	Mpembakazi	134,680.1	
Tabora	Tabora	Nyahua Mbuga		679,896.0
Tabora	Tabora	Sikonge	56,980.1	
Tabora	Tabora	Swangala	271,950.3	
Tabora	Tabora	Nyonga		578,623.8
Tabora	Tabora	Ugunda		129,504.0
Tabora	Tabora	Uyui-Kigwa	135,198.1	
Tabora	Tabora	Wala river	160,584.9	
Urambo	Tabora	Igombe river	210,049.2	
Urambo	Tabora	Mpanda Line	427,363.2	
Urambo	Tabora	Ugalla North	278,423.3	
Urambo	Tabora	Ulyankulu	239,841.4	
Songea	Matogoro B	Territorial	32,900.0	

Appendix 7: Import of Petroleum and Petroleum product (Net weight Kg) 2012 – 2014

HS Codes	Commodity Description	2012	2013	2014
27011100	Anthracite, not agglomerated	381	111,644	23,161
27011200	Bituminous coal, not agglomerated	27,500,000	0	0
27011900	Other coal, not agglomerated, nes	16,804,591	12,802,492	61,513,008
27012000	Briquettes, ovoids and similar solid fuels manufactured from coal	12	727	0
27021000	Lignite, not agglomerated	110,544	16,751	10
27022000	Agglomerated lignite	70,818	26,921	0
27030000	Peat (incl. peat litter)	0	13,551	68,216
27040000	Coke and semi-coke of coal, of lignite or of peat; retort carbon	30,298	574	0
27050000	Coal gas, water gas, producer gas and similar gases, not petroleum gases	10,227	1,377	20,164
27060000	Tar distilled from coal, lignite or peat, and other mineral tars	1,578	0	4,280
27071000	Benzole	510	0	1
27072000	Toluole	7,429	1,729	0
27073000	Xylole	6,534	0	1,614
27074000	Naphthalene	3,311	15,716	10,612
27075000	Aromatic hydrocarbon mixtures which $\geq 65\%$ distills at 250°C	135,903	176,149	147,684
27079100	Creosote oils	99	0	0
27079900	Other oils and oil products, nes	28,069	6,432	17,615
27081000	Pitch obtained from coal tar or from other mineral tars	0	1,618	44
27082000	Pitch coke obtained from coal tar or from other mineral tars	50,020	0	0
27090000	Petroleum oils and oils obtained from bituminous minerals, crude	43,313	5,872	5,618,124
27101120	Motor Spirit (gasoline) regular	477,666,969	0	0
27101130	Aviation Spirit	450,556	0	0
27101140	Spirit type Jet Fuel	11,976,376	0	0
27101150	Special boiling point spirit and white spirit	704,738	0	0
27101190	Other light oils and preparations	5,375,119	60	0
27101210	Motor spirit (gasoline) regular	0	14,298	20,581
27101220	Motor spirit (gasoline) premium	356,647,017	1,029,899,983	1,008,168,317
27101230	Aviation spirit	359,071	582,962	497,493
27101240	Spirit type Jet Fuel	5	14	236
27101250	special boiling point spirit and white spirit	547,650	1,203,447	2,482,948
27101290	Other light oils and preparations	1,000	269,698	864,489
27101910	Partly refined (including topped crudes)	10,167,206	13,492,370	16,117,197
27101921	Kerosene type Jet Fuel	261,964,134	309,750,788	240,745,441
27101922	Illuminating Kerosene (IK)	46,071,412	84,192,196	81,365,091
27101929	Other medium oils and preparations	554,943	1,273,637	10,309,869
27101931	Gas oil (automotive, light, amber for high speed engines)	2,000,123,059	2,783,510,409	2,242,433,155
27101932	Diesel oil (industrial heavy, black, for low speed marine and statio	22,028	12	23,288
27101939	Other gas oils	251	39,248	15,615
27101941	Residual fuel oils(marine, furnace and similar fuel oils) of a Kine	505	12,963,648	1,153
27101942	Residual fuel oils (marine, furnace and similar fuel oils) of a Kin	183,438,334	223,031,981	237,957,768
27101943	Residual fuel oils (marine, furnace and similar fuel oils) of a Kin	5,561,380	587,824	17
27101949	Other residual fuels	2,066,413	31,192	407
27101951	Lubricating oils	14,040,843	13,974,378	13,117,209

Appendix 7 (Ctd): Import of Petroleum and Petroleum product (Net weight Kg) 2012 – 2014

HS Codes	Commodity Description	2012	2013	2014
27101952	Lubricating greases	2,872,610	2,574,176	1,943,762
27101953	Mould release oils	13,607	19,496	20,534
27101954	Batching oils	635	1,794	1,688
27101955	Transformer oils	828,107	702,496	877,332
27101956	Non-lubricating oils (cutting oils, coolants, anti-rust, brake fluids)	1,598,451	1,049,458	1,522,547
27101957	White oil-Technical grade	8,918,868	12,999,868	20,764,637
27101959	Other: Petroleum oils and oils obtained from bituminous minerals, oth	316,527	503,502	364,937
27102000	Petroleum oils and oils obtained from than crude and preparation nes	0	261	15,980
27109100	Containing polychlorinated biphenyls (PCBs), polychlorinated terphenyls (P	1,729	824	17
27109900	Other: Petroleum oils and oils obtained from bituminous minerals, other: Was	34,895	15,922	4,589
27111100	Natural gas, liquefied	1,085,070	225	112
27111200	Propane, liquefied	1,184	0	19,834
27111300	Butanes, liquefied	11,192,623	73,910,973	58,929,065
27111900	Petroleum gases and other gaseous hydrocarbons, liquefied, nes	67,881,593	28,134,455	18,944,704
27112100	Natural gas in gaseous state	0	421	124
27112900	Petroleum gases and other gaseous hydrocarbons in gaseous state, nes	1,867	803	3,561
27121000	Petroleum jelly	633,647	462,786	817,267
27122000	Paraffin wax, containing <0.75% oil	4,016,349	2,302,550	1,921,309
27129000	Other paraffin wax... and similar products, nes	9,254,560	9,052,398	8,414,582
27131100	Petroleum coke, not calcined	1,239,139	0	41,724,000
27131200	Calcined petroleum coke	3,249,645	67,773	68,484
27132000	Petroleum bitumen	41,719,731	45,739,253	28,770,433
27139000	Other residues of petroleum oils , e.t.c.	751,867	1,524	1,200
27141000	Bituminous or oil shale and tar sands	5,765	178,910	4,612
27149000	Bitumen and asphalt; natural asphaltites and asphaltic rocks	10,174,246	9,695,752	5,910,617
27150000	Bituminous mixtures based on natural asphalt, bitumen...(e.g. cut-backs)	20,759,912	9,144,362	2,606,287
27160000	Electrical energy	5	1,184	4,429

Appendix 8: Grid Generation – KWH and Isolated Stations – Generation Units (KWH)**Appendix 8(i): Grid Generation – KWH**

HYDRO	2005	2006	2007	2008	2009	2010	2011	2012
Kidatu	683,274,000	488,103,000	1,028,637,000	1,061,637,000	1,097,838,000	1,110,576,000	759,343,000	710,728,000
Kihansi	616,582,500	500,805,300	664,546,900	893,150,200	845,615,610	867,315,880	772,845,330	590,933,100
Mtera	233,248,000	96,784,000	421,971,000	344,019,000	451,109,000	433,305,000	229,254,000	261,717,000
Hale	51,131,140	62,038,500	69,247,200	60,184,410	43,044,549	48,955,570	2,548,660	31,894,520
Nyumba ya Mungu	23,199,950	22,256,500	27,068,250	25,061,650	32,880,950	30,166,550	29,346,200	37,391,160
New Pangani	170,624,600	266,256,400	309,461,300	261,991,800	166,685,500	207,936,100	197,322,200	131,581,460
Uwemba Minhydro	0	0	2,699,742	2,866,292	3,293,739	2,814,914	1,916,734	2,348,004
Total Hydro	1,778,060,190	1,436,243,700	2,523,631,392	2,648,910,352	2,640,467,348	2,701,070,014	1,992,576,124	1,766,593,244
Thermal								
Ubungo Wartsila (UGP1)				266,067,728	622,010,424	679,498,036	631,348,500	667,571,000
Tegeta - Gas					15,047,400	243,728,500	320,225,300	286,671,100
Ubungo-GT-ABB (UGP2)	0	0	0	0	0	0	0	244,673,850
Ubungo-EPP	0	0	0	0	0	0	0	0
Arusha						0	0	0
Ubungo	3,694,700	4,088,000	28,500	0		0	0	0
Iyunga	550,300	1,733,100	15,100	0	0	0	0	0
Zuzu	1,656,580	9,410,423	316,750	2,084,360	2,426,910	1,062,099	5,406,920	4,910,790
Tabora	2,545,300	4,735,400	95,600	4,200	0	0	0	0
Nyakato	918,500	221,400	0	0	0	0	0	0
Mwanza South						0	0	0
Musoma	0	0	0		0	0	0	0
Njombe			1,258,878	3,377	0	0	0	0
Total Thermal	9,365,380	20,188,323	1,714,828	268,159,665	639,484,734	924,288,635	956,980,720	1,203,826,740
Total TANESCO Grid	1,787,425,570	1,456,432,023	2,525,346,220	2,917,070,017	3,279,952,082	3,625,358,649	2,949,556,844	2,970,419,984

Zero figure indicate one of the following possibilities (i) No generation at all (ii) Station not yet operating or not installed

Source: TANESCO

Appendix 8(ii): Isolated Stations – Generation Units (KWH)

Thermal	2005	2006	2007	2008	2009	2010	2011	2012
Ikwiriri	1,404,965	1,493,008	1,672,852	1,771,322	2,299,602	2,824,805	271,197	0
Kigoma	14,702,532	17,251,170	14,720,302	17,818,420	15,185,844	21,222,772	23,076,031	23,408,746
Kilwamasoko	2,194,265	2,416,182	2,147,943	2,335,669	2,466,410	1,364,167	0	0
Kasulu	0	0	0	0	0	0	179,508	2,170,879
Lindi	6,397,659	6,129,621	3,408,063	35,631	0	0	0	0
Liwale	839,959	1,122,966	1,303,948	1,311,963	1,322,900	966,788	1,309,268	1,058,149
Masasi	15,085,670	15,959,159	16,385,625	13,740,248	13,228,646	10,116,748	0	0
Mpanda	4,194,370	4,456,270	4,937,490	3,945,130	4,572,820	6,956,560	7,600,490	8,282,031
Mtwara	14,488,442	13,070,415	581,718	0	0	0	0	50,022,080
Njombe	5,472,053	5,009,423	0	0	2,660,280	0	0	0
Sumbawanga	0	0	0	0	0	0	2,448,076	10,953,410
Songea	15,579,584	15,445,144	15,082,822	17,145,766	16,381,306	18,762,319	19,285,314	20,598,696
Tunduru	2,174,130	2,330,398	2,611,770	1,830,030	2,851,420	3,754,970	3,939,440	3,729,930
Somanga	0	0	0	0	0	0	5,463,600	11,803,100
Mafia	2,920,240	2,857,190	2,819,680	2,153,170	2,660,280	2,704,770	3,509,800	4,160,250
Kibondo	0	0	0	0	0	0	133,710	1,544,006
Babati	0	0	0	0	0	0	0	0
Bukoba	73,790	26,710	103,230	94,110	124,300	157,560	69,310	163,200
Ngara	1,106,430	1,773,030	2,076,275	2,170,606	2,572,690	2,775,240	3,011,790	3,157,165
Biharamulo	1,247,040	2,010,716	2,381,335	2,617,830	2,416,980	3,297,256	3,656,960	3,719,870
Mbinga	0	0	0	1,135,556	2,132,666	3,104,591	3,393,258	4,008,97
Loliondo	0	0	0	0	0	0	0	240,066
Ludewa	0	0	0	102,173	647,009	849,036	876,324	886,156
Total Isolated	87,881,129	91,351,402	70,233,053	68,207,624	71,523,153	78,857,582	78,224,076	149,905,931
TANESCO Total	1,875,306,699	1,547,783,425	2,595,579,273	2,985,277,641	3,351,475,235	3,703,881,802	3,027,780,920	3,120,325,915

Appendix 9: Mean Distance (km) and time (in Minutes) to the nearest sources of water in dry season and place of firewood collection - Mainland Tanzania.

		Urban areas		Group Total	Rural areas		Group Total
		Type of facility			Type of facility		
		Nearest water supply in dry season	Nearest place for collecting firewood/charcoal	Mean	Nearest water supply in dry season	Nearest place for collecting firewood/charcoal	Mean
		Mean	Mean		Mean	Mean	
Dodoma	Distance to facility (km)	0.74	1.23	0.99	1.64	2.73	2.19
	Time to facility in minutes	10.02	16.25	13.14	20.30	32.99	26.65
Arusha	Distance to facility in km	0.21	0.33	0.27	2.59	2.82	2.71
	Time to facility in minutes	5.16	6.94	6.03	33.31	29.69	31.50
Kilimanjaro	Distance to facility in km	0.68	1.45	1.07	1.29	1.46	1.38
	Time to facility in minutes	16.64	33.98	25.36	25.61	29.86	27.72
Tanga	Distance to facility in km	0.47	1.73	1.10	2.89	3.16	3.02
	Time to facility in minutes	8.23	20.31	14.35	34.95	38.97	36.96
Morogoro	Distance to facility in km	0.85	0.82	0.83	1.01	2.83	1.92
	Time to facility in minutes	25.80	17.61	21.74	20.90	53.01	36.97
Pwani	Distance to facility in km	0.33	0.90	0.61	0.98	1.69	1.33
	Time to facility in minutes	9.40	29.07	19.12	19.12	30.13	24.61
Dar es salaam	Distance to facility in km	0.48	0.21	0.34	.	.	.
	Time to facility in minutes	8.86	7.05	7.95	.	.	.
Lindi	Distance to facility in km	0.82	2.38	1.60	1.44	1.59	1.52
	Time to facility in minutes	15.69	35.66	25.63	23.35	27.06	25.20
Mtwara	Distance to facility in km	0.90	1.43	1.17	2.67	3.19	2.93

Appendix 9 (Ctd): Mean Distance (km) and time (in Minutes) to the nearest sources of water in dry season and place of firewood collection - Mainland Tanzania.

		Urban areas		Group Total	Rural areas		Group Total
		Type of facility			Type of facility		
		Nearest water supply in dry season	Nearest place for collecting firewood/charcoal	Mean	Nearest water supply in dry season	Nearest place for collecting firewood/charcoal	Mean
		Mean	Mean		Mean	Mean	
Ruvuma	Time to facility in minutes	15.08	25.94	20.44	42.36	66.18	54.28
	Distance to facility in km	0.11	1.00	0.55	0.27	1.97	1.12
Iringa	Time to facility in minutes	7.29	21.87	14.53	12.54	62.21	37.38
	Distance to facility in km	0.47	1.15	0.81	0.92	3.62	2.27
Mbeya	Time to facility in minutes	10.69	27.27	18.97	19.06	60.83	39.97
	Distance to facility in km	0.24	1.26	0.75	0.40	1.87	1.13
Singida	Time to facility in minutes	10.19	27.39	18.84	21.71	44.28	32.93
	Distance to facility in km	1.27	1.86	1.57	1.30	3.42	2.35
Tabora	Time to facility in minutes	14.49	21.65	18.03	19.74	44.78	32.10
	Distance to facility in km	0.44	1.42	0.92	1.71	2.52	2.12
Rukwa	Time to facility in minutes	10.16	22.87	16.41	25.54	33.82	29.69
	Distance to facility in km	0.36	1.59	0.97	1.23	2.30	1.76
Kigoma	Time to facility in minutes	14.14	31.27	22.59	22.18	56.52	39.14
	Distance to facility in km	1.05	1.69	1.37	1.14	6.22	3.68
	Time to facility in minutes	12.90	20.99	16.96	16.05	59.22	37.63

Appendix 9 (Ctd): Mean Distance (km) and time (in Minutes) to the nearest sources of water in dry season and place of firewood collection - Mainland Tanzania.

		Urban areas		Group Total	Rural areas		Group Total
		Type of facility		Mean	Type of facility		Mean
		Nearest water supply in dry season	Nearest place for collecting firewood/charcoal		Nearest place for collecting firewood/charcoal		
		Mean	Mean	Mean	Mean		
Shinyanga	Distance to facility in km	2.40	1.77	2.09	3.11	4.20	3.65
	Time to facility in minutes	32.07	27.94	30.05	35.75	46.98	41.29
Kagera	Distance to facility in km	0.88	1.16	1.02	1.29	1.89	1.59
	Time to facility in minutes	12.79	15.91	14.34	32.59	29.61	31.10
Mwanza	Distance to facility in km	0.67	0.81	0.74	1.80	1.94	1.87
	Time to facility in minutes	15.55	19.09	17.32	27.20	31.64	29.41
Mara	Distance to facility in km	0.40	0.52	0.46	2.49	2.89	2.69
	Time to facility in minutes	7.92	8.24	8.08	28.97	38.03	33.50
Group Total	Distance to facility in km	0.58	0.88	0.73	1.63	2.74	2.19
	Time to facility in minutes	11.95	17.39	14.66	26.13	42.11	34.10

Appendix 10: Weight and Value of Export Fish Data by Country of Destination for the Year 2012.

Country of Destination	Weight in kgs	Live Fish in Pcs	FOB value in USD	FOB value in TZS.	Royalty in TZS.
Angola	1,080.0	0	8,297.00	12,690,000.00	123,000.00
Australia	588,463.0	0	3,191,825.00	4,988,829,328.33	118,166,938.67
Belgium	1,414,695.0	0	7,716,590.40	12,023,481,441.65	267,657,203.84
Thailand	280.0	230	7,622.00	12,093,330.28	553,288.00
Botswana	2,450.0	0	12,693.78	20,128,776.22	1,480,762.00
Brazil	4,730.0	0	1,540.00	2,440,900.00	187,430.00
Brighton VIC	54,000.0	0	282,600.00	440,301,096.00	10,095,837.84
Burundi	445,393.6	0	1,252,924.94	1,967,034,286.25	73,595,005.76
Canada	37,780.7	1,821	159,683.31	253,973,742.74	16,301,876.00
China	75,271.0	480	621,495.16	979,944,466.78	51,358,635.00
Columbia	36,980.0	0	200,200.00	313,410,536.00	7,039,426.00
Cuba	52,800.0	0	303,600.00	472,606,863.96	9,863,099.77
Cyprus	280,410.0	0	1,233,345.00	1,926,266,796.00	55,862,625.83
Czech Republic	0.0	766	4,744.00	7,497,406.00	505,507.00
Denmark	1,485,338.0	911	7,036,787.30	10,975,521,578.30	318,620,157.08
DRC	4,675,797.5	0	4,233,343.45	6,793,742,809.99	195,092,722.50
Spain	50,400.0	0	249,000.00	387,703,668.00	9,420,540.60
Ethiopia	26,325.0	0	105,762.00	167,690,860.00	5,756,479.03
France	744,564.0	1,486	3,547,019.40	5,556,574,122.13	144,155,082.77
Germany	268,780.5	12,692	1,380,541.00	2,131,419,550.60	53,187,788.22
Greece	412,472.0	0	1,918,382.83	2,886,491,530.37	78,129,139.76
Hong Kong	829,787.0	4,612	12,632,174.75	19,739,715,883.56	296,983,430.27
Reunion	18,000.0	0	99,000.00	154,242,000.00	3,365,280.00
Israel	1,449,930.0	0	7,887,557.00	12,314,870,963.11	283,610,406.87
Italy	4,328,099.1	0	18,563,377.39	28,949,647,173.55	892,038,468.50
Japan	1,049,739.0	278	5,987,029.40	9,330,302,598.38	193,291,808.51
Jordan	504.0		3,603.60	5,592,068.64	93,852.90
Kenya	8,008,621.5	0	10,787,358.51	16,918,535,286.60	784,664,155.40
Malawi	418,161.0	0	313,367.25	489,679,033.32	19,649,500.00
Malaysia	33,916.0	572	228,444.00	356,491,037.20	7,053,504.11
Malta	59,730.0	0	275,381.00	430,507,071.24	16,056,735.00
Mauritius	16,800.0	0	85,680.00	133,755,810.55	3,147,196.00
Mexico	24,000.0	0	120,000.00	187,374,648.00	4,496,992.00
Murcia	35,952.0	0	166,729.20	260,843,986.57	6,748,225.00
India	35,360.0	0	20,459.70	32,408,985.00	2,848,950.00
Netherlands	3,733,694.7	0	19,028,519.89	29,714,682,998.81	784,813,105.28
Norway	28.0	0	14.25	22,520.00	3,300.00
Philippines	24,000.0	226	92,782.00	144,866,616.00	5,651,103.81
Polland	750.0	500	4,170.00	6,513,651.20	493,620.00
Portigual	1,729,634.5	0	8,193,371.51	12,570,660,269.10	489,027,128.78
Romania	349,678.0	0	1,942,185.80	3,024,930,021.15	65,714,431.40
Rwanda	1,128,317.0	0	1,058,537.83	1,666,122,180.39	84,064,345.19
South Korea	26,218.7	987	198,055.83	314,504,204.80	10,992,736.00
Saud Arabia	529,810.0	0	3,441,751.20	5,469,789,477.26	98,947,231.00

Appendix 10 (Ctd): Weight and Value of Export Fish Data by Country of Destination for the Year 2012.

Country of Destination	Weight in kgs	Live Fish in Pcs	FOB value in USD	FOB value in TZS.	Royalty in TZS.
Scotland	55.4	0	111.00	178,155.00	6,470.00
Singapore	270,349.0	3,928	1,184,827.32	1,868,509,366.60	174,726,501.14
South Africa	1,106.2	0	7,076.00	11,033,668.29	217,211.85
Spain	1,389,182.0	0.0	7,467,918.3	11,642,340,982.0	236,248,243.6
Sweden	8.0	764	3,756.13	5,966,162.00	1,110,875.29
Taiwan	0.0	112	320.00	503,800.00	74,795.00
Iran	89,004.0	0	530,374.60	913,000,000.82	16,632,026.76
Thailand	5,850.0	0	99,250.00	156,815,001.00	5,374,730.00
Tortola Island	1,165,400.0	0	6,697,376.40	10,440,320,380.29	248,672,218.68
Turkey	60,140.0	9,210.0	267,130.6	422,430,007.1	26,930,567.0
UAE	2,427,726.8	200	17,399,671.06	27,142,720,084.49	444,010,515.64
Uganda	354,378.0	0	487,394.52	760,066,299.29	12,054,975.00
UK	24,414.0	320	99,621.70	159,140,604.00	1,250,640.00
U S A	180,140.0	5,455	867,348.00	1,377,050,817.00	79,015,492.00
Venezuela	24,000.0	0	139,250.00	220,931,126.00	4,488,437.00
Vietam	114,376.0	0	1,149,790.60	1,817,589,432.31	30,821,181.00
Zambia	793,123.9	0	2,407,786.12	3,592,705,165.15	71,570,500.52
Zimbabwe	42,226.0	0	59,545.70	94,658,472.51	2,560,800.00
Total	41,394,267.9	45,550	163,299,365.50	254,901,017,111.31	6,819,926,007.14

Appendix 11: Concepts/Definitions of Environment Terms.

1 Afforestation

An establishment of forest through planting and/or deliberate seeding on land that, until then was not classified as forest.

2 Air-borne Disease

A disease that is generally transmitted by nasopharyngeal discharges and by respiratory secretions, through coughing and sneezing, though it may also be conveyed through close contact. Respiratory diseases include the common childhood infections, measles, whooping cough, chickenpox, mumps, diphtheria and acute sore throat as well as disease of the respiratory tract, influenza and other acute viral infection, the pneumonias and pulmonary tuberculosis (WHO, 1992).

3 Air Pollution

The presence of contaminant or pollutant substances in the air that do not disperse properly and those which interfere with human health or welfare or produce other harmful environmental effects.

4 Biodiversity

Biodiversity is the variability among living organism from all sources including terrestrial, marine and other.aquatic ecosystems and the ecological complexes of which they are a part including diversity within within species, between species and of ecosystem

5 Biogas

Mixture of methane and carbon dioxide in the ratio of 7:3 that is produced by the treatment of animal dung, industrial wastes and crop residues.

6 Catchments Area

Area from which rainwater drains into river systems, lakes and seas.

7 Climate Change

A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climatic variability observed over comparable time periods.

8. Deforestation

The conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold.

9 Depletion

(In Natural Resource Accounting - NRA): for renewable resources, the part of the harvest, logging, catch and so forth above the sustainable level of the resource stock; for **non-renewable resources**, the quantity of resources extracted.

10 Desertification

Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations (drought) and human activities (overexploitation of dry lands).

11 Disposal of Waste

Waste elimination techniques comprising landfills, containment, underground disposal, dumping at sea and all other disposal methods.

12. Drought

Prolonged absence or marked deficiency of precipitation which may contribute to desertification.

13 Ecosystem

A dynamic complex of plant, animal and microorganism communities and their non living environment interaction as a functional unit.

14 Effluent

Liquid waste product (whether treated or untreated), discharge from an industrial process or human activity that is discharged into the environment.

15. Emission

Discharge of pollutants into the atmosphere from stationary sources such as smokestacks, other vents, surface areas of commercial or industrial facilities and mobile sources for example, motor vehicles, locomotives and aircraft.

16. Endangered Species

Taxa in danger of extinction and whose survival is unlikely if causal factors continue operating. Included are taxa whose numbers have been drastically reduced to a critical level or whose habitats have been so drastically impaired that they are deemed to be in

immediate danger of extinction. Also included are those that possibly are already extinct, in so far as they definitely have not been seen in the wild in the past 50 years.

17. Energy Sources

All solid, liquid and gaseous fuels; electricity; uranium; steam and hot water; and the traditional fuels such as fuel wood, charcoal, vegetable and animal wastes.

18. Erosion

Wearing away and transport of the soil by wind or running water, glaciers or waves. Erosion occurs naturally but is often intensified by human land-clearing activities related to farming, animal rearing, residential or industrial development.

19. Exhaust Gases

Gases produced by the burning of petrol (gasoline) in combustion engines. Exhaust gases are harmful to human beings, plants and animals.

1.6.18 Extinct Species

Species not definitely located in the wild during the past 50 years.

20. Fossil Fuels

Coal, oil and natural gas. They are derived from the remains of ancient plant and animal life.

21. Fuel Wood

All wood in the rough used for fuel purposes. It is common non-commercial biological fuel.

22. Geologic Hazard

Extreme natural events in the crust of the earth that pose a threat to life and property, for example, earthquakes, volcanic eruptions, floods, drought and land slides.

23. Greenhouse Effect

Warming of the earth's atmosphere caused by a build-up of carbon dioxide and other greenhouse or trace gases that act like a pane of glass in a greenhouse, allowing sunlight to pass through and heat the earth but preventing a counterbalancing loss of heat.

24. Ground water

Water that collects in porous layers of underground formations known as aquifers

- 25. Habitat**
Place where an organism (human animal, plant, micro-organism) lives.
- 25. Hazardous Waste**
Wastes that, owing to their toxic, infectious, radioactive or flammable properties pose a substantial actual or potential hazard to the health of human and other living organisms and the environment.
- 26. Household Waste**
Waste material usually generated in the residential environment. Waste with similar characteristics may be generated in other economic activities and can thus be treated and disposed of together with household waste.
- 27. Hydrocarbons**
Compounds of hydrogen and carbon in various combinations which are present in petroleum products and natural gas. Some hydrocarbons are major air pollutants, some may be carcinogenic and other contribute to photochemical smog.
- 28. Indoor Air Pollution**
Chemical, biological and physical contamination of indoor air. It may result in adverse health effects. In developing countries the main source of indoor air pollution is biomass smoke which contains suspended particulate matter (SPM), nitrogen dioxide (NO₂), sulphur dioxide (SO₂), carbon monoxide (CO), formaldehyde and polycyclic aromatic hydrocarbons. In industrialized countries in addition to NO₂, CO and formaldehyde, radon, asbestos, mercury, human made mineral fibres, volatile organic compounds, allergens, tobacco smoke, bacteria and viruses are the main contributors to indoor air pollution.
- 29. Industrial Wastes**
Liquid, solid and gaseous wastes originating from the manufacture of specific products.
- 30. Land Degradation**
Reduction or loss of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest or woodlands resulting from nature processes, land uses or other human activities and habitation patterns such as land contamination, soil erosion and destruction of the vegetation cover.
- 31. Land Use**
Information on land cover and the types of human activity involved in land use.

- 32. Logging**
Process of harvesting trees, sawing them into appropriate lengths and transporting them to a sawmill.
- 33. Marginal Settlements**
Housing units that, lacking basic amenities, are not considered fit for human habitation.
- 34. Marine Park**
Permanent marine reservation for the conservation of species.
- 35. Marine Pollution**
Direct or indirect introduction by humans of substances or energy into the marine environment, resulting in harm to living resources, hazards to human health, hindrances to marine activities including fishing, impairment of the quality of sea water and reduction of amenities.
- 36. Mercury**
Heavy metal that can accumulate in the environment and is highly toxic if breathed or swallowed.
- 37. Methane (CH₄)**
Colourless, non-poisonous and flammable gaseous hydrocarbon created by anaerobic decomposition of organic compounds. Methane is an important greenhouse gas.
- 38. Municipal Wastes**
Wastes produced by residential, commercial and public services sectors that are collected by local authorities for treatment and/or disposal in a central location.
- 39. Natural Disaster**
Sudden calamitous event as in the case of earthquakes, tsunamis, floods, volcanic eruption, cyclones and landslide or ongoing misfortune as in conditions or processes such as drought and desertification.
- 40. Nitrate**
Nitrogen-containing compound that can exist in the atmosphere or as a dissolved gas in water.

- 41. Nitrites**
Nitrous oxide salts used in food preservation.
- 42. Nitrogen Oxygen Demand (NOD)**
Quantitative measure of the amount of the dissolved oxygen required for the biological oxidation of nitrogenous material.
- 43. Noise Pollution**
Sound at excessive levels that may be detrimental to human health.
- 44. Ocean Dumping**
Deliberate disposal of hazardous wastes at sea from vessels, aircraft, platforms or other human-made structures
- 45. Open Dump**
Uncovered site used for disposal of waste without environmental controls.
- 46. Overgrazing**
Grazing by livestock or wildlife to the point where the grass cover is depleted, leaving bare, unprotected patches of soil.
- 47. Ozone**
Pungent, colourless, toxic gas that contains three atoms of oxygen in each molecule. In the stratosphere, ozone provides a protective layer shielding the earth from the harmful effects of ultraviolet radiation on human beings and other biota.
- 48. Ozone Depletion**
Destruction of ozone in the stratosphere, where it shields the earth from harmful ultraviolet radiation.
- 49. Pest**
Species, viruses, bacteria and other micro-organism considered harmful to the health of human beings, crops and other living organisms.
- 50. Pesticide**
Any substance or mixture of substances that is used to prevent, destroy or control pests – including vectors of human or animal disease, and unwanted species of plants or animals

51. pH Value

Measure of the acidity or alkalinity of a liquid. A pH value in the range 0 to 7 indicates acidity, a pH value in the range of 7 to 14 indicates alkalinity, and pH value of 7 signifies neutrality.

52. Physical Pollution

Pollution caused by colour (change), suspended solids, foaming, temperature conditions or radioactivity.

- 53. Plankton**
Floating or weakly swimming plant and animal life in water, often microscopic in size
- 54. Pollutant**
Substance that is present in concentrations that may harm organisms (humans, plants and animals) or exceed an environmental quality standard.
- 55. Pollution**
Presence of substances and heat in environmental media (air, water, land) whose nature, location or quantity produces undesirable environmental effects or activity that generates pollutants.
- 56. Precipitation**
Rain or snow falling from the atmosphere and deposited on land or water surface; or forced removal of particles from flue gases or wastewater.
- 57. Rain Shadow**
Area in which there is little or no rainfall because it is located to the leeward side of mountains, the opposite side being exposed to moisture-laden winds.
- 58. Red Tide**
Proliferation of marine plankton that is toxic and often fatal to fish. This natural phenomenon is stimulated by phosphorous and other nutrients that are discharged into water ways by human beings.
- 59. Reforestation**
Artificial or natural re-establishment of forest in an area that was previously under forest cover.
- 60. Remote sensing**
The science of obtaining information about objects or areas from a distance typically from air craft or satellites.
- 61. Reservoir**
Place where water is collected and stored in large quantities for use when required.
- 62. River Basin**
Total land area drained by a river and its tributaries.

- 63. Round Wood**
Wood in the rough, that is, wood in its natural state as felled or otherwise harvested, with or without bark, round, split roughly squared or in some other form.
- 64. Run-Off**
Portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams.
- 65. Salinity**
Salt content of environmental media.
- 66. Salinization**
Increase in salt concentration in an environmental medium, notably soil. It is also known as salination.
- 67. Sanitation**
Improvement of environmental conditions in households that affect human health by means of drainage and disposal of sewage and refuse.
- 68. Semi-arid Zones**
Area where annual rain fall is between about 250 to 600 millimetres (mm), rainfall seasonal and variable, and potential evaporation high.
- 69. Sewage**
Organic waste and wastewater produced by residential and commercial establishments.
- 70. Species**
All the individuals and populations of a particular kind of organism, maintained by biological mechanism that result in their breeding only with their own kind.
- 71. Swamp**
Type of wetland with water standing permanently or for a considerable period of time and with a dense cover of native vegetation.
- 72. Toxicity**
Ability of a substance to cause poisonous effect resulting in severe biological harm or death after exposure to, or contamination with, that substance.

- 73. Toxic Pollutants**
Materials contaminating the environment that cause death, disease and/or birth defects in the organism that ingest or absorb them.
- 74. Tsunami**
Transliteration of Japanese term meaning “**storm wave**”, giant ocean wave produced by a seismic disturbance beneath the ocean floor.
- 75. Urban Run-off**
Storm water from city streets and adjacent domestic or commercial properties that contain litter, and organic and bacterial wastes.
- 76. Urban Sprawl**
Expansion of an urban area to accommodate its growing population.
- 77. Vector-bone diseases**
Diseases that are transmitted by organisms (e.g. insects and arachnids) that carry viruses, bacteria, protozoa and other pathogens. Common vector-bone diseases include, but are not limited to malaria, dengue fever, yellow fever and Lyme diseases. Some vector-bone diseases are being directly affected by climate change, notably by the change in rain patterns and floods.
- 78. Vegetation Cover**
All trees, shrubs, herbs, deciduous plants and so forth that cover an area or region.
- 79. Vulnerability**
Measure of the extent to which a community, structure, service or geographical area is likely to be damaged or disrupted, on accounts of its nature or location, by the impact of a particular disaster hazard.
- 80. Waste**
Materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purpose of production, transformation or composition, and of which he/she wants to dispose.
- 81. Wastewater**
Wastewater is discarded water that is no longer required by the owner or user.

82. Water Pollution

Presence in water of harmful and objectionable material – obtained from sewers, industrial wastes and rain water run – off – in sufficient concentrations to make it unfit for use.

83. Wetland

Area of low-lying land where the water table is at or near the surface most of the time. Wetlands include swamps, bogs, fens, marshes and estuaries.

84. Wildlife Refuge

Area designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly regulated.

85. Wildlife Reserve

Area of land reserved for occupancy by wild animals.

Appendix 12: Sources of Domestic Energy Data

Data on prevalence, quantities and values of the sources of domestic energy can be obtained from surveys, research studies and administrative records from sector ministries such as the Ministry of Natural Resources and Tourism (MNRT), Ministry of Energy and Minerals (MEM); and government and non government institutions dealing with environment such as National Environment Management Council (NEMC), Vice President's Office-Division of Environment (VPO-DOE), Institute of Resource Assessment (IRA), University College of Lands and Architectural Studies (UCLAS), the Sokoine University of Agriculture (SUA), Tanzania Fisheries Research Institute (TAFIRI), Tanzania Forest Research Institute (TAFORI) and Tanzania Wildlife Research Institute (TAWIRI).

These insititutions publish documentation materials that contain data on domestic energy, which include the following:-

- Reports from the research studies and research journals.
- Survey reports such as the HBS.
- Regional Socio-Economic Profiles.
- Economic Survey.
- Documents and reports prepared by institutions such as the Forestry Department of the MNRT, NEMC, DOE, and IRA.
- Reports from international and global organizations such as the World Bank (WB), the United Nations (UN), universities and non-governmental organizations.

However, most of the data from these sources are at national level and moreover they cannot be disaggregated into domestic and non-domestic uses.

