THE UNITED REPUBLIC OF TANZANIA

PRESIDENT'S OFFICE – REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

MUSOMA MUNICIPAL COUNCIL

STATE OF THE ENVIRONMENT REPORT

2016

Published by the Municipal Directors' Office, Department of Environment,

Musoma Municipal Council, Mara Region, United Republic of Tanzania, 2016.

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ACRONYMS AND ABBREVIATIONS

BMU: Beach Management Unit

CMT: Council Management Team

D.C: District Council

EA: Environmental Audit

EE: Environmental Education

EIA: Environmental Impact Assessment

EMA: Environment Management Act

LGA: Local Government Authority

LGRP: Local Government Reform Program

LVEMP: Lake Victoria Environmental Management Program

MMC: Musoma Municipal Council

NEMC: National Environmental Management Council

T.C: Town Council

TFS: Tanzania Forest Service

UNDP: United Nations Environment Program

UNEP: United Nations Environment Program

VOC: Volatile Organic Compounds

VPO: Vice President's Office

WDC: Ward Development Committee

WEO: Ward Executive Officer

WWF: World Wild Fund

FOREWORD

Musoma Municipal Council State of the Environment report (2016) presents a comprehensive picture of how Musoma Municipal Council environmental assets are faring, the pressures on them and the actions taken to protect, maintain and restore them. This report is produced to assess the key factors affecting Musoma Municipality's air, land, water and heritage and the progress towards achieving ecologically sustainable development.

Musoma Municipality's environment is essential for maintaining the high quality of life we have become accustomed to, as well as providing a base for Musoma Municipality's economic and social development. Our environment provides many essential ecosystem services that we take for granted on a daily basis, such as clean air and water.

The report has been prepared in collaboration with individuals and organizations from both the private and public sectors. Without the concerted effort and commitment of everyone involved, it would not have been possible to produce such a comprehensive report. I would like to personally thank the many contributors for their assistance over this short period.

The information in this report will further our collective understanding of the status of Musoma environment and inform environmental policy settings and programs. It will help policy makers, policy implementers, decision makers and investors to make informed actions and try as much as possible to have the environment in mind when doing anything thereby helping to improve on conserving the environment and ensure sustainable development.

This is the first State of the Environment Report for Musoma Municipality to be produced by the Musoma Municipal Council. State of the Environment reports are produced to ensure that decisions made in the pursuit of economic growth and higher living standards are well informed and does not result in unintended consequences arising from the degradation of the environment and the natural assets on which all life depend.

This report explores the impact of human endeavor on the environment and society's capacity to respond and manage these impacts. This analysis has been achieved by applying the **Driving forces–Pressures– State–Impacts–Responses (DPSIR) framework** (see Diagram 1). The **DPSIR** framework is an internationally accepted approach to assessing environmental performance and the condition and trend of natural capital (Kristensen, 2004).

The approach generally revolved around key assets such as atmosphere, land, water and cultural heritage and examined these primarily in terms of their pressures, state and

responses (EPA, 1999, 2003). The report begins with a general introduction to state of the environment reporting (Chapter 1) and then moves on to investigate the main driving forces that affect Musoma Municipality (Chapter 2). The subsequent chapters include Pressures (Chapter 3), State (Chapter 4), Impacts (Chapter 5) and Responses (Chapter 6). The report concludes with a summary of future challenges (Chapter 7).

In this report, the key natural and cultural assets—atmosphere, water, land and cultural heritage—are central to the discussion. However, they are considered as topics under each of the DPSIR headings. The purpose of adopting this approach was to move away from a purely asset-based approach to reporting and towards a more integrated and synthesized analysis and presentation of issues. Data and information have been provided by a range of sources including field study, literature review and interview.

Hon: Zelothe Steven
Musoma District Commissioner

ACKNOWLEDGEMENT

Musoma Municipal Council is happy to present its first State of Environment Report (SoER). While the Report is in fulfillment of our obligation under the national Environment Management Act (EMA) 2004, section 36 (2) (e), it also aims to provide information on the condition and health of the components of the environment. It describes the quality of environment for the municipal through systematic acquisition, analysis and presentation of information on environmental conditions and trends, and the assessment of key driving forces and policies that cause or influence environmental trends in the area.

I am indebted as the Municipal Mayor to all those who made it possible to produce this document. I wish to extend my sincere thanks to the Municipal Environment Office especially Mr. Fikiri S. Kenyela (Municipal Environment Management Officer) for coordinating and facilitating the production of the first State of Environment Report for our Council.

Special thanks go to various Heads of Department who provided the information on management of the environment. Special appreciation goes to the members of the DSOER task force for producing the report. The contribution of the editors is also acknowledged.

Thanks go to the Town Planning and Environmental Committee for their support. Their effort in guiding the process, political input and approval of the document is acknowledged.

Finally, as we strive to improve future editions, Musoma Municipal Council welcomes your comments and suggestions on this report. I wish you good reading.

Hon. Capt. William Gumbo
Municipal Mayor
Musoma Municipal Council

Introduction

The wellbeing of all dwellers of Musoma Municipality, both now and into the future, is intimately linked to and dependent upon the natural environment. Musoma Municipality's landscape is vast, covering an area of around 63 square kilometers. It encompasses areas such hills, lake, wetlands, rivers to highly modified areas such as built environment (settlement and institutions) and agricultural lands.
Historically, the environment has been regarded as a resource, providing us with minerals, food and fiber, building materials and fuel. More recently, there has been greater acknowledgement of the many other services provided by the environment that are necessary for our long-term survival. These services are known as ecosystem services.

Sustaining healthy, functioning ecosystems to deliver the range of ecosystem services currently available to us will ensure that the state's environment, society and the economy all work together and remain in good condition.

Achieving the right balance between maintaining enough natural capital to deliver nature's free ecosystem services, while supporting the demands of a growing population, is a major challenge for all the people of Musoma. Ecosystems have been naturally adapting to changing conditions and natural disasters over many millennia.

This capacity to absorb change without altering the state is known as 'resilience'. Resilience can be defined as: 'the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks' (Walker et al., 2004). There is a threshold point beyond which the state of the system is altered, sometimes irreversibly. In natural systems, this usually results in a shift from a higher functioning state to a lower one. This change in state leads to a loss of ecosystem function and subsequently, a loss or reduction in ecosystem services.

Human activities often exacerbate and can even drive this shift in state. While it may be possible to rehabilitate and regenerate affected ecosystems to facilitate recovery back to the higher functioning state, this is a costly exercise that may not always succeed. This suggests that, wherever possible, it is far better to prevent these shifts occurring in the first place (TEEB, 2010).

Ecosystem services

All humans depend on nature for their existence and wellbeing—from their basic physical needs such as food, fresh water, fiber or fuel, to requirements such as storm protection and air regulation, or to satisfy more intrinsic needs such as recreation and spiritual fulfillment. The earth's many and diverse ecosystems provide these benefits upon which humans depend. Collectively, ecosystems form the earth's green infrastructure or natural capital and the benefits derived from them are known as ecosystem services.

Ecosystems services are classified as:

• supporting (e.g. soil formation and nutrient cycling)
• provisioning (e.g. food, fibre and water)
• regulating (e.g. regulating climate, flood and disease)
• cultural (e.g. aesthetic, spiritual and educational).

The ecosystem services approach recognizes that in order to maintain healthy ecosystem functions (i.e. the processes that generate ecosystem services), resources should not be used at a rate faster than they can be replenished and/or recycled; or the environment's capacity to absorb and neutralize waste. Additionally, the ecosystem services concept recognizes that the environment provides more than just its productive or extractive value to humans, it provides for spiritual needs and has its own intrinsic value separate to the services it provides. Ecosystem services are an important approach for directly relating human health and wellbeing to environmental health and wellbeing.

In Tanzania, state of the environment reporting includes an assessment of the state of major environmental and cultural assets and the identification of significant trends. Reporting also includes a review of the significant programs, activities and achievements of public authorities in the protection, maintenance, restoration and enhancement of the state's environment.

Statutory requirements

State of the environment reporting in Tanzania is a statutory requirement under the *Environmental Management Act* (EMA) *No.20 of 2004.* The EMA requirement applies to Tanzania's environment generally. The EMA require the preparation of an assessment of the state of the environment. This report is designed to meet the requirements of EMA No. 20 of 2004*and it is intended to;*

• identify significant trends in environmental values
• review significant programs, activities and achievements of persons and public authorities relating to the protection, restoration or enhancement of the environment.
• evaluate the efficiency and effectiveness of environmental management strategies implemented to achieve the objects of the Acts.

Scope

The scope of this report is broad, examining a range of physical and cultural topics. The physical aspects revolve around the state's major natural assets of atmosphere, water and land. The cultural aspects relate to Tanzania's heritage given that the country's history and traditions greatly influence the present, including how the environment is perceived, used and managed.

The topics considered in this report are consistent with the definition of the environment provided in section 3 of the EMA: "environment" includes the physical factors of the surroundings of human beings, including air, land, water, climate, sound, light, odour, taste, micro-organism, the biological factors of animals and plants, cultural resources and the social economic; factor of aesthetics and includes both the natural and the built environment and the way they interact;

The importance of reporting

The EMA outlines that the protection of Tanzania's environment is to be achieved by an integrated management program that is consistent with ecologically sustainable development (ESD). Ecologically sustainable development is defined in the EMA as:

"sustainable development" means development that meets the needs of the present generation without compromising the ability of future generations to meet their needs by maintaining the carrying capacity of the supporting ecosystems;

State of the environment reports provides an assessment of Musoma's natural and cultural assets. The findings reflect how well Musoma is responding to environmental challenges, both in reducing or eliminating pressures and the underlying driving forces that cause these pressures. Actions to achieve this include protecting the environment and preventing or limiting damaging activities, restoring and rehabilitating degraded natural assets, and changing behavior and practices to reduce the demand or pressures placed on environmental resources. Usually, a combination of these actions is required to produce the desired outcome of a win–win solution for the economy, society and the environment.

Reporting on the state of the environment is important to ensure accountability of environmental strategies and policies. It also provides objective measures of environmental performance to inform evidence-based decision making and progress towards sustainability. Additionally, state of the environment report plays a role in assisting strategic planning by identifying new and emerging issues that require intervention.

The successful performance of the initiatives instigated by public authorities is often not immediate due to long environmental time lags. Thus, the importance of a continuous reporting system such as state of the environment reporting that assesses progress over time becomes apparent.

Musoma's natural and cultural assets

Musoma natural and cultural assets include the atmosphere, water, land and cultural heritage. These assets are the cornerstone for our existence and support the high quality of life enjoyed by Tanzanians in general and the people of Musoma in particular.

Atmosphere

The atmosphere is essential for life and links all the principal components of the earth's systems including water, land and the organisms living within them. It provides us with clean air, the stratosphere protects us from damaging ultraviolet radiation from the sun, and it plays a major role in regulating climate. Good air quality is critical to the health and wellbeing of all living things that use the atmosphere as the basis of their metabolic processes that sustain life.

Air pollution can result in impacts to public health, ecosystem processes and climate change.

Aquatic ecosystems

Musoma Municipality's aquatic ecosystems are diverse and encompass rivers (riverine) such as rivers found in Bweri, Makoko, Nyasho, and Mwisenge wards, lakes (lacustrine) where Musoma is bordered to Lake Victoria and swamps/ponds (palustrine) like Kitaji pond, and underground water bodies (subterranean) under the entire Musoma terrestrial area.

Land and terrestrial ecosystems

The total area of the Musoma Municipality is 8,207.48 Hectares based on the approved Town Planning Drawing No. 15/MUS/300/012014. With five isolated hills, the land form of Musoma is generally flat.

Analysis of existing land uses provides baseline information for future land requirements, which reflects projected population, social and physical infrastructural facilities. Although all wards in Musoma are considered urban, existing land use depicts both rural and urban characteristics by mixed land uses.

The declaration of Musoma Municipal boundary by the Government is as follows: The boundary starts from the mouth of Msimbi Stream on 6 km Western side of Makoko Seminary, the boundary proceeds in the Southern direction to Barima Hill; thence South Eastern to the Bridge on Kurumuri River along Musoma/Majita Road, thence further South – Southern to the Bridge on Nyangoromoko River along the road to Kiabakari; Nyangoromoko River to Nyahungu River; thence along Nyahungu River to its mouth in Lake Victoria. Then from the mouth of Nyahungu River in the North – Western direction along the Shores of Lake Victoria to the Pint of Commencement.

The main land uses in Musoma include residential, commercial, institutional, industrial, urban farming/agriculture, circulation system/roads and open spaces, hills, valleys and recreational areas. The residential area is further sub-divided into two sub-components namely the planned and unplanned areas. Other land uses include water ponds, sanitation ponds, airport, marine port, cemetery, power station and high tension power line.

Wild animals are rare in Musoma Municipality because of the land use which is largely residential (built environment) which naturally eliminates wild animals. However, some animals like leopard, monkey, hippos and crocodiles appear in Musoma.

Musoma Municipality land terrestrial area appears with a promising tree cover which makes Musoma Municipality appear fairly green. The trees include indigenous and alien species (planted species). Mukendo hill is one of the few natural forests in Musoma Municipality. The forest of Mukendo hill hosts several species of plants, small mammals, reptilia and birds. In the hill bee keeping is one of the conservation measures being undertaken while yielding economic benefits from bee products. Animal husbandry is also practiced. Domesticated animals include cows, poultry, pigs, sheep and goats.

Cultural heritage

Cultural heritage is the invaluable physical, spiritual and intellectual evidence of who and what has been here before us. The tangible cultural heritage includes places and items, while the intangible cultural heritage includes language, spiritual beliefs and stories. The integration of traditional and modern principles into environmental and natural resource management is a key step towards achieving future sustainable outcomes, and encourages the re-establishment of connections between humans and their landscape.

Musoma Municipal Council hosts a primary school at which, Mwalimu Julius Kambarage Nyerere, the father and founder of the United Republic of Tanzania took his primary education. That is Mwisenge primary school located in Mwisenge ward near Lake Victoria. The school has become culturally significant as it demonstrates one of the important records of the icons of Tanzania to be traced in Mara region. Plans are underway to make Mwisenge primary school officially gazetted for illustrating that history by introducing a Mwalimu Nyerere Museum.

DPSIR framework

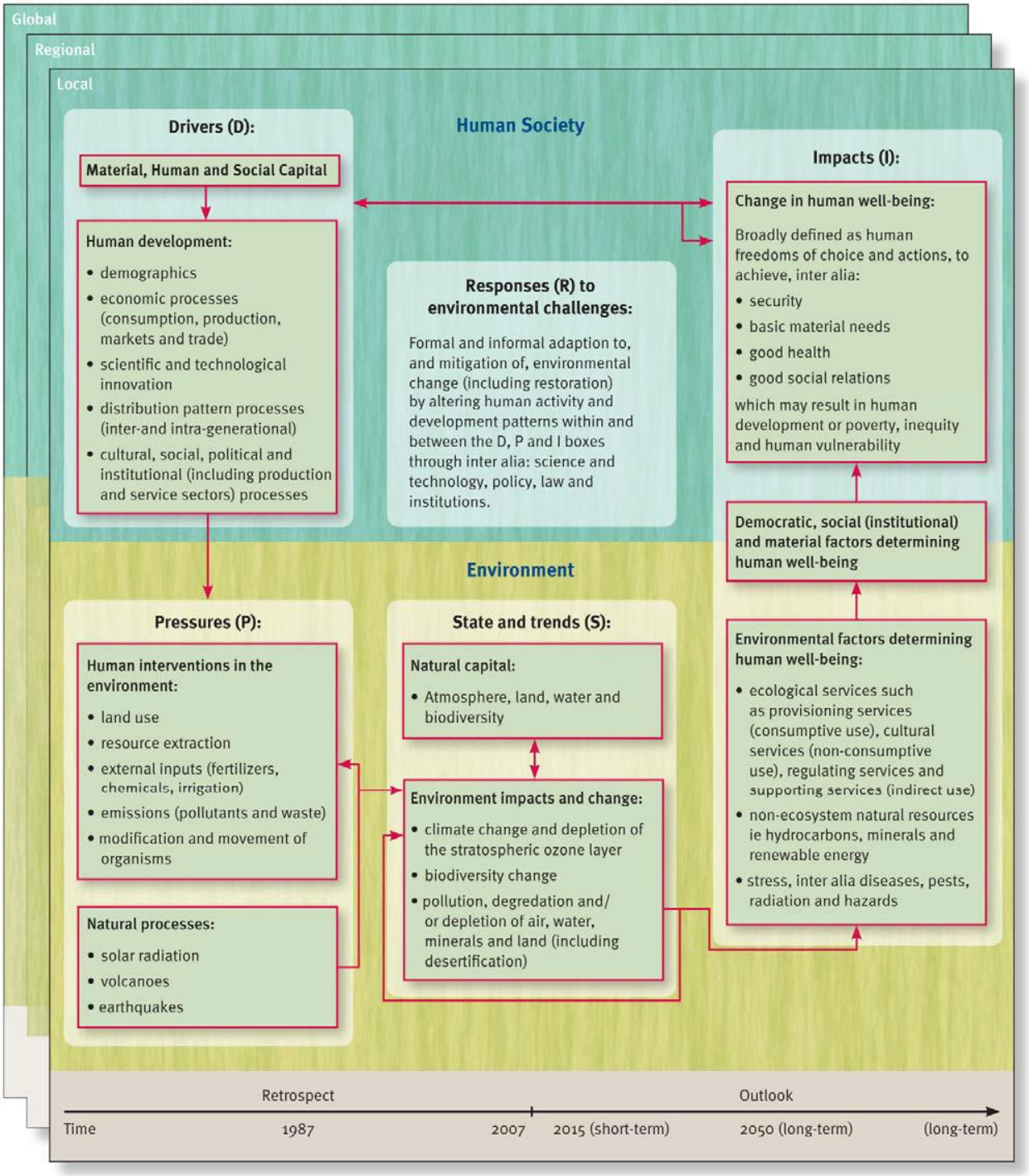
The state of the environment report uses the Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework to explore key contemporary environmental issues for Musoma Municipality. The DPSIR framework was developed by the European Environmental Agency to improve the socio-economic and socio-cultural aspects of environmental reporting.

This framework recognizes the role of humans in environmental degradation and the capacity for society to manage these impacts (Figure 2). Driving forces are the socio-economic, cultural and political forces that guide human activities and that increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State encompasses quantity, quality, extent and/or condition of the environment, while impacts are the consequences of environmental degradation and/or interventions. The responses refer to the actions undertaken by society to improve, manage, mitigate and adapt to environmental changes.

It is widely recognized that the costs of prevention of environmental damage are lower than the costs of rehabilitation or repair of degraded areas and the costs associated with threat of extinction, habitat loss, loss of ecosystem functionality, or impaired human health. Indeed, some environmental damage is irreversible in that no amount of action can remedy the impact. Thus, understanding driving forces and the pressures they exert is critical to the development and implementation of initiatives (legislation, policies, strategies, plans, partnerships and projects) that change human behavior to facilitate sustainable practices and inhibit harmful ones.

The DPSIR framework is not a simple linear cause-and-effect framework. As explained in the Global Environment Outlook 4 report (UNEP, 2007), the conceptual framework reflects the key components of a complex chain of spatial and temporal cause-and-effects and the many feedback loops that characterize the interactions between society and the environment. Environmental changes are induced by drivers and caused by pressures, but they do also affect each other. These changes interact with demographic, social, material and other factors in determining human wellbeing. These processes take place at all spatial scales, from global to local (UNEP, 2007). A key purpose of the framework is to assist with informing an effective transition towards sustainable development.

Source: Adapted from UNEP, 2007 (GEO 4, page 31). *Combining the Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework with the concepts of human wellbeing and ecosystem services.



Source: Adapted from UNEP, 2007 (GEO 4, page 31). *Combining the Driving forces–Pressures–State–Impacts–Responses (DPSIR) framework with the concepts of human wellbeing and ecosystem services.

Figure1: DPSIR framework

Dr. Khalfany Haule
Municipal Director
Musoma.

CHAPTER ONE

1.0 MUSOMA MUNICIPAL COUNCIL AT A GLANCE

1.1 Location and Administrative Boundaries

I.1.1 Location

Musoma Municipality is the head quarter of Mara region in The United Republic of Tanzania. It covers approximately 63 square kilometers. The Municipality sits on the eastern edge of Lake Victoria, close to the International borders of Tanzania with Kenya and Uganda. Musoma is located approximately 60 kilometers (37 mi), directly south of the geographical point where the borders of the three East African countries intersect. The town is located approximately 225 kilometers (140 mi), by road, northeast of Mwanza, the nearest large city. Musoma lies approximately 480 kilometers (300 mi), by road, northwest of Arusha, the location of the headquarters of the East African Community.The coordinates of Musoma are:1° 30' 0.00"S, 33° 48' 0.00"E (Latitude:-1.5000; Longitude:33.8000).

Musoma Municipality is one of the Local Government Authorities (LGAs) of Mara region. Other LGAs are Butiama, Rorya, Serengeti, Musoma D.C, Tarime D.C, Tarime T.C Bunda D.C and Bunda T.C. Mara region has a total surface area of 30,150 square kilometers of which Musoma Municipality takes 2.9 percent. The Municipal is the capital and head quarter of Mara region. It serves as the administrative and commercial centre for the region. Gazettment of Musoma town as a Municipal council took place in 2005.

Figure 2: Musoma Municipality aerial view

Musoma Municipal Council is not only the administrative, industrial and commercial centre of Mara region, but also a 'gateway' linking cities, towns and neighboring countries of Kenya and Uganda. The town is well linked to other centres by both surface, water and air transport services. A bituminous road link Musoma Municipality to Mwanza City. Other link roads include Musoma to Sirari (on the Kenya boarder via Tarime) which leads to Kisumu in Kenya up to Busia boader (in Uganda).

Figure3: Map of Tanzania Showing Mara Region and Musoma Municipality

1.1.2 Administrative Setting

Musoma Town Council was elevated to Municipal status on 1st July, 2005. The Municipality is the head quarter of Mara region. Administratively, the Municipal is made up of one division and one parliamentary constituency. There are 16 administrative wards. Each ward has an elected Councilor and Ward Executive Officer (WEO) and is coordinated by a Ward Development Committee (WDC). These wards are further subdivided into 73 sub-wards administrative units (Mitaa). Each Mtaa is represented by Mtaa Chairperson. Councilors are elected from each ward and six special seat councilors representing minority and special groups like women. Thus, currently Musoma Municipal Council has a total of 22 Councilors. The Municipality functions through two interdependent Administrative and Management Organs, namely Council Management Team (CMT) under the chairmanship of the Municipal Director and the Musoma Municipal Full Council under the chairmanship of the Municipal Mayor.

Musoma Municipal Director (Dr. Khalfany B. Haule) concentrating on his daily office duties

The CMT is made by all HODs. It comprises of 13 departments which include Planning and Economics; Community Development, Health, Sanitation and Environment; Agriculture, Irrigation and Cooperatives; Livestock and Fisheries; Finance and Trade; Administration and Personnel; Works; Water; Town Planning and Lands; Primary Education and Secondary Education. Within the Institutional Structure, there are also 6 Advisory Units to the Municipal Director namely: Legal Affairs, Internal Audit; Technology Information Communication and Relations; Procurement; Elections and Beekeeping. The CMT is obliged to implement all decisions from the Municipal Full Council and the three Standing committees namely Finance and Administration Committee; Town Planning and Environment Committee and Education; Health and Economics Committee. The standing Committees are charged with the responsibility to oversee implementation of council decisions in the most efficient and cost effective way.

The full Council is headed by a chairperson (Mayor) elected from among the Ward Councilors. The local Member of Parliament also attend council meeting. The Municipal Director is the Chief Executive and the secretary of the Full Council which is the decision making organ of the municipality.

1.2 The Historical Development

Musoma is one of the historical towns of Tanzania. It started in the late years of 19th century by the Germans as a military base (fortification point). History shows that the first areas to be settled in the town were those along the shoreline of Lake Victoria where life was easier and safer. The sandy soils on the shores of the lake were easy to work given the purity of hand tools to work the soils. Further inland soils were heavier and hence not so easy to work. The proximity to the lake also meant easy access to fishing to supplement diets. The lake waters also provided easy transport over long distances by canoe. Inland areas were also unsafe due to the profusion of wild animals especially predators like lions and leopards.

Remains of the original fortified ground can be seen at the middle of Mitchell point. The term Musoma is derived from the local dialect, which literally translated as a promontory means a

high long narrow piece of land that goes out into the lake/sea. Although the original meaning of Musoma is supposed to be confined to the water-penetrating portion of the area, Musoma Municipality today abounds far beyond this point. The latter together with the adjacent Mwigobero point which has alternatively acted as a harbours and are believed to be the starting point for the development of the present Musoma town.

During the German era, Musoma Settlement continued to play the role of a military base. Alongside this function, during the German colonial period the settlement slowly assumed additional roles of been administrative and service centre. The military role ended with declaration of Tanganyika as a British protectorate territory after the First World War. After the Second World War in 1945, the territory was placed under the supervision of the United Nations. Musoma Township therefore, was enhanced after Tanganyika's Independence when Musoma became regional headquarters of the newly formed Mara region.

1.3 People and Population Dynamics

1.3.1 People of Musoma

The main ethnic groups of Musoma Municipal Council include Wakwaya, Kuria, Wajita, Wajaluo, Waruri, Wakabwa, Wakiroba and Wasimbiti. However, todate, Musoma is a cosmopolitan town comprising of many tribes from all over Tanzania and neighbouring countries. Unlike the prejudices about the people of Mara region that they are cruel and harsh, Musoma Municipality habours 134,327 polity people with a Tanzanian hospitality standards.

1.3.2 Population Dynamics

According to the 2012 Population and Housing Census, Musoma Municipal Council had a total population of 134,327 inhabitants of which 62,694 were males and 71, 633 females. This accounted for about 14.8% of the total regional population. The average household size is 4.9. The annual rate of population growth in Musoma Municipality was 2.2 percent. Although, population growth rate decreases from 3.3 to 2.2 in 2002 and 2012 respectively, there was net increase in population size from 108,242 to 134, 327 in the same period. The population however increased by only 24% (26, 085) i.e from 108, 242 to 134, 327 in a period of ten years.

1.4 Economic Activities

The performance of Musoma Municipal economy is not promising due to deterioration of basic economic infrastructure and industries. While other industries have totally collapsed some of them are under-utilized. The major economic activities of the people of Musoma include fishing, agriculture, small industries, commerce and small trade, employment in the private and public sectors, mining, forestry and beekeeping, bodaboda cycling among the youth and vending.

1.5 Physiographic Features

The physiographic features of the Musoma Town are categorized into 4 types as follows:

- Topography and Drainage
- Soils and Geology
- Rainfall and Climate
- Vegetation

1.5.1 Topography and Drainage

The landscape of the Musoma Town is generally flat and rises gently towards Mukendo Hill which is the prominent and remarkable feature in the municipality. From Mukendo Hill the landscape gradually slopes down towards Lake Victoria. Low-lying areas are also found on the southern part of the central area of the town resulting into Kitaji pond. Within the municipal area, altitude levels range between 1140 metres and 1320 metres above the lake shore; and the gently sloping landscape is featured by small rolling hills punctuated by valleys with rivers and streams, notably the Zigi, Nzimwi and Mkurumuzi in the north, and Mgombani/Kalindu and Gombero in the south. They all drain into the Lake Victoria.

1.5.2 Soils and Geology

In Musoma Municipality the soils are mainly light and sandy but heavier ones in seasonal swamps, river valley and in black soil plains. Geologically, Musoma Municipality is a flat sheet of dark grey basalt associated with meta-volcanic rocks. The rocks belong to pre-Cambrian age forming a base for the formation of younger rocks. Musoma Urban area consist of granite granodiorite foliated gneisses and magnetite. Southern highlands: his part occupies the areas of Bunda and Serengeti districts in the south - western part of the region. It consists of mainly volcanic rocks of alkaline basalt, trachyte, nephelinite and pyroclastics. The volcanic rocks are bonded with iron stone.

1.5.3 Rainfall and Climate

Musoma Municipal area experiences tropical type of climate. Temperature ranges 24^{o}C and 32^{o}C. High temperature are recorded in the months of September, October and November when the mean maximum temperatures reach up to 31.6oC. The minimum temperatures are experienced in the months of June, July and August when temperatures go down about 15.00^{o}C average. Rainfall pattern is bimodal which ranges from 900-1200mm per annum. The short rainfall season starts from October to December while the long rains are from March to June.

1.5.4 Vegetation

In general, the vegetation coverage of the Musoma includes scattered trees, short grass and shrubs. Large area of Musoma Municipality, about 3500 hectares is still undeveloped and largely covered by vegetation. The most predominant natural vegetation is the savannah type, formed by forest vegetation mainly scattered woodlands and wooded grasslands. The most predominant trees include *Acacia comniphora* species, *focus hoschiteteria, podocarpus usambaran,* as well as *bohemia.*

1.6 Aesthetic Value of the area

Musoma Municipal Council has both natural and human made environment sceneries which are attractive to observe. These sceneries include Mukendo hill with its natural flora and fauna and its ever green appearance; the view of Lake Victoria: its fresh waters, lake breeze, and green shores and sand beaches; Fertile land with a massive green forest cover; Rivers (seasonal rivers); Peninsula view of the Lake side area of

Mukendo ward. Some other attractive places to go while in Musoma Municipality include Matvilla beach, Tembo beach and Silver Sand beach all located in Mukendo ward, while Peninsula Hotel, Mara Paradise and Ngeregere Lodge are other destinations out of Mukendo ward within Musoma Municipality.

Figure 4: A view of Mukendo hill from Lake Victoria

CHAPTER TWO

2.0 DRIVING FORCES

Driving forces are the socio-economic, socio-cultural and socio-political forces that guide human activities and which increase or mitigate pressures on the environment. The level of pressure exerted on the environment that is induced by driving forces can range from low to high. The amount of damage incurred at any given time depends on the combination of socio-economic, socio-cultural and socio-political forces applied and the current status of the environment, amongst other factors. Driving forces include demography, economic activity, culture, human development, governance and science and technology. The consequences of these driving forces have led to significant pressures on the environment.

These pressures have significant potential to incur, or have resulted in, substantial costs to Musoma Municipality's wellbeing and prosperity.

2.1 An interconnected world

The world in which we live is a complex place consisting of interrelated social, economic and environmental systems. This interconnectivity has meant that changing one element within a system may cause unexpected and sometimes harmful effects to another element, either within the same system or between systems.

In the past, damage to these systems was largely confined to specific regions and countries and managed that way. However, through globalization, the different parts of the world have become much more connected than ever before. As a consequence, the influences of human activities, both positive and negative, are now impacting at a much larger scale. To achieve sustainable practices, it has become increasingly important to understand the mechanics of the world's complex and interrelated social, economic and environmental systems at multiple scales of operation.

Musoma Municipality's prosperity depends on global interests. International, regional and national development have a significant bearing on what happens in Musoma. Such development can influence patterns of behaviour and the use of natural resources, and can result in both positive and negative outcomes for the environment. The impact of climate change, driven by global trends, will also influence the wellbeing of the people. Decision-makers in Musoma contend with state matters within this highly complex, global web. Their objective to seek sustainable, long-term outcomes for society, the economy and the environment is a challenging one, given that many issues shaping the future of Musoma are often outside the realm of the state's direct influence.

This section of the report explores the key driving forces influencing the Municipality's environmental systems. It concludes with a brief examination of the environmental consequences, leading on to topics that will be discussed in more detail in the following sections of the report.

2.2 Key drivers for Musoma Municipal Council

2.2.1 Demography

The size, growth rate, distribution and migration patterns of Musoma Municipality's population are all important demographic factors that drive land use, natural resource demand and challenge the provision of socio-economic services that support high or improved living standards.

Musoma Municipality has a population of 134,327 as per 2012 population census, of which 46.7% are male and 53.3% female. Musoma is one of the municipalities in Tanzania with lowest population size. Only Lindi (78,841 people), Mtwara-Mikindani (108,299 people) and Bukoba (128,796 people) Municipalities rank the last three with the lowest population size as shown in Figure 2.1. Figure 2.1 excludes Municipalities from cities such as Dar es salaam, Mwanza, Tanga, Mbeya and Arusha. The Mara regional average inter – censual annual population growth rates between 1967 – 1978, 1978 – 1988, 1988 – 2002, 2002 – 2012 were 2.6 percent,2.9 percent, 2.5 percent and 2.5 percent respectively. This trend is quite different from that of Musoma Municipality where population growth declined from 3.3 percent in 2002 to 2.2 percent in 2012. The collapse of many public industries after introduction of liberalization policy in the early 1990s could be one of the major reasons for the decline in population growth. Other reasons for decline in population include High Internal Mortality Rate.

Despite the fact that Musoma Municipality's population growth is slow, but the area of Musoma is small. The Municipality is already experiencing the impacts of high population. Environmental problems caused by demographic factors include; Encroachment to environmentally fragile areas such as wetlands, beaches, hills and forests for anthropogenic socio-economic activities including trade and construction. This tendency has an environmental degradation potential. Resources become limited because of many resource users that exceed the supply of resources. That is to say, overpopulation results into environmental resources depletion.

Because of the growing population, Musoma Municipality has unplanned settlement as people try to occupy virgin lands prior to town planning processes.

Table 1: Musoma Population Size in relation to other municipalities in Tanzania

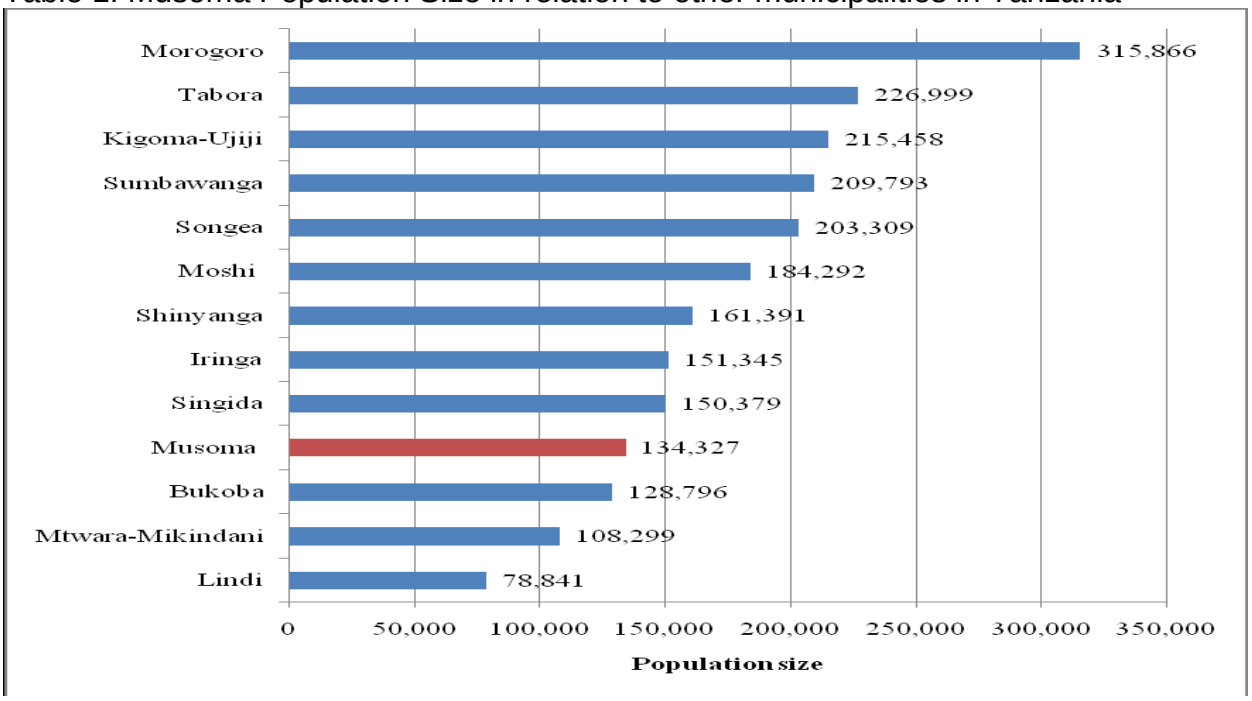


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Table 2: Population Sizes by Ward in Musoma Municipality for the year 2002 and 2012

Na	Ward	Status	Population Size in 2002	Population Size in 2012	Remarks
1.	Mukendo	Urban	3,295	2,426	Population declined
2.	Mwigobero	Urban	3,051	2,179	Population declined
3.	Iringo	Urban	5,966	5,321	Slightly Population declined
4.	Kitaji	Urban	6,847	5,464	Population declined
5.	Nyasho	Urban	7,793	6,344	Population declined
6.	Bweri	Mixed	13,485	25,943	Population increased
7.	Nyakato	Urban	16,512	20,419	Population increased
8.	Kigera	Rural	15,146	21,080	Population increased
9.	Kamunyonge	Urban	5,581	5,004	Slightly population decrease
10.	Nyamatare	Mixed	6,387	6,527	Slightly population increase
11.	Mwisenge	Urban	12,280	13,603	Population increased
12	Buhare	Mixed	4,791	10,129	Population increased
13	Makoko	Mixed	7,108	9,888	Population increased
Total			**108,242**	**134,327**	

Table 2 shows that there are significant variations in terms of population size and growth among different wards in Musoma Municipality. While there is population decreases in some wards such as Mukendo, Mwigobero, Kitaji and Nyasho, other wards such as Bweri, Nyakato, Kigera, Mwisenge, Buhare and Makoko shows increase in population. Generally, there is only slight increase of population by 26,085 people in a period of ten years (2002 – 2012).

The 2012 National population census recorded the lowest population size in Musoma Municipality (134, 327 people) among all Districts in Mara Region. Tarime District Council recorded the largest population size of 339,693 people. The average house hold size is 4.9. The annual rate of population growth in Musoma Municipality was 2.2 percent. Although, population growth rate decreases from 3.3 to 2.2 in 2002 and 2012 respectively, there was net increase in population size from 108,242 to 134,327 in the same period. Population however increased by only 24% (26, 085) i.e from 108,242 to

134,327 in a period of ten years. However, there are claims by Musoma dwellers that, slow increase of population size observed by the 2012 National Population Census is not a true reflection of the actual situation as many people were not counted due to various reasons including religious and political issues.

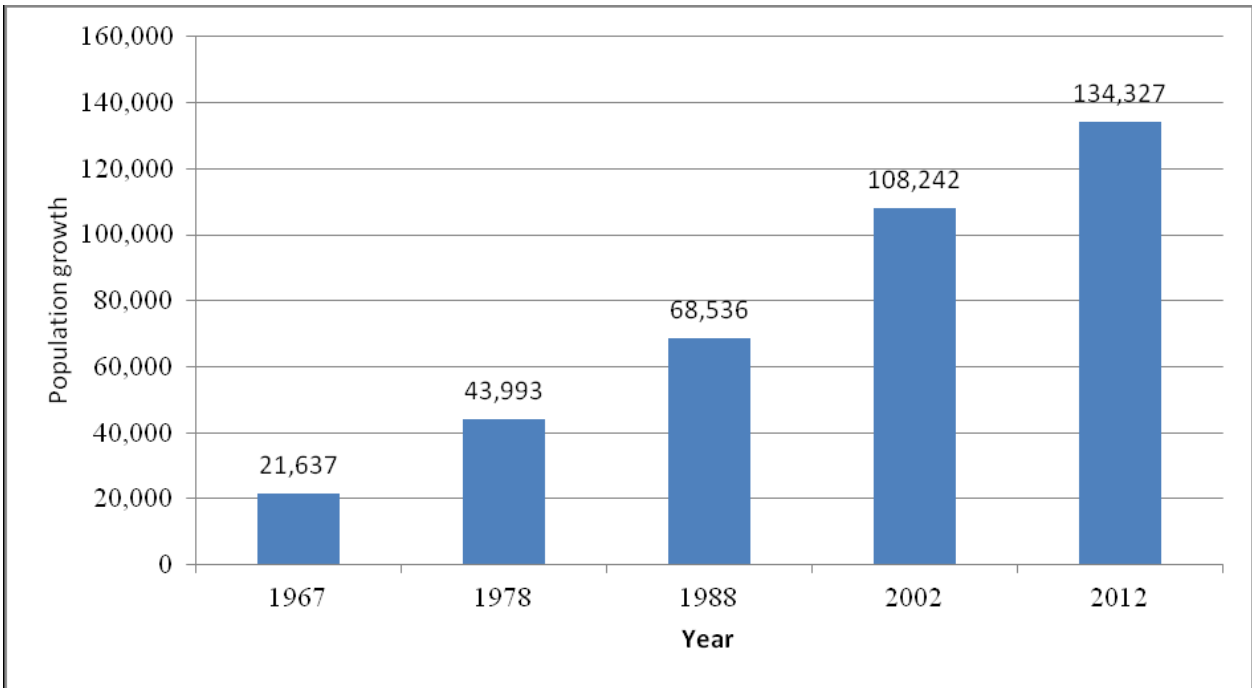


Table 3: Population Growth trend (1967-2012)
Source: National Bureau of Statistics (2006 and 2012)

2.2.2 Economic activities

The second State of the Environment Driving forces for Musoma Municipality is Economic activity. The major economic activities for Musoma Municipality include agriculture, fisheries, mining, manufacturing, construction and tourism. Both of these industries rely heavily upon the environment for their output.

The extraction of resources, cropping and grazing practices, along with associated infrastructure requirements (e.g. ports, roads, processing plants and storage facilities), directly and indirectly affect ecosystems by modifying land-scapes and generating pollution. In contrast, other industries such as tourism rely heavily on the maintenance of Musoma's environmental assets for their viability.

The generation of waste is often a consequence of economic growth. Waste includes surplus, leftover or unwanted materials from domestic, commercial, industrial and other activities. Waste may contain contaminants, which could pose a hazard to human and ecosystem health and the sustainability of agricultural production systems. Ecosystem processes may be able to break down some of the waste produced by humans; however this capacity is finite and intrinsic waste detoxification capabilities could be lost with environmental degradation or overwhelmed with large quantities of waste production.

Most of the few industries available in Musoma are also key emitters of greenhouse gases—through energy generation, land clearing and land-use change, agricultural production and transport. The dilemma faced in maintaining prosperity is balancing the

needs of today, while ensuring that the needs of future generations are not compromised. Current economic measures such as the Gross Domestic Product or State Gross Product do not incorporate environmental transactions. A System of Environment-Economic Accounting (SEEA) has been developed to provide a more comprehensive overview of the economy, incorporating an improved account of collective social, environmental and economic outcomes (UNSD, 2012; SEEA, 2003).

Human actions are driven in part by culture and attitudes, amongst other factors such as socio-economic influences. The main driver of urbanization is economic growth (MA, 2005). While economic growth provides a range of benefits to society, it can also lead to pressures on the environment (Browne and McPhail, 2011). Many Tanzanians have a high standard of living supported by economic growth, which drives a culture of consumerism. Globally consumption has grown significantly over the past five decades, with consumption expenditures per person almost tripling (Assadourian, 2010).

The ecological footprint is a measure of the biologically productive area (land and water) that people use for provision of renewable resources, occupy with infrastructure, or required for the absorption of wastes (Wackernagel and Rees, 1996). Essentially, it measures what resources nature can provide or generate to support human activities. The earth's biocapacity is 11.9 billion gha or 1.8 gha per person. In 2007, the world's average ecological footprint was 2.7 gha per person, representing an ecological overshoot of 50 per cent (WWF, 2010). Using more resources than can be regenerated is only possible until the resources become depleted.

Biocapacity refers to the capacity of a given biologically productive area to generate an on-going supply of renewable resources and to absorb its spillover wastes. Unsustainability occurs if the area's ecological footprint exceeds its biocapacity. The biocapacity or biological capacity of an ecosystem is an estimate of its production of certain biological materials such as natural resources, and its absorption and filtering of other materials such as carbon dioxide from the atmosphere. "Useful biological materials" are defined as those demanded by the human economy.

Biological capacity available per person (or per capita): There were 12 billion hectares of biologically productive land and water on this planet in 2008. Dividing by the number of people alive in that year, 6.7 billion, gives 1.8 global hectares per person . This assumes that no land is set aside for other species that consume the same biological material as humans

Musoma Municipality's consumption activities that contribute most significantly to its ecological footprint include, construction industry (require construction minerals like stone, gravel, soils, sand that also require space, land, metal and timber), manufacturing and trade that require biomass consumption for fuel (charcoal and fire wood), manufacture and transportation that require petrol/diesel, water, electricity, gas, kerosene and flora and fauna.

It is important to remember that Musoma Municipal Council is one of the poor LGAs in Tanzania. Poverty exerts a huge threat to the environment which generally lead to environmental degradation rather than conservation. Some poverty lead economic activities in Musoma include illegal fishing, charcoal burning and poor and unsustainable farming methods. All these activities exert a great negative threat to the environment.

2.2.3 Human development

Human development is about enabling people to lead long, healthy, educated and fulfilling lives. Sustainable human development is about making sure that future generations can do the same (intergenerational equity). These two concepts are not mutually exclusive and cannot be separated (UNDP, 2010). Poorer rural households in developing countries face disproportionate losses from the depletion of natural assets due to their relatively high dependence on certain ecosystem services for income and insurance against hard times (TEEB, 2010). Musoma is not immune to this trend.

2.2.4 Governance

Governance refers to how authority is exercised via actions, processes, traditions and institutions in private and public institutions (UNEP, 2002; McGrath, 2011). Governance can drive changes in human behaviour, which ultimately determines how the natural environment is treated, from the extraction of resources to environmental protection.
Sound governance at all levels is needed to ensure that environmental considerations receive the weight they deserve in the balance of economic, social and cultural rights.

Globally, there has been a rise in the development of environmental agreements over the past few decades to counteract several concurrent environmental crises including a changing climate, biodiversity loss, pollution, and fuel, food and water security (Figure 6; UNEP, 2011a). This trend highlights growing recognition of the importance of governance in bringing about positive environmental outcomes.

Musoma Municipality's environmental conservation is also largely dependent upon how the political and government leaders decide. For instance, there has been a serious conflict of interest between the Municipal Environment Management Officer (MEMO) and other leaders (Heads of Departments and Councilors) regarding sand mining from the Lake Victoria shores and River floors and banks. Except for the MEMO, who has been promoting zero sand mining from these fragile areas and has been penalizing defaulters, the rest of the leaders have been promoting the sand mining activity by both public and private construction works.

2.2.5 Level of Science and Technology

In today's world, humans are living in a continuously accelerating knowledge revolution. Science and technological innovation continues to alter the structure of production, the nature of work and the use of leisure time (UNEP, 2002). It is the driver behind how the needs and desires of society are met and, thus, a fundamental determinant of humanity's impact on the environment.

It is unknown whether the aggregate effects of science and technology are positive or negative. For instance, science and technology can reduce environmental pressure through greater efficiency, allowing for reductions in the use of resources and the production of wastes to meet the same level of demand. At the same time, these decreases in pressure per unit of demand can lead to increases in overall environmental pressures if they result in increased demand. The speed of technological change can result in redundancy or replacement of technology and lead to increased waste, such as with computers and televisions.

Science and technological advances have, however, significantly improved our ability to monitor and understand the environment, helping to promote better environmental

outcomes. Taxonomy, mapping, ecological studies, monitoring programs and modelling can all add to our understanding of how natural systems work and lead to more informed management decisions.

2.3 Implications for the environment

It is of little doubt that humans are having a massive effect on the natural world (CEC, 2010; EEA, 2010; UNEP, 2011b).The rate and extent of environmental change as a consequence of human activity is now considered by many as unsustainable and a potential threat to the health and wellbeing of future generations.

The most notable global environmental pressures that have been internationally recognized and are being addressed on a large scale include biodiversity loss, modifications to terrestrial and aquatic ecosystems, the spread of invasive species and climate change. The depletion of the stratospheric ozone layer and the generation of pollution through emissions and waste also fit within these notable pressures (UNEP, 2011b). The following section will explore the pressures on the state's environment, stemming from human and natural causes and/or a combination of both.

2.3.1 A changing climate

Musoma Municipal Council like other LGAs in Tanzania is already suffering from the effects of Climate change. Some of the effects of climate change happening in Musoma include a twist in the rain seasons and pronounced occurrence of dry spells that cause severe draught and heavy rains during the rainy season that cause flooding. Both of the two weather extremes result into food insecurity, destruction of properties and claim lives of people.

Future impacts of climate change on Tanzania in general and Musoma in particular are likely to include:

- projected increases in average surface temperature
- Increased draughts due to increased dry spell seasons
- more intense rainfall on days with heavy rainfall over many areas
- more frequent heat waves
- more frequent droughts that alternate with floods
- water ways acidification
- sea level rise. The potentially profound consequences of a changing climate have meant that it has become a key driver in its own right.

The following chapters are going to give more details about the pressures exerted by the driving forces.

CHAPTER THREE

3.0 PRESSURES

Pressures are the stresses that human activities place on the environment. They can range in intensity depending on a number of factors, such as spatial and temporal scale, toxicity, sensitivity of the receiving environment, past exposure and frequency. The spatial scale of the effect can range from very small (local) to large (global). In some instances the effect may be cumulative, such as the concentration of chemicals in food webs. Some pressures are highly toxic in nature, while others can cause sub-lethal chronic effects. Pressures may originate from a point source, such as a sewage plant discharge, or from multiple diffuse sources, such as agricultural or urban run-off. The effects of the pressure may occur on-site or off-site.

The capacity of an ecosystem, community or species to deal with a given pressure and/or set of pressures depends on their natural susceptibility to the pressure, as well as recent or historical events that may have made them more vulnerable to harm. Pressures may be exacerbated by natural events, such as floods, droughts, cyclones and dust storms. These events can reduce the resilience of ecosystems, communities and species, impairing their capacity for recovery.

All systems have some capacity to absorb change. However, there may be tipping points beyond which the state of the system becomes radically altered, sometimes irreversibly. Monitoring programs that track changes in the environment are crucial to successfully identifying and addressing pressures. There is a wide range of monitoring programs in place to assess air and water quality, track coastal physical processes, and follow the health of ecosystems, communities and species.

Five main threats to biodiversity are commonly recognized in invasive alien species, climate change, nutrient loading and pollution, habitat change, and overexploitation. Unless we successfully mitigate the impacts of these direct drivers of change on biodiversity, they will contribute to the loss of biodiversity components, negatively affect ecosystem integrity and hamper aspirations towards sustainable use.

In discussing threats to biodiversity it is important to keep in mind that, behind these direct drivers of biodiversity loss, there are a number of indirect drivers that interact in complex ways to cause human-induced changes in biodiversity. They include demographic, economic, socio-political, cultural, religious, scientific and technological factors, which influence human activities that directly impact on biodiversity.

Indicators for trends in nutrient loading and invasive alien species have been identified under the focal area addressed here, and are described below. Information on habitat change is provided by the indicator trends in extent of selected biomes, ecosystems and habitats. Overexploitation is discussed under the focal area on sustainable use. While there is no single indicator of the impacts of climate change on biodiversity, a number of indicators, including those on trends in extent of selected biomes, ecosystems and

habitats (particularly applied to coral reefs, polar ice and glaciers, and certain types of forests and dry lands), abundance and distribution of selected species, and incidence of human induced ecosystem failure, can serve to derive trends where specific data are available. Because small, fragmented ecosystems are more affected by changes in temperature and humidity than large contiguous ecosystems with a more balanced micro-climate, trends in connectivity/fragmentation of ecosystems provide an indicator of the vulnerability of ecosystems to climate change.

Building Nature's Resilience – A Biodiversity Strategy for Musoma identifies the following as key threats to Musoma's native biodiversity: habitat loss, degradation and fragmentation, invasive species, unsustainable use of resources, changes to aquatic environments, water flows, freshwater systems and wetlands, altered fire regimes, climate change.

Other major threats to the environment include air, water and land pollution. For example. Natural disasters have also impacted upon the state of the environment. While these occurrences may be an intrinsic part of the natural environment with many positive outcomes, they can also cause detrimental impacts when considered in the context of the multitude of other pressures caused by human activity.

Human activities resulting in the above pressures can include: Urban, infrastructure and industry development; agriculture; mining; forestry and Fishing. Some of the major types of pressures relevant to Musoma are explained in detail below. These pressures are not listed in any priority order; however the section begins with climate change because of its potentially pervasive influence on ecosystems and society. The pressures are presented separately, yet many overlap or reinforce one another. For example, vegetation loss is a key driver of many ecosystem changes and is often influenced by the growing demand for food and fibre production, which itself has impacts. The nature of these pressures have not changed significantly since the advent of state of the environment reporting in Queensland, although the severity of each may have changed markedly. For example, the balance between vegetation clearing and energy resource extraction as key pressures has reversed in just a few years. Also, recognition of the importance of some pressures may have changed due to improved scientific information or community awareness.

3.1 Wetlands

Kitaji pond is among the few wetlands in Musoma. Other wetlands include lake shore wetlands, rivers and streams found in Makoko, Mwisenge, Nyasho, Kigera and Bweri wards. Some pressures result in wetland loss, while others impact the condition of the wetland ecosystems and the services they provide. Pressures include those in the surrounding catchment area, as well as those directly affecting the wetland itself.

Indirect pressures include catchment disturbance, impacts on the fringing zone of the wetland, hydrological disturbances and the loss of connectivity of the wetland to the overall landscape. Catchment disturbance includes land use changes, wetland draining or filling, vegetation clearing, the introduction of sediments and pollutants to the wetland and an increase in weed and pest animal species. Hydrological disturbances, generally associated with catchment disturbance, include the diversion of water from wetlands, increased flows of water to wetlands through altered storm water flows, changes to the hydrological water regime of the wetland through water extraction (both surface and groundwater) and

impoundments. Modification of the fringing zone can affect the area required to support key wetland process and services.

Direct pressures on wetlands include those associated with impacts on wetland soils and water quality, wetland biota and the physical form of the wetland. Grazing can result in the disturbance of the soil, leading to increased sediment suspension, nutrient input from faeces and disturbance to wetland plants. Direct input of contaminants (nutrients, sediments, metals, pesticides and herbicides, pathogens, litter, excess heat) to wetlands can occur through storm water, groundwater contamination (e.g. septic systems), sewage outfalls, agricultural run-off and seepage from landfills.

Musoma wetlands are being degraded due to wetland filling (land reclamation) for construction purposes, farming activities, dumping of wastes, sand mining, diversion of water course, and cutting of wetland vegetation.

Mechanical disturbance of acid sulphate soils can lead to a low pH and metal mobilization.
Feral pigs, cane toads, carp, tilapia and other pest species can have a significant effect on wetland condition by disturbing soils, contaminating water, out-competing and feeding on wetland biota. Likewise aquatic and terrestrial weeds such as water hyacinth, hymen acne, chinee apple and others impact wetlands condition. Unsustainable harvesting or removal of wetland plants and animals is a pressure on wetlands as are inappropriate fire regimes, which can damage sensitive wetland soil and plants.

Climate change will compound the pressures above. Rising sea levels will affect the landward movement of estuarine wetlands, thus putting pressure on existing freshwater wetlands which have little opportunity to migrate landward. Extreme weather events associated with climate change, including higher temperatures, more intense rainfall and droughts will result in increased pressure on wetland ecosystems.

For each ecosystem type, two assessments were carried out, separating the ongoing risks and one-off incident-based risks. Ongoing risks are those that occur continuously or regularly (such a loss of riparian vegetation from residential development; run-off from grazing areas). One-off incident-based risks occur through accidents (such as
a failure of a water treatment plant, overflow from containment structures at a mine site), or unanticipated climaticevents. Areas of the state where aquatic ecosystems are under greatest ongoing pressure from human activities are the Kitaji pond, Makoko-Mwisenge River, Nyasho-Musoma bus river and the Lake Victoria shoreline wetlands in Makoko, Iringo, Kitaji, Nyakato and Bweri wards.

3.2 Climate change

Changes to our climate have a direct effect not only on the environment but also on social and economic aspects of life. Global increases in temperature, ocean heat content and rising sea levels all indicate the world is warming.

It is now considered very likely that human activity has played a role in contributing to changes to the global climate by altering the composition of the atmosphere, in particular, through the rise in concentrations of greenhouse gases (CSIRO, 2011). The 2002–2011 10-year period (matched by the period 2001–2010) was the warmest decade on record, with global temperatures 0.46°C above the 1961–1990 mean (WMO, 2012). Global sea levels are rising at around 3 mm a year (Church and White, 2011).

3.2.1 Changes in atmospheric composition

Changes to atmospheric composition from human activities, such as from the combustion of fuel and the clearing of land, as well as from some natural events (e.g. carbon from fires) can change the earth's radiative (energy) balance. Radiative forcing from CO2 is the largest single contributor to human-induced climate change (CSIRO, 2011). Global CO2 concentrations are calculated from a network of global observation sites coordinated by the World Meteorological Organization (WMO). These observations indicate that in 2010, the concentration of CO2 in the atmosphere had increased to around 390 parts per million (ppm), from about 280 ppm in 1750 at the start of the industrial revolution (WMO, 2011). Le Quéré et al. (2009) found that CO2 emissions grew 3.4 per cent per year between 2000 and 2008, more than triple the growth experienced during the 1990s. Methane (CH4) concentrations plateaued to near zero growth from 1999 to 2006; however since 2007 atmospheric CH4 has been increasing again. The reasons for the renewed growth are not fully understood (WMO, 2011).

3.2.2 Changes in sea levels

Sea-level rise and an increase in the frequency and intensity of tropical storms, coupled with storm surges that inundate property, have been predicted as a consequence of climate change (BoM, 2011b). Coastal zones of Tanzania are not immune to the effects of climate change. Short and long term intervention programs need to be put in place to combat climate change.

Although it is far from the coastal zones (Indian ocean), Musoma Municipality is bordered to the Lake Victoria which can in the same way be impacted by the global trends of climate change.

3.2.3 Productive lands and climate change

The continuing change in the state of the global climate patterns—for example, from the increasing levels of greenhouses gases and their projected regional impacts—present new major drivers of change in the management and use of Musoma's productive lands. The effects of declining rainfall and run-off into streams are already being felt by primary producers and the effects of temperature changes are likely to be felt within the next decade. Key impacts on the primary industries sector are likely to include:

- warmer and drier weather in future decades
- more frequent droughts
- increased frequency of severe weather events, including flooding that could also reduce primary and agricultural production through reduction in crop yields and through stock losses
- changes in average rainfall and temperatures, in seasonal distribution of rainfall and in rainfall variability, which directly affect crop production (DERM, 2010a).

3.2.4 Tree cutting and vegetation clearing

Musoma Municipal Council faces a big problem of tree cutting and vegetation loss due to a number of reasons including charcoal burning and fire wood gathering for fuel, brick making (fire baked bricks), timber, construction poles and clearing land for construction and agricultural activities. Because of energy poverty, the continued use of biomass as source

of energy for cooking by households and other institutions such as schools and prisons exerts huge threats to the Musoma Municipality's fauna.

3.3 Agriculture and Food production

Agriculture is the main economic activity in Musoma Municipality which employs about 508 households as the labour force. The main crops grown in the area include cassava, sorghum, maize, sweet potatoes, rice, beans, paddy and horticulture crops. The Municipality has a potential arable land of about 1020 hectares mainly for small scale farming. However, out of the area only 520 hectares are under cultivation annually. There are two farming seasons (1) during short rains i.e. September to December and (2) During long rains i.e. February to May. Generally, the Municipal climate offers favorable conditions for agriculture through adequate and reliable rainfalls. Agriculture sector contributes 30 percent of the GDP in the economy of Musoma Municipal Council. Table 3.1 shows the production of different types of crops for the past nine years.

Musoma Municipal Council has an area of 6300 Ha. The distribution of the land use of Municipal area is as follows:

- Settlement area 2600 Ha. (41.2%)
- Public Institutions area 800 Ha. (12.7%)
- Open space area 701 Ha. (18.5%)
- Arable land 1027 Ha. (16.3%) *Source: HoD, Agriculture, January 2016.*

Musoma has two rain seasons per year. One season starts from September to Desember (short season) while the second season starts from March to Mei (heavy rain season). Average rainfall is 500 – 750 mm per year. Although there is an arable land of 1027 Ha. Only 650-750 Ha. of land is cultivated. There is no land which is officially allocated for farming because Musoma is town setting area.

Table 4: Average yields from the food crops

No.	Crop	Average Yield per Year
1.	Cassava	5t/Ha.
2.	Maize	2.5t/Ha
3.	Rice	2.5t/Ha
4.	Sweet potatoes	5t/Ha
5.	Tomatoes	32t/Ha
6.	Onion	5t/Ha
7.	Vegetables	1.5t/Ha

Source: Agricultural Department, Musoma Municipal Council, January 2016

The production of food is an important contributor to the Musoma Municipality's economy. However, it is associated with significant landscape change that can exert both direct and indirect environmental pressures. These include:

• the modification of the environment from clearing of native vegetation resulting in a change in species composition and reconfiguration of land form
• the use of resources, such as soil and water, beyond their rate of formation or recharge
• fire regimes unsuited for the land type
• stocking rates too high for the prevailing conditions
• management techniques that degrade soil structure, composition and fertility
• the misuse of external inputs, such as agro-chemicals and nutrients
• the introduction and spread of invasive species.

Below are challenges facing agriculture sector in Musoma Municipality:
1. Changing of the weather: unreliable rainfall patterns resulting in long periods of droughts and crop failures in some year
2. Increased pests and disease infestation
3. Low and unreliable rainfall
4. Poor farming practices: majority of farmers do not practice modern agricultural technology because of the high cost of inputs.
5. Shortage of fertile farming land caused by population increase and demand of land for other urban land uses.
6. Urbanisation-resulting into decrease of farm land
7. Lack of trained labour and farm inputs, weak agro-industries and poor linkages in marketing, processing and production chains as well as weak farmers' organization.
8. Lack of credits to support agricultural production also hampers output, especially that of rural, small-holders.

Food insecurity is still a problem facing Musoma Municipal Council. Only 10% of the required food store is produced on site. The remaining 90% is to be bought from other places. Most of the dwellers of Musoma Municipality are employed in the formal or informal sector and therefore they buy food. However, seasons of hunger are still striking this Municipality where the government is required to distribute "hunger food" to the people.

3.4 Livestock Keeping

Musoma Municipal Council has a potential of keeping almost all types of domestic animals because of its favorable good weather, availability of compounded feeding material, and of grazing land around the municipality. There are two main types of livestock breeds in Musoma Municipal; 1) Exotic livestock breeds 2) Indigenous livestock breeds. Exotic livestock breeds include cattle (2,458) and chicken (348,000). The number of indigenous livestock breeds is shown in Table 3.3.

Table 5: Indigenous Livestock breeds

S/N	Livestock Type	Quantity
1	Cattle	29,870
2	Goats	12, 692
3	Sheep	610
4	Pigs	3,144
5	Dogs	20,550
6	Chicken	266,000
7	Cats	2,212

Source: Musoma Municipal Council Agricultural Officer, 2014

The different types of livestock are kept in three main different systems namely intensive, extensive and semi intensive systems. Intensive system is used mainly for chicken and zero grazing for cattle. While, extensive system is used for local chicken and indigenous zebu, semi intensive system is used for chicken and pig. However, there is acute problem of inadequate availability of pasture especially for animals kept indoors i.e those depend on zero grazing. There are over 960 dairy animals in Musoma Municipality. Bweri, Buhare,

Kigera and Makoko are the wards mostly practicing extensive grazing. In total, there are about 4200 indigenous cattle in Musoma Municipal Council of which 15% of the residents are livestock keepers. Table 3.4 shows the production of different types of livestock products for the past ten years in Musoma Municipality.

Livestock sector generate income to the people through selling of livestock and their products (meat, milk, skin, horns etc). The livestock products are sold mainly at local markets. According to the Municipal Livestock officer, the sector employs about 3000 people and gets livestock revenue annually approximately to Tanzania Shillings 40,000,000. The data obtained from the Municipal Economic Department showed that livestock activities contribute about 27.25% of the Municipal revenue, which mainly come from abattoir slaughter service fees.

Figure 5: Free range system in goat rearing in Kitaji area
Source: Musoma Master Plan- 2015

Below are challenges facing Livestock Keeping sector in Musoma Municipality:

- Poor livestock breeds due to low rate of adoption of improved cattle breeds.
- Inadequate market for the livestock and their products
- Lack of reliable water sources and pastures making livestock move around freely thereby destroying tree seedlings and vegetation causing environmental degradation.
- Shortage of livestock field officers,
- Inadequate veterinary services and the high price of veterinary drugs.
- Prevalence of livestock diseases such as east coast fever, new castle fowl, pox, coccidiosis and worm infestation
- Dilapidated livestock dipping facilities. Musoma has a total of 30 dips of which only 11 are working and 19 not working
- Inadequate customers and poor infrastructure for livestock market

3.5 Soil loss and degradation

Soils are a vital part of the natural environment. They are complex and many different types occur in Musoma Municipality. The different properties of soils influence the types of flora and fauna that exist on them and the ways in which we may use them. Our soils are directly linked to the health of our land and water ecosystems and, after the oceans, our soils are the largest store of carbon.

Loss of ground cover in pastoral, mining and cropping areas may make the land resource more susceptible to wind and water erosion. Soil erosion by wind and water can be a natural process that results in the movement or loss of topsoil, organic matter and nutrients through a catchment. However, it can also be associated with a decline in soil health when combined with the impacts of human activities and with severe climatic and weather events. Covering of soils in urban and industrial settings, for example for development purposes, results in a permanent loss of the function of soil in that landscape.

Destruction and contamination of soils can also result in the permanent loss of soil ecosystem function. Soil acidification from excessive use of nitrogenous fertilisers and build up of organic matter can affect overall soil fertility, toxicity and biodiversity and result in leakage of nutrients to aquifers and waterways. Increasing sodicity (the proportion of sodium in the soil) from irrigating or fertilising with high sodium content leads to a decline in soil structure, hard-setting of soils and increased risk of erosion.

Soil structure is the arrangement of the solid and porous parts of a soil that allow oxygen and moisture movement and access to nutrients and, depending upon how the soil was formed, it maximises soil biodiversity and productivity. While some soils are more resilient to disturbance, others are very vulnerable. Soil structure will decline under most forms of cultivation. Compaction of soil from tractor tyres in cropping areas or trampling from hoofed animals (domestic or feral) can cause further physical damage to soils, changing its structure and reducing its productivity.

Increasing secondary soil salinity (the concentration of salt in the soil profile or at the surface) progressively limits which organisms can thrive within soils and alters the physical and chemical properties of the soil. Salts may also flow onto neighbouring properties and waterways.

Musoma Municipality's soils are affected by poor farming methods such as farming in steep slopes unsustainably leading to the removal of top soils and its nutrients. Construction activities and farming both crop and animal husbandry contribute to soil degradation.

3.6 Urban development

Growing human settlements have impacts on the environment through land use conversion, the development of physical and social infrastructure, the consumption of water and energy and the generation of waste. Well planned and densely populated urban development is considered to have less impact on the environment than suburban sprawl (UNEP, 2002; MA, 2005). Well planned urban development can concentrate any impacts into a smaller area, reduce the need for land conversion, provide opportunities for energy saving and make recycling more cost effective (MA, 2005). While state and local governments have been adopting planning policies that encourage greater urban consolidation, urban sprawl

coupled with the concentration of business in the CBD can create pressures (both directly and indirectly) on the environment.

Indicators demonstrating some of these trends include: continued dominance of large detached houses as residential dwellings, with these often built on land outside of existing urban areas, continued reliance on private motor vehicles and an increase in the distance people travel from home to work, an increase in the total amount of energy consumed and a large increase in domestic waste production.

As town expansion continues unplanned settlement emerge. Such settlement go with several environmental implications including the problem with sewage and solid waste management which lead to a potential eruption of diseases such as Cholera.

Expanding towns normally go with increased cost of land acquisition. In Musoma municipal council most land is already developed. Some investors are tempering with buffer lands such as beaches of Lake Victoria and rivers.

Musoma Municipal council has several challenges in terms of solid waste and liquid waste management. There is no sanitary land fill for solid waste disposal but solid waste is disposed through crude dumping located at Buhare ward. Likewise the Municipality lacks waste water treatment plants before discharging sewage in natural water ways.

Figure 6: showing refuse bay at Nyasho market area.

Figure 7: Showing seasonal river reclamation at Musoma bus river bridge along Nyerere Road, Nyakato/Nyasho boarder. Source: Field Work, November, 2015.

3.7 Invasive species

An invasive species is one that has spread and multiplied to a point where it has an impact on ecosystems, agriculture, industry, human health, recreation or scenic amenity.

Invasive species can pose a significant threat to the Musoma environment. Additionally, numerous invasive species have been associated with major economic and social impacts to humans. Globalization has resulted in increasing levels of trade, transport, travel and

tourism, such that the potential to spread non-native species from one country to another has greatly increased (CBD, 2009). Once an exotic species has been transported to Musoma Municipality, it has the potential to become an invasive species.. Native species can also become potentially invasive when transported outside their area of natural occurrence. There are a range of mechanisms for the introduction and/or spread of invasive species, these include:

- Released or escaped into the wild from the pet, aquarium or nursery trade
- hitchhiking on products, equipment and vehicles
- Introductions for agriculture or forestry
- Historical releases for biological control
- Transportation via shipping
- Introduced via travel for tourism purposes (CBD, 2009).

The prevalence and impacts of invasive species can be perpetuated by other pressures such as a changing climate; habitat loss, fragmentation and degradation; pollution; and other forms of human disturbance (CBD, 2009). In turn, invasive species can exacerbate other pressures, for example weed growth increasing the incidence of fires and pest animal species spreading disease (Attiwill and Wilson, 2006).

In Musoma Municipality, water weeds are increasing and are impacting the shoreline ecosystems, scenic and aesthetic value of lake shores and swimming and fishing activities. Also Nile perch (*Lates niloticus)* is among the worst invades of Lake Victoria ecosystem.

Figure 8: Water weeds along the shore of Makoko beaches.

Lates niloticus is a large perch-like predator that is native and widespread in parts of Africa, mainly above the equator (Froese and Pauly, 2009). During the 1950s and 1960s *L. niloticus* was introduced into several East-African lakes (Pringle, 2005). It became established in most of these, however only Lakes Victoria, Kyoga and Nabugabo were relatively well studied. In each of the latter lakes *L. niloticus* became the dominant fish species and concomitantly many other species declined or disappeared completely (Ogutu-Ohwayo, 1990a; 1993; Kaufman, 1992; Witte et al., 1992). Most striking was the case of Lake Victoria, where *L. niloticus* boomed some 25 years after its introduction and subsequently comprised over 90% of the demersal fish mass. It is estimated that some 200

endemic haplochromine cichlid species vanished as a result of predation and competition (Witte et al., 1992a,b). *L. niloticus* has been listed among the 100 "World's Worst" invaders (ISSG, 2009).

3.8 Disease

Diseases can lead to significant social, ecological or economic harm. Both plants and animal population growth are limited by diseases. Diseases cause death of organisms. Diseases have a huge impact on the management of the environment and its resources. The number of organisms of a given species of organisms dying when exceeds the its replacement through reproduction (sexual or asexual) will enventully lead to the extinction of a species.

Human diseases receives a bigger attention since it compromises with the wellbeing of humanity. For Musoma Municipality, the common diseases include malaria, interstinal worms, pneumonia, skin diseases, Upper Respiratory Track Infection (URTI), Clinical AIDS, TB, anemia and typhoid fever.

Table 6: The leading diseases that cause death.

S/N	DISEASE	NUMBER OF DEATHS
1.	Malaria	236
2.	Clinical aids	61
3.	Anemia	45
4.	Pneumonia	21
5.	TB	12

Challenges facing the Health sector in Musoma Municipality include the following;

- Shortage of medical personnel
- Shortage of drugs and medical equipments
- Lack of enough medical infrastructure including buildings

3.9 Pollution

Pollution enters our natural environment through a number of different ways, such as via emissions, run-off, precipitation and discharge. The key pressures arising from pollution are discussed below.

3.9.1 Air pollution

This is among the major kinds of pollution that impact the Musoma Municipal environment. Among the major causes of air pollution include the following:

Dust plumes exist especially along construction sites especially civil works. The Municipality has a road network of 416.58 kms. Only a total 7.6Km of the road network is tarmac road. The remaining 408.98km is either gravel or earth road which is a great source of dust pollution in Musoma municipality. This pollution is linked to the transmission of diseases like URTI, eye irritation and skin diseases. It is also a source of particulates that impair atmospheric clearness, cause soiling of buildings and garments. Indirect effect of dust pollution include water pollution.

The major pressures on the atmosphere and many aspects of the environment are emissions, including greenhouse gases, arising from human activities. The key sources of human caused greenhouse gas emissions include electricity generation, land clearing,

agriculture and transport. The emission of greenhouse gases beyond natural limits is the main driver behind climate change and places significant pressure across all areas of the environment and ecosystems.

Other pressures include emissions of oxides of nitrogen (NOx), CO, SO_2, volatile organic compounds (VOCs) and particles. These emissions can impact on the health of people, plants and animals, cause acidification of land and water, and diminish amenity (e.g. via reduced visibility and the deposition of dust and soot). The release of O_3-depleting substances with long life spans in the past has reduced the stratospheric ozone layer, resulting in increased exposure to ultra-violet radiation. The people of Musoma are now days becoming car dependent, with car ownership increasing. Both private and public vehicles emit smokes which cause air pollution. The few industrial facilities existing in Musoma such as MUTEX, Prime Catch Limited, and Musoma Fish Processors Ltd, Mara Milk etc emit a wide range of air pollutants (NOx, CO, SO2, VOCs, metals and particles).

Burning of waste is a common reported case by many neighboring groups. Since separation of waste is not practiced, in most of cases, burnt waste includes polymers such as plastics, car tyres and rubber which emits noxious smell and harmful gases like dioxin, CO, CO_2 and SO_X to the atmosphere hence disturbing public and environmental heath.

Vegetation, through its natural metabolic processes, contributes to VOC emission, Additionally, burning of vegetation, whether during agricultural burning, hazard reduction burning or bushfires, releases large amounts of particles, NOx and VOCs into the atmosphere.

The rise of levels of greenhouse gases in the atmosphere is the main driver of human-induced climate change. In particular, the concentration of CO2 has been increasing rapidly, rising to 390 ppm in 2010, which is well above the concentration at the start of the industrial revolution, estimated at about 280 ppm in 1750. While Queensland's total greenhouse gas emissions in the global context are relatively small, the state is a high per capita emitter.

3.9.2 Water pollution

The most significant pressure on inland waters (both surface and groundwater) is that of pollution from agriculture, mining, industry, fishing, marine transport, human settlements, and construction activities. The pressure arises from chemical (such as fertilizers, pesticides, various wastes, sewage and storm water), physical (such as sediments), and biological (such as vegetation from invasive water weeds and organic debris) pollutants.

Artificial changes to natural temperature variations can lead to thermal pollution and may also affect the behaviour of other contaminants.

Pollution can have serious ecosystem impacts and, at the extreme, result in eutrophication (i.e. increases in nutrient concentrations in aquatic ecosystems). This can result in the development of algal blooms leading to depletion in oxygen levels that can threaten aquatic populations of plants and animals.

Figure 9: Pollution of Lake Victoria shores along Iringo beaches. Solid waste dumping from households

An emerging issue in freshwater management is the disposal of large quantities of untreated water from industrial effluents, sewage and other water releasing anthropogenic activities. The regular introduction of large quantities of water, even if treated, into systems that have evolved within a regime of minimal flows for most of the year has the potential to result in adverse effects.

Pollution entering Lake Victoria and other wet lands from freshwater streams has had major impacts to their ecosystems. For example, accelerated eutrophication has adverse consequences on aquatic ecosystems, while rural diffuse pollution, including from far inland, has resulted in the decline of aquatic biodiversity on the Lake Victoria. Litter, sourced from both land and lake-based activities, is of growing concern. The impacts include the dispersion of invasive species, plus the entanglement of aquatic life and the ingestion of litter by aquatic organisms.

Wetlands and waterways can become polluted through point source discharges (e.g. sewage outfalls and industrial waste), through run-off after rainfall events, or through leaching to groundwater. Pollutants can also concentrate in these systems in times of drought. Less commonly, waterways can become polluted through incident-based occurrences, such as oil spills and the overtopping of mining dams.

Illegal fishing especially through the use of poison, introduces deadly chemicals to water ecosystems. Cases of poison use in fishing are still bitterly reported in Musoma

Municipality. Such polluting fishing method claims lives of aquatic organisms. The use of such water for human consumption may claim lives of people or endanger their health.

Oil pollution of Lake Victoria is caused by oil spills from boats, garages and carwash. Introduction of oils in water ecosystems has huge impacts to aquatic ecosystem.

Kitaji pond located at Kitaji ward was initially used as a solid waste dump site before it was realizes that the practice was potentially destructive. Despite the fact that measures are being taken to rehabilitate the polluted Kitaji pond, there is still litering of solid waste done by nearby households and other people.

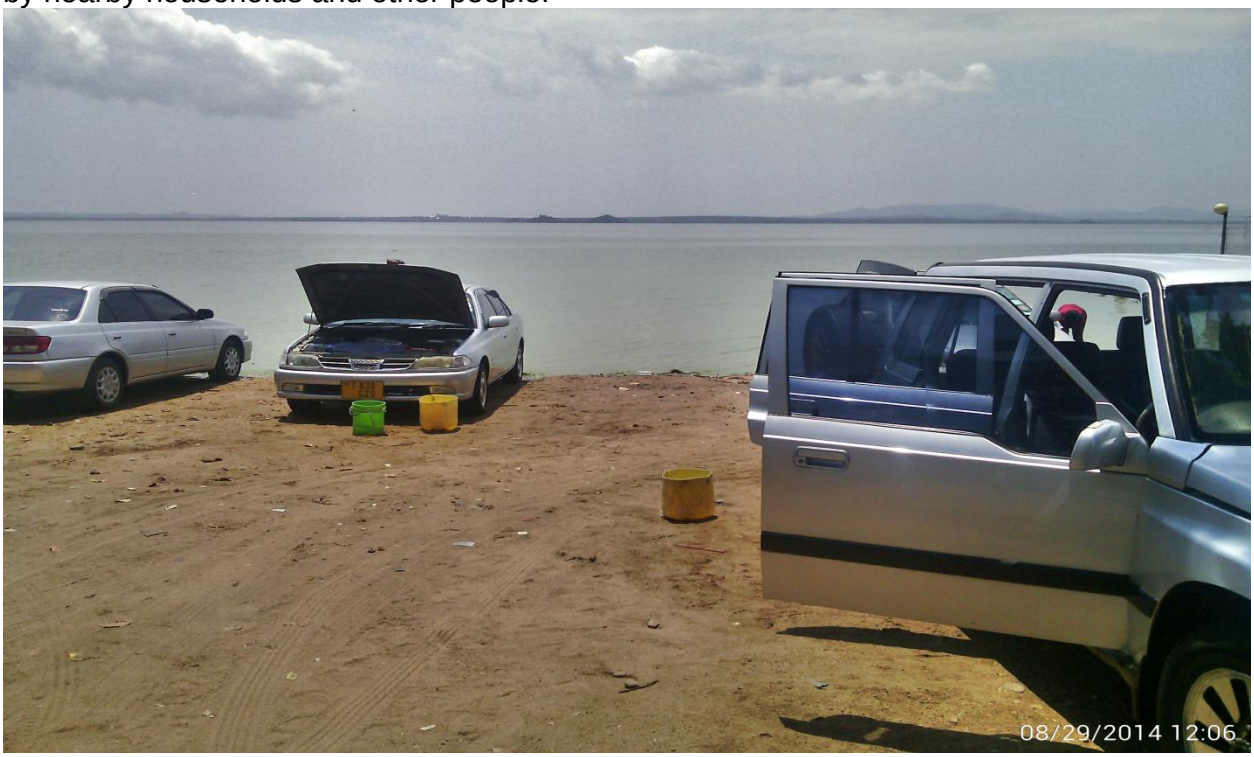


Figure 10: Illegal car washing being practiced at Mwigobero beach.

3.9.3 Land pollution

Land pollution generally results from the incorrect disposal of chemicals and wastes the excessive application of fertilisers and pesticides or the disturbance of acid sulfate soils resulting in land degradation.

Musoma Municipal land is being polluted through careless disposal of polyethylene bags and plastic bottles and cans. Other sources of soil pollution in Musoma Municipality include poor methods of farming and careless use and disposal of agro-chemicals, hydrocarbons, solid waste, illegal cutting of trees and encroachment to environmentally fragile lands such as wetlands and sloppy areas.

Chemicals are used in every aspect of life, including industrial processes, energy, transport, agriculture, pharmaceuticals, cleaning and refrigeration (UNEP, 2007). However,
the use of some chemicals presents risks for public health, workplace safety, the environment and national security (Productivity Commission, 2008).

The disposal of solid wastes generated by households, businesses and public agencies into landfill can be of concern. Potential pressures include reducing scenic amenity and causing long-term pollution of the environment through leaching of toxic substances (e.g. heavy metals and household chemicals).

3.10 Water extraction and consumption

Water is one of the world's most abundant yet most exploited resources. Queensland's freshwater resources consist of both natural wetlands (e.g. upland streams, rivers, lakes and groundwaters) and artificial reservoirs (e.g. dams and tanks).

Water is very basic for socio-economic development of any nation. Water is life, life cannot be sustained without water, water is a major factor commanding the progress of people's civilization, and it is equality an important commodity for both domestic and industrial uses. The ultimate objective of development is improving the quality of life. Of the basic requirements of life, water and sanitation services are extremely vital for survival of human being.

Musoma Water Supply and Sanitation Authority (MUWASA) is a fully autonomous public water utility responsible for the overall operation and management of water supply and sanitation services in the Musoma Municipality. The authority relies on the Lake Victoria as it's solely source of water. Musoma Municipality is currently receiving water from three main intakes which are Mwisenge producing about 95% of all the water supplied in town, MUTEX intake which contributes about 3% of the water supplied while Bweri intake contributes only 2% of the water supplied. These intakes capacities are only limited by the abstraction and conveyance infrastructure as the Lake has abundant water. The total water production stands at an average of 10,000m3/day, supplying to 136,000 people residing in the town.

The supply of water is greatly influenced by climate and weather variability. Musoma Municipal Council is bordering with Lake Victoria hence ensuring a permanent source of fresh water to all wards. However because of poor technology to enable efficient water supply system, there are some areas where the water supply (piped water) by MUWASA does not reach.

A number of water sources exists in Musoma Municipal Council as indicated in the table bellow;

Table 7: Water Sources of Musoma Municipality

No.	Water Source	Percentage
1.	Wells	12.4
2.	Tap (MUWASA)	80.6
3.	Rain harvesting	1.7
4.	River/lake	5.3
5.	Total	100.00

Source: Musoma Master Plan, 2015.

Water is needed for domestic consumption, construction works, animal husbandry, industrial processes, irrigation, fishing, transportation and recreation purposes to mention but a few.

3.11 Fishing

Fishing is among the major economic activities of the people of Musoma Municipality. Sustainable fisheries can support strong commercial and recreational fishing sectors. Maintaining sustainable fisheries' resources presents a range of challenges, including the potential for overexploitation of fish resources to meet an increasing consumer demand. Competing uses of finite aquatic resources can also create conflict between user groups.

Figure 12: Ferry M.V. Musoma in the port of Musoma town.

The Municipal data show that, for the year 2013/2014 there are about 11,077 active fishermen engaging on daily fish harvesting an average production of 58,933 tons annually. Fishing species caught in Musoma are tilapia, Nile perch, *'dagaa'* and *haplochromis.* Fishing contributes about 28% of the Municipal revenue, mainly through fishing vessels licence fees and fish handling facilities fee. Despite the significant contribution of the fishing industry into the Municipal economy, most of the fishermen employ traditional fishing gear using low technology and therefore their catchment are normally low. Fishing activities, especially using modern fishing tools like improved fishing gear and canoe motorization with outboard engines is recommended so as to full utilize the resources in the Lake Victoria. Fishing as an economic activity is expanding fast because of fish processing factories which have been established in the area which include the Musoma Fish Processors Limited and Prime Catch Exports.

There is a potential of investing in fish farming, which is currently underutilised for business purposes. In addition, fishing has great potential for expansion and generation of employment and income and therefore a major source of revenue to the council apart from being good source of protein to the community.
Below are current challenges facing fishing sector in Musoma Municipality:

- Inadequate investment in fishing activities.
- Lack of permanent commercial storage facilities.
- Failure of fishermen to make fishing as an economic activities rather than subsistence.
- Lack of security and safety equipments and tools for the fishermen.
- Lack of reliable market for fish products.
- Use of prohibited fishing gears.

 Lack of environmental knowledge to fishermen.

Unsustainable fishing methods are among the huge threat of Lake Victoria ecosystems. The use of dynamite, poison and illegal nets are among the pressures exerted from fishing in Musoma Municipality's waters especially Lake Victoria.

3.12 Mining

Increasing world demand for mineral and energy resources has led to further emphasis on mineral and energy production in Tanzania. While exploration and mining activity can result in significant economic growth for the state and benefits for the community, it also places pressure on the environment. Pressures arising from mining and extractive industries may result from site development, resource demands for energy, land and water, and the extraction, treatment and movement of raw materials.

However the dominant mining activities in Musoma Municipality involves construction materials such as stone, gravel, soils and sand. It can be generally inferred, mining of construction minerals especially sand, gravel and stone is among the great source of land degradation and wetland pollution in Musoma Municipal Council. There are pits every where left especially after large construction projects like civil works. Sand mining along the beaches of Makoko and Mwisenge wards is exerting a great threat to Lake Victoria shore ecosystems.

Figure 13: Sand mining along the beaches of Makoko and Mwisenge wards

3.12 Environmental Disturbances and Natural Catastrophes

Environmental disturbances include hazard events such as floods, fires, cyclones, storm surges, landslides and oil spills. Hazard events become disasters when they cause a serious disruption in a community that requires a significant coordinated response by the state and other entities to help the community recover from the disruption'. The Act also notes that a serious disruption means loss of human life, or illness or injury to humans, or

widespread or severe property loss or damage, or widespread or severe damage to the environment.

Natural disasters can have a severe impact on the state of the environment. While these occurrences may be an intrinsic part of the natural environment with many positive outcomes, they can also impact in a detrimental way when considered in the context of the multitude of other pressures caused by human activity.

Climate change is a major driver of natural disasters. Rainfall flooding occurrences has been recorded in Musoma Municipality. Rainfall flooding in Musoma Municipality has several huge impacts: Short term impacts include loss of lives (death of people), destruction and loss of properties, loss of food in crop fields and stored food, homelessness and stress.

Medium term impacts include lack of social services such as education provision to school children as the school buildings and infrastructure are destroyed and needs time for reconstruction for pupils to go back to school. Eruption of diseases such as cholera is another medium term impact caused by rainfall flooding. Rainfall flooding normally causes destruction of roads and bridges hence blocking roads. Also destruction of houses by flood imposes a big problem for people and households who lose their shelter.

Long term effects of rainfall flooding includes dwarfing economic development of the Municipality because much of the resources are used for rehabilitation of affected infrastructure and provision of humanitarian assistance such as food, health service and shelter to the survivors and many other emergency logistics needed to help people affected by such disasters.
Reconstruction of roads, bridges and other infrastructures affected by flood has huge economic implications born by the local government authority (Musoma Municipal Council). Flooding also will indirectly impact the resources such as crop fields making it difficult for the community o recover with easy. Mitigation and adaptation measures to alleviate these impacts include having resilient infrastructures such as sound drainage system, disaster preparedness and environmental conservation.

Although the rainfall/storm water eventually goes to the lake, when flooding occur the water causes several chaos before reaching the lake. Despite the fact that rain seasons are known, but flooding can only be forecasted by weather forecast stations. Flooding is spontaneous in the sense that heavy rains are likely to occur at any time of the rainy season and result floods. Drainage plan is within the plans prepared by the engineering (works) department. Besides benefiting the farm fields, rain water is utilized for drinking and other water dependent activities by households and institutions. It is collected through simple ways such as buckets. No constructed dams are in place to capture and store storm water for economic activities.

Resilience from flooding shock does not take short time in the Municipality. Recovery period is usually between 6 and 12 months or more.

As a balance of nature, natural flooding events help to 'reset' the environment and cause 'booms' in natural cycles. For example, bumper breeding events for birds have been recorded following floods (Porter and Kingsford, 2011). However, the effects of floods can be exacerbated by human activities that have affected natural flood mitigation processes or predisposed the landscape to deliver above natural impacts, for example, through clearing or over-grazing. Water erosion can result in a loss of top soil, stream bank erosion, gully expansion, landslips, sediment redistribution, channel redirection and vegetation removal

(Gordon et al., 1992). Additionally, flood waters facilitate the downstream flow of pollutants, such as pesticides, as well as weed species. This can affect water quality and potentially cause harm to freshwater, estuarine and marine ecosystems, as well as damage pasture, crops and infrastructure. Harmful algal blooms can also follow floods through the introduction of excessive nutrients into aquatic systems.

Drought spells is another disaster that is caused by climate change too. This disaster normally leads to famine (food insecurity) which another disaster.

CHAPTER FOUR

4.0 State

This chapter discusses the current state of the environment of Musoma Municipal Council. The state of the environment refers to its extent, condition, quality and/or quantity at a particular point in time. The state is influenced by current and past pressures, both human-induced and natural, and long-term trends are desirable when assessing state. If the environment has been damaged, benchmarks from which to determine the degree of damage and rates of recovery are also important.

4.1 Atmosphere

The atmosphere is the envelope of air surrounding the earth. It is essential for life, providing the air that we breathe, regulating climate, and protecting us from the sun's damaging ultraviolet radiation. Presented below is a summary of Musoma Municipality's climate variability and air quality.

4.1.1 Climate

The earth's climate system is complex and controlled by the exchange and storage of energy through the ocean, land, atmosphere and snow or ice. The climate system is finely balanced and changes to any of these components can lead to significant changes in global and regional climate. Climate is how the atmosphere behaves over long periods of time. It is characterized by the average of variables such as temperature, rainfall and evaporation and how these variables change over years, decades and centuries.

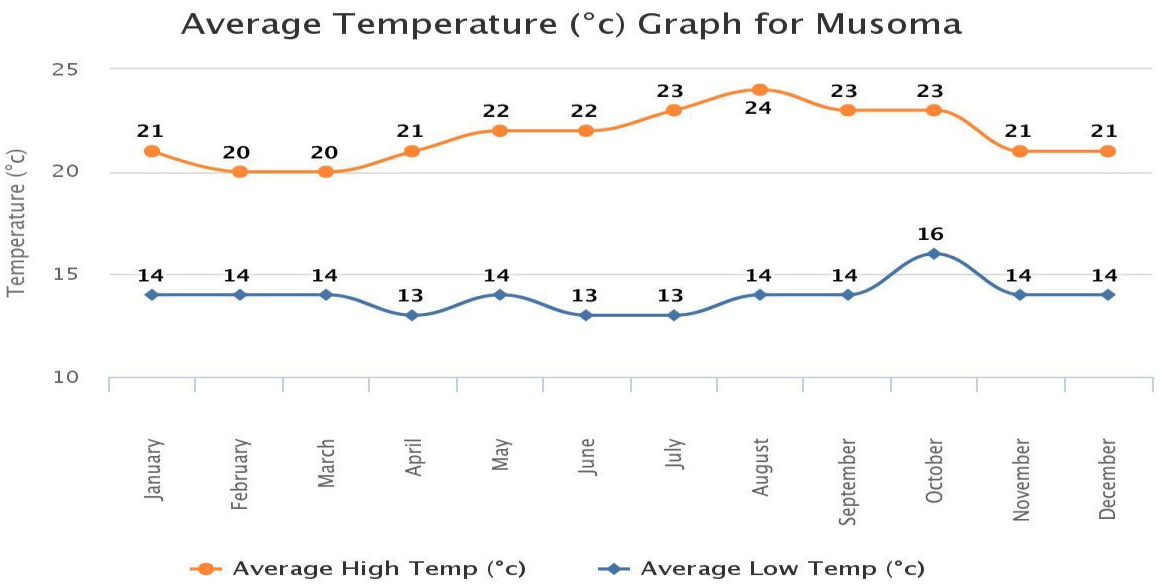
4.1.1.1 Rainfall and Temperature

Musoma Municipal area experiences tropical type of climate. Temperature ranges 24^{o}C and 32^{o}C. High temperature are recorded in the months of September, October and November when the mean maximum temperatures reach up to 31.6oC. The minimum temperatures are experienced in the months of June, July and August when temperatures go down about 15.00oC average. Rainfall pattern is bimodal which ranges from 900-1200mm per annum. The short rainfall season starts from October to December while the long rains are from March to June.

Table 8: Climate data for Musoma

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	28 (82)	28 (83)	28 (83)	28 (82)	28 (82)	27 (81)	28 (82)	28 (82)	28 (83)	29 (84)	28 (83)	28 (82)	28 (82.4)
Average low °C (°F)	19 (66)	19 (66)	20 (68)	19 (66)	18 (65)	18 (64)	17 (63)	18 (64)	20 (68)	19 (66)	19 (66)	19 (66)	18.8 (65.7)
Average precipitation mm (inches)	56 (2.2)	58 (2.3)	114 (4.5)	173 (6.8)	107 (4.2)	30 (1)	20 (0.8)	20 (0.8)	30 (1)	36 (1.4)	69 (2.7)	66 (2.6)	779 (30.3)

Source: Weatherbase



4.1.1.2 Air Quality

Pressure 1014 hPa
Visibility 10.0 kilometers
Clouds Few 701 m
Dew Point 21 °C
Humidity 74%
*Snow Depth*Not available.
Source: http://www.wunderground.com/tz/musoma

4.2 Water and Aquatic Ecosystems

Musoma Municipality's aquatic ecosystems include Lake Victoria, Rivers (all are seasonal rivers) and wetlands such as Kitaji Pond and riparian wetlands along the shores of Lake Victoria. These ecosystems harbor a great deal of biodiversity including fish species, reptiles such as crocodiles, birds, amphibians and mammals such as hippopotamus. Most of these groups of organisms are found in Lake Victoria ecosystem while the remaining wetlands host few kinds of aquatic organisms while hippos and crocodiles are exclusively found in Lake Victoria for the case of Musoma Municipality's aquatic ecosystems.

4.2.1 Kitaji Pond

Kitaji pond is probably the wetland that has received enough public attention next to Lake Victoria for the case of Musoma Municipality's water bodies. Kitaji pond is situated within the Musoma Municipality and is estimated to have flooding area covering 6.24 hectares. The pond is currently surrounded by residential houses and businesses in all directions. The history of the pond is rather interesting. The tale goes that the pond which was originally a mere land depression without water started in 1961 after some

very heavy rains. For many years the pond had been viewed as a nuisance to Musoma residents as it was believed to;

- Cause regular flooding of the adjacent areas
- Act as mosquito breeding site
- Aesthetically unpleasing due to bad smell, waste dumping

A lot of efforts were directed to eliminating the pond. In 1962 and 1963/64 a drainage channel was constructed on the eastern side to drain the pond into Lake Victoria. This however was not very successful as it was realized that the levels in the pond and in Lake Victoria were the same. This was confirmed in 1997 after establishing that the pond level and the Lake Victroria level were both at an elevation of 1134 m above mean sea level.

A lot of efforts were directed at gradually backfilling the pond. Most houses situated around the pond are sitting on reclaimed land from the pond by backfilling. At one time the then Musoma Town Council (MTC) encouraged the use of the pond as a solid waste dumping site. This caused other nuisances like bad smell, rodent and vermin infestation and therefore calls for the establishment of a new dumping site. At another point there were plans within MTC to reclaim Kitaji pond and construct inter-town bus terminal.

During LVEMP I, environmental education was promoted around the Lake Victoria Basin. The issues of wetlands around the Lake were critical. This drew attention to the Kitaji Pond as a wetland that needs to be conserved. Although not so many studies were conducted on Kitaji pond some limited studies conducted reported the high bird biodiversity of Kitaji pond (LVEMP, 2007; LVBC, 2011). LVEMP I therefore developed management strategy for the sustainable use and rehabilitation of degraded Kitaji pond wetland.

The shared strategy for the conservation of Kitaji Pond wetland was developed in March 2007 by the Wetland Component of LVEMP I in close collaboration with the Musoma Town Council. One could argue that this was a turning point on the part of Musoma Town Council to turn away from the intention of eliminating the Kitaji Pond to that of rehabilitating and conserving it. In an expert workshop on Urban Development, Biodiversity and Wetland Management organized by UN Habitat in 2009 it was reported that a Kitaji Pond was established as a pilot project aimed at mobilizing the community to improve the pond for the benefit of the local community (Rob McInnes, 2009).

According to the current Musoma Municipal Council (MMC) (discussions held in March 2014) UN-HABITAT financed the erection of a fence around the pond extending from the northern side of the pond to the eastern side. This is the best protected area of the pond against encroachment although such efforts are meeting some resistance from some individuals due to the fact that initially the MTC encouraged individuals to back fill the pond in order to eliminate it. It is however, clear from the current thinking that MCC wants to keep the new momentum of rehabilitating and conserving the pond. MCC have stopped using the pond as refuse dumping site. Any current solid waste dumping is done illegally by individuals living in the close proximity of the Pond.

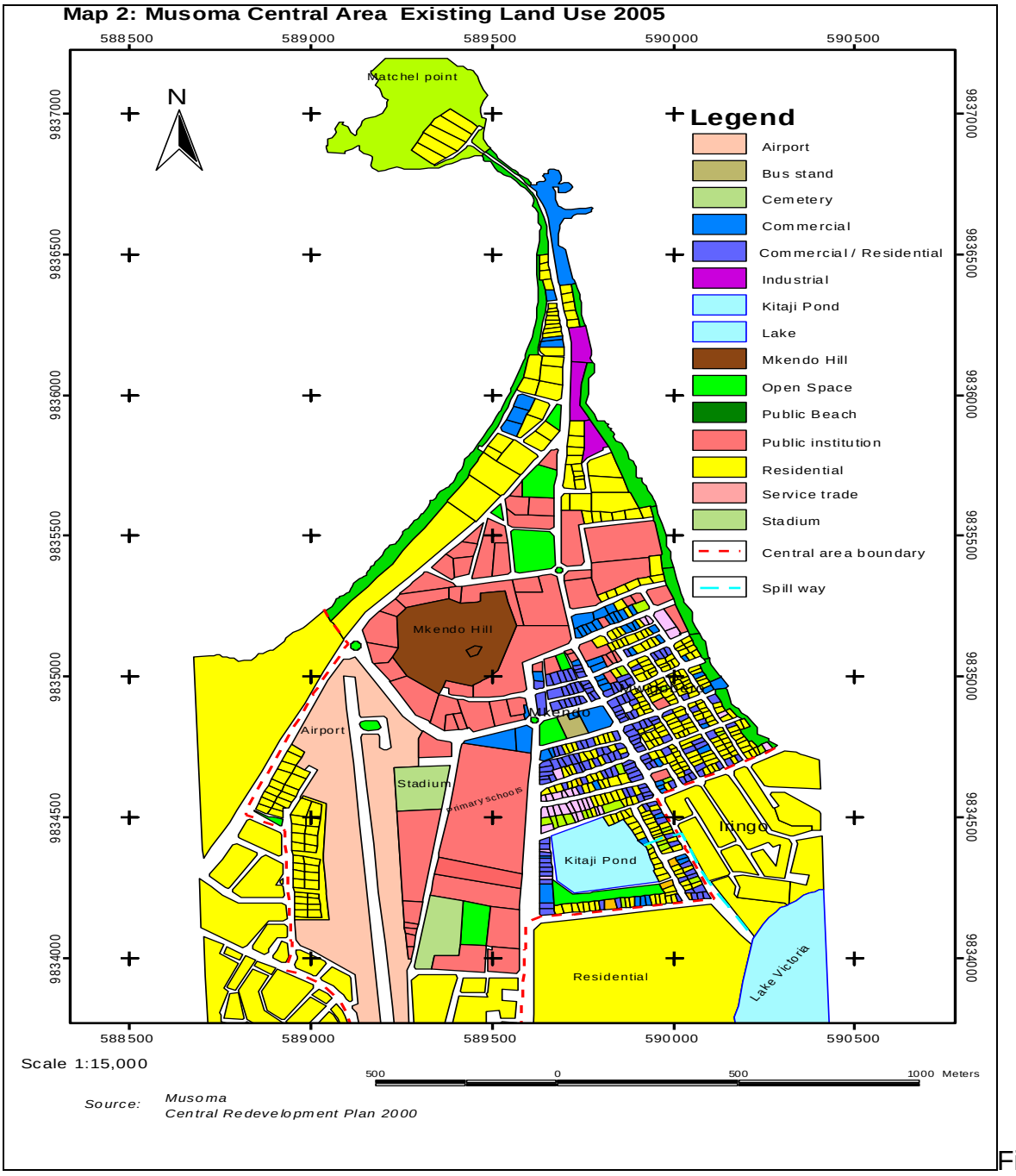


Figure 14 : Musoma Central Area Land Use (2005) source : LVEMP (2007)

Kitaji Pond Biodiversity

4.2.1.1 Bird diversity

The bird diversity of the lake was fairly established during the LVEMP I. Table 1 shows about 33 bird species visiting Kitaji pond (LVEMP, 2007). Seven of the identified species are migratory. Even during our visit on 21st and 22nd March 2014, the pond which did not have much water, was full of bird life. The bird life is probably the best reason why the pond should be restored and used as recreational area. For the purpose it is intended it is also important to document other biodiversity species found in

the Kitaji pond. The baseline can also be used as a way of monitoring the restoration efforts.

4.2.1.2 Aquatic Fauna Biodiversity

Biota inhabiting aquatic ecosystems provides a direct, holistic and integrated measure of the integrity or health of the ecosystem as a whole. Macro invertebrates and fish are the commonest indicators of aquatic ecosystem health and monitoring their populations in the proposed projectcan generate baseline data that could provide insight into key aspects of aquatic habitat and hydrology that support the Kitaji Pond. The characteristics of macro invertebrate and fish assemblages (e.g. species richness, composition, relative abundances and sensitivity to pollution) are robust indicators of human impacts and have been widely used in bioassessment programs. The other reason justifying fish biodiversity sampling in the proposed study is the report which suggests that swamps, ponds and satellite lakes around Lake Victoria basin provide important refugia to stocks of the native fish species which were thought to have disappeared in the lake (Katunzi, 2003). From biodiversity perspective, it would be important to document the presence or absence of fish populations in the Kitaji Pond.

Table 9: The list of bird species found in Kitaji Pond (LVEMP, 2007)

S/No.	Bird Species	Resident/Migratory
1	African Jacana *Actophilornis africana*	Resident
2	African open-billed stork *Anastomus lamelligerus*	Resident
3	African spoonbill *Platalea alba*	Resident
4	African wattled lapwing *Vanellus senegallus*	Resident
5	Black-crake *Amaurornis flavirostris*	Resident
6	Black-headed heron *Ardea melanocephala*	Resident
7	Cattle egret *Bubulcus ibis*	Resident
8	Common moorhen *Gallinula chloropus*	Resident
9	Common sandpiper *Actitis hypoleucos*	Migratory
10	Common stilt *Himantopus himantopus*	Resident
11	Glossy ibis *Plegadis falcinellus*	Resident
12	Great-white egret *Egretta alba*	Resident
13	Green shank *Tringa nebularia*	Migratory
14	Grey heron *Ardea cinerea*	Resident
16	Grey-crowned crane *Balearica regulorum*	Resident
15	Hadada ibis *Bostrychia hagedash*	Resident
16	House sparrow *Passer domesticus*	Resident
17	Little egret *Egretta garzetta*	Resident
18	Little stint *Caladris minuta*	Migratory
19	Long-toed lapwing *Vanellus crassirostris*	Resident
20	Pectoral sandpiper *Caladris melanotos*	Migratory
21	Pied crow *Corvus splendens*	Resident
22	Pied kingfisher *Ceryle rudis*	Resident
23	Purple swamphen *Porphyrio porphyrio*	Resident
24	Redshank *Tringa tetanus*	Migratory

S/No.	Bird Species	Resident/Migratory
25	Ringed plover *Charadrius hiaticula*	Resident
26	Ruff *Philomachus pugnax*	Migratory
27	Sacred ibis *Threskiornis aethiopica*	Resident
28	Spur-winged lapwing *Vanellus spinosus*	Resident
29	Squacco heron *Ardea ralloides*	Resident
30	White-faced whistling duck *Dendocyna viduata*	Resident
31	Wood sandpiper *Tringa glareola*	Migratory
32	Yellow-billed egret *Egretta intermedia*	Resident
33	Yellow-billed stork *Mycteria ibis*	Resident

In addition, the use of fish in mosquito control has been well known for more than 100 years and there are numerous reports of the effectiveness of various species of fish in controlling malaria disease. WHO (1981) lists eight species that are used directly in mosquito control including *Tilapia zillii* (Somalia), *Oreochromis mossambicus* (Pakistan), *Oreochromis niloticus* (India), *Carassius auratus* (Iran), *Aphanius dispar* (Oman, Somalia), and *Nothobranchius palmquisti* and *N. guentheri* (Somalia). In Kenya a recent study has shown that farming tilapia (*Oreochromis niloticus)* provide a secondary benefit by helping to control mosquitoes (Howard et al., 2007). The use of larvivorous fish for vector control is a simple, inexpensive and reasonably effective measure, and should be considered as a component of integrated management strategy for the Sustainable use and rehabilitation of degraded Kitaji pond wetland.

4.2.1.3 The diversity of macrophytes

Aquatic macrophytes are important component of the Kitaji pond and constitute the most visible part of the biotic communities. Currently the pond is infested with water hyacinth and other plant species occupying the pond. As water regime changes during rehabilitation plant diversity may change. It is important to document the current plant diversity in order to establish a baseline which will be used in future to assess the success or failure of the rehabilitation actions. Establishing plant diversity will also contribute to the control of existing and future invasive plant species that may establish in the Pond

4.2.1.4 Water Quality

Currently there is no regular water quality information documented. The only report that seems to mention the water quality issues is the draft Social and Environmental Impact Assessment and the Strategic Environmental Management Plan report (2010) conducted by Jomo Kenyatta University which reported that water samples from the pond have registered very high coliform counts (5.0×10^6 and 1.9×10^3 for total and fecal coliform forming units/100ml respectively) indicating a high degree of sewage contamination. In addition, the pond water was found to be infested by *Vibrio cholerae* (causes cholera), *Shigella* sp and *Salmonella typhi* (causes typhoid).

This is negative both to the intended purpose of recreating the pond as a recreation area. The Musoma Water laboratory is able to document the water quality parameters of importance namely pathogens, physical parameters (pH, Conductivity, salinity or TDS TSS), and nutrients (NO_3, NH_4 and PO_4) and organics (BOD/COD). Since the pollution is diffuse, It is proposed to establish sampling points along transects running perpendicular to the general water flow direction from inlet to outlet. Four to five such transects should be established with up to four sampling points depending on the length of the transect. The samples should be analyzed for the key parameters that would indicate the extent of pollution by human excreta. These parameters of interest are Fecal Coliform, BOD/COD, NO_3, NH_4, PO_4 and TSS. Moreover pH, Conductivity and TDS(or salinity) can be measured in situ during sampling. The results of these analyses should be processed to produce a map of pollutant concentrations on Kitaji pond. Areas that are seriously polluted will be clearly indicated. This information shall assist in designing the measures to arrest the pollution such as the location of constructed wetland discussed in Chapter 5.1.

It is this kind of information that will direct interventions to improve the water quality and also provide baseline information for monitoring purposes.

4.2.1.5 Water hyacinth

The pond in its current state has been infested by water hyacinth. One important activity of the project is to manually or otherwise remove the water hyacinth from the water pond. This activity has been covered in the current project proposal.

4.2.1.6 Mosquito Problem

Mosquito problem has consistently been mentioned one of the reasons that the residents wanted the pond to be eliminated. Although no specific mosquito study has been carried out to establish the contribution of the pond to the mosquito problem it is important for the project to clearly put forward measures to control mosquito infestation in the area. A scientific study should be initiated to study the mosquito problem in the pond area in terms of type, intensity, distribution and control options.

Figure 15: Kitaji pond showing solid waste littering

4.2.1.7 Pollution

There are currently three challenges related to pollution namely sediments and solids, pollution from domestic wastewater, and continued solid waste dumping into the pond. There is also a problem of animals grazing in the pond.

4.3 Solid Waste Management.

Among the very challenging issues of urbanization in Musoma Municipality is the increase of solid waste generation while the Council's ability to manage it is still ill. Musoma Municipality generates approximately 87.3 Metric tons of solid-waste per day, equal to 31,864.5 metric tons per year. Waste composition include organics, metals, plastics, textile, glass, soil/ash, paper and hospital wastes. Only 39.3 metric tons (45%) of solid waste is collected and transported to final disposal sites per day(crude dumping). Generation rate is estimated to be 0.65 Kg/capita/day (Source: World Bank Data on MSWM, 2005).

The remaining load (55%) is disposed locally through burying, burning or reuse in crop fields as manure but largely remain as environmental threat and nuisance. Thus it is apparent that Waste management is one of the essential public services. However there is no sanitary landfill. Final disposal is by crude dumping. Sorting of MSW is done locally by individuals who reclaim plastic bottles for reuse and metals for selling to recyclers agents who transport them to Dar es Salaam and other areas for recycling.

Musoma Municipality has only two (2) Secondary solid-waste secondary storage points or refuse bays located behind Musoma Main Market and Nyasho Market. There are six (6) CBO groups involved in solid waste collection in six (6) wards namely Iringo, Mwigobero, Mukendo, Kitaji, Nyakato and Nyasho. These are generally called refuse collectors. They collect solid-waste from source and transport it to the closest refuse bay. The remaining Seven (7) wards are located in the periphery of the town and hence their solid-waste generation rate is relatively low and is missing such CBO groups of refuse collectors and solid waste is disposed through burying, open burning and reuse. However because of the continued expansion of the periphery wards, efforts are made to ensure that solid waste collection is managed by CBOs under the supervision of the Health Officer for that particular ward.

Musoma Municipal Council, despite the fact that it has an extraordinary shortage of refuse vehicles, having only one obsolete refuse vehicle, it also lacks a sanitary land fill being the recommended final destination of solid waste. Currently disposal of municipal solid waste is done by crude dumping at Buhare ward area, which remains as an environmental health threat.

Figure 16: Solid waste disposed on the soil without any storage facility

Due to lack of public litter bins, littering remains a challenge in Musoma. Solid waste can be carried by both air and water currents to the drainage systems, natural water ways like rivers and ponds and finally find its way to Lake Victoria.

Figure 17: Wastes brought off shore by the wave action close to Mwegobelo ferry station

Figure 18: Crude solid waste dumping at Buhare area.

4.4 Liquid Waste

Liquid waste originates from households, industries, commercial areas, institutions and storm drain. Simple technologies such as pit latrine and septic tanks are used by many households and institutions to store/dispose sewage. Musoma Municipal Council does

not have a sewerage system. Sewage is collected by using cesspit emptier. Sewage is disposed locally in open pits excavated for that purpose in Nyamitwebiri area approximately 20km from Musoma town centre.

Figure 19: Final waste water disposal pit located at Nyamitwebiri, Bweri Ward

Currently, Musoma Municipality has no sewage treatment plants. Construction of waste water treatment lagoons at Bweri area by The Musoma Water and Sewerage Authority (MUWASA) is in progress. Likewise MUWASA is intending to construct a sewerage system in Musoma and another sewage treatment facility in Makoko ward. This is hoped to be the panacea of poor sewage disposal in Musoma.

There is a tendency that when it rains and drainage channels are filled with storm water, some households do empty their septic tanks so that sewage from their toilets is washed by storm drain. This act is very dangerous to public and environmental health as it is among the causes of disease eruptions such as cholera, typhoid and worms.

Figure 20: Cesspit emptier empting sewage at the Nyamitwebiri sewage pits

CHAPTER FIVE

5.0 IMPACTS

Changes in the state of the environment can result in detrimental environmental impacts, as well as affect human health and the economic and social performance of society (Kristensen, 2004). There are many costs associated with environmental degradation (e.g. TEEB, 2010). The examples below highlight some of these, as well as the importance of effective responses to alleviate future costs.

5.1 Impacts of Pollution of Fresh Water Sources and Ecosystems

Pollution is an undesirable change in the natural state of the environment that affects the wellbeing of living things and human being. Water pollution has several negative impacts including the following;

- Next to air, water is an important constituent of life support system. Pollution of water renders the water fail to support life of aquatic organisms.
- Because of water pollution caused by the use of poison for fishing, aquatic organisms die in big numbers and cause loss of biodiversity.
- Health effects to animals and humans. Polluted water pose a health threat to man and other organisms because of chemicals contaminants, particulates and pathogens. Waterborne diseases are among the leading killer diseases in Musoma.
- Nuisance. Polluted water has unpleasant appearance. It reduces the aesthetic beauty of a place.
- High cost of treatment of diseases caused by water pollution and treatment of water by water authorities has an economic implication by itself.

5.2 Impacts of Air Pollution

- Cause climate change. The effects of climate change include flooding, drought, food insecurity and loss of biodiversity.
- Cause diseases both to man, plants and animals.
- Result in acid rain.
- Particulates affect buildings, water surfaces and clothing.
- Impaired visibility due to particulates (dust in the atmosphere)
- Release of green house gases such as methane and Carbondioxide cause global warming which triggers climate change.
- Release of Ozone depleting gases like Chlorofluorocarbons (CFCs) and Oxides of Nitrogen cause Ozone layer depression which make destructive radiations reach the biosphere and impact on health of living organisms including man.
- Cause acid rain.

5.3 Impacts of Land pollution

As mentioned earlier, Land pollution in Musoma is cause by poor methods of farming, encroachment to fragile lands such as water source and slopping lands for settlement or farming. Land degradation has several negative effects as follows;

- Loss of soil fertility. This affects agriculture and farming activities resulting into poor yield of crops due to soil nutrient impoverishment.
- Loss of vegetation cover which in turn cause several consequences including affecting the hydrological cycle.
- Destroying the natural aesthetic value of the environment.
- Reducing arable land.
- Sedimentation of water bodies. This is an introduction of solid particles especially soils into water bodies which eventually clog living things, burry their breeding caves and make water not clear in favor of aquatic organisms.
- Landslides may occur if farming or mining is done irresponsibly in slopping lands.

5.4 Impacts of Poor Solid Waste Management

- Eruption of diseases such as cholera
- Blockage of drainage system
- Pollution of surface water sources
- Pollution of ground water sources due to leachates sinking and percolating to the bottom reaching underground water sources.
- Solid waste act as the breeding sites of mosquitoes and rodents.
- Source of bad smell and nuisance
- Destroy the aesthetic beauty of Musoma town. For instance, the two refuse bays are situated at Nyasho market and Queen Elizabeth Garden. When these refuse bays are filled with solid waste, the areas appear very dirty and unpleasant.
- Become breeding sites of mosquitoes causing malaria.
- High cost of treating diseases resulting from poor disposal of solid waste.

5.5 Impacts of Sand Mining along the Beach of Lake Victoria

- Destruction of the beach vegetation cover which supports lakeshore ecosystem
- Destruction of breeding sites of fishes and amphibians
- Destroying the habitats of birds, reptiles and amphibians
- Water pollution due to sedimentation
- Soil erosion
- Making water extend beyond the original water boundary endangering those households near the lake shore to be reached by water waves. This has already happened in Makoko ward where some households are already affected by being reached by water following continued sand mining at the shore close to them.

CHAPTER SIX

6.0 Responses

Responses refer to the actions or initiatives undertaken to prevent, mediate or adapt to changes in the environment. Responses are generally developed in reaction to the observed or anticipated pressures, impacts, or the state of the environment. Responses act in a multitude of ways, either individually, or more often in concert with one another to bring about environmental change. They protect the environment from damage or further harm; they encourage recovery through rehabilitation and remediation, they facilitate the transition from harmful or damaging behaviors to more sustainable ones, they encourage the adoption of more efficient practices; they seek to resolve conflicts of interest in an equitable manner and/or they pave the way for adapting to major shifts in circumstances.

The *Environmental Management Act, No.20 of 2004* (EMA) specifies that every person has a general environmental duty to take all reasonable and practicable measures to prevent or minimize environmental harm from their activities. Protecting, maintaining and restoring the environment are responsibilities shared by many, including government at all levels, industry, natural resource management groups and non-government organizations, landholders and individuals. Complementing the wide range of initiatives for environmental planning and management are environmental literacy initiatives including education and awareness projects, scientific studies and monitoring and reporting programs.

The responses in place for Musoma Municipal Council cover a wide range of statutory and non-statutory initiatives including legislation, policies, plans, strategies, programs, projects and guidelines. This chapter provides an overview of these responses.

6.1 Conserving natural assets

A range of responses are needed to slow or reverse the decline in biodiversity and increase the resilience of species, ecosystems and ecosystem processes.

Tanzania prepared The National Biodiversity Strategy and Action Plan in August, 2001. Several measures are taken at National level to conserve biodiversity. For Musoma Municipal council, conserving biodiversity is done through collaborations that involve various stakeholders. The Municipal Council has established Beach Management Units (BMU) to guard on the human activities at the shore and in the Lake Victoria to ensure that no destructive activities are taking place. These groups are supervised by the Ward Development Committees (WDC) but they also report to the Municipal Fisheries Officer and Environment Management Officer to intervene in critical issues. The BMUs help to prevent illegal fishing and destruction of the Lake Victoria shore environment.

Other stakeholders who work to ensure conservation of biodiversity in Musoma Municipality include WWF, TFS, VI-Agro forestry, The Green Aid, LVEMP and Natural Resources department Mara region at Samara.

The Department of Environment of Musoma Municipal Council has been making serious campaigns in collaboration with the police force, to arrest sand miners who were caught mining sands at the shores of the Lake and those truck drivers and owners who transport beach sand for construction requirements. These defaulters are penalized and upon payment of fines, they are released from police. This initiative has greatly helped to reduce the rampart degradation of lake shores due to sand mining at the Lake shore.

Campaign to prevent undersize fish harvesting and illegal fishing in Lake Victoria is a daily task done by the Municipal Fisheries Officer and the Municipal Environmental Management Officer.

Mussoma Municipality put enough effort to ensure that at least 1.5million seedlings are planted per year in order to comply with the government order. Tree planting is done at all levels including the land occupiers, institutions and the Council led initiatives.

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6.2 Policies, Legislation, and plans

6.2.1 Policies

Musoma Municipal Council implements several policies set at the National level. Tanzania has promulgated a number of national policies on different aspects including environmental and natural resources management in the 1990s. There are number of existing policies that relate to environmental management in Tanzania. These are policies that provide guidance or impact the implementation of management at different levels of governance in the country. Environmental management is complex, multi-sectoral and cross-sectoral it requires a holistic approach and multi-level operation. Effective environmental management involves many actors and incorporates many different and sometimes overlapping institutional and legal mandates, which require cooperation and coordination.

Tanzania has promulgated the **National Environmental Management Policy, 1997** and other sector specific policies, which provide the policy guidance on how its environment and natural resources will be sustainably managed. There is in place a solid institutional framework mandated among institutions to coordinate the implementation of policies and enforce laws that have been enacted by the Parliament for the conservation and management of the environment and natural resources.
The role of National Environmental Policy, 1997 (NEP) can be summarized to include the following:
i.) Developing consensual agreement at all levels for the challenge of making trade-offs and the right choices between immediate economic benefits to meet short term and urgent development needs, and long term sustainability benefits;
ii.) Developing a unifying set of principles and objectives for integrated multisectoral approaches necessary in addressing the totality of the environment;
iii.) Fostering Government-wide commitment to the integration of environmental concerns in the sectoral policies, strategies and investment decisions, and to the development and use of relevant policy instruments which can do the most to achieve this objective;
iv.) Creating the context for planning and coordinating at a multisectoral level, to ensure a more systematic approach, focus and consistency, for the ever-increasing variety of players and intensity of environmental activities.

One of the major thrusts of NEP is that it provides for the need to develop ways for encouraging a holistic multi-sectoral approach to environmental management by integrating environmental concerns in sectoral policies, strategies and decisions. In that way it creates the context for cross-sectoral planning and coordination.

NEP articulates the concept of shared responsibility and distinct accountability for environmental management so as to inculcate collective responsibility in environmental management without blurring specific mandates and responsibilities that have been assigned to each institution.

That NEP is comprehensive and covers environmental mandates assigned to other sectors. Paragraphs 45 to 60 of the National Environmental Policy provides on Sectoral policies covering agriculture, livestock, water and sanitation, health, transport, energy, mining, human settlement, industry, tourism, wildlife, forestry and fisheries. This position is also reciprocated and reflected in Sectoral policies by including paragraphs on environment management in general and specifically on the requirement of undertaking an EIA.
The National Environmental Policy, 1997 in its diagnosis of the state of the environment in Tanzania identified six major problems that require urgent attention. These are problems of:-

i.) Land degradation;
ii.) Lack of accessible, good quality water for both urban and rural inhabitants;
iii.) Environmental pollution;
iv.) Loss of wildlife habitats and biodiversity;
v.) Deterioration of aquatic systems; and
vi.) Deforestation.

In finding solutions and tackling these problems the National Environmental Policy, 1997 outlines its overall objectives as follows:-

i.) to ensure sustainability, security and equitable use of resources for meeting the basic needs of the present and future generations without degrading the environment or risking health or safety;
ii.) to prevent and control degradation of land, water, vegetation, and air which constitute life support systems;
iii.) to conserve and enhance our natural and manmade heritage, including the biological diversity of the unique ecosystems of Tanzania;
iv.) to improve the condition and productivity of degraded areas including rural and urban settlements in order that all Tanzanians and aesthetically pleasing surroundings;
v.) to raise public awareness and understanding of the essential linkages between environment and development, and to promote individual and community participation in environmental action;
vi.) to promote international cooperation on the environment agenda, and expand our participation and contribution to relevant bilateral, sub-regional, regional, and global organizations and programs, including implementation of Treaties.

Challenges and problems identified in the National Environmental Policy as well as the overall objectives have informed the enactment of the Environmental Management Act, 2004.

6.2.2 Institutional and Legal Framework

The Environmental Management Act, 2004 has been enacted by the Parliament in order to provide for legal and institutional framework for sustainable management of the environment and natural resources in implementation of the National Environmental Policy. The following discussion outlines the institutional as well as legal instruments and systems that have been established or recognised by the Act. Specifically the Act creates a legal and institutional framework for coordination of environmental management functions.

6.2.3 Institutional Framework

As a local government authority, Musoma Municipal Council has a clearly defined Institutional framework in relation to Environmental Management**.** The bulk of implementation of Government functions under the policy of decentralisation by devolution espoused in the LGRP and provided for under the Local Government Laws lies with Local Government Authorities. It is recognition of that fact that EMA has given the responsibility of implementation of the Act at the local government level to the same institutions that have been established under the Local Government (District Authorities) Act, 1982 and the Local Government (Urban Authorities) Act, 1982 as amended to effect changes introduced by LGRP. At the local government level is it the standing committees dealing with environment that have been designated as environmental management committees under EMA. The cross-referencing to the Local Government Acts makes sure that all the existing committees at that level existing now and which will be created in future are automatically committees under EMA. That ensures that there is no discrepancy or gap of the existence of committees responsible for environmental management under EMA and Local Government Acts.

In view of that the Standing Committee on Urban Planning and Environment established under subsection (1) of section 42 of the Local Government (Urban Authorities) Act, 1982 as well as the Standing Committee on Economic Affairs Works and Environment established under subsection (1) of section 74 of the Local Government (District Authorities) Act, 1982 shall each be the City, Municipal or District Environment Management Committee in respect of the City, Municipal or District to which each of such Standing Committee is established. Also each Standing Committee of Economic Affairs, Works and Environment of a township established under subsection (1) of section 96 of the Local Government (District Authorities) Act, 1982, a special committee formed pursuant to section 107 of the Local Government (District Authorities) Act, 1982 as well as the Ward Development Committee established under subsection (1) of section 31 of the Local Government (District Authorities) Act, 1982. In the case of a village it is the Village Development Committee of each village shall be responsible for the proper management of the environment in respect of the area in which it is established.
The same applies to town councils where the committee that deals with environmental matters under the Local Government (Urban Authorities) Act, 1982 will also be the Town Environment Management Committee. EMA 2004 requires each Local Government Authority to designate or appoint an Environment Management Officer who

will be a public officer. This Environmental management officer will among others be responsible for coordinating implementation of the Act in that respective authority.

3.2.2 Legal Framework

The Constitution of the United Republic of Tanzania, 1977 contains a provision on the protection of natural resources, which covers the environment. Natural resources include forests, vegetation, landscape and geographical layout of the country, lakes, rivers and 22

other water bodies, land and minerals beneath and flora and fauna. . Article 27(1) of the Constitution of Tanzania stipulates that:

"Every person is obliged to safeguard and protect the natural resources of the United Republic, State property and all property jointly owned y the people, as well as to respect another person's property."

The Directive Principles of State Policy in the Constitution obliges the state and all its organs to ensure that the natural resources and heritage are harnessed, preserved and applied to the common good of Tanzanians. This shows that the Constitution, which is the above, all laws lays a firm constitutional foundation for the sustainable management of the environment in Tanzania.

All along, Tanzania had several pieces of legislation on natural resources, which touched on some issues of environment. Most of these pieces of legislation are aimed at regulating use and management of natural resources, have evolved along sector lines governing specific environmental media. Nevertheless, a notable development in Tanzania has been the change in approach in legislating on management of natural resources and the environment. There is a shift from the solely using the "command and control" approach. The recent pieces of legislation have provisions on conservation of biodiversity and the use of environmental management instruments such as General Management Plans and Environmental Impact Assessment (EIA) in most of the pieces of legislation enacted after the Rio Conference in 1992. Such recent pieces of legislation include the Marine Parks and Reserves Act, 1994, the Mining Act, 1998, the Forest Act, 2002, the Beekeeping Act, 2002, Industrial and Consumer Chemicals (Management and Control) Act, 2003 and the Fisheries Act, 2003.

However, it is truism that before 2004 there was no specific law for the holistic management of the environment in Mainland Tanzania unlike the repealed National Environment Management Act, 1983 that basically created NEMC and provided for its functions. It is the enactment of the Environmental Management Act, 2004 that has provided framework legislation for environmental management in Mainland Tanzania. This is a comprehensive piece of legislation providing for mechanisms and forums of coordination as well as tools/instruments of environmental management. There are instruments or tools of modern environmental management, which are now universally accepted and included in legislation taking into account the specific situation of each country.

6.3 Land Use Planning (Musoma Master Plan)

Musoma Municipal Master Plan (2015-2035) is under preparation. The final draft report has been prepared and is awaiting approval by the tertiary government authority. The

Master plan, being an instrument to foster best land use practices for Musoma, it is expected to encourage reduced land degradation and pollution and have avenues for green belts which will improve the green appearance of Musoma being one of the key efforts to fight global warming and climate change.

The General Planning Scheme is also intended to curb unsustainable development especially from urban settlement and encroachment to fragile lands by human socio-economic activities.

6.4 Environmental Impact Assessment (EIA) and Environmental Audit (EA)

To avoid negative impacts to the environment, project proponents are required by law to undergo EIA for new projects or EA for existing projects. These instruments help to minimize negative impacts to the environment from development projects in order to ensure sustainable development.

6.5 Sustainable fisheries and ecologically sustainable aquaculture

Musoma Municipal Council is encouraging sustainable fishing using recommended fishing nets and other fishing instruments. The use of poison, illegal nets and dynamite is greatly discouraged and defaulters are severely punished.

Those who invest in fish farming (aqua culture) are required to do so in an environmentally friendly manner. Fish ponds must not be excavated in the shore within 60 miters. Enough protection must be done to the fish ponds to ensure that, no harmful chemicals is introduced to fish ponds to threaten the health of consumers.

6. 6 Waste Management and Electronic Waste (e-waste)

Musoma Municipality has a need to construct a sanitary landfill for final disposal of solid waste. The current crude dumping is environmentally unfriendly. Also, Musoma Municipality must increase the tools and equipments for collection, storage and transportation of solid waste.

There is a growing concern of the management of electronic wastes (E-wastes). Musoma Municipality is becoming over stuffed with scrap electronic gadgets which are not properly disposed managed. These include typewriters, computers, television sets, DVD players, radios, printers, refrigerators, iron box, laptops, fans, UPS, etc. They are almost found at each private and public offices and institutions. Some electronics repair shops have turned into e-waste dump site, since they have become the final destination of electronics waste.

The metal recycling companies have helped to reduce the burden of metal scrap disposal. Metal scrap buyers are available in Musoma and they do purchase scrap metals which have become not waste at all.

Musoma Municipal Council requires construction of a sewerage system and a sewage treatment plant to effectively handle and dispose properly liquid waste unlike the current practice where liquid waste do not receive any treatment prior to being disposed into the environment.

6.7 Tree planting initiatives

Tree planting initiatives must be embraced and practiced routinely in order to fight global warming, climate change and desertification. The Municipal Council needs to engage the entire public to embark on serious programs of tree planting. The government has set a minimum of 1.5million trees planted per district council per year. Musoma Municipal Council needs to aim higher than that goal.

6.8 Environmental Education (EE)

Musoma Municipal Council need to invest on environmental education programs in order to include all community in environmental stewardship.

Environmental education is a process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones (UNESCO, 1978)

Educations, which enable citizens to design, devise and plan actions, which are in harmony with the environment (UNESCO-UNEP Newsletter, Sept 1981). EE is education that enables people to understand appreciate work with and sustains environmental systems in their totality. The goal of EE is to develop a population that is aware of and concerned about the environment with its associated problems which provide knowledge, skills, attitude, motivation and commitment to work towards solution of current problems and the prevention of new ones. (Belgrade Charter 1975)

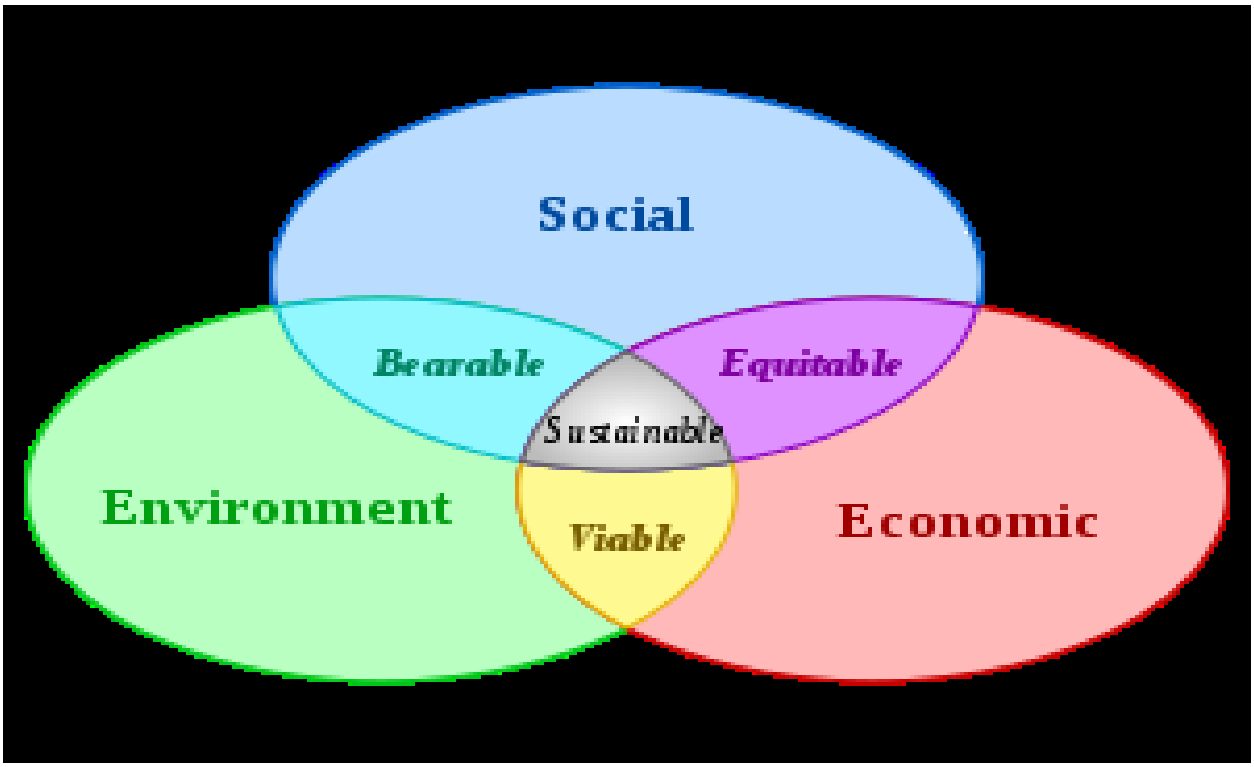

Figure 20: The link between economic and social development and the Environment

CHAPTER SEVEN

7.0 CHALLENGES FOR THE FUTURE

This report (Musoma Municipal Council State of the Environment Report-2016), was written to check on the current status of the natural and built environment of Musoma Municipal Council. As the previous chapters have indicated, the Musoma environment is not faring well but with several challenges which need to be addressed using both short and long term interventions.

Some of the challenges are global such as global warming, climate change, loss of biodiversity and ozone layer depletion. But the causes of these problems are contributed by different sources which are distributed all over the World. Pollution knows no boundaries. Each country must be determined to reduce these problems by ensuring that its economic and social development activities are accomplished in an environmentally friendly and sustainable manner. The concept of sustainable development must be embraced keenly. For the case of Musoma Municipality, there are many things that the future holds and efforts must be done today to reduce the future environmental problems. Some of the challenges for the future include the following;

7.1 Climate change

The warming of the Earth's atmosphere and water bodies, loss of land and sea ice, and rising global sea levels are not new phenomena. However, these global changes have been occurring at increasing rates in the last 30 years, particularly in the last decade. Scientific studies show that climate change will continue, and accelerate, in the years ahead, with significant impacts on everything from our coastlines and our health to water supplies, ecosystems, and other natural resources.

The key sectors which are most likely to be affected by climate change include coastal areas, the water resources sector, agriculture, public health and infrastructure. The magnitude of the impact of climate change and variability, however, is contingent upon the vulnerability and adaptive capacity of the affected people and economic sectors.

Tanzania like other third world countries has started to experience significant climate variability and climate change. Researches done by Orindi and Murray (2005), Yanda and Mubaya (2011) and NAPA (2007) have shown that:

- Over the past years the climate in regions throughout the country has changed significantly indicating that by the end of the century, average temperatures are projected to increase between 1.9^0C and 3.6^0C, while sea level is projected to rise between 65 cm to one meter compared;
- Rainfall is said to decrease in the dry season and it is expected to increase during the rainy season, leading to a growing risk of floods, water shortage and related conflicts;

- Rising temperature and changing rainfall affect agricultural production and water resources availability, hence threatening lives and livelihoods for millions of poor people;
- The medium and small rivers in the central and eastern parts of Tanzania, for example, could become exhausted in the dry season while underground water have been diminishing accompanied with water-salt intrusion leading to water shortages;
- The icecap on Mount Kilimanjaro has been disappearing with serious implications for the rivers that depend on ice melt for their flow. Several rivers are already drying out in the summer season due to depletion in melting water, and recent projections suggest that if the recession continues at its present rate, the ice cap may have disappeared completely by the year 2025;
- Climate change is also expected to increase the severity, duration and frequency of weather related extreme events such as drought and floods, threatening water availability and food security for millions of poor people. So to say climate change is viewed as one of the gravest threats of the present and future of humanity in Tanzania;
- Climate change has been the main driver of biodiversity loss, and has already affected biodiversity resources. In the future, some species will not be able to keep up, leading to a sharp increase in extinction rates. This will result to more loss of revenues from tourism due to loss of key species (fauna and flora);

NGOs have a great role to play by putting in place strategies aiming to reduce human dangerous activities through research, raising awareness, advocacy, mobilization and empowerment of most vulnerable communities to start with. Above all, in order to respond to the impacts of climate change and variability, it is clear that adaptive strategies have to be implemented from household-, community-, national- and international levels so as to enhance already existing adaptation strategies while designing the new ones.

7.2 Desertification

The rapid disappearance of forest is an alarming signal for the growing concern of desertification. Loss of tree and vegetation is aggravated by rapid population growth, urbanization and economic activities. Trees and vegetation forms the base of the food chain and without which life of organisms above them could cease altogether. Being the primary producers, trees manufacture food for them and pass it to the entire ecosystem. They are the only organisms which capture solar energy and make it available to the entire ecosystem. Trees are also a very important component of the hydrological cycle and provide various ecological services to other organisms including humans.

7.3 Waste generation

Because of the growing population and the level of urbanization, generation of both solid and liquid waste is expected to increase. Management levels for both kinds of wastes need to be increased. Musoma Municipal Council need to construct a sanitary landfill besides other municipal solid waste management approaches such as composting (biodegradable solid waste), energy production (biofuel), reuse and recycling, source reduction and incineration.

7.4 Loss of biodiversity

Anthropogenic factors such as overfishing, poor farming methods, poaching, illegal fishing and Pollution causes loss of biodiversity. Efforts need be put in place to rescue biodiversity loss especially due to human factors.

7.5 Challenges due to growing population

Population explosion puts a big pressure on resources which are always limited. Increase in population normally has a negative environmental implication. The growing population requires more water, more soils for farming, more space for settlement and more food. Since all these resources are limited, increased population may exceed the carrying capacity of the environment. Musoma Municipal Council must get prepared to face demographic challenges.

7.6 Poverty

Poverty is an enemy of the environment. The relationship between the environment and poverty is always not promising. Poor people degrade the environment through activities such as charcoal making, poor farming methods, illegal fishing methods and poaching. Measures to combat poverty are also measures to conserve the environment at the same time.

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