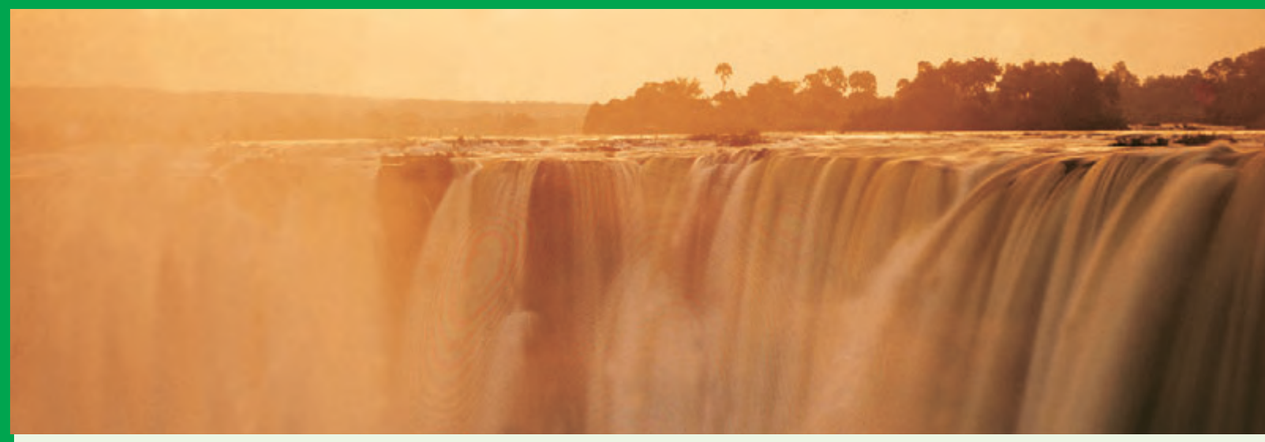
ENVIRONMENTAL COUNCIL OF ZAMBIA

CARING INTO THE FUTURE

ENVIRONMENTAL COUNCIL OF ZAMBIA

ZAMBIA ENVIRONMENT OUTLOOK REPORT 3

A report by Environmental Council of Zambia



2008

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ACRONYMS

AIDS	Acquired Immunodeficiency Syndrome
CSO	Central Statistical Office
CBD	Convention on Biological Diversity
DPSIR	Driving-Force, Pressure, State, Impact and Response
FNDP	Fifth National Development Plan
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EPPCA	Environmental Protection and Pollution Control Act
ERB	Energy Regulation Board
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
HIV	Human Immune Virus
IEA	Integrated Environmental Assessment
MDG	Millennium Development Goal
MTENR	Ministry of Tourism, Environment, and Natural Resources
MoFNP	Ministry of Finance and National Planning
NEAP	National Environmental Action Plan
SARDC	Southern Africa Research and Documentation Centre
SoE	State of Environment
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
wrap	Water Resources Action Plan
ZAWA	Zambia Wildlife Authority

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FOREWORD

The Zambia Environment Outlook (ZEO) is a product of an Integrated Environmental Assessment (IEA), a process of producing and communicating policy-relevant information on key interactions between the natural environment and society. It marks an improvement from previous State of Environment (SoE) reports of 1990, 1994 and 2000. Traditional SoE reports gave a good description of the state of the environment at the time of writing the report and have been useful in pointing out environmental trends and conditions.

However, SoE reporting has evolved and demands linking the environment to development as a basis for sustainable socio-economic development. Such Integrated Environmental Assessments help to increase awareness and general understanding of environmental trends and conditions by showing linkages between causes and consequences of environmental degradation as well as identify actions which must be taken to mitigate or prevent adverse environmental impacts. IEAs attempt to answer five consecutive questions that are key to effective decision making. These are:

1. What is happening to the environment and why?
2. What is the consequence for the environment and humanity?
3. What is being done about it and how effective is it?
4. What could be alternative futures of environmentally sustainable (or unsustainable) development?
5. What alternative futures could be taken?

Government recognizes that achieving sustainable development in Zambia requires access to data and information so that those involved in decision making can reach the level of knowledge and understanding needed for successful programme planning and service delivery.

Zambia's ecosystems are diverse and support many livelihoods. For this reason, measures must be put in place so as to protect the environment and prevent degradation of our natural resources. The major reasons for producing the ZEO report are to:

i. Improve upon knowledge on the state of our environment and its change over time, in order to assess better, the results of past actions and contribute to the development and harmonization of environment and natural resources and other related policies, laws and regulations;

ii. Fully integrate environmental considerations in decision making and effective implementation of policies, programmes and plans; and

iii. Improve public awareness and information on the state of environment in Zambia.

Government attaches great importance to SoE outlook reporting because it provides some measurement of progress on our efforts towards attaining sustainable development. This commitment is reflected in the development of appropriate policy and establishment of legal and institutional frameworks to guide environmental management in the country, by enacting

laws and regulations and developing plans and programmes. These include; the National Conservation Strategy (NCS) of 1985, National Environmental Action Plan (NEAP) of 1994 and Environmental Protection and Pollution Control Act (EPPCA) of 1990 which led to the subsequent establishment of the Environmental Council of Zambia (ECZ) in 1992.

The 2007 National Policy on Environment (NPE) is aimed at ensuring that socio-economic development is achieved effectively without damaging the integrity of the environment or its resources; Fifth National Development Plan (FNDP) developed to guide medium and long term development goals and; Vision 2030 aimed at making Zambia a medium income country. The country is committed to fully integrate principles of sustainable development in order to meet Millennium Development Goal (MDG) one of which is ensuring environmental sustainability.

SoE outlook reporting requires bringing together information and insight that usually lay scattered across a variety of disciplines and organizations. The Environmental Council of Zambia (ECZ) was established through enactment of the Environmental Protection and Pollution Control Act (EPPCA) of 1990 with a mandate of regulating and co-coordinating environmental management in the country. Management of environmental information is critical to promoting sustainable development. In this regard, the wide stakeholder participation in the SoE process has been useful in improving collaboration and reporting periods.

Government is optimistic that through the environmental assessment and reporting process, there will be increasing responsibility for environmental planning and management at all levels.

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EXECUTIVE SUMMARY

Background

The United Nations Conference on Environment and Development (UNCED) of 1992 held in Rio de Janeiro set forth a programme of action called "Agenda 21" as a blue print for implementing sustainable development. Sustainable development is defined as "development that meets the needs and aspirations of the present generation without deteriorating and compromising the ability to meet the needs of future generations" (WCED, 1987). As a follow up to this and other related developments, many nations including Zambia have come to recognise the concept of sustainable development as a basis for environmental policies and programmes.

It has become clear that economic and social wellbeing are mutually reinforcing. Economic prosperity provides opportunities and resources that government needs to reduce poverty and improve people's access to basic social services such as education and health. Improved social conditions and food security are also essential for sustainable economic development and environmental wellbeing. However, sustainable socio-economic development is required so as to effectively manage the natural resource base.

In embracing the concept of sustainable development as a key national priority, the Ministry of Tourism, Environment and Natural Resources (MTENR) provides policy guidance on environmental issues in the country. A number of policies, strategies and programmes have been formulated.

In 1985, the National Conservation Strategy (NCS) was formulated as a policy framework document. It provided an overview of the status of environmental resources in Zambia, identified key environmental issues and made recommendations for policies, programmes and actions to address these issues. One of the proposed actions was the enactment of environmental legislation.

In response to this recommendation, the Environmental Protection and Pollution Act (EPPCA) was enacted in 1990 and subsequently the Environmental Council of Zambia (ECZ) was establishment in 1992. The EPPCA is the principal Act on environmental management in Zambia.

In 1994, government developed the National Environment Action Plan (NEAP) whose overall objective was to integrate environmental concerns into the social and economic development planning process. The NEAP also identified five priority areas of concern, namely; water pollution and inadequate sanitation; soil erosion; air pollution; wildlife depletion; and deforestation.

In 2003, the government initiated the formulation of the National Policy on Environment (NPE) which was adopted in 2007. The main purpose of the NPE is to create an umbrella policy for the welfare of the nation's environment so that socio-economic development will be achieved effectively without damaging the integrity of the environment or its resources.

In addition, the United Nations Millennium Development Goals (MDGs) have also added significant impetus to Government's efforts and programmes intended to improve people's living conditions, especially in addressing the plight of the poor. The MDGs have helped to

strengthen the nation's aspirations sought through such interventions as the implementation of the Fifth National Development Plan (FNDP) for the period 2006-2011 and Vision 2030. The FNDP provides a medium term plan to generate growth and address poverty in the medium term by identifying growth sectors for priority financing while taking into account, cross cutting issues such as governance, environment, HIV/AIDS and gender. The Vision 2030 provides a long term framework to address poverty issues through a broad based economic growth paradigm.

Among other significant developments is the New Partnership for Africa's Development (NEPAD), which if effectively domesticated and aligned with the FNDP is likely to contribute significantly towards Zambia's economic growth and development within the broader context of poverty reduction. (CSPR; 2005).

State of Environment Assessment and Reporting

The Government of the Republic of Zambia attaches great importance to State of Environment (SoE) reporting. Traditionally, SoE reporting has been used to highlight the condition of the biophysical environment. It identifies key driving forces of environmental change and policies that in turn influence environmental trends. The new approach in environmental reporting is Integrated Environmental Assessment (IEA) defined as a process of producing and communicating policy-relevant information on key interactions between the natural environment and society (UNEP;2005). IEA is considered a step beyond traditional SoE reporting. It answers four questions that are a key to effective decision making. These are:

1. What is happening to the environment?
2. Why is it happening?
3. What can we do, and what are we doing about it?
4. What will happen if we do not act now?

Government is aware that over the years many lessons have been learnt regarding the process that must be followed in producing these reports. One of them is the need for wider stakeholder participation and collaboration in environmental reporting and assessment.

The process of producing the Zambia Environment Outlook (ZEO) Report was participatory involving key government ministries and departments, private sector, academic and research institutions, civil society, regional and international organizations. A number of workshops were held for purposes of identifying issues, themes, formation of Technical Working Groups (TWGs) and development of environmental indicators to be used for the report. In addition, training in IEA and reporting was provided for TWG members. Other meetings were held for purposes of reviewing the draft and consolidating the report.

Methodology

The reporting framework selected for the ZEO report was the environmental process framework which emphasises the Driving Force-Pressure-State-Impact-Response (DPSIR) analysis model and highlights the interactions among society, economy and the environment.

Drivers are activities and processes that cause pressures such as agriculture, industries, consumption, demographics and governance.

Pressures are often classified into underlying forces such as population growth consumption or poverty. The pressures on the environment are often considered from a policy perspective as the starting point for tackling environmental issues. Information on pressures tends to be the most readily available since they are derived from socio-economic databases.

State refers to the state of the environment resulting from the pressures outlined above; for example, the level of air pollution, land degradation or deforestation. The state of the environment will in turn affect human health and well-being as well as the socio-economic fabric of society, for example, increased land degradation will lead to one or a combination of the following; decreased food production, increased food imports, increased fertiliser use and malnutrition. Knowing both the state of environment and its indirect effects is critical for decision makers and the public.

Impacts are long term results of activities. They are the effects due to the changes in the state of the natural environment. This could include consequences on health, nutrition, economic loss, floods, siltation etc.

Response component of pressure-state- response model corresponds to societal actions taken collectively or individually to ease or prevent negative environmental impact, correct environmental damage, or conserve natural resources. Responses may include regulatory action, environmental or research expenditures, public opinion and consumer references, changes in management strategies and providing environmental information. Satisfactory indicators or measurements of societal response tend to be the most difficult to develop and interpret.

Box 1.1: DPSIR Reporting Framework (UNDP, 2005)

Themes were constructed through clustering issues by their similarities as they were identified as follows:

1. Socio-economics;
2. Land;
3. Atmosphere;
4. Settlements;
5. Mineral Resources
6. Biodiversity;
7. Water Resources;
8. Emerging issues which discussed Genetically Modified Organisms (GMOs) and Invasive Alien Species;
9. Scenarios and Policy Options.

This process should not be regarded as a static entity at a particular time. It is vital to recognise that the environment and global systems are a series of dynamic and interconnected processes changing and interacting overtime. Therefore, SoE reporting on a regular basis is cardinal in attaining and measuring our efforts towards sustainable development.

Chapter 1: Socio-economics

In achieving sustainable development, human well-being and the environment are strongly interlinked. Ecosystems provide materials and services upon which human life is sustained. People depend on natural resources for their basic needs such as food, water, energy and housing. Environmental changes and impacts on human well-being are induced by various drivers and pressures among them demographic changes, trade, science and technology as well as institutional and socio-political frameworks. The chapter analyses the interlinkages between the environment and economic development as principle focuses of sustainable development.

Zambia continued to experience economic growth between 2000 and 2005 at an average annual rate of 4.6percent. However, inequalities exist in the distribution of income. The impacts range from the inability of the poor to access basic social services such as education and health to the inability to participate in governance despite their dependence on natural resources for their livelihoods. The environmental and social impacts of economic development include employment creation, urbanization, increased natural resource exploitation, changing consumer patterns, pollution, and subsequent pressures on the environment for example, Zambia's energy consumption has risen over the last few years as a result of increasing economic activities in sectors such as mining and quarrying, manufacturing, agriculture and services. In addition, the economy has continued to experience a corresponding increase in the overall demand for energy in both electricity and petroleum products. Therefore, the concept of sustainable development which emerged in the context of global concerns and debates requires local action in order to foster national development.

Chapter 2: Atmosphere

The atmosphere influences the state of the environment mainly through the variations and changes in weather and climate patterns. The main indicators of climate change and variability are changes in temperature and rainfall patterns. In Zambia, the most significant impacts are associated with the variations in precipitation trends evidenced in floods and droughts. An analysis of daily temperature for the period 1961 to 2000 showed that temperature extremes depicted consistent warming patterns over Zambia and most of Southern Africa.

Various emissions are discharged into the atmosphere from both natural and anthropogenic sources. Natural air pollution stems from biological and non-biological sources such as plants, radiological decomposition, forest fires and other geothermal sources, and emissions from land and water. These result in a natural background concentration that varies according to local sources or specific weather conditions. The increase in air pollution resulting from the expanding use of fossil energy sources and the growth in the manufacture and use of chemicals has resulted in detrimental effects on ambient air quality with negative impacts on health and the environment. However, limited research has been undertaken in Zambia to determine the pattern of these changes.

Chapter 3: Land

Land has been recognised worldwide as a major factor of production and an important

resource for human, animal and plant life. The country has a total area of 752,614 km^2 and Land administration is carried out through a system of land tenure divided into two, leasehold and customary. The Commissioner of Lands administers state land for agricultural, commercial, industrial and residential purposes. On the other hand, traditional rulers administer land in customary areas. Demand for land in the country both in the rural and urban areas has been increasing.

The economic growth that the country is experiencing has resulted in increased demand for land and changes in land uses. Although the demand is much more in the urban areas particularly along the line of rail, population growth, investments in agriculture, mining, tourism, construction and real estate, has seen expansion in areas, which were previously idle. Currently, the land delivery system is unable to meet the increase in the demand for land particularly in urban areas. This has resulted in increasing social and environment impacts such as animal/human conflicts, land degradation and conflicts between customary and private rights. In view of the challenges of land management in Zambia, the chapter also discusses a number of institutional and legal reforms which have been put in place which include formulation and adoption of the Land Policy in order to redress gender imbalances and other forms of discrimination in land tenure.

Chapter 4: Water Resources

Out of the total land area of 752,614Km^2, water covers an estimated area of 11,890Km^2. Water resources in Zambia comprise both surface and ground water. However, its availability has been affected by climate change and other factors such as increase in population, growth in industry and agriculture. Urban development including development in recharge areas have resulted in reduced water retention and increase in direct runoff over short periods resulting in flush floods especially where the drainage is poor. Additionally, poorly managed wastes contribute to the blockage of drains, pollution of water and outbreak of diseases. Groundwater is more at risk in large settlements because of lack of proper sanitation facilities and solid waste management systems. There been no corresponding expansion of sewerage infrastructure and most existing ones are in a poor state of repair despite the growth in population.

To counter these, water resources management traditionally focused on water assessment and development, flood routing and protection. In response to changing dynamics and related economic and social activities, issues such as assessment of water demand and climate change have been included. Commercialisation of water supply has contributed to improved access of water resources and is crucial to sustaining improvement in service delivery in urban areas.

Chapter 5: Biodiversity

Biological resources support livelihoods of the majority of the rural population in Zambia. The contribution of agriculture, forestry and fishing to GDP was 15 percent in 2004, 14.2 percent in 2005 and 13.8 percent in 2006. Nevertheless, the intrinsic value of biodiversity is not reflected in national accounts. The protected area system in Zambia consists of National

Parks, bird sanctuaries, GMAs, game ranches, national heritage sites, forest and botanical reserves.

Various species are under increasing threats from habitat alternations, climate variability and anthropogenic activities. Land use conflicts and threats to ecosystems are prevalent particularly in GMAs and national parks. Activities such as human settlements, road construction and mining also result in the fragmentation of ecosystems, habitats and obstruct migratory routes to breeding and feeding grounds used by wildlife. Human encroachments are associated with cultivation, livestock grazing and deforestation. For this reason, biodiversity management continues to be a challenge in the country.

Chapter 6: Mineral Resources

The mining industry has played a pivotal role in the development of the country. Zambia's mineral wealth includes metals, gemstones, industrial, agro, building and energy minerals. The most developed is the metallic group dominated by copper and cobalt. Zambia has a vast potential for mineral resources due to its unique geographic location. However, availability of exposed, accessible and near surface mineral deposits are increasingly becoming scarce requiring more expensive equipment to locate deeper buried ore deposits. Existing mines are becoming more costly to mine as they become deeper with declining mineral reserves. There has been an increase in the issuance of large and small scale mining licences accounting for 63 and 294 respectively by 2006. The small-scale mining sector is largely dominated by the exploitation of gemstones among them emerald, amethyst, aquamarine and garnet are most significant.

The growing mining sector requires corresponding improved management in the regulation and monitoring of the industry. For this reason, the chapter highlights Governments' measures to implement mining policies and a fiscal regime that encourages private investment in the sector.

Chapter 7: Settlements

The main issues in Zambia associated with settlements are migration, housing, waste management and sanitation. They are mainly influenced by poverty, population growth and income levels.

The shortage of housing and urban services has persisted as the country continues facing effects of urbanisation. Out of the total housing stock in Zambia, only 31 percent meet the minimum development and health standards. Rapidly increasing quantities of waste generated due to industrialization, population growth and inadequate investment in infrastructure have become a major concern for the country. Further, the introduction of new consumer products on the market has also contributed to the problem of waste management. Further, the rate of water supply and sanitation coverage has remained quite low especially in peri-urban areas where 50 to 70 percent of the people in urban areas reside.

Major urban centres in the country rely on outdated master plans which neither reflect what is obtaining on the ground nor provide the vision and framework for future development. The

lack of up to date plans has resulted in un-coordinated and disorderly development and contributes to the establishment of unplanned settlements. In place of master plans, there has been an introduction of structure plans which are strategic in character, less resource and time consuming to prepare and respond to robust development trends. In line with this, Integrated Development Plans (IDPs) have been developed for a number of cities among them Kafue, Mazabuka, Lusaka, Ndola and Luanshya.

Chapter 8: Emerging Issues

The chapter identifies Genetically Modified Organisms (GMOs) and Invasive Alien Species (IAS) as emerging issues for this report.

Central to the discussion on GMOs is the concept of biotechnology defined as the integration of biological and bioengineering sciences in order to enable the use of organisms, cells, enzymes and other derivatives. There are three major concerns about the application of GMOs and these are the:

i. manner by which GMOs are produced or nature of genetic engineering itself;
ii. acquired characteristics expressed by GMOs; and
iii. consequences of releasing GMOs to the environment.

While genetic engineering promises benefits to society, its very nature raises ethical, social, environmental and developmental concerns. It also poses new regulatory challenges. Currently, there is insufficient data to adequately show the effects of GMOs on the environment. In response to the challenges posed by GMOs, a number of international and national instruments have been put in place to address this issue which includes the Cartagena Protocol on Biosafety and Convention on Biological Diversity (CBD).

Invasive Alien Species (IAS) is another area of concern for Zambia's rich biodiversity. The driving forces of the proliferation of IAS are associated with pollution, desire for ornamentals resulting into intentional and unintentional introductions.

The spread of IAS in Zambia creates complex and far reaching challenges that threaten biodiversity, food security, health and economic development. Direct and indirect effects are increasingly serious and the damage to nature is often irreversible. Several responses to address the increasing effects of IAS in Zambia have been initiated and implemented. These include the use of biological, chemical and mechanical measures to control and manage IAS by a wide range of institutions among them Plant Quarantine and Phytosanitary Services (PQPS), ECZ, Forestry Department (FD), Zambezi River Authority (ZRA) and ZESCO Ltd.

Chapter 9: Scenarios and Policy Options

Scenarios are indispensable tools for environmental management that focus on large-scale, long-term interactions between development and environment. They are an outline of a natural or an expected course of events and are neither predictions nor forecasts. Rather, they are useful tools for assessing either the future implications of current environmental problems

or emergence of new problems. Scenarios have two particular advantageous qualities:

1. They provide a coherent framework for analysis of how various issues or sectors impinge on one another or interact and;
2. They serve as tools to foster creativity, stimulate discussion and focus attention on specific points of interest for policy on environment and development and for opening up a constructive analysis of future problems.

For these reasons, it is important that society considers the range of policies available and possible outcomes associated with alternative policy paths. This chapter discusses possible scenarios within the context of thematic areas covered by the report. The base year used for these scenarios is 2000 and the time horizon is 2000 to 2030 in line with the country's Vision 2030.

Three scenarios have been developed namely; (i) Business As Usual (ii) Policy Reform and (iii) Investment Scenarios.

In the **Business as usual Scenario,** an analysis of the current situation for each thematic area has been conducted using baseline data. The scenario recognises the various current interventions being undertaken to achieve sustainable development. Further, analyses of the consequences of not taking appropriate actions and their impact on the environment have been discussed.

The **Policy Reform Scenario** recognises that in order to achieve sustainable development, there is need to develop policies that support economic growth and appropriate levels of service delivery. These include policies that support improved planning, service delivery, compliance to set regulations and leadership in environmental management. This scenario also acknowledges the need for the active participation of stakeholders in national development.

In response to issues and policies identified in the Business As Usual and Policy Reform Scenarios, the **Investment Scenario** proposes investments required in the identified sectors to improve the country's socio-economic status. This scenario recommends economic and industrial growth, technological innovation, value addition and improved provision of resources as key elements to sustainable development.

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CHAPTER 1
SOCIO-ECONOMICS

The environment and economic development are the principle focuses of sustainable development. In achieving sustainable development, human well-being and the environment are strongly interlinked. Ecosystems provide the materials and services upon which human life is sustained. People depend on natural resources for their basic needs such as food, energy, water and housing. In many communities, environmental resources including fisheries, timber, and wildlife directly contribute to income and other material assets required in life. However, development can sometimes negatively affect the environment. For this reason, there is need to ensure that natural resources on which the economy is built are not exploited beyond a sustainable level.

Environmental changes and the effects on human well-being are induced by various drivers and pressures. Drivers such as demographic changes, economic demand and trade, science and technology, as well as institutional and socio-political frameworks induce pressures on the environment. These pressures in turn, impact the environment itself, society and economic activities.

1.1 Population

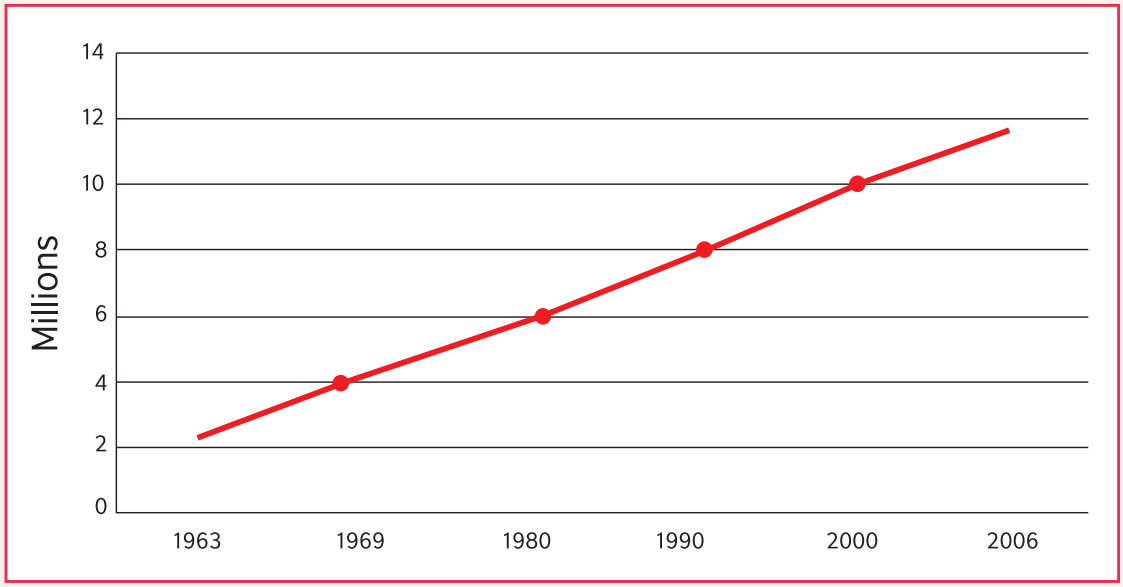
In 2006, the population of Zambia was estimated at 11.7 million. The highest proportion of the population lived on Copperbelt Province at 15percent while the lowest proportion was in North-Western Province at 6percent. Three provinces had a population proportion of less than 8percent to the total population and these were; Luapula, Western and North Western Provinces (CSO; 2006).

Table 1.1 Population Distribution by Province, Rural and Urban Areas of Zambia

Province	Number of Percentage	Percentage Share	Rural	Percentage Share	Urban	Percentage Share
Central	1,221,667	10	950,056	78	271,610	22
Copperbelt	1,782,799	15	370,736	21	1,412,064	79
Eastern	1,604,257	14	1,473,253	92	131,004	8
Luapula	929,310	8	814,599	88	114,711	12
Lusaka	1,640,853	14	254,224	15	1,386,629	85
Northern	1,482,946	13	1,242,473	84	240,474	16
North Western	709,095	6	602,116	85	106,979	15
Southern	1,453,112	12	1,139,136	78	313,976	22
Western	887,183	8	765,879	86	121,304	14
Total	**11,711,223**	**100.0**	**7,612,472**	**65**	**4,098,751**	**35**

Source: LCMS 2006

Figure 1.1: Population growth from 1963 to 2006



As observed in Figure 1.1, the national population has been growing from 2.3 million in 1963 to 11.7million in 2006. 65percent and 35percent of the population live in urban and rural areas respectively. Lusaka and Copperbelt Provinces are the most urbanized with 85percent and 79percent of their population living in urban areas respectively. This can be attributed to economic activities such as mining, industries and other social services. The implication of this is a need to develop the rural areas where the majority of the population lives. This means improving access to basic social services such as education health, energy and infrastructure.

1.2 Economic Performance

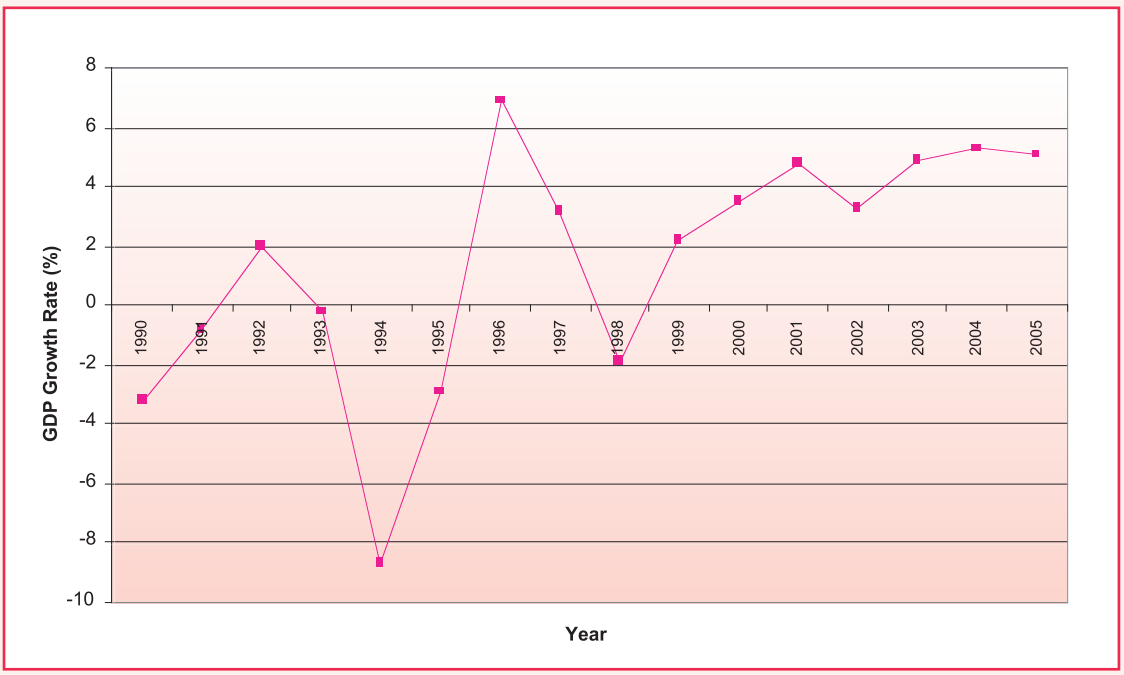
The Zambian economy is market driven following enactment of the Zambia Privatization Act (ZPA) of 1992 which paved way for enhanced private sector participation in national development. Zambia's economy is still largely dependant on the mining industry. However, government has recognized the need to diversify the economy and promote growth in key sectors such as agriculture and manufacturing in line with priorities and strategies outlined in the FNDP and Vision 2030.

In recent years, sustained growth in the global economy primarily driven by Asia (particularly China) and western world has led to an increase in demand for primary commodities. Zambia being a metal exporter has also been affected by the growth in demand for metals and non-metal products on the global market. The volume of world trade grew from 7.2 percent in 2005 to 8.9percent in 2006 (MoFNP, 2006). Regional economic reforms have been a driver in the national economy. Zambia is a member of COMESA and SADC. The SADC free movement of people protocol signed in 2006 presents benefits and challenges to regional integration. By bringing in more actors into the market, there are more organized entities and individuals involved in the exploitation of natural resources. It has thus been acknowledged that "in the move to a market economy, government will have to rely on sound economic and legal instruments to achieve sustainable development and environmental management" (MTENR,

1994). The increasing activities in the mining and construction industries are proving to be a significant source of pressure on the environment.

Zambia has continued to experience economic growth between 2000 and 2005 at an average annual rate of 4.6percent. The growth in 2000 and 2002 was slow at 3.6percent and 3.3percent respectively which was attributed to factors including negative effects of privatization process especially of the mines, low copper prices and production. The economy continued to perform well in 2006 with Gross Domestic Product (GDP) growth rate of 6.2 percent in comparison to 5.2 percent in 2005 as shown in Figure 1.2

Figure 1.2: Gross Domestic Product (GDP) Growth Rate



Source: Bank of Zambia, 2006

Sectors such as agriculture, forestry and fisheries recorded the highest contribution. Similarly, GDP per capita equally increased during the same period.

Table 1.2: Gross Domestic Product (GDP)

Year	1999	2000	2001	2002	2003	2004	2005	2006
GDP	2.2	3.6	4.9	3.3	5.1	5.4	5.2	6.2
GDP per capita at	782,201	1,028,587	1,301,621	1,562,085	1,906,038	2,344,290	2,836,723	3,278,034

Source: CSO, 2008

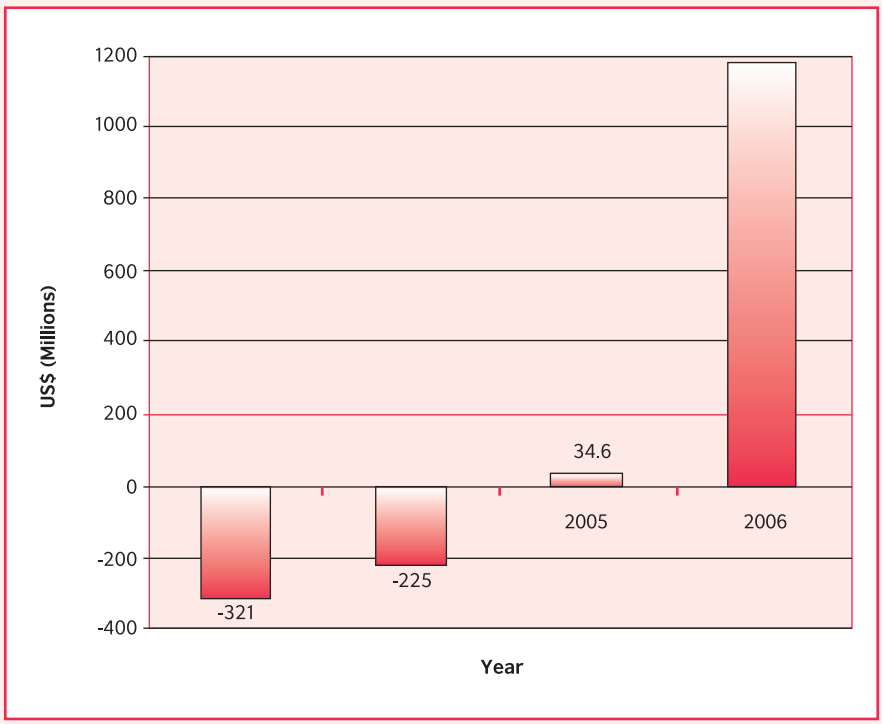
There has been a progressive increase in sector shares of GDP for sectors such as construction, manufacturing, mining and quarrying as can be observed from Table 1.3.

Table 1.3: Sector Share of G.D.P. at Constant 1994 Prices

Sector	2000	2001	2002	2003	2004	2005	2006
Agric. Forestry and Fishing	17.2	16.0	15.2	15.2	15.0	14.2	13.8
Mining and Quarrying	6.4	7.0	7.9	7.7	8.4	8.6	9.1
Manufacturing	10.5	10.4	10.7	10.9	10.9	10.6	10.4
Electricity, Gas and Water	2.9	3.1	2.9	2.7	2.6	2.6	2.7
Construction	4.9	5.3	6.0	6.9	7.9	9.1	9.4
Wholesale and Retail Trade	18.3	18.4	18.7	18.8	18.8	18.3	17.9
Restaurants Bars and Hotels	1.9	2.3	2.3	2.4	2.4	2.5	2.6
Transport, Storage and Communications	6.3	6.2	6.1	6.1	6.1	6.5	6.9
Financial Institutions and Insurance	8.2	7.8	7.9	7.7	7.6	7.5	7.3
Real Estate and Business Services	9.5	9.4	9.5	9.4	9.3	9.1	-
Community, Social / Personal Services	7.7	7.8	7.7	7.4	7.1	7.5	-
Less: FISIM	-4.9	-4.8	-4.7	-4.6	-4.5	-4.4	-
Taxes on Products	10.9	11.1	10.0	9.3	8.5	8.0	-
Total G.D.P. at Market Prices	**100**	**100**	**100**	**100**	**100**	**100**	

Trade and investment promotion have been ranked highly on government's agenda for promoting economic development and strengthening the country's position regionally and globally.

Figure 1.3: Trade deficits and Surplus



Prior to 2005, Zambia has been recording a trade deficit of US$ 225 million in 2004 to US$ 321 million in 2003. Trade surplus however increased in 2005 and 2006 to US$ 34.6 million and US$1,178.4 million respectively. This has been attributed mainly to the increase in the

international price of copper coupled with growth in copper export volumes. Foreign Direct Investment (FDI) has been a significant factor in boosting Zambia's economic activities in many sectors. Mining, manufacturing, agriculture, construction and tourism are some of the sectors that have attracted significant foreign investment. Despite fluctuations in some years, Zambia's annual FDI in 2004 was recorded at US$344 million (MoFNP; 2004). There were significant improvements in the foreign investment portfolio in 2006 as net portfolio investments increased by 49.1 percent.

1.3 Poverty

Poverty is defined as a level of living when individuals and households are not able to meet their food and basic needs, such as shelter, energy, sanitation and water supply. (CSO,1993). Levels of education attainment and employment status especially of the head of the household have a significant bearing on the poverty status of a household.

In 2004, the poverty level in Zambia was 68 percent with 53 percent of the population being extremely poor. Extreme poverty is more prevalent among female-headed households than male headed households. The rural population of Zambia is predominantly poor with overall poverty level at 78 percent as compared to their urban counterparts at 53 percent. Incidence of extreme poverty is also high in rural areas where two thirds are extremely poor in comparison to one third in urban areas.

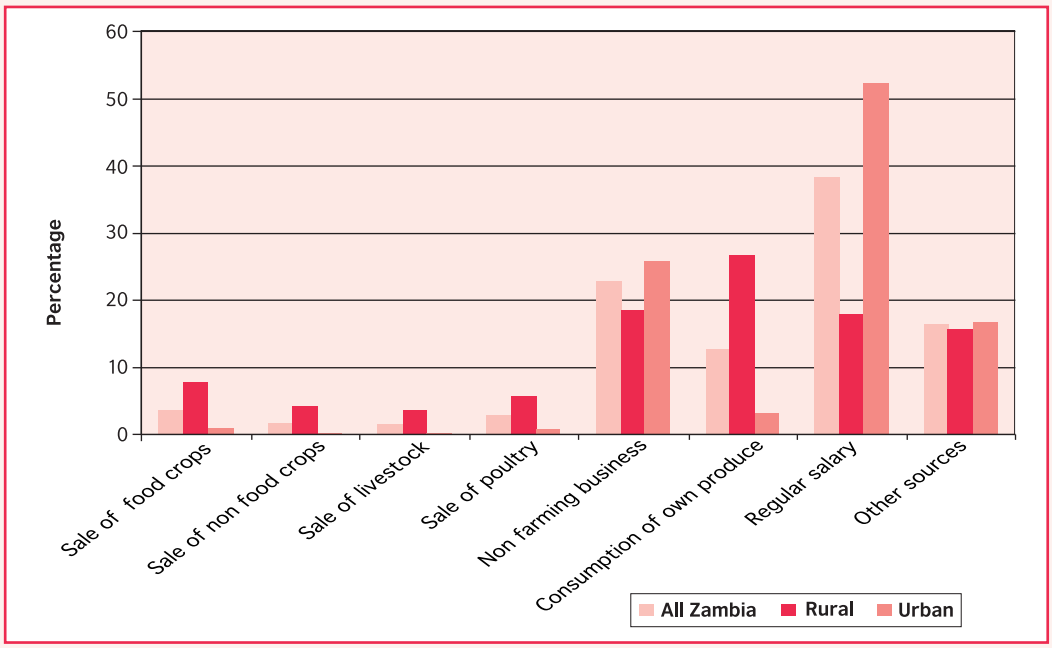
Table 1.4: Percentage Change in Poverty between 2004 and 2006

Location	2004	2006	Percentage change
	Incidence of poverty	Incidence of poverty	
Zambia	68	64	-6.3
Residence			
Rural	78	80	2.5
Urban	53	34	-55.9
Province			
Central	76	72	-5.5
Copperbelt	56	42	-33.3
Eastern	70	79	11.4
Luapula	79	73	-8.2
Lusaka	48	29	-65.5
Northern	74	78	5.1
North Western	76	72	-5.5
Southern	69	63	-9.5
Western	83	84	1.2

Source: CSO, 2006

In 2006, overall incidence of poverty in Zambia was 64 percent thereby registering a reduction of 6.3 percent between 2004 and 2006. However, poverty in rural areas increased by 2.5 percent while it reduced in urban areas by 55.9 percent during the same period as illustrated in Table 1.5. This could be attributed to the growing economic activities in the urban areas such as mining, construction and tourism.

Figure 1.4: Proportional Distribution of Total Household Income by Source



Source: Adapted from CSO 2004

Income distribution in Zambia is uneven as indicated by the Gini coefficient[1] of 0.57. This finding was consistent for both the 2002/2003 and 2004 LCMS. The 2002/2003 survey indicated that income inequalities were more pronounced in urban areas whereas in 2004, it was more pronounced in rural areas (CSO 2004). This variation could be attributed to differences in amounts of rainfall received as well as varying crop production.

Further analysis of the trends in income distribution from 2002 to 2004 showed that there had been an increase from 15.4 percent in 2002 to 21 percent in 2004. Similarly, the top 10 percent income bracket reduced from 48 percent of the total income in 2002 to 28 percent in 2004, (CSO 2004).

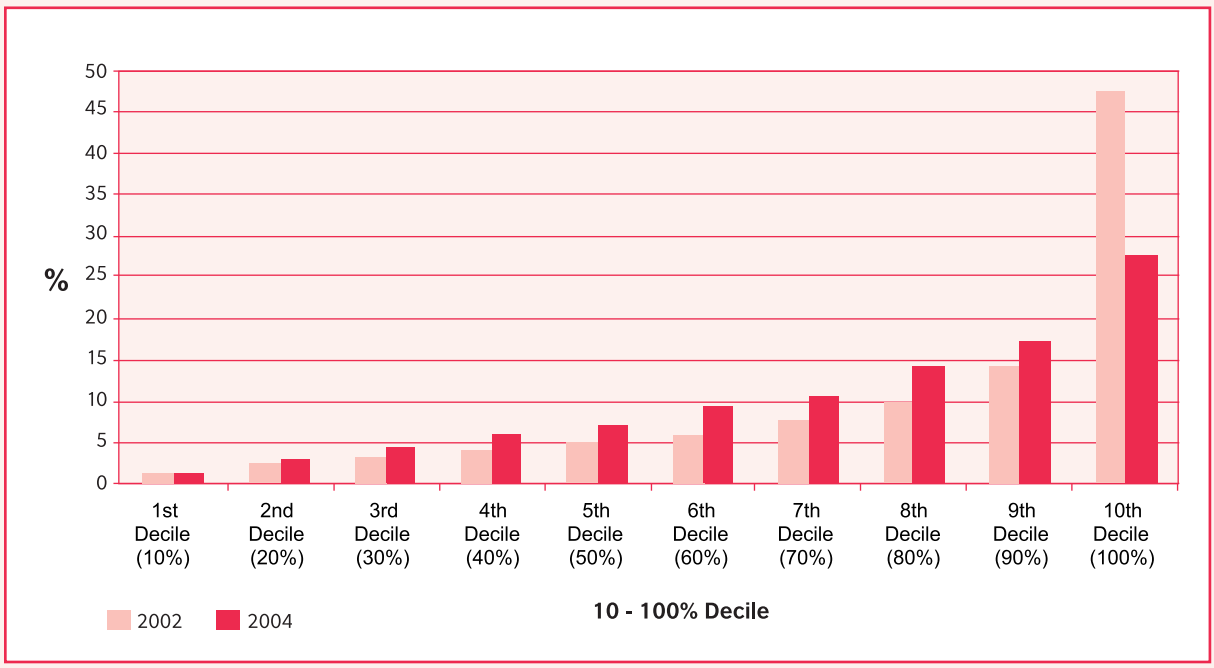
These inequalities in the distribution of income have various impacts on humans and the environment which are wide ranging. It ranges from the inability of the poor to access basic social services such as education and health to the inability to participate in environmental governance despite their dependence on natural resources for their livelihoods. Consequently, poverty has social and health impacts on families in poor households. With regard to environmental governance, often the channels of communication act as barriers to dissemination of information due to high illiteracy levels in the affected areas.

The majority of Zambians are not in formal employment implying that they have to turn to other sources of income. The most readily available is the exploitation of natural resources.

[1] The Gini coefficient measures income distribution using an index of inequality. It always ranges from 0 to 1. A coefficient of 0 represents total equality in income distribution, while a coefficient of 1 represents total inequality." (CSO 2004)

The link between poverty and environmental degradation has been widely acknowledged due to poor people's high and direct dependence on exploitation of natural resources for their survival. For instance, their heavy dependence on firewood and charcoal as energy sources has significant impact on the environment in terms of deforestation. Further, they are also affected by the ways in which other resource users exploit the environment e.g. sand mining, collection of 'black soil', stone mining and crushing are some the activities that have been induced by the construction activities being undertaken in most urban parts of the country. In addition, inadequate access to safe water and sanitation contributes to high incidences of water borne diseases such as Diarrhoea, Dysentery and Cholera.

Figure 1.5: Distribution of Households by Per Capita Deciles, 2002 and 2004



1.4 Access to Basic Needs and Services

Addressing access to basic needs and services is one of the approaches to the measurement of poverty alleviation. It attempts to define the minimum resources necessary for long term physical well being. A traditional list of immediate basic needs includes food, shelter and clothing. However, many modern lists emphasise the minimum level of basic needs to include not only food, water and shelter but also sanitation, education and healthcare.

1.5 Education

Education is a key determinant of the lifestyle and general status of the population. Studies consistently show that education attainment has a substantial effect on the population and socio economic issues such as health, poverty levels, employment earnings and nutrition.

In 2004, a survey conducted revealed that 22 percent of the population aged 5 years and above have had no formal education, 25 percent completed lower primary, 27 percent completed upper primary, 13 percent junior secondary and only 11 percent managed to

complete senior secondary. It further showed that 1 percent completed A level education where as only 2 percent have gone as far as completing a Bachelor's degree and above (CSO 2004). Another significant issue that came out was a clear decline in the proportions of the population with every increase in the level of education attained. This indicates how restrictive higher and tertiary education is in Zambia. Tertiary education is crucial to long term economic development as well as to strengthening democracy and achieving social cohesion.

Table 1.6: Percentage Distribution of population of 5 years and above by level of education attained, Sex and Age group, Zambia, 2006

		Highest Level of Education Attained								
		None	Grade 1-4	Grade 5-7	Grade 8-9	Grade 10-12 (A)/College/ Undergraduate	Grade 12 GCE	Bachelors Degree & above	Number of persons	Total
Zambia	Total	28.1	21.6	24.5	12.2	10.9	0.3	2.5	1,113,0328	100
	Male	26.6	20.7	23.1	12.9	13.3	0.3	3.1	5,444,431	100
	Female	29.5	22.5	25.8	11.5	8.6	0.2	1.8	5,685,897	100
Rural	Total	33.0	24.7	26.2	9.8	5.4	0.1	0.9	7,212,960	100
	Male	31.0	23.7	25.7	11.1	7.0	0.2	1.2	3,533,845	100
	Female	34.9	25.6	26.7	8.4	3.8	0.0	0.5	3,679,115	100
Urban	Total	19.0	16.0	21.4	16.7	21.0	0.6	5.4	3,917,368	100
	Male	18.3	15.1	18.3	16.1	24.8	0.6	6.6	1,910,586	100
	Female	19.7	16.7	24.3	17.2	17.4	0.5	4.2	2,006,782	100
Age Group										
5-9		67.3	32.0	0.6	0.1	0.0	.	0.0	1,722,611	100
10-14		16.6	52.4	27.5	3.1	0.3	0.0	0.0	1,867,966	100
15-19		13.8	11.8	36.7	24.0	13.5	0.2	2.5	11,130,328	100
20-24		17.7	10.3	27.4	19.2	22.9	0.7	1.8	1,358,727	100
25-29		18.2	9.2	29.8	18.5	18.4	0.6	5.3	1,093,481	100
30-39		22.7	9.5	28.8	17.7	15.0	0.4	5.8	1,600,883	100
40-49		31.3	9.5	26.8	10.8	15.4	0.3	6.0	972,807	100
50-59		32.8	14.5	23.8	9.5	13.1	0.2	6.1	524,045	100
60+		37.3	30.7	19.8	5.1	5.3	0.2	1.6	436,170	100

By 2006 as illustrated in Table 1.6, 28.1 percent of Zambians had never attended school with considerably higher rates of 33 percent for rural areas and 19 percent for urban areas. The 60+ age group was the most illiterate at 37.3 percent. Only 8.6 percent of females had attained senior secondary level. The rates for those who never went to school are higher for females at 29.5 percent than for males at 26.6 percent (CSO, 2006).

The incidence of poverty by education status of the household indicates that the highest proportions of the poor were recorded in households where the head had no formal education or had low levels of education compared to households headed by individuals with higher levels of education. In particular, the results showed that the incidence of poverty in households headed by those with no formal education was at 81 percent and of these, 70 percent were extremely poor (CSO 2004).

Correspondingly, school attendance is also affected by poverty status. Studies showed that

attendance rates were more likely to be higher for children from moderately poor or not poor families. However, attendance rates increased with improving poverty status for all the school age groups.

Table 1.7: School attendance rate by sex, age group and Poverty Status 2006

		Age-group						Persons aged between 5-22 yrs
		5-6 yrs	7-10 yrs	11-13 yrs	14-15 yrs	16-18 yrs	18-22 yrs	
All Children		19	70	90	85	65	25	50,938
Sex								
Boys		19	69	88	86	73	36	24,953
Girls		19	71	91	84	57	15	25,985
Poverty Status								
Extremely Poor	Total	11	63	87	82	64	23	22,219
	Boys	11	61	85	85	70	34	11,251
	Girls	11	66	88	79	56	13	10,968
Moderately Poor	Total	22	77	91	84	65	26	7,165
	Boys	20	75	89	83	74	37	3,526
	Girls	23	79	93	86	57	17	3,639
Not Poor	Total	35	83	96	90	68	26	21,498
	Boys	36	86	95	88	80	38	10,152
	Girls	34	80	96	92	58	17	11,346

Government policy of free education to basic level is a good initiative which provides a foundation for an enlightened citizenry. The challenge is to formulate programmes in the education sector which will expand to all levels in order to address the needs of the poor and higher education requirements.

1.6 Health

Good health is an essential resource for social and economic prosperity. Health is a key sector in the economic standing of the country. Productivity is severely hampered when disease prevalence is high. There are a number of challenges in health provision in the country among them; access to health facilities and incidences of disease driven by the state of the environment.

The level of mortality in Zambia is still high despite various attempts by the Government to improve the quality of life of Zambians through various public health measures and programmes. For example, Infant Mortality Rate was 99 deaths per 1000 live-births in 1980, 123 in 1990, 110 in 2000 and 94 in 2001/2002. Similarly, life expectancy at birth was 52 years in 1980, 47 years in 1990 and 50 years in 2000. Under-Five mortality was 121 in 1980, 151 in 1990, 162 in 2000 and 168 deaths per 1000 live-births in 2001/2002. Adult survivorship levels (life expectancy at a given age) have been declining in the last 20 years. For instance at age 20 for females, the levels dropped from 46 years in 1980 to 44 in 1990 and 29 in 2000. In the same categories for males, it was 44 years in 1980, 42 in 1990 and 23 in 2000. (MoFNP, 2007).

The major causes of mobility and motality in Zambia are HIV/AIDS, Tuberculosis, Malaria and diarrhoea. HIV and AIDS prevalence rate for the age group 15-49 years (16 percent) has also contributed to the high mortality levels Zambia is experiencing. Projections from CSO show that the population by 2015 will be 15.3 million; 7.7 million males and 7.6 million females taking into account HIV and AIDS. Without the effect of AIDS, the population would have been 15.9 million; 7.96 million males and 7.98 females, indicating the higher impact of HIV and AIDS on females. (MoFNP, 2007).

Table 1.8 shows the percentage of persons reporting various symptoms/illnesses by rural/urban. Malaria/fever was the most common illness/symptom experienced by persons who reported having had an illness at 42 percent. This was followed by cold/cough/chest infection reports at15 percent. The proportion of persons that reported having had a headache was 7 percent. Other common symptoms/illnesses reported were Diarrhoea without blood, abdominal pains, backache and tooth ache/mouth infection.

Table 1.8: Proportion of persons reporting illness by Rural/Urban and Type of Illness reported, Zambia, 2006

Type of Illness/Symptom	Rural	Urban	Total
Fever/malaria	40	46	42
Cough/cold/chest infection	15	15	15
Tuberculosis (TB)	1	2	2
Asthma	1	1	1
Bronchitis	0	0	0
Pneumonia/chest pain	2	1	1
Diarrhea without blood	4	4	4
Diarrhea with blood	1	1	1
Diarrhea and vomiting	2	2	2
Vomiting	1	0	0
Abdominal pains	4	3	4
Constipation/stomach upset	1	1	1
Liver infection/side pain	0	0	0
Lack of blood/anemia	1	0	1
Boils	1	0	1
Skin rash/skin infection	3	2	3
Piles/hemorrhoids	0	0	0
Shingles/herpes zoster	0	0	0
Paralysis of any kind	1	1	1
Stroke	0	0	0
Hypertension	1	1	1
Diabetes/sugar disease	0	1	0
Eye infection	1	2	2
Ear infection	1	1	1
Toothache/mouth infection	3	2	3
Headache	7	5	6
Measles	0	0	0
Jaundice/yellowness	0	0	0
Backache	3	1	3
Other (specify)	5	6	5
Total	100	100	100

Analysis by residence shows that the prevalence of malaria was higher in urban (46 percent) than in rural areas (40 percent).

1.7 Employment

Zambia's employment sector comprises of formal and informal categories. Out of the total number of 3,954,612 people in employment at national level, there were more persons employed in the informal sector with 81 percent while the formal sector had 751, 376 representing 19 percent. These findings also revealed that there were more males than females in the formal sector in comparison to the informal sector which had more females as shown in Table 1.9

Table 1.9: Percentage Distribution of Employed Persons Aged Twelve Years and Above by Formal and Informal Sectors

Sex	Employment Status				
	Formal Sector		Informal Sector		Total
	No. of Persons	Percentage	No. of Persons	Percentage	
All Zambia	751,376	19	3,203,236	81	3,954,612
Male	543,509	26	1,546,910	74	2,090,419
Female	205,061	11	1,659,132	89	1,864,193

Source: Adapted from CSO 2004

In terms of occupational distribution of employed persons, natural resource based sectors such as agriculture, forestry and fisheries were the most dominant with a total number of 2,736,501 representing a percentage share of 69 percent as indicated in Table 1.10. Given the direct dependency of this sector on natural resources, this scenario poses significant environmental management challenges.

Table 1.10: Occupational Distribution by Rural/Urban and by Sex

Type of Occupation	]x}j u			[~{j u		^{kj w			]x}j uW~v kn{	
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	
All Zambia	100	100	100	100	100	100	100	100	100	**3,954,612**
Admin/Managerial	1	1	0	0	0	0	2	2	1	23,255
Professional/Technical	5	6	4	2	3	1	13	13	12	212,481
Clerical and Related	1	1	1	0	0	0	4	3	4	51,491
Service	6	7	4	1	2	1	15	17	13	229,437
Sales	8	7	10	2	2	2	23	16	33	324,801
Agric./Forestry/Fisheries	69	63	76	92	89	94	20	16	25	2,736,501
Production and related	9	14	4	3	4	1	23	32	11	361,774
Workers not else classified										
Not stated	0	0	0	0	0	0	1	1	0	14,830
	0	.	0	0	-	0	0	-	0	42

Source: CSO 2004

1.8 Food Security

Population growth and the cost of essential food items have a profound influence on the nation's food requirements and food security[2]. Zambia has experienced broad fluctuations in food production as a result of severe climatic conditions such as drought and floods particularly during the 2001/2002 and 2006/2007 agricultural seasons. Other factors such as inadequate local and national food storage, high input and transport costs, and poor infrastructure as well as agricultural marketing policies have compounded the problem. Subsistence and small scale farmers have been most affected.

A household is food secure when it has access to the food needed for a healthy life for all its members and is not at undue risk of losing such access (Saad, 1999). In addition, the food has to be adequate in terms quality, quantity, safety and must be culturally acceptable. Among the indicators that can be used to analyze food security at household level include the food basket and expenditure on food as a proportion of the total household expenditure.

In 2004, the majority of households in Zambia apportioned a large percentage of their expenditure to food accounting for 65 percent. Rural-urban comparison further indicated that expenditure shares to food were higher among rural households at 79 percent than urban households with 53 percent (CSO, 2004). CSO also indicated that the number of meals per day on average was two for both adults and children. The same trend prevailed in rural parts of Zambia. The report further indicated that a reduced number of dietary food intake leads to deficiencies in life sustaining nutrients such as vitamins, minerals, proteins and carbohydrates.

A surplus of 185 000 metric tonnes (mt) of maize was recorded for the 2003/2004 agricultural season. On the contrary, the country registered a deficit of about 85 000 mt of maize for the 2004/2005 season, while a surplus of 324 834 mt of cassava equivalent was recorded. A total surplus of all cereals plus cassava, Irish and sweet potatoes when converted to maize meal equivalent amounted to 214 413 mt (MACO,2005).

Table 1.11: Crop Production for Selected Crops in Metric Tonnes 2001-2005

Crop	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	% Change 05/06
Maize	601 606	1 207 202	1 213 601	866 176	1 424 439	1.8
Sorghum	16 801	20 300	24 467	18 714	21 047	0.5
Millet	37 615	35 331	39 784	29 583	48 159	0.7
Paddy Rice	11 645	10 743	11 699	13 337	13 964	0.9
Wheat	74 527	135 968	82 858	136 833	97 648	5.7
Cassava	850 627	981 757	897 049	1 059 000	1 059 887	11.7
Groundnuts	41 421	82 549	69 696	74 218	84 010	0.6
Mixed Beans	16 619	24 097	16 878	23 098	27 697	0.5

Source: Adapted from Ministry of Agriculture and Co-operatives (MACO) 2006

[2] Food security refers to access by all people at all times to enough food (that is culturally acceptable) for an active and healthy life (CSO, 2003).

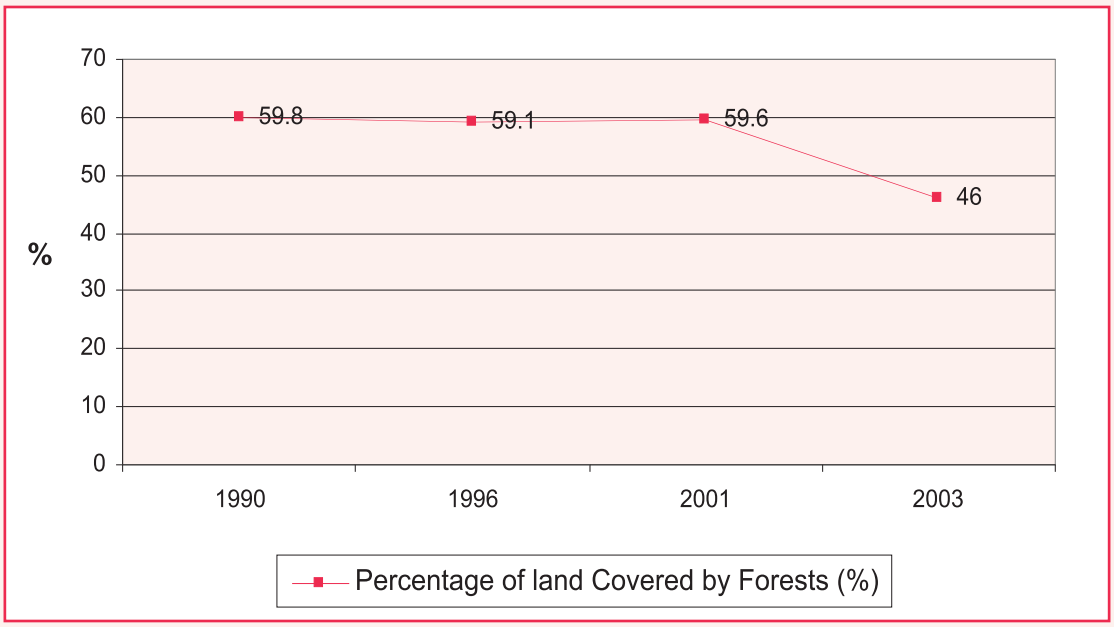
The fluctuations that the country has experienced from surplus to deficit, even within a short period of time are perhaps an indicator of the inability to utilize strategic food reserves and management. Consequently, Zambia's food security situation requires improved management despite the occasional surpluses the country produces during good crop years.

One of the most pressing or immediate impact of poverty is the inability by the affected households to meet their food requirements. This has contributed significantly to the problem of street children and child labour. However the percentage of under-five children reported to be underweight was 28 percent but reduced to 19.7 percent in 2006 while vitamin A deficiency was reported to be constant at 54 percent (National Food and Nutrition Commission/CSO, 2006).

1.9 Environmental Considerations for Socio-Economic Development

Environment and development are not separate challenges; they are inexorably linked. Development cannot subsist upon a deteriorating environmental resource base; the environment cannot be protected when growth leaves out of account the cost of environmental destruction (WCED 1987). The environmental and social impacts of economic development include employment creation, urbanization, increased natural resource exploitation, changing consumer patterns, pollution, and the consequent pressures on the environment.

Figure 1.6: Percentage of Land Covered by Forests in Zambia



Source:

Zambia's forests continue to be under tremendous pressure from a number of activities such as clearance of land for; agriculture, human settlements and wood harvesting. The increasing activities in the mining and construction industries are also proving to be a significant source of pressure. The rate of deforestation has been increasing over a period of time from 300 000hectares per annum to 800 000 hectares per annum (FAO 2000). As shown in Figure 1.6, a sharp reduction was recorded between 2001 and 2003 in terms of percentage of land

covered by forests. Construction sites are now a common feature and are in most cases responsible for the loss of trees.

Construction in Lusaka

Source: John Mukose, 2003

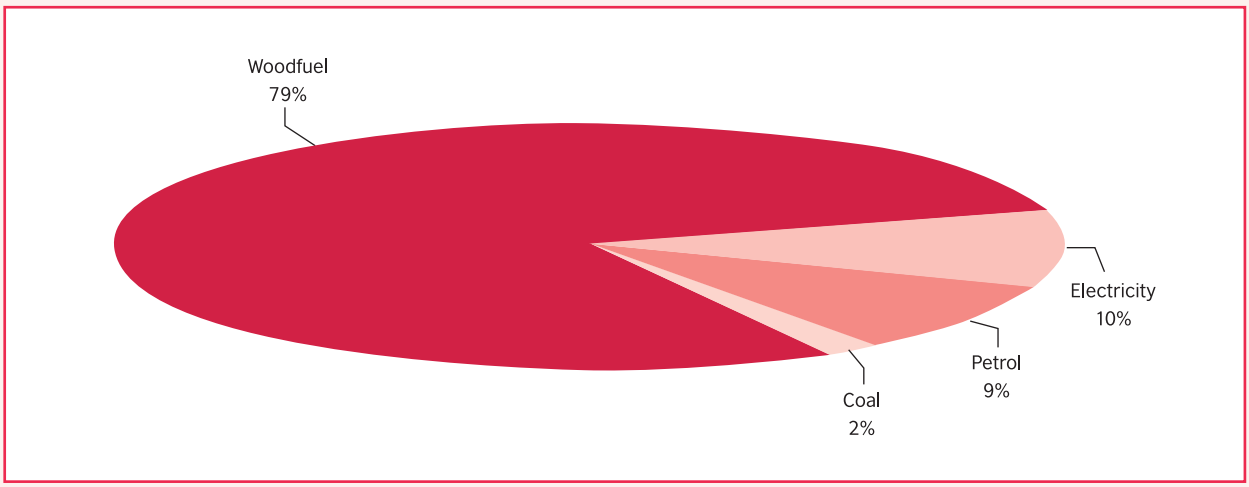
Other impacts associated with construction sites are waste dumps. The materials resulting from excavation works can however be used for land filling purposes in areas were there has been land degradation due to activities such as stone and sand mining.

Waste generated from construction

Source: John Mweshi, 2003

Zambia's energy consumption has risen over the last few years as a result of increasing economic activities in sectors such as mining and quarrying, manufacturing, agriculture and services. The economy has continued to experience a corresponding increase in the overall demand for energy in both electricity and petroleum products. Figure 1.7 shows energy consumption by source. Diesel has been the major fuel driving most industrial processes in Zambia with the transport and mining sectors forming the largest consumer. Diesel consumption has been rising steadily at 55 percent for the period 2002 and 2006 (ERB, 2006).

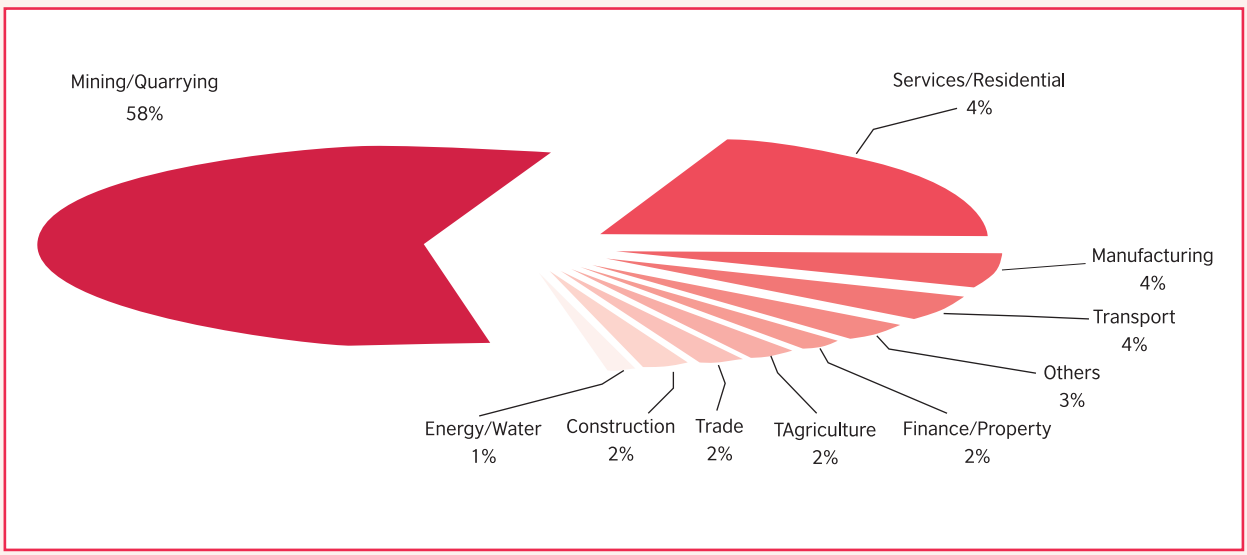
Figure 1.7: Energy Usage by Product in 2000



Adapted from the Energy Bulletin 2000

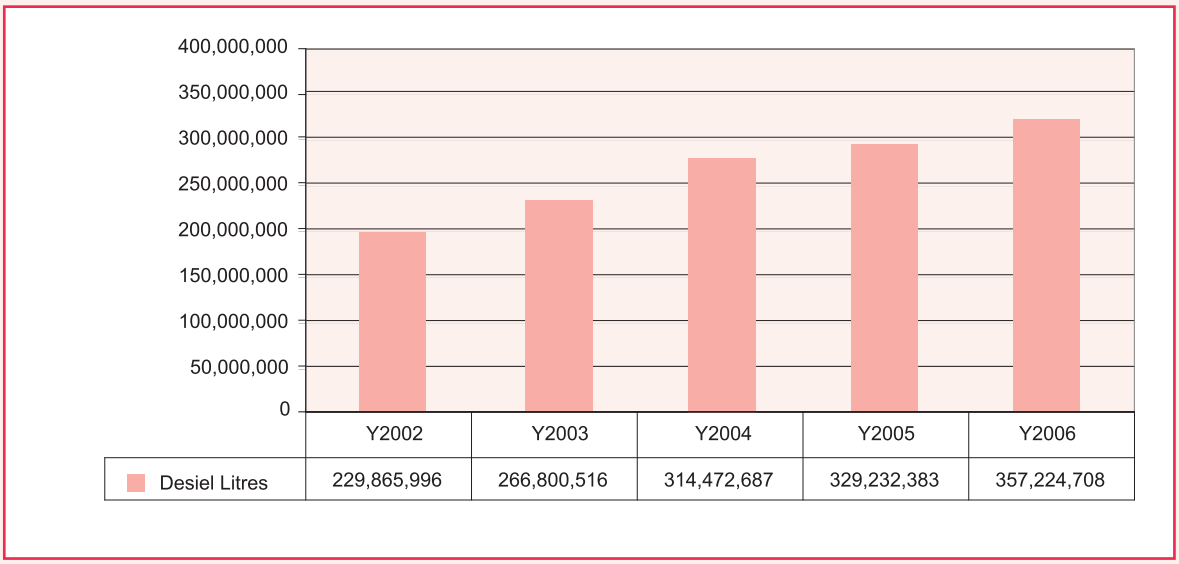
In 2006, the mining sector was the largest consumer of electricity at 58 percent followed by the services and residential category with 20 percent as shown in Figure 1.8

Figure 1.8: Electricity Consumptions by Sector in 2006



Source: Adapted from ERB 2006

Figure 1.9: Trends in Diesel Consumption between 2002-2006



	Y2002	Y2003	Y2004	Y2005	Y2006
Desiel Litres	229,865,996	266,800,516	314,472,687	329,232,383	357,224,708

Source: Adapted from ERB 2006

Increasing and changing consumer patterns have also led to increased importation of both consumer and utility products such as motor vehicles. There has been a rising trend in vehicle imports into the country. The total number of imported vehicles rose by 67 percent from 19 391 in 2005 to 32 294 in 2006. (ZRA, 2006). This trend has resulted in increased volumes of traffic on the country's busiest routes. Consequently, fuel consumption and air pollution have increased. Parking space is also increasingly becoming a problem for motorists in major cities.

Traffic in Lusaka

Source: John Mweshi, 2003

Challeges of parking space

Source: John Mweshi

Furthermore, the increased production, consumption and introduction of new consumer products on the market has adversely contributed to the problem of waste management in Zambia. The annual average waste generation growth rate of Lusaka City for instance, was expected to grow from 220 000tonnes in 1996 to 530 000 tonnes in 2011, posting an increase of 141 percent (ECZ 2001). In some areas, measures have been taken to improve waste management. However, indiscriminate waste disposal is common in many parts of the country.

Health Care Waste

In line with government policy to attract local and foreign investments, potential environmental impacts such as pollution and land degradation are likely to occur.

Recognising the impacts of poverty on the environment and other sectors, government has embarked on several initiatives aimed at improving environmental management. Some of these are:

- The PRSP and TNDP implemented during the period 2002 to 2005 provided an opportunity for government to partner with civil society, cooperating partners and other stakeholders to determine priority areas in national development with a view to raising people's income and reduce poverty.
- The FNDP (2006 - 2011) also recognises that socio-economic development is imperative to addressing poverty in Zambia, economic growth can however result in the deterioration of environment in the short term if uncontrolled and further cause irreparable damage to the natural resources that support it. To this end, several strategies have been proposed to ensure maintenance of essential environmental processes and sustainable utilisation of natural resources.
- Zambia Social Investment Fund (ZAMSIF) and the Micro Projects Unit (MPU) whose goal was to contribute to improving the welfare and living conditions of the poor and vulnerable communities in Zambia were put in place by government. Investments through ZAMSIF and MPU resulted in improvements in selected infrastructure and delivery of safe water and access to sanitation in both rural and peri-urban areas.
- A number of sector plans have been developed to prioritise issues in those areas. E.g through the Education Strategic Plan (2003-2007) is a policy document through which government has recognized that education is essential in efforts to alleviate poverty and access to basic education.
- Government with the assistance of UNICEF and the World Bank established the Programme against Malnutrition (PAM). PAM has been mandated by the government to manage food relief programmes in communities affected by food insecurity. Overall, the Drought Impact Monitoring System (DIMS) was established to provide information on community and household food security and nutrition status to assist with targeting and management of relief programmes. In addition, many other organizations promote food security and nutrition. These include civil society, research institutions, cooperating partners and the private sector.

To supplement government's efforts, the private sector has put in place voluntary programmes aimed at improving environmental management. The United Nations Millennium Development Goals (MDGs) have also added significant impetus to government's efforts and programmes intended to improve people's living conditions, especially in addressing the plight of the poor. The MDGs have helped to strengthen the nation's aspirations sought through such interventions as the implementation of the FNDP.

1.10 Conclusion

Government has initiated programmes and activities in view of the need to diversify the economy from copper dependence into other potential sectors such as agriculture and

tourism. It has also recognized that the private sector can play a pivotal role in this process given incentives to boost their investment.

The concept of sustainable development emerged in the context of global concerns and debates but requires local action. Sustainable development is only feasible if living conditions show improvement in ensuring food security and access to basic needs and social services in order to foster national development.

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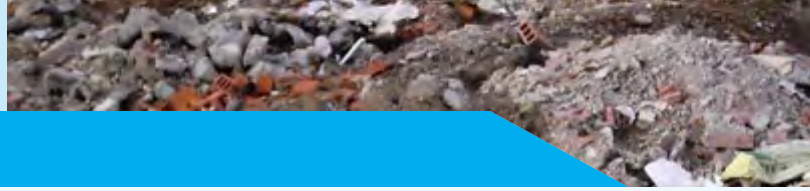
CHAPTER 2
ATMOSPHERE

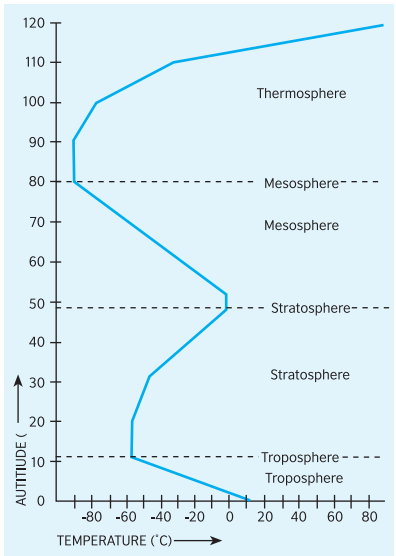


The atmosphere is essential for life and ordinary functioning of physical and biological processes on earth (Moran, 1989). It shields organisms from exposure to ultraviolet rays; and contains gases that are required for life-sustaining processes. The atmosphere influences the state of the environment mainly through the variations and changes in weather and climate patterns. The fluctuations mainly manifest in terms of rainfall and temperature changes. In Zambia, the most significant impacts are associated with the variations in precipitation trends evidenced in floods and droughts.

Box 2.1: Definition of Atmosphere

The atmosphere, where weather and climate occurs, is a relatively thin envelope of gases, and tiny, suspended particles that encircles the globe (Moran, 1989). The atmosphere is usually subdivided into four concentric layers, namely, Troposphere, Stratosphere, Mesosphere and Thermosphere. These subdivisions are based on the vertical profile of the average air temperature. Weather variations occur within the lowest layer, the Troposphere, which extends from the earth's surface to an average altitude ranging from 20 km at the equator to 8 km at the poles.

The average variation of temperature with altitude in the atmosphere.



2.1 Atmospheric Emissions

Pressures for atmospheric emissions emanate from population growth, economic growth and poverty. In 1990, the Zambian population was 7.8 million and 9.8 in 2000 representing an average annual intercensal growth rate of 2.5percent (CSO, 2003). The increase in population entails increased demand on sectors such as energy, transport and services, whose operations have implications on emission generation and climate change and variability.

There has been a steady expansion in the economy with most sectors recording growth (MoFNP, 2006). During the 2005 fiscal year, tertiary sectors especially construction and commercial services were the main drivers of growth. Between 2004 and 2006, the economy consistently registered positive GDP. This meant an increase in activities within the national economy, most of which had implications on generation of atmospheric emissions. Despite, the economic growth, poverty levels in the country are still. The average poverty level in Zambia was 68percent. This has implications on the environment as most people depend on utilisation of natural resources for their livelihoods. Activities with implications on atmospheric emissions include slash and burn agriculture (e.g. chitemene), charcoal production and firewood collection. For instance, statistics show that, 20 percent of households have access to electricity with the remaining 80 percent depend on alternative energy sources (CSO, 2006).

Open air burning contributes to air pollution

Various emissions are discharged into the atmosphere from both natural and anthropogenic (human induced) sources. Natural air pollution stems from various biological and non-biological sources such as plants, radiological decomposition, forest fires, volcanoes and other geothermal sources, and emissions from land and water. These result in a natural background concentration that varies according to local sources or specific weather conditions. The main anthropogenic drivers of emissions include:

1. **Energy demand:** Zambia's energy sector consists of electricity (mostly generated by hydro), fossil fuels (petroleum and coal) and renewable energy (solar and biofuels), Wood fuel is another significant energy source in Zambia accounting for 80percent of domestic energy. The hydroelectric sector recorded an increase in generation between 2005 and 2006 of 13percent from the main power stations and 44percent from mini-stations, as shown in Tables 2.1 and 2.2 respectively (ERB, 2006). Diesel generated energy accounted for 3percent as indicated in Table 2.3. Government policy encourages the development of hydro electric power generation and renewable energy.

Table 2.1: Generation from Main Hydro Stations (MWh)

Hydro-Plant	2005	2006	percent Change
Kariba North	3,574,533	4,055,396	13
Kafue Gorge	4,498,210	4,838,260	8
Victoria Falls	445,772	717,875	61
Total	**8,515,515**	**9,611,531**	**13**

Source: ERB, 2006

Table 2.2: Generation from Mini-Hydro Stations (MWh)

Hydro Plant	2005	2006	percent Change
Lusiwasi	Nil	27,384	100t
Musonda Falls	17,566	16,084	-8
Chishimba Falls	17,817	11,459	-36
Lunzua	2,010	2,825	41
Total	**37,393**	**54,028**	**44**

Source: ERB, 2006

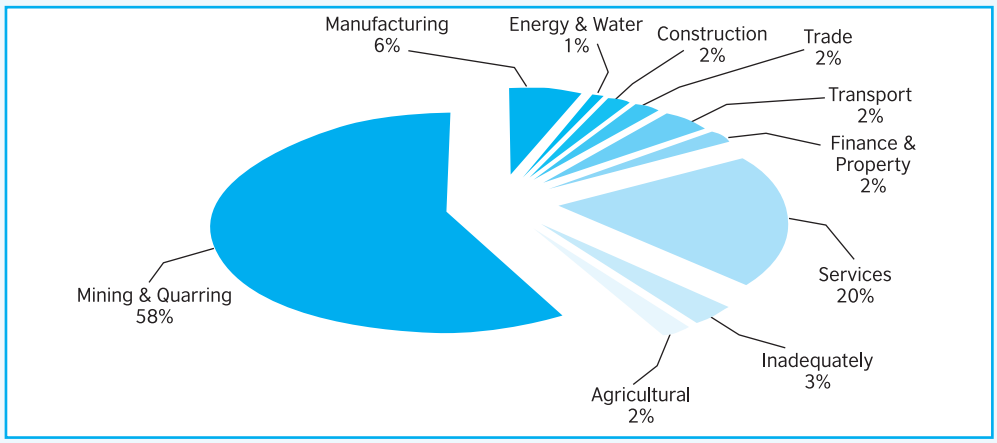
Table 2.3: Diesel generation in MWh

Diesel Station	2005	2006	percent Change
Kabompo	2,638	2,759	5
Chavuma	0	701	100
Zambezi	2,528	2,201	(13)
Mwinilunga	2,495	2,469	(1)
Kaoma	688	0	(100)
Lukulu	869	1,109	28
Luangwa	1,029	783	(24)
Kaputa	836	1,167	40
Mufumbwe	982	1,036	5
Chama	674	836	24
Total	**12,739**	**13,069**	**3**

Source: ERB, 2006

Figure 2.1 shows that in terms of sectoral power consumption, mining and construction industries recorded the highest power consumption at 58 percent.

Figure 2.1: Sectoral power consumption during 2006 (ERB, 2006)



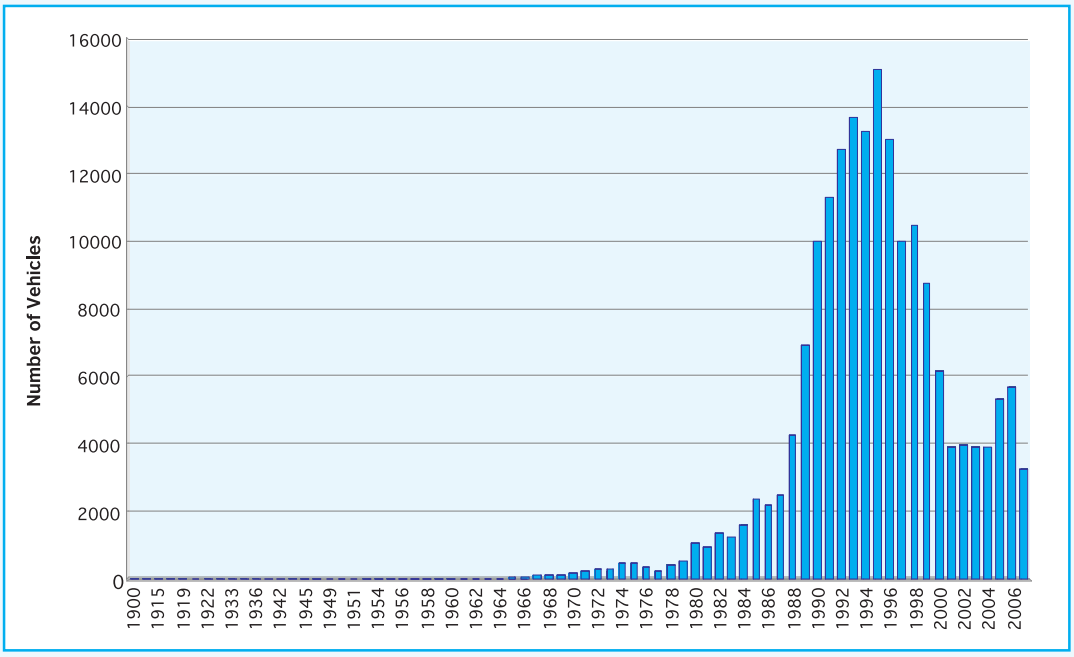
Source: ERB 2006

In 2006, consumption of petroleum products increased from 672 to 683million litres in 2005 representing an increment of 1.6 percent, whilst lubricants increased from 17.6 million litres to 17.8 million litres representing an increment of 1percent (ERB, 2006). Non-conventional energy sources such as fuel-wood and charcoal have remained the major primary source of energy in most households. It is estimated that 95 percent of people living in rural areas depend on fuel-wood and 90 percent of urban households depend on charcoal.

Traders selling Charcoal at a market

2. **Transportation:** There has been a rising trend in vehicle importation into the country. The total number of imported vehicles increased by 67 percent from 19 391 in 2005 to 32 294 in 2006. (ZRA, 2006). Most of these vehicles are reconditioned and therefore expected to release reasonable quantities of emissions due to their age (Figure 2.2).

Figure 2.2: Vehicle age analysis in Zambia by Year

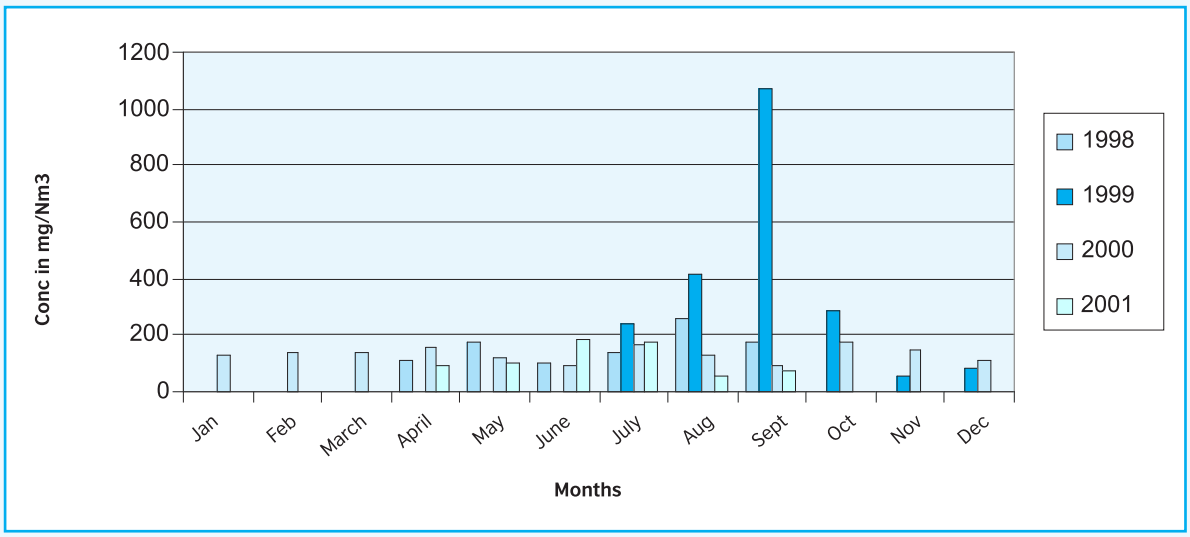


Source ERB

Most of the Zambian roads are not tarred and these are a source of dust emissions.

3. **Construction industry:** with the change in government housing policy, which saw a transfer from institutional to privately owned housing, there has been a notable increase in the construction industry. This has placed an increased demand on both cement production and quarrying with resultant increase in construction related dust and particulate matter. Figure 2.3 shows the dust emissions measured from a cement manufacturing company from 1998 to 2001.

Figure 2.3: Variation of Dust Emissions from a Cement Plant

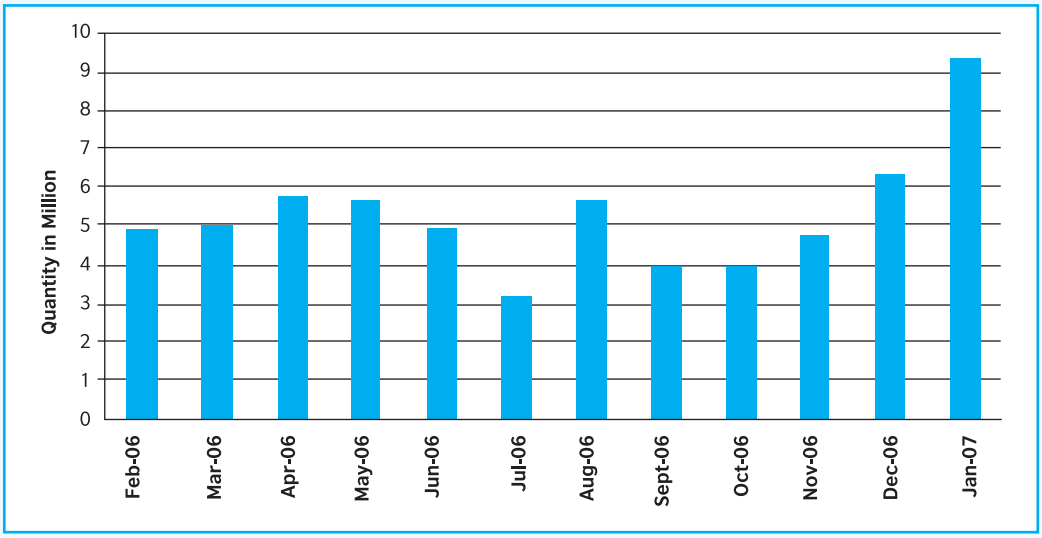


Source: (ECZ, 2002)

4. **Metal smelting industries:** There has been a rise in copper (and other minerals) production levels, with new mines becoming operational in North-western Province This has implications on production of sulphur related emissions associated with smelting.

5. **Waste management**: The issues as regards waste management relate to emissions from landfills and open air burning. An example of the quantities of waste disposed at the Chunga land fill in Lusaka (LCC, 2007) is shown in Figure 2.4. There is an increasing trend in waste production in Lusaka which has implications on the production of volatile organic related emissions.

Figure 2.4: Total Quantity of Waste (Kg) Disposed of at the Chunga Waste Disposal Site, Lusaka (February 2006 - January 2007)



Source : LCC, 2007

6. **Agriculture:** The country recorded variations in crop production. For instance, the 2004/2005 agricultural season recorded a decline in food crops while that of cash crops increased (MoFNP, 2006). However, the area planted increased for all crops while yields per hectare declined largely due to the unfavourable weather conditions. This means large farming areas were cleared (most of it under the slash and burn system) resulting in air pollution. Since most of agricultural practice in Zambia depends on fertilizers, the large hectarage clearance for agriculture means that more fertilizer was used and therefore more chemicals released to the atmosphere.

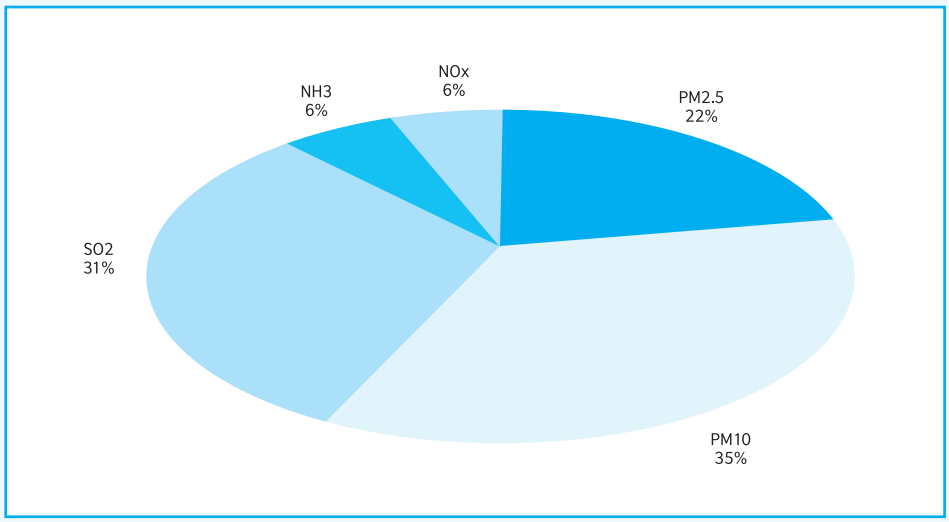
2.2 Emissions in Zambia

The increase in air pollution resulting from the expanding use of fossil energy sources and the growth in the manufacture and use of chemicals has resulted in detrimental effects on ambient air quality with negative impacts on health and the environment (WHO, 2001).

To ascertain the levels of air pollution in Zambia, the Air Pollution Information Network for Africa (APINA) conducted studies in 2000. The air pollutants considered were sulphur dioxide (SO2), oxides of nitrogen (NOx), ammonia (NH3) and particulate matter (PM). However, the emissions were computed as total national area emissions and do not give an indication of spatial distribution (APINA, 2003).

Findings from the study showed that, for Zambia, the highest total emissions in 2000 were PM10 emissions which recorded 406.8 kilotonnes per year (kt/yr) and accounted for 35percent of the total emissions for that year (Figure 2.5). This was followed by SO2 which recorded 359.5 kt/yr, accounting for 31 percent. PM2.5 was 252.7 kt/yr, NH3 was 75.8 kt/yr and NOx emissions were 72.8 kt/yr. It should be noted that data was segregated for purposes of easy understanding of this report. PM2.5 is conventionally accounted as part of PM10.

Figure 2.5: Percentage contribution by emission types to total emissions in kilotonnes per year (kt/yr) for Zambia in 2000.

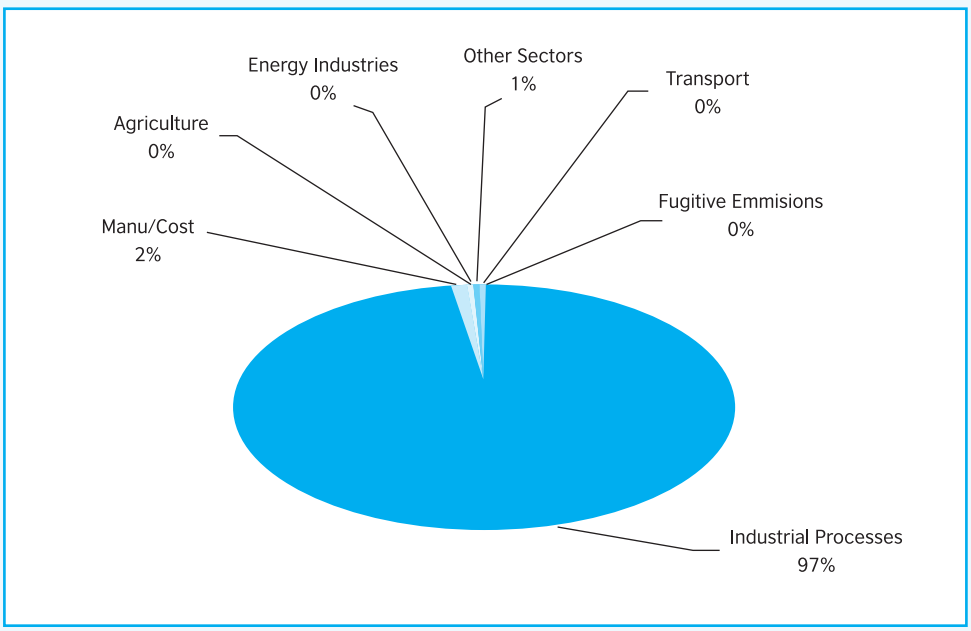


Source: APINA 2003

2.3 Sulphur dioxide Emissions

The major sources of SO2 emissions were from industrial processes, which contributed 346.7kt/yr per year, accounting for 98 percent of the total emissions (Figure 2.6). These were mainly from metal processing (mostly copper smelting). Other contributions were from combustion in the manufacturing industries and construction with 4.9 kt/yr. Combustion in other sectors contributed 2.6 kt/yr, mostly from residential areas. The transport and agriculture sectors contributed 0.9 kt/yr and 0.6 kt/yr respectively. Contributions from combustion in the energy sector were negligible at 0.1 kt/yr

Figure 2.6: Percentage contribution by sector to total Sulphur dioxide (SO2) Emissions.

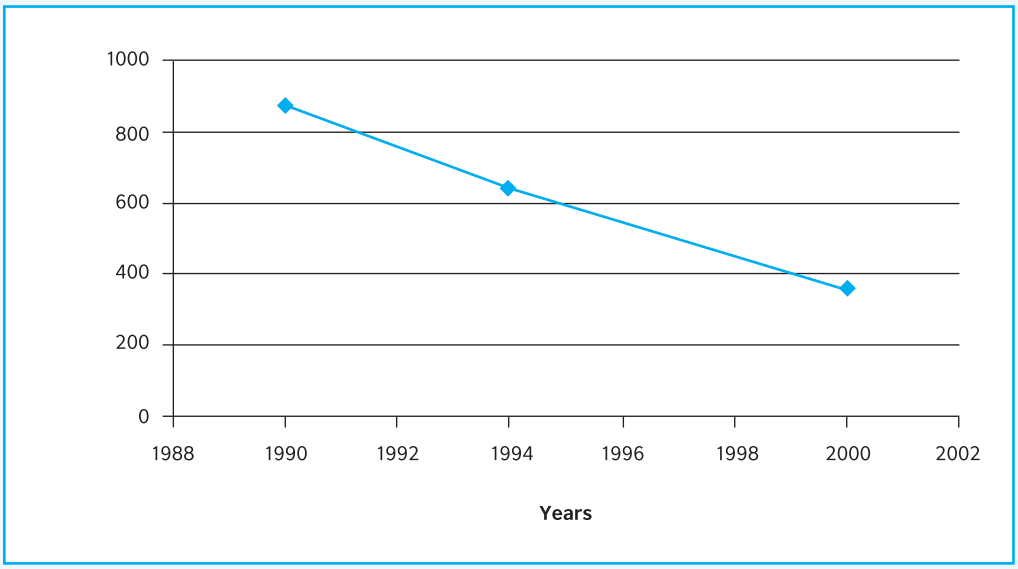


Source: APINA 2003

The total SO2 emissions were 873 kt/yr in 1990, 642 kt/yr in 1994 and 359 kt/yr in 2000 (Figure 2.7). It can be observed that there was a decrease in SO2 emissions between 1990 and 2000. This trend could be attributed to the privatization of the mining sector during the 1990s, which resulted in reduced mining and their related industrial activities. The increase in investments in mining activities is expected to yield an upward trend in SO2 emissions.

Emissions from mining operations

Figure 2.7: Trends in SO2 emissions in Zambia (1990, 1994 and 2000)

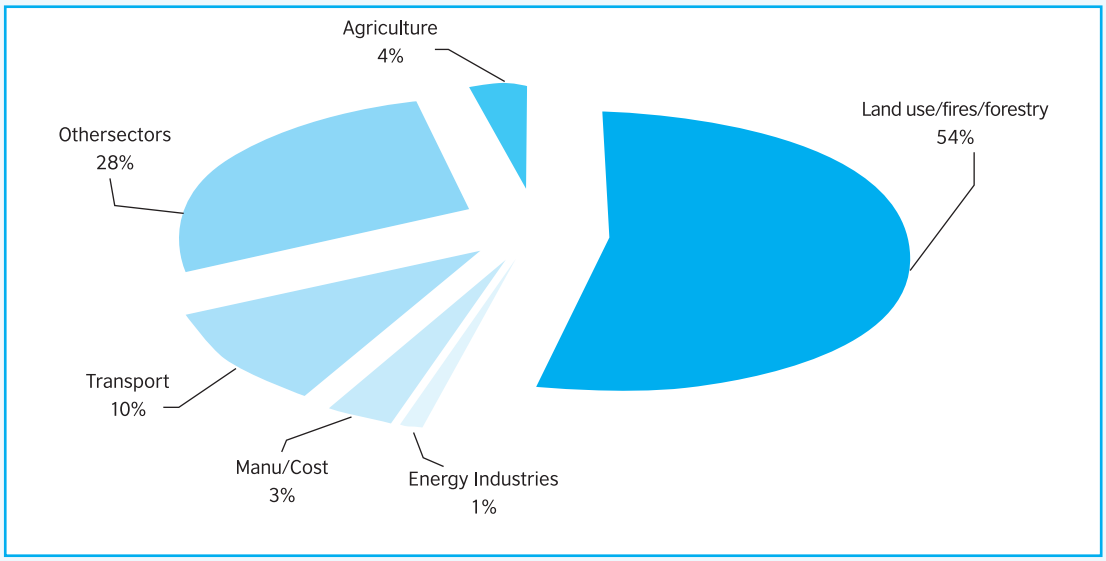


Source: APINA 2003

2.4 NOx Emissions

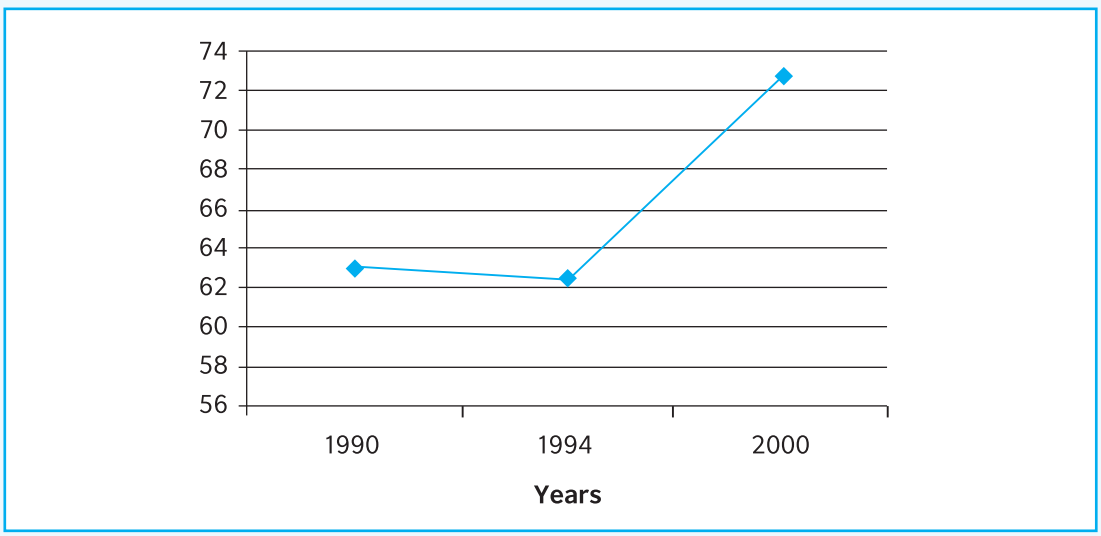
The main source of NOx emissions was the land-use change, fires and forestry sector which contributed 40 kt/yr, accounting for 54 percent of the total NOx emissions (Figure 2.8). These emissions were from on-site burning of forests and grasslands. Other contributions were from combustion in other sectors which recorded 20.2 kt/yr, mostly from residential areas. Other contributions were from the transport, agriculture, manufacturing industries, construction and energy sectors

Figure 2.8: Percentage contribution by sector to total NOx emissions for Zambia



The total NOx emissions were 63.1 kt/yr in 1990, 62.5 kt/yr in 1994 and 72.8 kt/yr in 2000 (Figure 2.9). There was a marked increase in the emissions between 1994 and 2000 which may be due to the growth of the agricultural sector following privatisation of the mines. In addition, normal rainfall conditions were experienced in the country.

Figure 2.9: Trend of NOx emissions in Zambia using 1990, 1994 and 2000 data

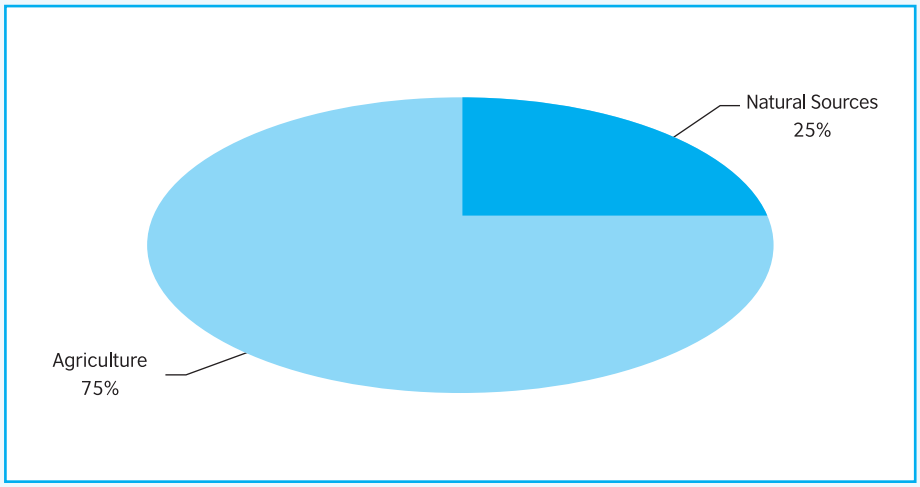


Source: APINA 2003

2.5 Ammonia (NH3) Emissions

The agriculture sector and natural sources were the major contributors to NH3 emission at 57.1 kt/yr and 18.7 kt/yr respectively (Figure 2.10). These were mostly from manure management and organic emissions from natural vegetation.

Figure 2.10: Percentage contribution by sector to total NH3 emissions for Zambia

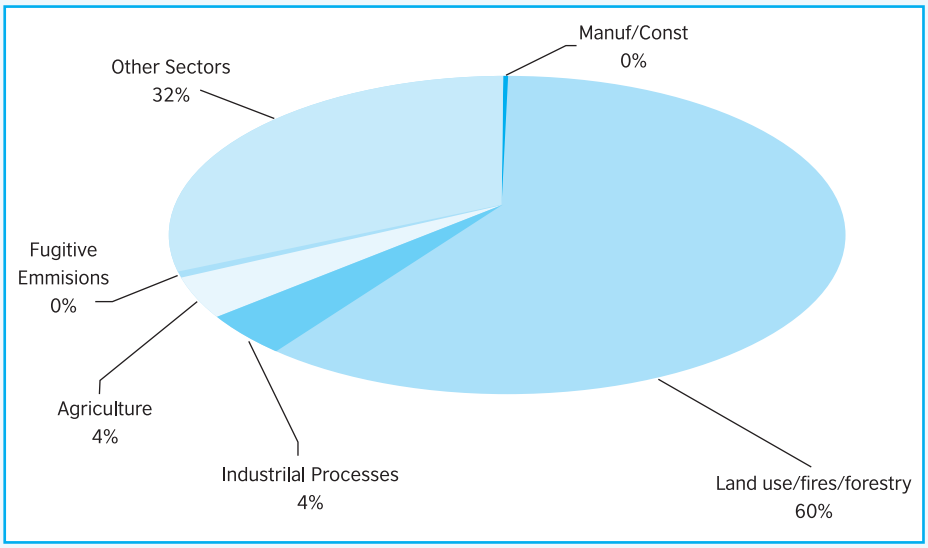


Source: APINA 2003

2.6 PM10 emissions

Land-use change, fires and forests were the major sources of PM10 emissions at 241.5 kt/yr (Figure 2.11). These were mainly from on-site burning of forests and grasslands. Combustion in other sectors e.g. open air burning of waste, agriculture, fugitive emissions and industrial processes were the other sources.

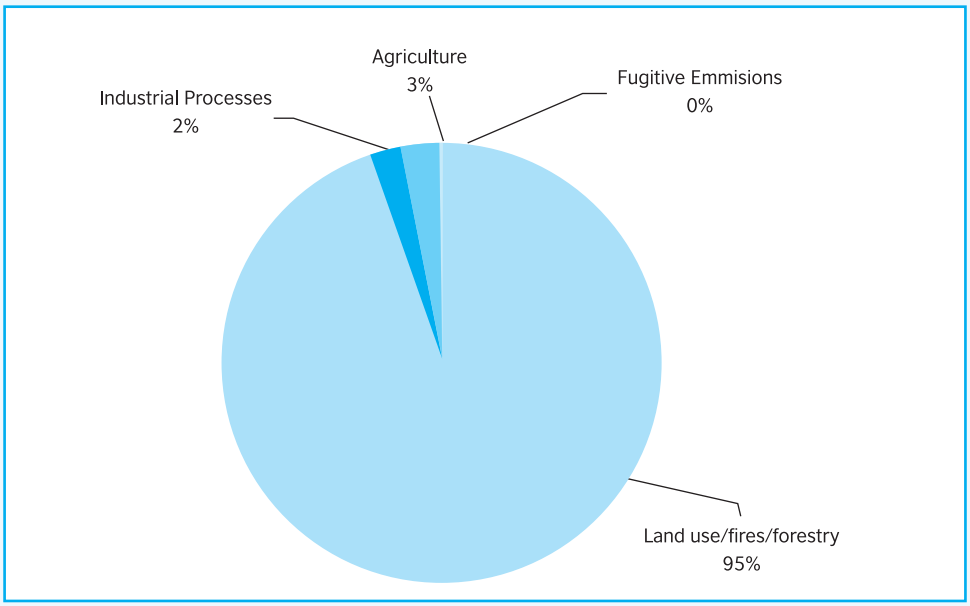
Figure 2.11: Percentage contributions by sector to total PM10 emissions



2.7 PM2.5 emissions

The major sources of PM2.5 emissions were land-use change, fires and forests (Figure 2.12). It contributed 241.5kt/yr, accounting for 95 percent of the total PM2.5 emissions. These were mostly from on-site burning of forests and grasslands.

Figure 2.12: Percentage contribution by sector to total PM2.5 emissions in 2000



2.8 Climate Change and Variability in Zambia

Climate change refers to a statistical significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forces or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Climate variability on the other hand refers to variations in the mean state and other statistics of the climate on all temporal and spatial scales beyond that of individual weather systems. The variability may be due to natural internal process within the climate system, or to variations in natural or anthropogenic external forces (IPCC, 2001a).

The main indicators of climate change and variability are changes in temperature and rainfall patterns (IPCC, 2001a). However, limited research has been undertaken in Zambia to determine the pattern of these changes.

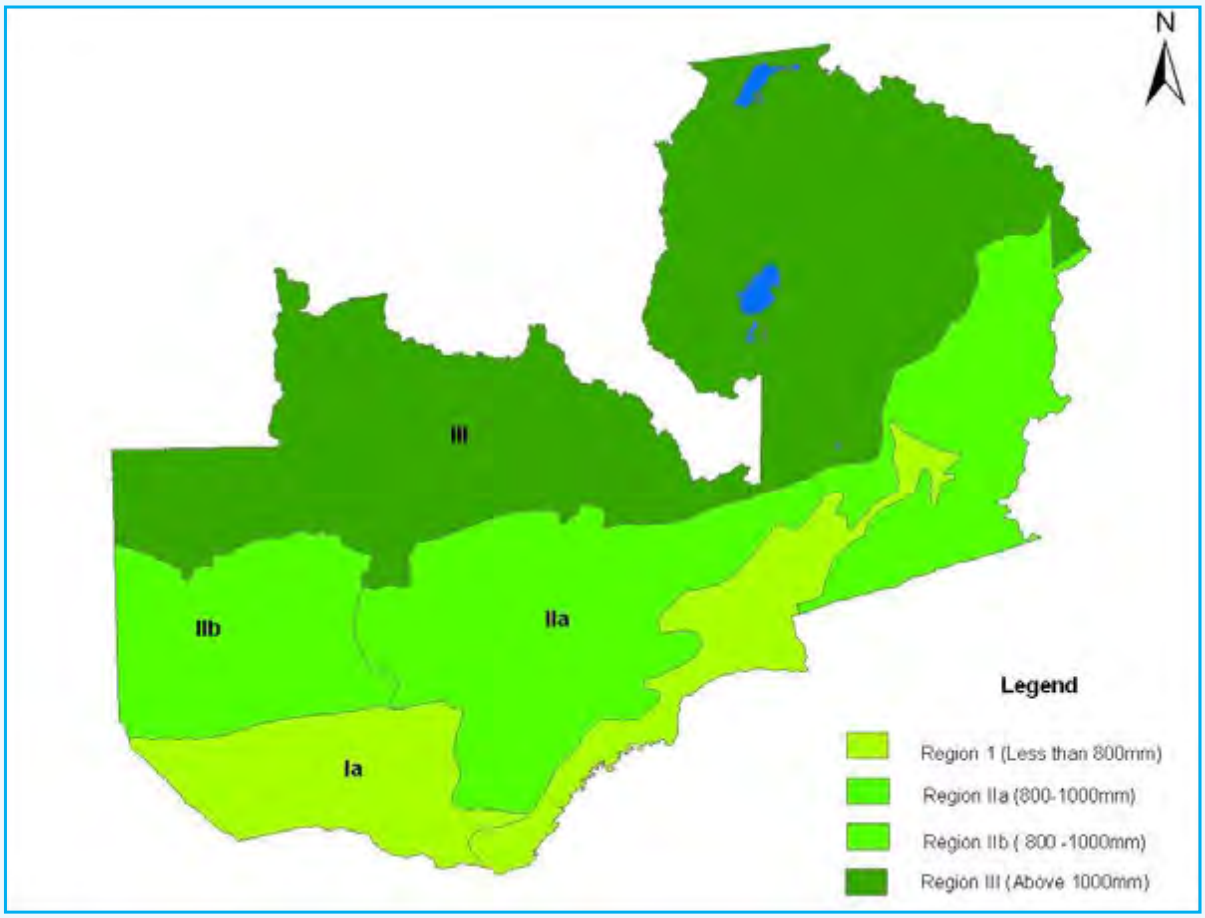
An analysis of daily temperature (maximum and minimum) for the period 1961–2000 showed that temperature extremes depicted consistent warming patterns over Zambia and most of Southern Africa (New et al., 2006).

Climate change affects water availability through its influence on rainfall patterns. The main cause is the emission of green house gases mainly from human activities. These emissions are trans-boundary in that impacts in one part of the world can have effects in another part of the world. It has been estimated that temperature rises will be 1 to 3.5o C by the year 2100

(WHO, 2003). This will change the weather pattern leading to severe flooding and droughts of varying proportion in different parts of the world.

An analysis of rainfall performance was made in terms of normals (in mm) for three 30-year periods i.e 1950–1979; 1961–1990 and 1976–2005 (ZMD, 2006). This was to determine changes in the rainfall patterns. The results of the analysis are discussed in the context of the three agro-ecological regions (Figure 2.13).

Figure 2.13: Agro-ecological Regions in Zambia Based on a 30 year Period 1961-1990



Source: ECZ, 2006

Zambia is divided into three ecological zones. Region I covers the plateau sub-region in the Southwest and the valley region in South Luangwa and Zambezi valleys. The region receives less than 800 mm annual rainfall and covers about 15 million hectares equivalent to 20 percent of the country.

Region II consists of the sand veld plateau of Central, Eastern and Southern provinces and the Kalahari Sand plateau of Western Province. The region receives 800-1000 mm annual rainfall and covers approximately 27 million hectares equivalent to 36 percent of the country.

Region III receives over 1000 mm annual rainfall and covers about 33 million hectares equivalent to 44 percent of the country. This region covers the Copperbelt, Luapula, Northern and North-western provinces.

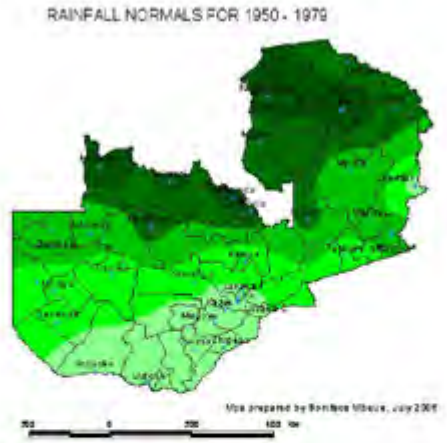
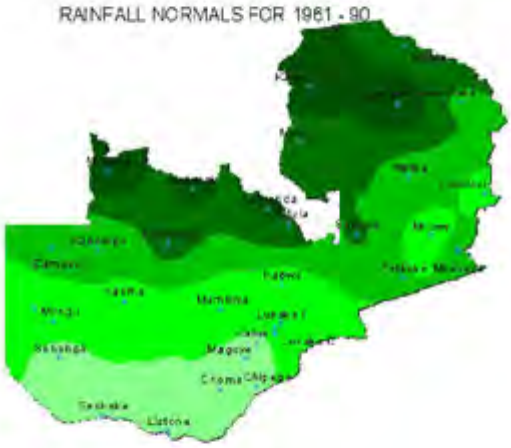
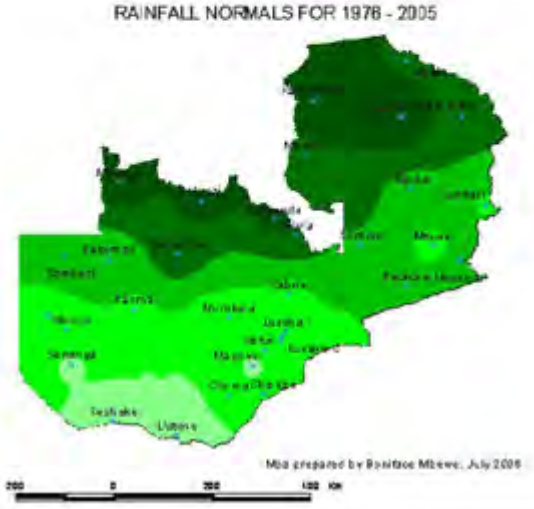
Table 2.4: Rainfall normal categories over 30 year periods -Each of the 30-year period is divided in five classes:

Year	Rainfall normals in mm				
	I	II	III	IV	V
1950-1979	757.7 – 891.2	891.2 – 1024.8	1024.8 – 1158.3	1158.3 – 1291.9	1291.9 – 1425.4
1961-1990	655.2 – 814.8	814.8 – 964.4	964.4 – 1113.9	1113.9 – 1263.5	1263.5 – 1413.1
1976-2005	539.6 – 747.7	747.7 – 895.8	895.8 - 1044.0	1044.0 – 1191.2	1191.2 – 1340.2

The resultant rainfall distribution maps for the three 30-year periods are shown in Figure 2.14. The lower and upper rainfall class limits in all the five categories during the period 1976-2000 were lower than the periods 1950–1979 and 1961–1990. This implies that on average, there has been progressive reduction in annual cumulative rainfall amounts since the 1950s through to 2005.

In Zambia, just like most of the Southern Africa, variations in rainfall patterns have normally been attributed to the El Nino Southern Oscillation (ENSO) phenomena (Garstang et al., 1996). The phenomenon refers to the global variations in the sea surface temperatures and the associated changes in global pressure systems. During the warm phase, El Nino, much of Zambia especially the southern parts experience below normal rainfall. On the other hand, during the cold phase, La Nina, most parts in Zambia experience normal to above normal rainfall.

Figure 2.14: Rainfall Normals over periods 1950 – 1979, 1961 – 1990, 1976 – 2005

Period	Legend	Rainfall pattern
1950 –1979	Normals (mm) 757.7 - 891.2 891.2 - 1024.8 1024.8 - 1158.3 1158.3 - 1291.9 1291.9 - 1425.4	
1961 – 1990	Normals (mm) 655.2 - 814.0 814.0 - 964.4 964.4 - 1113.9 1113.9 - 1263.5 1263.5 -1413.1	
1976 – 2005	Normals (mm) 599.6 - 747.7 747.7 - 895.8 895.8 - 1044.0 1044.0 - 1191.2 1191.2 - 1340.2	

Source: ZMD, 2006

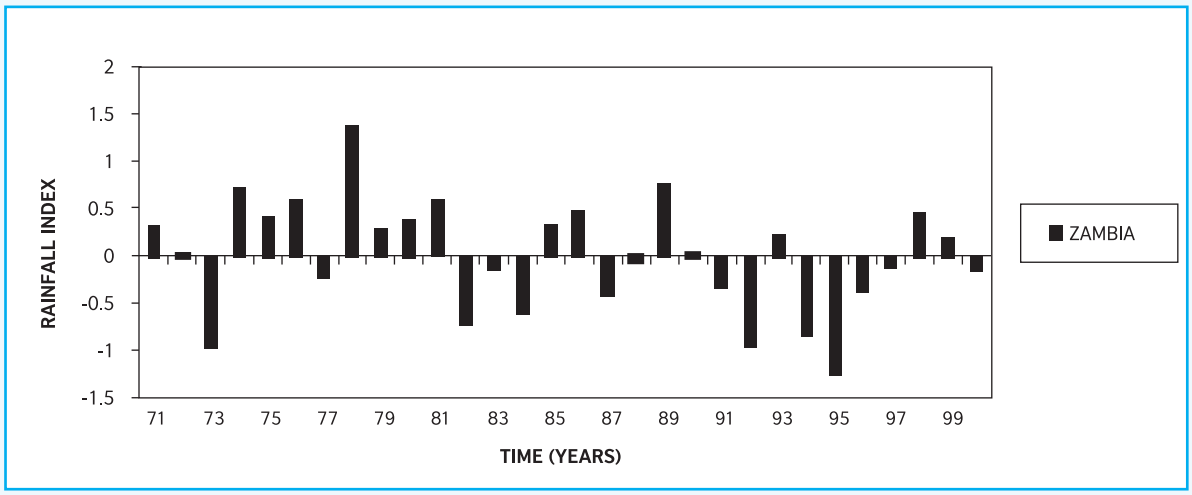
The variation of the Rainfall Index (RI)[3] across the three main agro-ecological regions was also examined using the classification by McKee et al. (1994) shown in Table 2.5 to determine regional differences in drought incidence and intensities over the three regions (Muchinda, 2001).

Table 2.5: RI categories (After McKee et al. (1994)

RI Values	Drought Category
0 to -0.99	Mild drought
-1.00 to -1.49	moderate drought
-1.50 to -1.99	severe drought
<-2.0	extreme drought

These results indicate that there is no definite periodicity in the wet and dry episodes over Zambia as can be observed in the varying rainfall indices shown in Figure 2.15.

Figure 2.15: Rainfall indices averaged over Zambia (1970/1971-1999/2000

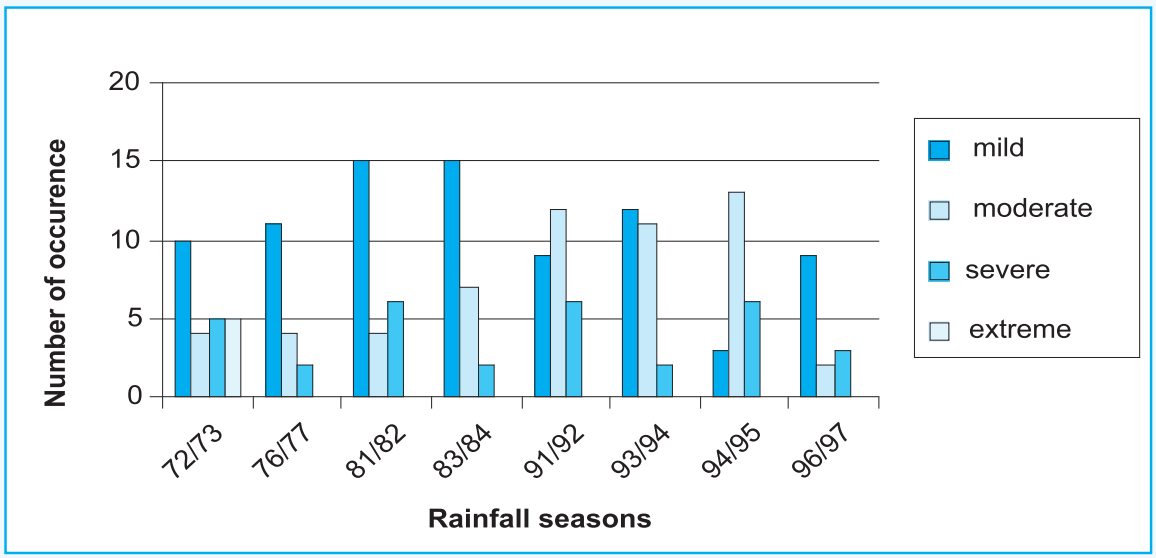


Source: Muchinda, 2001

In terms of drought classification, most of them have been mild or moderate, with a few falling in the severe or extreme category (Figure 2.16).

[3] The RI is calculated by taking the difference of the precipitation from the long-term average for a particular time scale, then dividing it by the standard deviation:
RI=(P-X)/alpha, where P = annual precipitation, X=long term average and alpha=standard deviation from P.

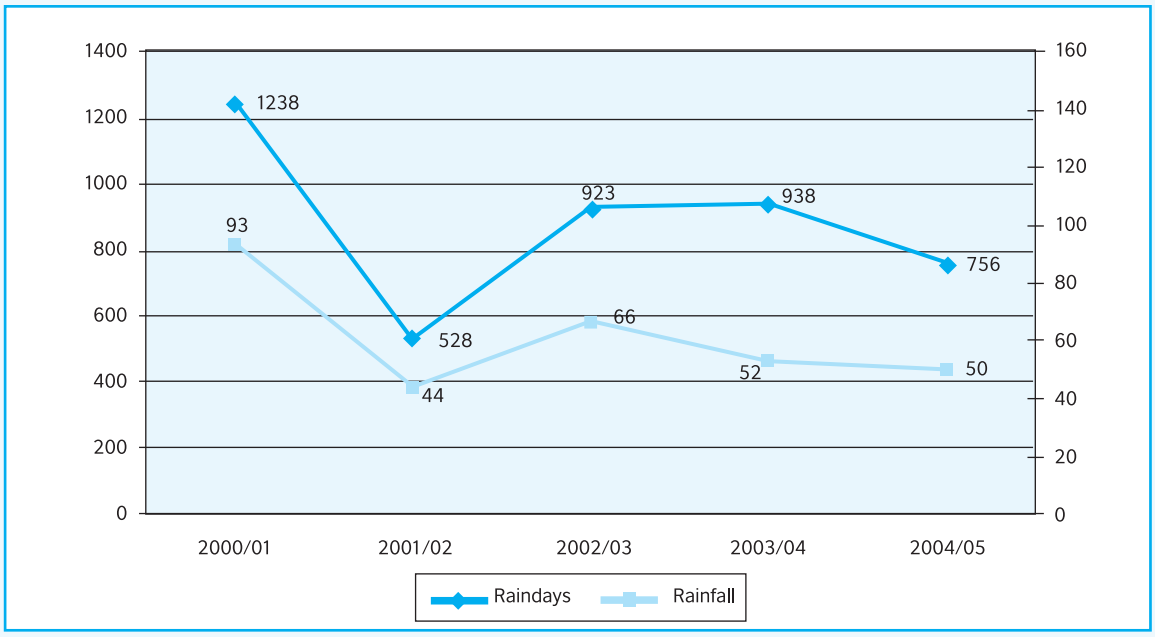
Figure 2.16: Analysis of drought classification in Zambia for the period 1970 – 2000



Rainfall tends to be more stable in the north. The Inter-Tropical Convergence Zone (ITCZ) and Congo Air Boundary (CAB)[4] have more resident time over the northern than the southern parts of the country thus increasing rainfall in these areas.

Box 2.2: Trend in Rainfall and Raindays over Lusaka from 2000-2005

Box 2.2 shows the rainfall characteristics for Lusaka. The annual rainfall shows a reduction of 1,238 mm during the 2000/01 rainy season compared to 756 mm during the 2004/05 rainy season. This indicates that Lusaka has been getting drier. In terms of raindays, the pattern over Lusaka also shows that the rainy season has been getting shorter during the five years considered.



Source: ZMD, 2006

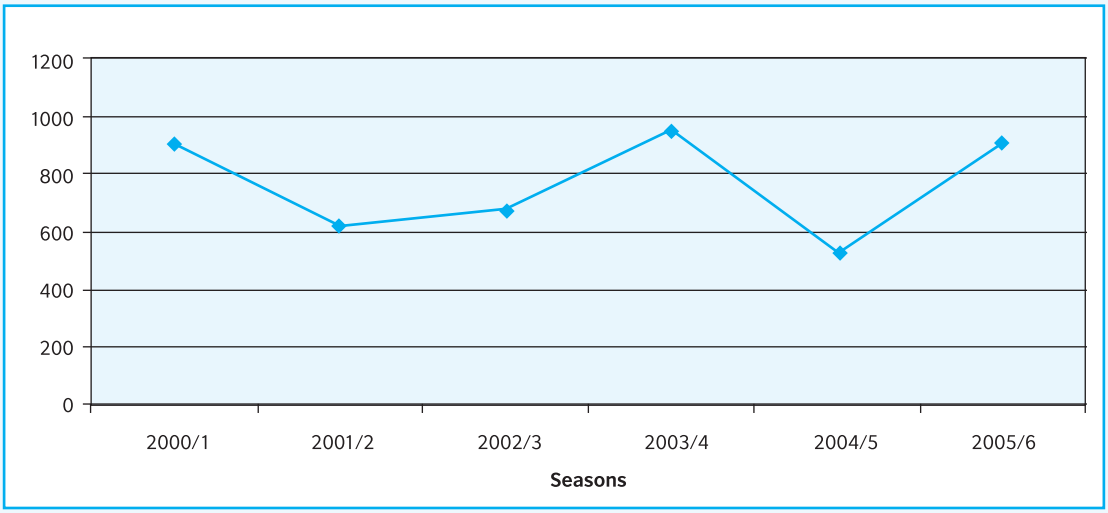
[4] CAB (Congo air boundary) is the boundary between the winds from the northwest (associated with the Congo Basin) and northeast. Normally responsible for the early rains over the northern half of Zambia.

Box 2.3: Trend in rainfall and rain days over Ndola from 2000 – 2005

Similar to Lusaka, the rainfall patterns in Ndola also showed a reduction between 2000 and 2005 in both seasonal rainfall totals and raindays. This implies there has been a general reduction in rainfall and the season has been shorter

Box 2.4: Trends in cumulative rainfall and rain days in Choma (2000/1-2005/6)

The seasonal rainfall trend for Choma during the period 2000 to 2006 was analysed. The findings revealed that Choma experienced significant rainfall variability.



Source: ZMD, 2006

Air pollution has a direct and/or indirect impact on the health of humans, animals and the environment. In humans, the pulmonary deposition and absorption of inhaled chemicals can have direct consequences on health (WHO, 2001). Public health can also be indirectly affected by deposition of air pollutants in environmental media and uptake by plants and animals, resulting in chemicals entering the food chain thereby constituting additional sources of human exposure. Further, the direct effects of air pollutants on plants, animals and soil can influence the structure and function of ecosystems, including their self-regulation ability, thus affecting their quality of life.

Box 2.5: Impacts of Air Pollution on Human Health

Carbon monoxide (CO): Inhaling CO causes slow reflexes, and impairs judgement; at high concentrations may lead to death. Since CO is odourless and tasteless, it defies human detection and constitutes a serious health hazard, especially where the concentration is high, as can be in highways and parking places.

Oxides of nitrogen (NOx): are highly toxic and at high concentration levels can cause heart, lung, liver and kidney damage. It is also linked to incidences of bronchitis and pneumonia.

Oxides of sulphur (SOx): Irritates respiratory passages and can aggravate asthma, emphysema and bronchitis.

Smog (e.g. tropospheric ozone and peroxyacetyl nitrates (PAN)): Irritates eyes and damages the respiratory system. They irritate the nose and throat. Ozone also degrades rubber and fabrics, retards tree growth and damage some crops.

Source: WHO, 2001

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental Convention that sets an overall framework for inter-governmental efforts to tackle the challenges posed by climate change. The main objective of the UNFCCC is to stabilize the Green House Gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous human induced interference with the climate system. **The Kyoto Protocol:** is a legally binding instrument of the UNFCCC which set emission reduction targets for over 35 industrialized countries to reduce their anthropogenic GHG emission by at least 5percent below 1990 level in the commitment period of 2008 – 2012. Zambia became a signatory to the Kyoto Protocol in 2006.

National Adaptation Programme of Action (NAPA): In order to guide the country in carrying out adaptation activities to climate change, and ensure limited resources are used prudently, the country has formulated the NAPA. The NAPA will provide a road map for adaptation activities and has identified vulnerable sectors and recommended actions. These include sustainable land use and management methods and public awareness and sensitization campaigns on climate change. In line with this, establishment of a Climate Change Facilitation Unit (CCFU) commenced in order to enhance co-ordination in addressing climate change in the country.

Second National Communication on Climate Change: Preparation for establishment of a Co-ordination Unit at ECZ was undertaken. This will include formulation of a National Communication Technical Working Group as well as research into the following:

- Preparation of National Green House Inventory Mitigation and Assessment;
- Climate Change Vulnerability and Adaptation Assessment;
- Formulation of institutional arrangements for future national communication on climate change;
- Production of information relevant to meeting obligations under the UNFCC.

Studies to be undertaken on the above are expected to culminate into preparation of the second national communication on climate change for Zambia.

Clean Development Mechanism (CDM): Zambia is also participating in reducing GHG emissions through the CDM. Through the CDM, investments are made in projects that result in reducing emissions and contribute to sustainable development.

In fulfilling its obligations to the UNFCCC, the initial National Communication on Climate Change was formulated. Its objective was to report on the country's emissions on GHGs and other activities being undertaken in the country to address issues of climate change.

The adoption of cleaner production by industries will help reduce emissions of GHGs and reduce their impact on the environment. It is therefore important to continue monitoring climate change and implement appropriate mitigation measures.

National Capacity Self Assessment for Global Environmental Management: This has been undertaken in order to address priority national and global environmental issues by developing capacities for implementing the UN Convention on Biological Diversity (UNCBD), UN Convention

to Combat Desertification (UNCCD) and UNFCCC. The Environment and Natural Management Department (ENRMD) of the MTENR is implementing the NCSA. Consequently, Zambia's strengths, constraints and priority needs to prepare the national capacity development plan will be developed.

National Policy on Environment (NPE) has been developed in order to achieve an integrated approach to the use and management of natural resources. The policy is aimed at ensuring that socio-economic development is achieved effectively without damaging the integrity of the environment or its resources. Among key issues of concern are atmospheric and climate change issues.

Development of Environmental Indicators: In order to provide for an assessment of the state of environment and monitor environmental trends, a set of environmental indicators has been developed. The indicators will allow for increased awareness and facilitate the measurement of progress towards sustainable development efforts.

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CHAPTER 3
LAND

Zambia has a total area of 752,614 km2 and lies on the Central African high Plateau with an average altitude of 1,200m above sea level. Land has been recognised worldwide as a major factor of production and an important resource for human, animal and plant life. For this reason, land should be managed in a sustainable manner so as to meet the needs of both present and future generations. In Zambia, major drivers and pressures on land are demographic changes arising from population growth and alterations of settlement patterns. The increase in economic activities in sectors such as agriculture, construction and mining have also caused considerable pressure on land.

According to Section 2 of the Lands Act of the Laws of Zambia, land is defined as, any interest in land whether the land is virgin, bare or has improvements, but does not include any mining right as defined in the Mines and Minerals Act in respect of any land. Another definition of land as provided by Mirriam Webster Dictionary is the surface of the earth and its natural resources. In the context of environmental management, land plays a very vital role in ecological stability. In Zambia all land is vested in the President in trust for the people of Zambia (Lands Act, 1995).

3.1 Land Tenure

In Zambia, land administration is carried out through a system of land tenure that is divided into two, leasehold and customary tenure. The Commissioner of Lands administers state land for agricultural, commercial, industrial and residential purposes. On the other hand, traditional rulers administer land in customary areas. However, the Commissioner may allocate land under customary tenure provided that it is vacant; and, that the concerned local traditional ruler does not object. The administration of state land is carried out in accordance with the provisions of the Lands Act. Subsection (1) of Section 7 which recognises customary tenure and states that:

> *...every piece of land in a customary area which immediately before the commencement of this Act was vested in or held by any person under customary tenure shall continue to be so held and recognised and any provision of this Act or any other law shall not be so construed as to infringe any customary right enjoyed by that person...*

Land administration is further executed by the Ministry of Lands through its constituent departments and agents e.g. Local Authorities dealing with land delivery, administration, survey and registration.

Customary tenure: The system of land ownership known as customary tenure includes land that was designated as reserve and trust land and is derived from continued occupation. It is administered according to local customs and therefore varies from place to place. Customary land is controlled by Chiefs and their Headmen but act with the consent of their people. Customary tenure accounts for 93 percent of the Zambian land (MoL, 2006). It is secure as long as the grantee or 'his' or "her" family continue to use land on the basis of their needs. This entitles persons in such areas to various use rights such as for cultivation, housing, grazing, collection of firewood and foods and any other legitimate uses. The advantages of customary tenure are that it provides multiple uses of land forms of tenure. It entitles an individual to communal holding of public goods such as a well, river and wild produce of the

community within which he/she leaves (MoL; 2006).

Leasehold tenure: The land under leasehold is referred to as state land. Interest in land held under leasehold tenure is acquired directly from the President through the Commissioner of Lands and is limited to a specified period, but can be revoked before or extended after the expiration of the lease. Due to limited state land, there is considerable interest in conversion of customary land to leasehold tenure for development purposes. Leasehold tenure accounts for about 7 percent of the total area of Zambia (MoL, 2006).

There are several factors causing increased demand for land which directly affect land tenure. Some of the factors include population growth, urban migration, economic growth coupled with local and foreign investment. The demand for land in the country both in the rural and urban areas is increasing each year. However, the demand is much more in the urban areas especially along the line of rail. Population growth, investments in agriculture, mining, tourism, construction and real estate, has seen expansion in areas, which were previously idle.

Currently, the land delivery system is unable to meet the increase in the demand for land particularly in urban areas. For instance, population density for Lusaka Province increased from 45.1 persons per square kilometre in 1990 to 63.5 persons per square kilometre in 2000. As for the Copperbelt province the population density in 2000 was estimated at 50.5. With the increasing population growth the country is experiencing artificial shortage of land especially in large cities such as Lusaka, Livingstone, Kitwe and Ndola (MoL, 2006).

3.2 Access to Land

Every Zambian citizen has the right to own land however imbalances in land ownership between men and women exist. Although current laws do not discriminate against women or youths to own land, women still lack access to land due to customary practices that encourage male dominance. Nsemiwe observed that customary practices such as inheritance contribute to unequal distribution of land (2006). The reason for this lies in limited women's access, control and management of land. The Zambia Land Alliance (ZLA) during its consultative process with various communities countrywide also observed that women did not have access to land as much as the men despite traditional land being free. In addition, women do not have land rights because of socio-economic obstacles such as capital and illiteracy. This makes it difficult for them to apply for title deeds (2005).

In addition, people who are physically challenged constitute about 10 percent of the Zambian population (MoL, 2006). The current Land Laws do not discriminate against anyone on the basis of disability. However, they are disadvantaged in accessing land due to customs, norms and beliefs that promote the perception that disabled persons cannot use land productively.

3.3 Land use

Land use is the application of human controls in a relatively systematic manner, to the key elements within any ecosystem, in order to derive benefits from it (SANTREN, 1998).

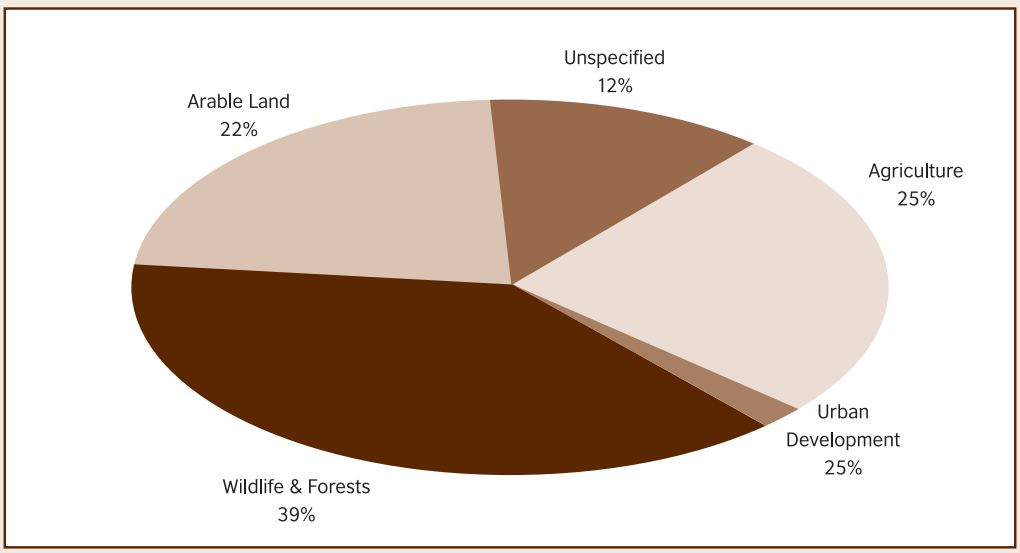
The major land uses in the country include agriculture and forestry. A significant amount of

the land use is in form of protected areas. Human activities include crop/livestock farming as well as mining. Agricultural activities form the major component of land use in rural Zambia as well as in the designated areas for agricultural development. In addition, the increase in mining activities in the country continues to exert pressure on demand for land.

Land Degradation

Land Degradation as a result of mining activities

Figure 3.1: Major Land uses in Zambia



The country is still dominated by vast open areas of natural vegetation (71 percent of the total area) comprising grasslands, thickets, woodlands and forests.

Figure 3.2: Vegetation Cover in Zambia

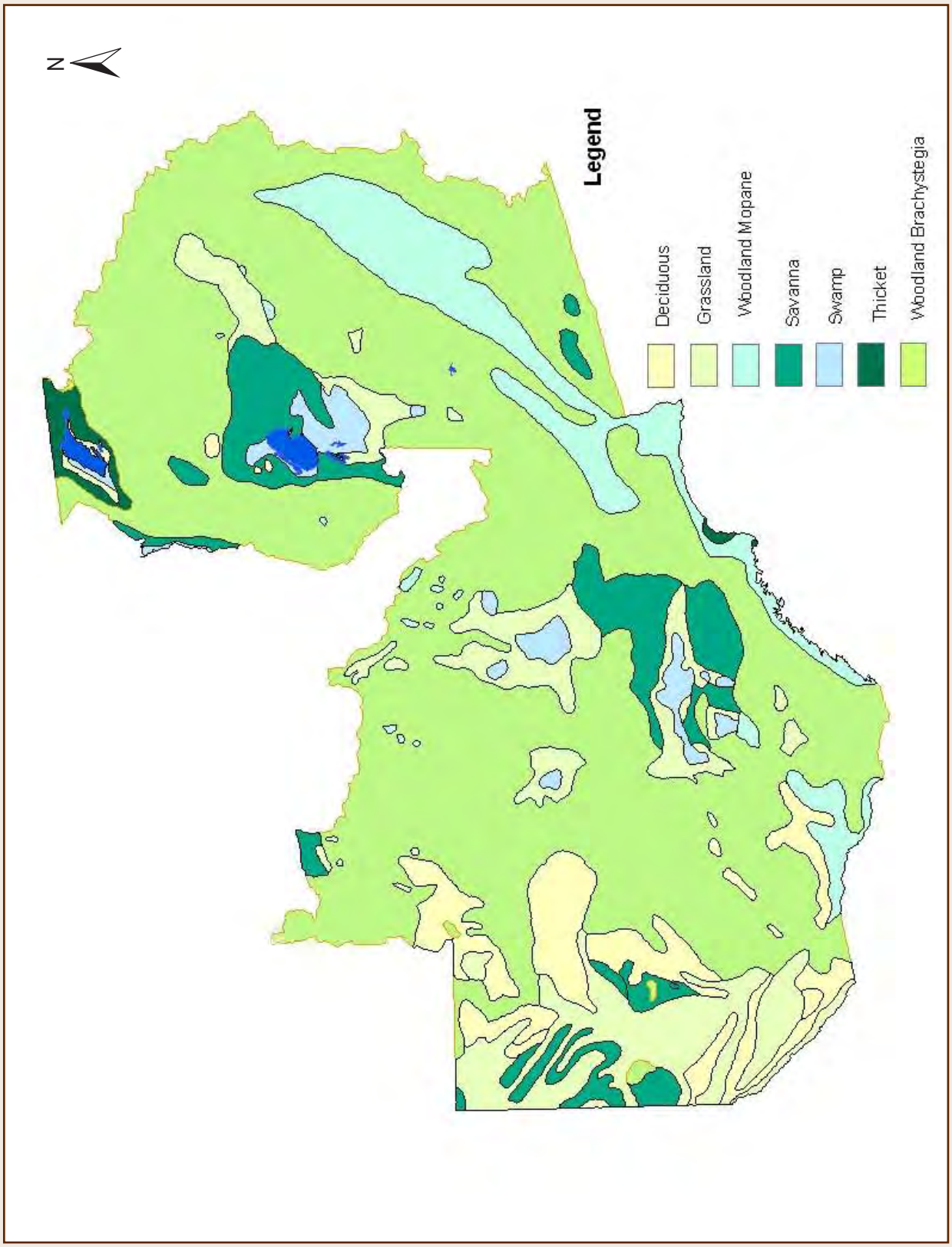
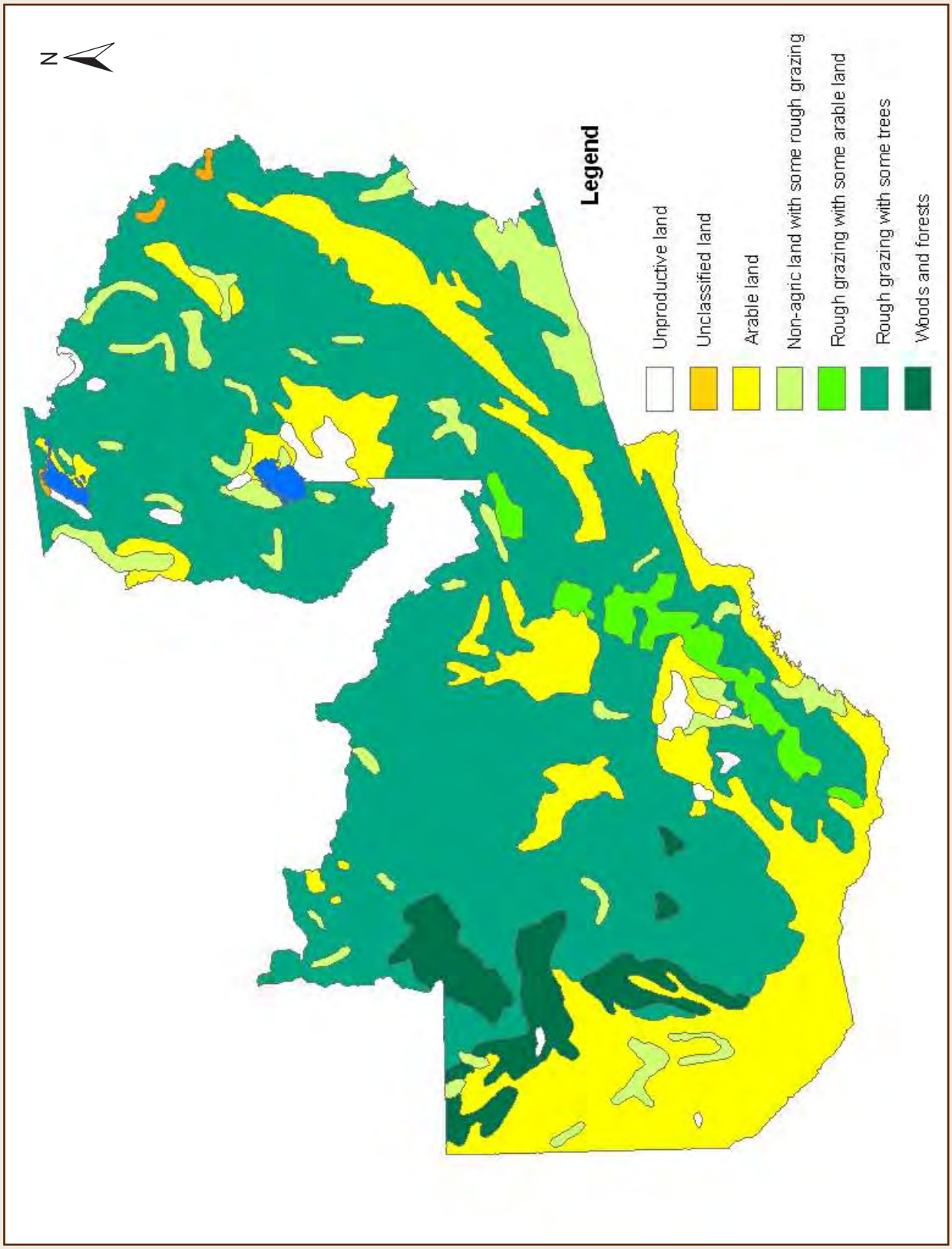


Figure 3.3: Land use in Zambia



3.4 Agriculture

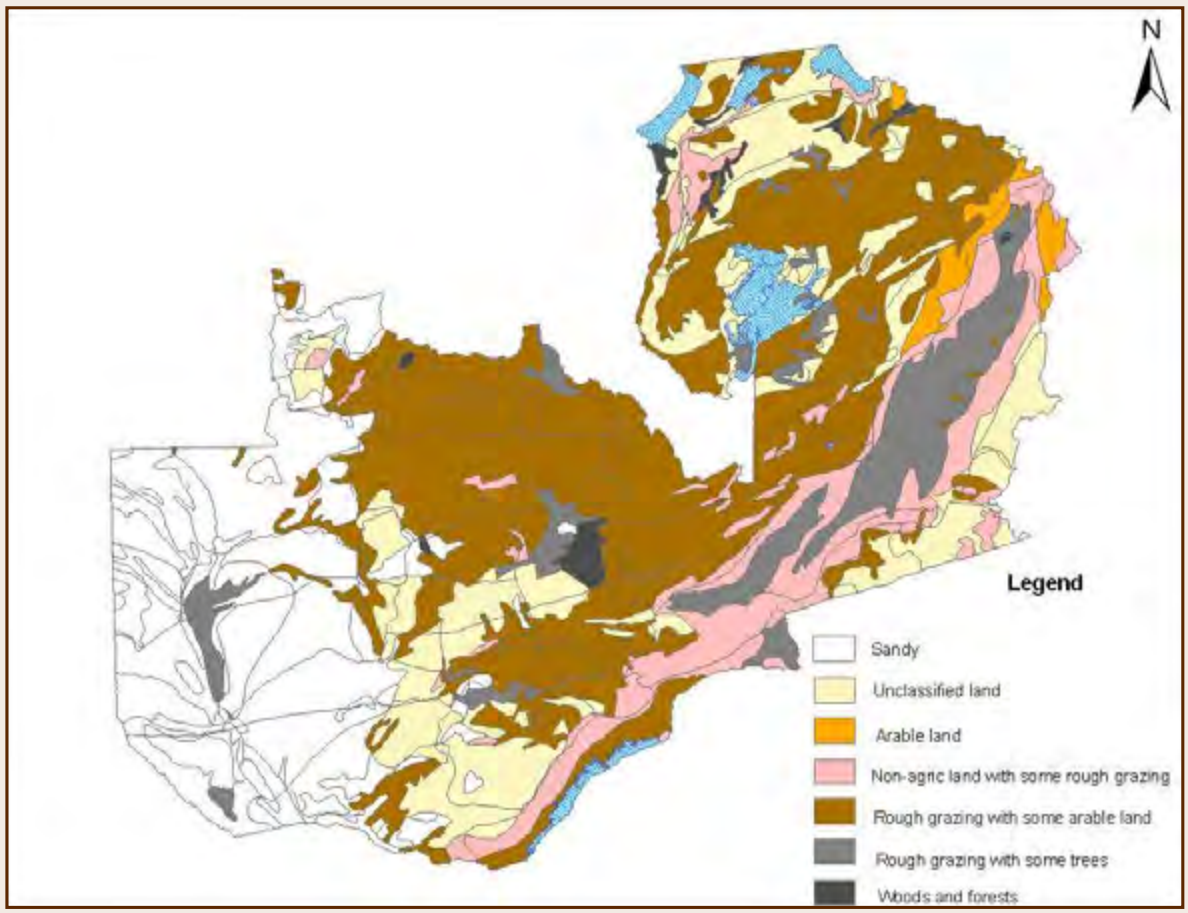
The country is divided into three agro-ecological zones of Regions I, II and III (refer to Figure 2.13 in Atmosphere chapter). Region I presents semi-arid conditions and Region III experiences tropical conditions while Region II has moderation of the two.

Region I covers the semi-arid, rift trough areas of Luangwa, Zambezi and Lusemfwa valleys, the main soil limitations include heavy-textured compacted soils and salinity. Drought and short cropping periods reduce the choice of crops to be grown. Region I has the most over-grazed areas in Zambia which has resulted in soil erosion and localized desertification.

In Region II, with the exception of Western Province, soil structure and organic matter deterioration is a problem on cultivated soils. The soil contributes to decline in crop yield and can be observed by the formation of crusts on the soil surface and hardpans or compacted layers.

In Region III, soils particularly those in the northern parts of the country are highly weathered, leached and acidic due to high rainfall (Figure 3.4). In the western part of Zambia, the soils are acidic, coarse to fine sandy soils with more than 90 percent quartz developed over Kalahari sands. The eastern and south central plateau has moderately leached clay to loam soils with medium to strong acidity.

Figure3.4: Soils of Zambia



Source: ECZ, 2006

Zambia's agriculture is mainly rain fed, with the rainy season starting in October/November to April/May. Irrigable land is estimated at about 420,000 hectares, but less than 10 percent is currently irrigated, mostly by commercial farmers cultivating sugar, wheat and other cash crops. Maize is the major staple crop and is grown throughout country. Majority are small scale farmers who own less than 5 hectares of land and use basic production technologies, relying on family labour and minimal farming inputs (FAO, 2005).

Most of the Zambians depend on agriculture for their livelihood. With the increase in crop production, resulting impacts include soil degradation through acidification, nutrient loss, deterioration of structure, soil erosion, salinization, pesticide and fertiliser pollution. The problem of soil acidification has been worsened by the use of nitrogenous fertiliser. It is estimated that acidification due to fertiliser may account for the loss of up to 15percent of arable land in 20 years in Northern Province (Blackwell et al, 1991). Although the use of nitrogen fertiliser increase soil organic matter, there are cases even in Region II, where continuous use of nitrogen fertilisers destabilises the clay and enhances pan formation which impairs plant root growth while losses in organic matter of up to 80 percent may occur (Robinson 1978). High soil organic matter content is important for the maintenance of nutrient exchange between the soil and plants. Total fertilizer use for the whole country for the 2004/05 season amounted to slightly more than 150 000 metric tonnes, with about 70 000 tonnes for commercial or large-scale (more than 20 hectares) sector use (ECZ, 2006).

National crop yield per hectare varies from year to year. The variation (Table 3.1) is attributed to factors such as differences in production practices at farm level, seasonal changes in rainfall patterns, availability of crop inputs etc. From the increase in yields per hectare, it is clear that the agriculture sector has potential in this country.

Table 3.1: Crop forecast Production Analysis

Crop	Area Planted (ha)		Yield (Mt/ha)	
	2004/05	2005/06	2004/05	2005/06
Maize	834,981	784,524	1.04	1.82
Rice	18,243	14,358	0.73	0.97
Groundnuts	161,962	144,250	0.46	0.58
Sorghum	57,432	43,627	0.33	0.48

Source: MACO, 2007

Agriculture also relies heavily on chemicals to control disease, pests, and weeds, in addition to enhancing soil nutrient levels. The toxicity level of a particular pesticide depends on several factors such as its residual effect on the environment and the quantity used.

Zambia is also witnessing a steady increase in the import and use of different types of pesticides for both agriculture and public health. For example herbicides in liquid form for 2005 was recorded at 46,050Litres whilst in 2006 the amount increased to 175814.7 Litres. Table 3.2 gives details.

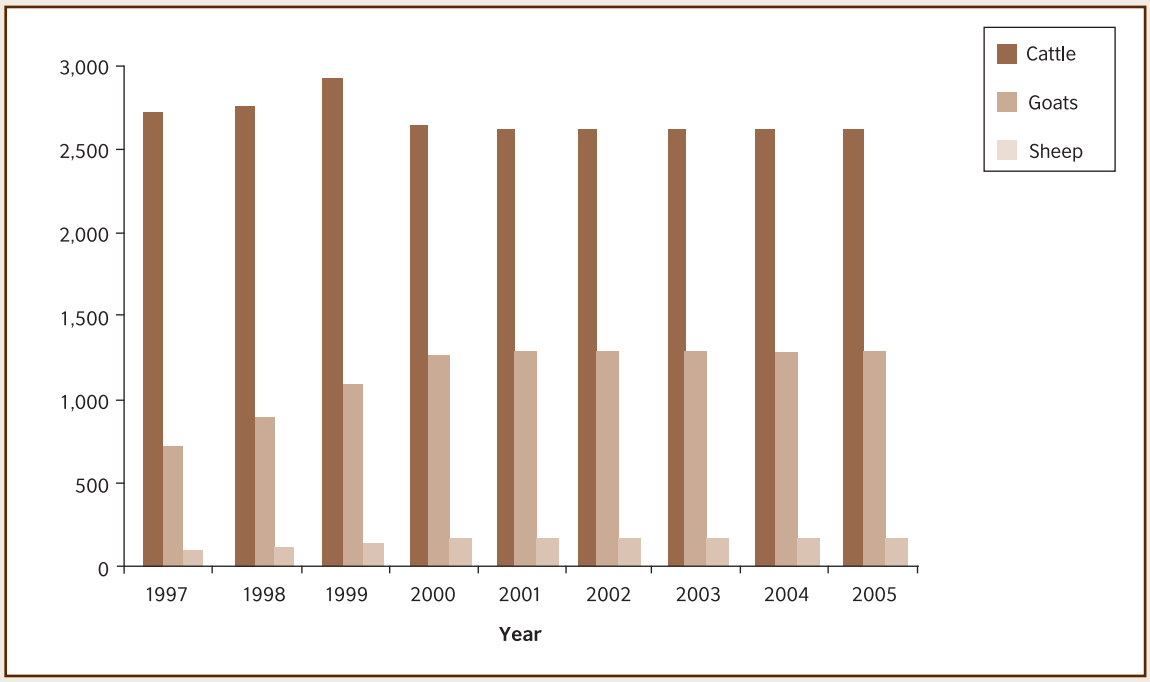
Table 3.2: Imports of Agrochemicals into Zambia between 2005 and 2006 through Chirundu Border

Type of Agrochemical	Qty Imported in 2005		Qty Imported in 2006	
	Tonnes	Liters	Tonnes	Liters
Herbicide	412.88	46,050.00	314.13	175,814.70
Insecticides	202.48	9,370.00	332.59	102,378.00
Fungicides	114.71	17,160.00	87.68	70,910.00

Source: ECZ Chemical Register, 2006

Livestock accounts for about 35 percent of national agricultural output and is concentrated in Western and Southern Provinces (FAO, 2005). For the period 1997 to 2005, commercial cattle population declined (Figure 3.5) largely because of outbreaks of diseases such as foot-and-mouth disease, contagious bovine pleuro-pneumonia and anthrax. There has been no comprehensive livestock census in Zambia since 1993 however, national herd of cattle is estimated to be about 2.34 million (MACO, 2007).

Figure 3.5: Livestock population in the period 1997-2005



Source: FAO statistics

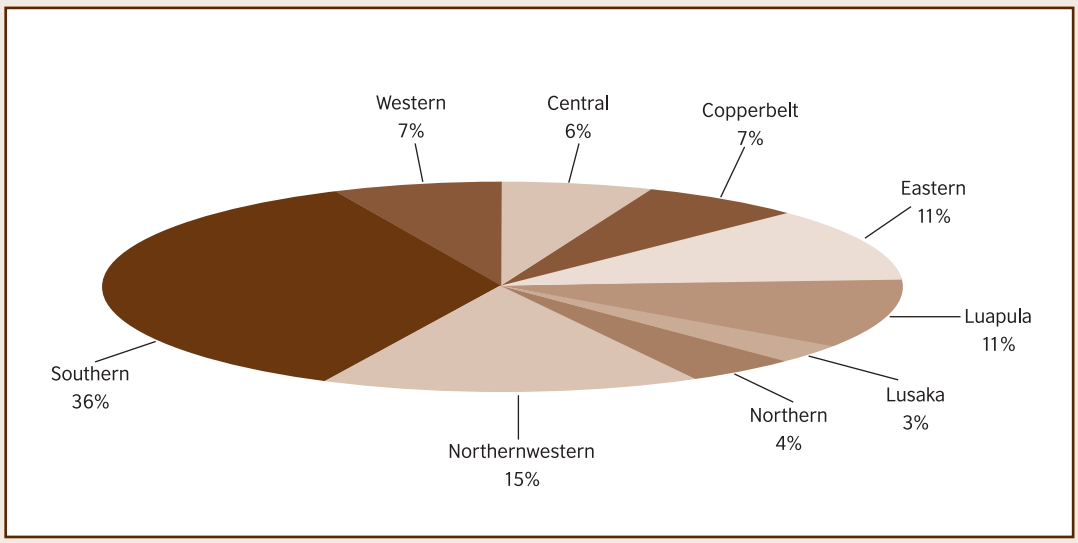
Notwithstanding the decline in national herd of cattle, increased output in the traditional sector has largely been due to animal numbers rather than productivity. The increase in cattle and goat numbers is a result of an increase in traditional farmers investing in livestock farming. Cattle numbers in the traditional sector increased by 3.5percent per annum (Figure 3.5). Sheep and goat numbers were estimated to be increasing at 5 to 7percent respectively per annum (MACO, 2007). The grazing of these animals is beyond the carrying capacity of most communal lands and continues to contribute to land degradation.

There is inadequate grazing management designed to ensure sustainability of rangelands in Zambia. This has resulted in low livestock productivity and localised over consumption of more suitable range lands. Consequently, overgrazing is not only caused by overstocking, but also by poor grazing management. In addition, animal health activities such as improper disposal of wastes from chemicals used in cattle dips to control ticks poses a threat to the environment.

3.5 Forests

Forests have been identified as a valuable environmental and economic resource for supporting natural systems and improving peoples' livelihoods. Of Zambia's total land area, 60percent, are forests (Figure 3.6) out of which 14.4percent are exotic plantations covering an area of 65,003.99 km2 (GRZ, 2004). Indigenous forest comprises mainly Miombo woodlands. Changes in forest reserves have occurred due to changes in land uses as a result of illegal human encroachment (Forestry Department, personal communication).

Figure3.6: Percentage Forest Estate by Province



Source: (Mwape, 2006)

3.6 Wetlands

Wetlands[5] in Zambia cover 10 percent of the country's land area. Important wetlands include Zambezi flood plains, Kafue flats, Mweru Wantipa, Bangweulu and Lukanga swamps (MTENR, 2007). Wetlands are a habitat for different types of wildlife such as black lechwe, tsessebe, oribi, sitatunga, elephant, African buffalo and a variety of bird species. Wetlands are utilised for different livelihood activities such as livestock rearing, fishing, gathering of wild, craft and building materials, crop production. Among the pressures on wetlands are human settlements, hunting and cattle grazing, dam construction (e.g. Itezhi-tezhi and Kafue Gorge) and mining.

[5] Areas of mash, fen, peat-land or water, with water that is static or flowing

In Zambia, it is estimated that 20 percent of the wetlands have been degraded. In Lusaka, Southern, Central, and Eastern Provinces are estimated that 40 percent of wetlands wildlife resources have been lost (MTENR, 2007). Schuyt (2005) attributes this to the public nature of many wetlands products and services. In Zambia there is no legal prohibition on the use of wetlands and there are no clear property rights (Frenken and Mharapara, 2002). Furthermore, failure arising from insufficient understanding of the functions and values of wetlands has led to their not being appreciated by local communities.

3.7 Links between Land use Changes and Human Well-being

The economic growth that the country is experiencing has resulted in increased demand for land and changes in land uses. This has resulted in increasing detrimental social and environment impacts such as animal/human conflicts, land degradation and conflicts between customary and private rights.

The number of human/animal conflicts reported throughout Zambia has steadily increased since 2003. A total of 3,575 and 3,100 cases were reported in 2005 and 2006 respectively. In 2006, Eastern Province had the highest number of human/animal conflict reports at 1,599 (51.6percent) followed by Central and Northern Provinces with 1,401 (45.2percent) and 81 (2.6percent) respectively. Western Province had the least number at 19. Of the reported cases, the majority involved elephants, hippos and crocodiles. The number of fatalities arising from the conflicts increased from 54 people in 2005 to 91 in 2006. The highest number of deaths was caused by crocodiles which claimed 52 lives and accounted for 57.1percent of the total deaths recorded. Elephants and hippos claimed 19 (20.9percent) and 12 (13.2percent) people respectively (ZAWA, 2006).

Land degradation manifested in displacement of soil material leads to a significant reduction in the productive capacity of land and often leads to desertification. The main contributors to land degradation include deforestation, quarrying, waste disposal, soil degradation and communal ownership of land.

Loss of forests occurs mainly due to clearing land for agriculture, wood fuel and settlements. Indigenous forest productivity and tolerance to environmental stress is reduced by bush fires. Severe or late fires are destructive to forests. Occurrence of frequent late fires prevents regeneration of tender species and thus changes species composition. Apart from destruction of vegetation, high intensity forest fires alter the physio-chemical and biological attributes of the surface soil and leave the land prone to erosion and lowering of soil quality. It is estimated that Zambia loses about 467, 368 hectares of forests every year (FAO, 2005). Clearance of land for agriculture is estimated to account for 80 percent of deforestation in Zambia. Most small-scale farmers producing rain-fed crops and usually practice shifting cultivation “Chitemene” which involves cutting trees and burning.

Wood fuel remains the principal source of energy for most households. It is consumed in the form of firewood and charcoal. It is estimated that about 700,000 tons of charcoal are consumed annually and this is projected to increase to over 1.2 million tonnes by 2010. Consumption of woodfuel has been estimated at 11 million tonnes per year with one third

being used as charcoal and two-thirds as woodfuel. Charcoal is mostly used in urban areas at 85 percent (Mwape, 2006).

Quarrying on Lusaka-Kafue Road

Source: Chikoh, Patrick

Human induced activities as a result of mining, construction and quarrying are common especially on the Copperbelt and Lusaka Provinces and contribute to land degradation. Zambia is largely a mining country with abundant deposits of copper, cobalt, emeralds, coal, amethyst, gold, lead and zinc. The main aspects of land degradation in mining activities include deforestation, unfilled mine pits and trenches, uncontrolled disposal of mine wastes and tailings and soil erosion leading to blockage of stream water courses, destruction of river banks and siltation. For instance, in 2004 the land area covered by mining waste disposal was estimated at 216,257ha. Consequently, this land is lost for other uses.

Copperbelt Province in September 1972

Copperbelt Province in September 2006

Large scale copper mining began in central Zambia during the 1930s attracting workers and turning this biologically rich savanna woodland into a heavily populated area with several large cities. Until the 1960s the mining industry used wood from the surrounding area to generate power for the copper mines, clear cutting approximately 127 000 hectares between 1947 and 1956 and selectively harvesting an equal area. The mining industry converted to hydroelectric power in the early 1960s, but the growing population continued to rely on woodfuel.

Mining began to decline in the 1970s when oil prices rose and copper prices dropped. By the 1990s the industry had collapsed leaving large numbers of workers unemployed. Many of these unemployed miners turned to small scale agriculture and charcoal production to make a living, putting additional pressure on the surrounding woodlands. Large urban centers, open pit mines and areas of deforestation are thus apparent in the 1972 image. These urban areas grew rapidly leading to the growing areas of degraded and deforested woodlands, visible in the 2006 image.
Source: UNEP, 2007

Waste management continues to be a challenge in Zambia. Out of a total of 72 districts, 18 have designated disposal sites resulting in indiscriminate disposal of waste. This scenario leads to contamination of land and water resources through accumulation of plastics and other wastes. These impacts are exhibited in the loss of arable land as well as soil fertility.

There is a widespread argument that Africa can only develop if traditional tenure, consisting of about 90 percent of Africa's land resources, is integrated into the leasehold tenure system (Brown, 2003). The conversion of customary land to state land has created conflicts in many rural areas of Zambia. Under the premise of market based land reforms, the conversion of communal land for tourism purposes has resulted in local people losing access to common pool resources upon which their livelihood depend. Tenure insecurity emanates from unclear institutional roles at local level. For instance, there are conflicts between state agencies and communities over forest reserve land. Community claims on land reserved for protected forests are denied even when the land legally falls under customary tenure.

Box 3.1: Displaced in my own country

The Times of Zambia newspaper issue of 22nd August 2002 carried a story headlined "Displaced in my own country". It is the story of the people of Kasembele village who woke up one morning and found themselves as squatters. From 1920, the people of Kasembele village have lived on this land, planted over 320 mango and guava trees, which they used as a medium of exchange with people who cultivate their maize. This had been their livelihood until an investor came and ordered the villagers to vacate, claiming he had bought the farm. 46 native families were given marching orders claiming they were illegal squatters. Out of desperation, some families left the village after being compensated with K1million each (approximately US$340) to begin new livelihood. The results were women and children sleeping at the nearest graveyard

Source: Times of Zambia, 22nd August, 2002

Source: Prof. Nyambe

Land conflicts such as those in Kasembele Village district occurs in most parts of the country, highlighting increasing tensions between customary and private land rights.

In view of the challenges of land management in Zambia, government has instituted a number of institutional, policy and legal reforms. These include interalia the following:

Formulation and adoption of the Land Policy which seeks to redress the gender imbalances and other forms of discrimination in land tenure by providing an enabling environment for women, people with special needs and all disadvantaged groups to access and/or own land. The policy states that 30percent of the land to be demarcated be allocated to women and other vulnerable groups (Nsemiwe, 2006).

To liberalise land acquisition and usage, the government enacted the 1995 Lands Act, Cap. 184 of the Laws of Zambia to provide for ownership of land, including land under customary tenure through title deeds. This act also guarantees women, the majority of whom are in rural areas, the possibility of being land owners.

In addition, development of robust pieces of legislation to manage land use have been put in place e.g. Town and Country Planning Act currently undergoing review for purposes of ensuring that land-use practices are streamlined.

The National Forestry Policy of 1998 was developed to ensure rational and sustainable management and utilization of the forest resources using a broad-based and participatory approach with multi-stakeholder recognition.

Further, the National Action Plan (NAP) on desertification whose vision is to restore land productivity in order to reduce poverty and foster development has been prepared The NAP provides a framework for identifying factors contributing to desertification and proposes mitigation measures.

MACO has put in place a number of strategies to promote sustainable land uses. These include research and extension services in soil fertility, restoration and maintenance, corrective liming, judicious use of fertilizer in combination with organic inputs.

The EPPCA and its Pesticides and Toxic Substances (PTS) Regulations of 1994 control the manufacture, import, export, transportation, distribution, storage and disposal of chemicals in Zambia.

3.8 Conclusion

Land use changes have had both positive and negative effects on human wellbeing and the provision of ecosystem services. The enormous increase in the production of agriculture and forestry products has brought greater wealth and more secure livelihoods but often at the cost of land degradation, biodiversity loss and disruption of bio-physical cycles such as water and nutrient cycles. For this reason, clear guidelines and policies are required for land management. Proactive approaches which involve local community participation in land management are vital.

Source: ECZ

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CHAPTER 4
WATER

Water plays an important role in all human activities and to some extent determines the level of development. It supports ecosystems, biodiversity, human health, provides habitat for flora and fauna, facilitates power generation and is a key raw material for industry and mining. Water resources are under increasing pressure from competing uses leading to shortage in some areas. Despite efforts aimed at managing the water resources in the country, the multiplicity and overlapping roles of institutions mandated to address its management possess a major challenge. In addition, the Water Act (1948) does not apply to shared water courses and Western Province.

Out of the total land area of 752,614Km2, water covers an estimated area of 11,890Km2. The main river catchments are the Zambezi and Congo with five main river systems: Zambezi, Luangwa, Kafue, Chambeshi-Luapula, and Tanganyika. It also has a number of large lakes such as Tanganyika, Mweru, Bangweulu Kariba and Itezhi-tezhi. In addition, the country has substantial quantities of groundwater. Figure 4.1 shows major water resources in Zambia.

Chishimba Falls in Kasama, Northern Province

Source: Mukuma Musenge

Population growth and increased human activities have led to a subsequent increase in water demand. Climate change, spatial variability and distribution of rainfall have further reduced available water resources. To counter these, water resources management traditionally focused on water assessment and development, flood routing and protection. In response to changing dynamics and related economic and social activities, issues such as assessment of water demand and climate change have been included. This new paradigm of managing water resources is commonly referred to as Integrated Water Resources Management (IWRM).

4.1 Water Availability

Water resources in Zambia comprise both surface and ground water. However, its availability has been affected by climate change and other factors such as increase in population, growth in industry and agriculture.

The country receives moderate rainfall ranging from 680mm in the south to over 1,400mm in the north with an annual average of about 1000mm. The country periodically experiences droughts and floods of varying proportions. For the period 2000 to 2005 hydrological years, the country received mainly normal to above normal rainfall in many parts. Table 5.1 presents the average annual rainfall by province.

Figure 4.1: Major Water Bodies in Zambia

Source: ECZ

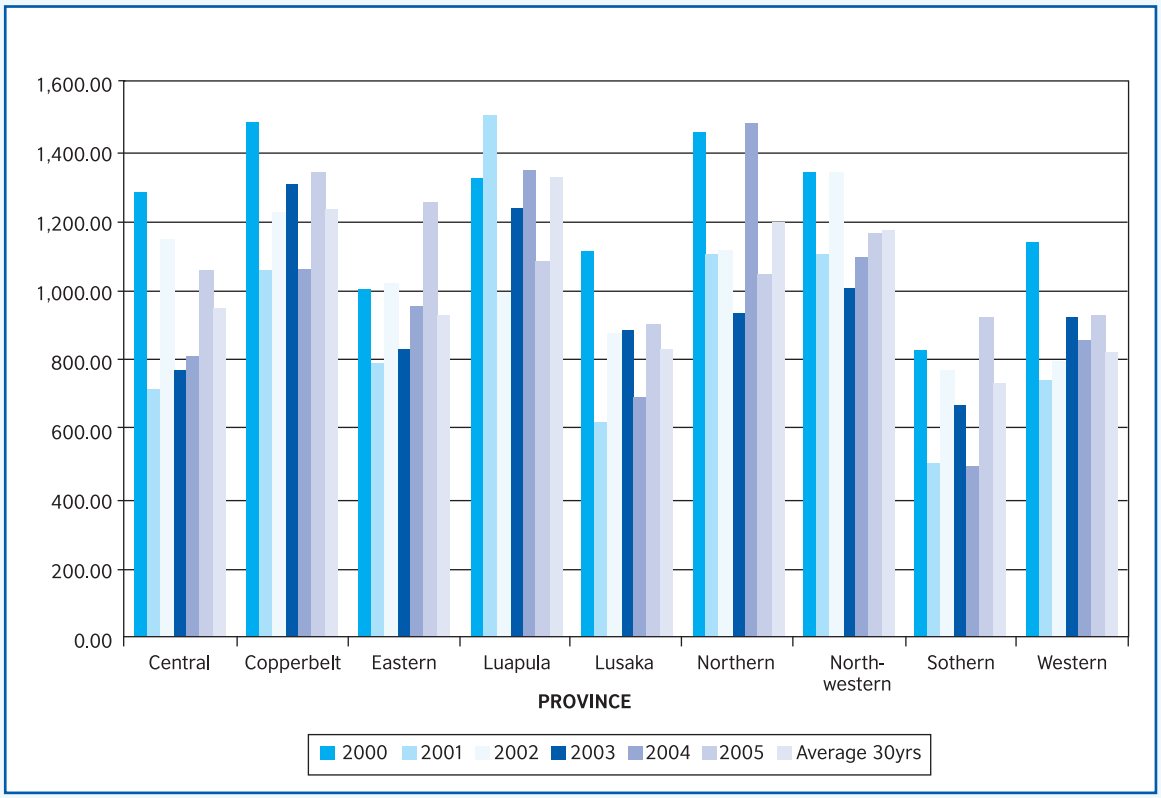
Table 4.1: Provincial Annual Rainfall from 2000-2005

Province	Value in (mm)						
	2000	2001	2002	2003	2004	2005	30 Yr Average
Central	1,276.00	719.00	1,145.00	770.75	809.00	1,058.00	947.00
Copperbelt	1,487.00	1,056.00	1,221.00	1,304.90	1,062.00	1,342.00	1,230.50
Eastern	1,004.00	789.75	1,024.75	830.80	955.67	1,255.67	936.60
Luapula	1,322.00	1,500.50	997.50	1,232.03	1,345.00	1,082.00	1,320.67
Lusaka	1,116.00	620.75	881.33	886.15	698.00	904.33	828.75
Northern	1,454.00	1,104.00	1,115.00	933.33	1,480.00	1,045.60	1,197.00
North-western	1,344.00	1,100.50	1,343.00	1,002.82	1,095.75	1,167.00	1,173.20
Southern	832.50	505.50	771.00	672.93	498.00	921.00	734.00
Western	1,143.00	739.33	798.50	920.88	852.00	930.00	822.00
National Average	**1,219.83**	**903.93**	**1,033.01**	**950.51**	**977.27**	**1,078.40**	**1,021.08**

Note: Adapted from Zambia Meteorological Department data.

The rainfall figures in Table 4.1 show that the hydrological year 2000/2001 had the highest rainfall with almost all the provinces receiving above normal rainfall.

Figure 4.2: Rainfall Chart between 2000 and 2005



4.1.1 Surface Water Potential

The assessment of the rainfall figures for the last six years show that most of the country had experienced relatively wetter years from 2000/2001 than the previous decade. In the hydrological year 2000/2001 and 2005/2006, most of the country received good rainfall resulting in improved river flows. River flows depend on groundwater discharged into the river channel and direct runoff, an important contributor to the flow in the rainy season. Characteristics such as the geomorphology of the catchments and the rainfall determine the amount of contribution to the river flow. In the hydrological year 2004/2005 most of the country received below normal rainfall. The hydrograph in Figure 4.3 is an example of river flow for the Kafue River at Kafue Hook Bridge hydrological station.

Figure 4.3: Hydrograph for Kafue Hook Bridge

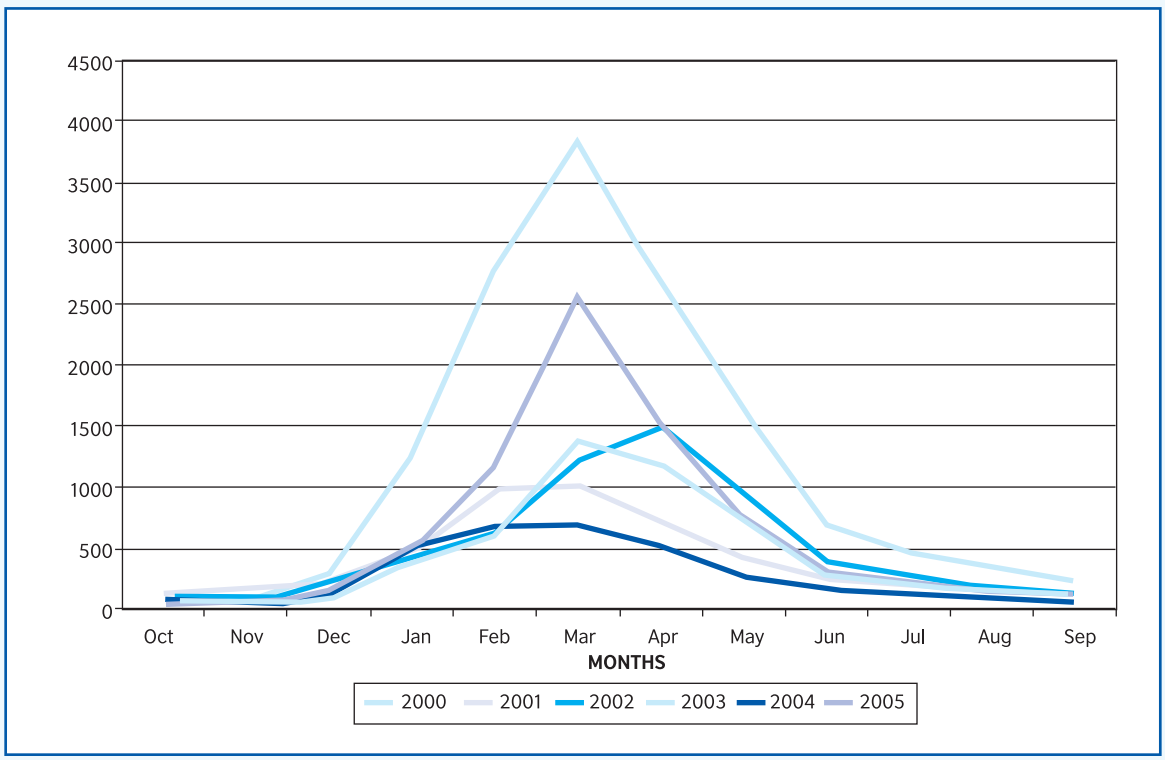


Table 4.2 shows the results of the estimated surface water potential for the last six hydrological years.

Table 4.2: Estimated annual surface water resources potential

		Year					
		2000	2001	2002	2003	2004	2005
Average annual runoff (Km^3)	133.42	82.22	98.03	87.71	92.46	100.59	

Estimates given in Table 4.2, show that Zambia had generated above normal runoff in the hydrological year 2000/2001 and 2005/2006. The hydrological year 2001/2002 was the lowest annual runoff. The high runoff resulted in wide spread flooding in many parts of the country, such as the Luangwa valley were most of the crops were either washed away or submerged leading to a reduction in crop yield. In most parts of the country, infrastructure such as bridges were damaged. This necessitated the opening of the Kariba spill gates for the first time in many years.

4.1.2 Groundwater Potential

Zambia has sufficient quantities of groundwater well distributed in many parts of the country. One of the best aquifers is nearly 25,000Km2 of Kundelungu dolomite (limestone) that extends from Lusaka to the Copperbelt. It is a source of water for some of the most populated areas in the country such as Lusaka, Kabwe and Ndola for domestic and other uses. A typical borehole of around 50 – 70 m below ground level in the Karstic section of the aquifer can yield 35 – 50 l/s (BGS, 2001).

Other aquifers include the Kalahari system in areas of course sediments mostly in the western parts of the country with borehole yields of 10 to 20 l/s. Crystalline basement rocks in other areas of the country present a challenge because groundwater is not readily availability since water is found within fractures, joints or weathered rock. Some of this groundwater has come under increasing threat from pollution especially in densely populated areas of Lusaka and Copperbelt Provinces. Areas with insufficient annual recharge such as Southern Province have experienced drying up of some wells and boreholes.

Currently, there is no specific legislation that directly regulates the development, protection and utilization of groundwater. As a result, most of this water is not adequately protected. For instance some recharge areas such George Compound in Lusaka have been developed into a residential area. With the annual rainfall of 822mm and an estimated annual recharge of 8 percent, Lusaka has a recharge area of 691 km2 (DWA, 2006). Due to lack of information, it is difficult to estimate the total volume of groundwater abstracted in the country. Based on DWA and LWSC data, groundwater abstraction in Lusaka is estimated at 0.05Km3.

Table 4.3: Groundwater Potential

		Year					
		2000	2001	2002	2003	2004	2005
Average Groundwater annual recharge (Km^3)	99.23	70.34	83.87	75.04	79.11	86.06	

While, DWA/JICA estimated the annual renewable groundwater potential at 57Km3, the estimates for the period where higher as shown in Table 4.3. This is attributed to the relatively wetter rainy seasons.

4.1.3 Total Water Resources Potential

The estimate of the total annual water potential is based on renewable groundwater and surface potential as given and summarized in Table 4.4.

Table 4.4: Estimated Annual Water Resources Potential

	Year					
	2000	2001	2002	2003	2004	2005
Average annual runoff (Km^3)	133.42	82.22	98.03	87.71	92.46	100.59
Avg Groundwater annual recharge (Km^3)	99.23	70.34	83.87	75.04	79.11	86.06
Total	232.65	156.56	181.9	162.75	171.57	186.65

Overall totals indicate above normal potential, although some of this water was lost through evaporation. DWA/JICA estimated the annual average evapo-traspiration to be 1,574mm. This means the country has a precipitation deficit. Assuming homogeneous conditions throughout the country, water losses can be as high as 70Km^3 per year. Table 4.5 gives an estimate of water losses from selected reservoirs.

Table 4.5: Estimated water losses from selected Reservoirs

Reservoir	Average Flow (m^3/s)	Live Storage ($1x10^6$ m^3)	Annual Evaporation ($1x10^6$ m^3)
Itezhi-tezhi	280	5,000	660
Kafue Gorge	307	700	1,472
Mulungushi Dam	13	300	50
Lunsemfwa Dam	29		72
Lusiwasi	3	72	5
Kariba	1,730	64,800	8,923
Total		**70,872**	**11,182**

Source: WRAP, 2005

4.1.4 Change in Ecosystem Processes

The alteration of the flow regime, storage of water through the construction of dams and indeed other water resources development projects contribute to changes in the environment. For instance the alteration of the flow at Itezhi-tezhi dam has led to the loss of habitats and changes to the breeding cycle of many species in the Kafue flats. This has contributed to a reduction of some species like Kafue Lechwe because the natural flooding pattern has been disturbed. The population has reduced from 100,000 in the late 70s to less than 40,000 by 2000. Further, the Kafue Gorge dam built in 1971 led to the permanent inundation of an area between 800 and 1,100Km2 of the eastern part of the flats.

The reduced water potential over the last two decades and the alteration of the natural flow regime in some cases have contributed to the proliferation of alien invasive aquatic weeds in many water bodies. Another example in the Kafue Flats is the infestation of water hyacinth which has been a source of environmental and socio economical concern. Measures were

taken to control this proliferation using mechanical, chemical and biological methods. The long period of low flows from the 1980s contributed to the proliferation of the weeds in the Kafue flats due to the high nutrient load from farming and industries in the flats. The high flows in the 2000/2001 helped flush downstream most of these weeds.

4.1.5 Wetlands

Wetlands continue to play an important role in hydrology and ecology. They provide water for different uses by storing water (sponge effect), helping to recharge both surface and groundwater and in the process, attenuates floods and droughts by storing most of the water. Additionally, wetlands improve the quality of water by filtering pollutants and sediments while retaining the nutrients required by to support the ecosystem thereby improving productivity of wetlands.

Zambia has several types of wetlands, common among these are the riverine type, which includes floodplains like the Barotse, Kafue and Luangwa. Others are Dambos which usually extend over large parts of the basin. 8 of these wetlands have been classified as Ramsar sites. Some of these wetlands are given in the Table 4.6.

Table 4.6: Major freshwater wetlands in the Zambezi basin

Wetland	Area (1000 ha)	Utilization	Conservation status
Kafue flats	650	Fishery, grazing, wildlife, limited agriculture	Partly protected
Lukanga	250	Fishery, grazing, transport.	Unprotected.
Barotse Plain	900	Fishery, grazing, wildlife, limited agriculture	Partly protected
Liuwa plain	350	No data	No data
Linyanti-Chobe	20	Fishery, tourism, area in general not utilized by local population Cuando	Almost all the wetland is protected. 200 No data No data
Elephant marsh	52	Fishery, grazing, agriculture	Unprotected.
Luangwa Busanga	250 200	No data Unexploited wildlife refuge.	Partly protected. Completely protected.
Luena	110	No data	No data
Kabompo	18	Reed, papyrus	Unprotected
Kandala Pan	0.8	Reed, papyrus	Unprotected
Lungue-Bungo	100	Grass	Unprotected
Litapi	9	Grass	Unprotected
Luena Flats and upstream (22)	67.7	Grass, papyrus	Unprotected
The Nye (max)	70	Grass, reeds	Unprotected
Lueti	14	Grass, reeds	Unprotected
Lui Swamps	23.5	Grass, reeds	Unprotected
Sesheke-Maramba Floodplain	150	Fish, grass, reeds	Partly protected
Lushwishi Swamp	9.9	Fish, grass, reeds	Unprotected
Lufwanyama Swamp	7.4	No data	Unprotected
Mininga Swamp	14.4	No data	Unprotected
Busanga Swamp	60	Grass, reeds	In Kafue National Park
Wetlands of the Bangweulu Basin (open water (273.3) and swampland)	700	Fish	Partly Protected
Lake Mweru & the Luapula Floodplain (open water (300) floodplain area in Zambia)	600	Fish	Unprotected apart from a section of the Kalungwishi in the Lusenga Plain and National Park

Wetland	Area (1000 ha)	Utilization	Conservation status
Lake Mweru Wantipa floodplain ha open water)	146.5	Fish	Protected though people stay in zoned 23,500 areas.
Lake Tanganyika (32,800 km2 in Zambia)	2.1	Fish, navigation	Partly protected
Lakes Lusiwasi	2.5	Fish	Unprotected
Ishiba Ngandu	2.5		Unprotected
Lake Kariba (241 200 ha in Zambia)	536.13	Fish, hydropower	Partly protected
KAFUE GORGE DAM lake only (part of kafue flats)	121	Hydropower	Restricted area
Lake Itezhi-tezhi 85 000 ha Mita Hills & Mulungushi Dams excess of 7000 ha each	85 14	Fish Fish, hydropower	Protected Unprotected
Kafue flats	650	Fishery, grazing, wildlife, limited agriculture	Partly protected
Lukanga	250	Fishery, grazing, transport.	Unprotected.
Barotse Plain	900	Fishery, grazing, wildlife, limited agriculture	Partly protected
Liuwa plain	350	No data	No data
Linyanti-Chobe	20	Fishery, tourism, area in general not utilized by local population	Almost all the wetland is protected.
Cuando	200	No data	No data
Elephant marsh	52	Fishery, grazing, agriculture	Unprotected.
Luangwa	250	No data	Partly protected.
Busanga	200	Unexploited wildlife refuge.	Completely protected.
Luena	110	No data	No data
Kabompo	18	Reed, papyrus	Unprotected
Kandala Pan	0.8	Reed, papyrus	Unprotected
Lungue-Bungo	100	Grass	Unprotected
Litapi	9	Grass	Unprotected
Luena Flats and upstream (22)	67.7	Grass, papyrus	Unprotected
The Nye (max)	70	Grass, reeds	Unprotected
Lueti	14	Grass, reeds	Unprotected
Lui Swamps	23.5	Grass, reeds	Unprotected
Sesheke-Maramba Floodplain	150	Fish, grass, reeds	Partly protected
Lushwishi Swamp	9.9	Fish, grass, reeds	Unprotected
Lufwanyama Swamp	7.4	No data	Unprotected
Mininga Swamp	14.4	No data	Unprotected
Busanga Swamp	60	Grass, reeds	In Kafue National Park
Wetlands of the Bangweulu Basin (open water (273.3)and swampland)	700	Fish	Partly Protected
Lake Mweru & the Luapula Floodplain water (300) and floodplain area in Zambia)	600	Fish	Unprotected apart from a section of the (open Kalungwishi in the Lusenga Plain National Park
Lake Mweru Wantipa floodplain ha open water)	146.5	Fish	Protected though people stay in zoned 23,500 areas.
Lake Tanganyika (32,800 km2 in Zambia)	2.1	Fish, navigation	Partly protected
Lakes Lusiwasi	2.5	Fish	Unprotected
Ishiba Ngandu Lake Kariba (241 200 ha in Zambia)	2.5 536.13	 Fish, hydropower	Unprotected Partly protected
KAFUE GORGE DAM lake only (part of kafue flats)	121	Hydropower	Restricted area
Lake Itezhi-tezhi 85 000 ha	85	Fish	Protected
Mita Hills & Mulungushi Dams excess of 7000 ha each	14	Fish, hydropower	Unprotected

Source: Adopted from I.M. Seyam et al 2001 and Irebelo 2006

4.2 Water Accessibility

Increase in the population of the country especially in urban areas has led to problems of accessing sufficient clean water supply and sanitation services. Development of infrastructure for water supply and sanitation has not matched this growth in population.

Photo Courtesy of NWASCO

Photo Courtesy of NWSC

Residents queuing for water

Agriculture which contributes 21.7 percent of GDP is important to the economic development of the country. Based on water availability and soil suitability for irrigation, the irrigation potential is estimated at 2.75 million hectares (IWMI, 2006). While the economically viable irrigation potential is about 420,000 hectares, only about 100,000 hectares has been developed.

The standard maximum walking distance to a water point (a borehole equipped with a hand pump) has been set at 500m. In most areas, this has been difficult to achieve mainly due to scattered settlement patterns and lack of infrastructure. In turn this has not met the target of 200 people per water point with access to safe water.

Most of the water resources in Zambia are used for the generation of hydropower. In 1995, DWA/JICA estimated this non consumptive use to about 36km3 per year. While, other sectors use less than 4km3 out of which about 77 percent is used for agriculture, 7 percent for industry and the reminder is mainly for domestic water supply.

Table 4.7: Estimated major water demand

	Water Use	Surface Water in Km^3 per Year			Groundwater in Km^3 per Year			Comments
		1995	2006	2015	1995	2006	2015	
1.	Agriculture	1.79	3.44	4.49	0.11	0.19	0.26	Include livestock,
2.	Industry and domestic	0.37	0.55	0.69	0.07	0.09	0.11	Including Mining and Manufacturing
3.	Hydro-electricity generation	36.28	36.28	37.85	-	-	-	
	Total Use	**38.44**	**40.27**	**43.03**	**0.18**	**0.28**	**0.37**	

Source: Adapted from DWA/JICA, 1995, 2015 estimates based on the agriculture scenario

Table 4.7 gives estimates of water demand per sector. It must be noted that since there has been no major hydro-power development, the demand for water for hydropower has remained the same.

It has been estimated that dams in Zambia have a total storage of 200km3 out of which 185km3 is stored in Lake Kariba accounting for 92 percent The remaining storage of about 12 km3 is in other smaller dams with Itezhi-tezhi taking about half of this storage.

Table 4.8: Distribution of Dams by Province

Province	Number of Dams					
	1996 Inventory	2002	2003	2004	2005	2006
Central	107		3	1	2	6
Eastern	311	2	4	3		1
Lusaka	103		2	2		3
Southern	889				2	4
Copperbelt	10		2	1		1
North-Western	3		1	2	1	1
Western	6					1
Northern	5		1	2		1
Luapula	4			1	1	1

Source: WRAP, Sector Report 2004

From Table 4.8, it is clear that access to water in areas like Southern and Eastern Provinces is limited the existence of more dams than other parts of the country.

Kafue River catchment is one of the most developed in the country. It is coming under increasing threat from pollution as well as competition in water utilization. The Copperbelt and the Kafue Flats are the most affected, streams such as the Mushishima and Chingola streams on the Copperbelt are heavily polluted rendering the water inaccessible.

Agriculture productivity depends on the quantity and quality of available water and land use practice. To ensure sustainability and continued productivity, the use of chemicals, soil erosion,

Water Polution as a result of mining activities.

and other sources of pollution must be properly managed. A number of conflicts in water shortage areas have emerged, e.g Kafue Flats, Kaleya, Chalimbana and Lunsenfwa river catchments. Most of these conflicts are associated with industries such as tourism, agriculture estates and hydropower generations.

In areas like Lusaka and the Copperbelt Provinces, the demand for potable water has increased. Generally, there is increased water demand for various uses including domestic, agriculture, industrial, hydropower generation and ecological services

4.3 Water Quality

Water pollution is a challenge in water resources management especially where you have to strike a balance between the environment and economic activities such as mining and agriculture. This is further exacerbated by poor solid waste management with leachate from these wastes reaching water bodies. Agriculture is one of the major sources of water pollution because of the effluent from large volumes of chemicals used. The high concentrations of nutrients like nitrates and phosphates have contributed to the proliferation of Water Hyacinth (Sinkala, 2002). Additionally, though on a small scale, riverine cultivation and poor land use practice have also contributed to pollution and siltation of rivers and reservoirs.

Urban development including development in recharge areas have resulted in reduced water retention and increase in direct runoff over short periods resulting in flush floods especially where drainage is poor. As a result, poorly managed wastes from surrounding areas contribute to the blockage of drains, pollution of water and outbreak of diseases. Groundwater is more at risk in large settlements because of lack of proper sanitation facilities and solid waste management systems. Despite the growth in population, there been no corresponding increase in sewerage infrastructure, most of the existing ones are in a poor state of repair. The prevalence of outbreaks of these diseases is commonly in peri-urban and rural areas.

Source: Chama Mwansa

Sedimentation has increased with soil erosion and soil loss is estimated at about 3 million tonnes annually (Gale, 2006). Some of the areas affected include the Lusitu area in Southern Province where there is both erosion and heavy river sedimentation. The Luangwa and Lunzua River have also shown signs of erosion within the catchments, which has increased sediment load.

It is clear that regulation in the sector remains largely fragmented with overlaps as shown in Table 4.9. The following are some of the responses that have been implemented in management of water resources in Zambia:

Table 4.9: Institutions in the Water Sector and their roles

Legislation/Agreements	Institution	Roles
- Water Act - Zambezi River Authority Act	MEWD, Water Board	- Sector Leadership - National Policy - IWRM policy and international water - Regulating Water Resources
- the Town and Country Planning Act	MLGH, DISS with Rural Water Supply and Sanitation Unit	- WSS sub-sector policy and strategy elaboration, oversee service provision to rural areas - (for institutional arrangement on RWSS refer to attachments, Figure 2)
- the Water Supply and Sanitation Act	MACO, MTENR, MoH,	- Sub-sector policy elaboration (i.e. irrigation policy), sanitation and hygiene promotion,
- the Fisheries Act	Statutory Bodies: NWASCO, Water Resource Authority ECZ	- Advisory role - Regulatory role - Provision of funds - Pollution Control (ECZ)
- the Environmental Protection and Pollution Control Act	CUs	- Service provision - Implementation of investment measures
- the Water Supply and Sanitation Act	Local Authorities	- Service provision in rural areas and in towns, whereby delegated in most urban areas to CUs
- Education Act	Training and Research Institutions	- Human Resource training - Research
- Bi-lateral and Multi-lateral Agreements	Co-operating Partners (CP), NGOs ZWP	- Financial provisions by CPs - Execution WSS programmes & projects by NGOS - Execution of a study on IWRM / WE plans for MEWD
- A number of Acts, some of them outside the Water Sector	Private Sector	- Low participation, but should take a lead in investment for development of local technologies and provide service, take over outsourced functions by providers (i.e. water vendors)
- Agreements	Community and CBOs	- Beneficiary of WSS services - Maintenance of sources

The Water Act Chapter 198 of 1949 regulates the allocation and utilization of water resources in Zambia except shared watercourses and western province. It is intended to assist in ensuring that there is equity in the allocation of water and monitoring its utilization.

Government has realized the need to improve access to water for different uses. The Water Resource Action Programme (WRAP) was implemented to strengthen the legal and institutional framework for water resources management.

The Department of Water Affairs (DWA) conducts monitoring of surface water quality. However, DWA has limited capacity in terms of financial and human resources to monitor and ensure

adherence to regulation in water utilization. In addition, there is no specific legislation to regulate groundwater.

A draft Water Bill is under review as well as the 1994 Water Policy. The new Water Bill proposes improved legal and institution framework and monitoring at all levels. It also proposes the creation of a new self-sustaining institution to manage and develop the water resources. It further includes the regulation of groundwater development and the management of international waters which are currently excluded in the Water Act.

However, there is need for improved investment in infrastructure and self regulation to reduce the amount of effluent discharged into water bodies.

EPPCA and its subsequent Water Pollution Control Regulations of 1993 regulate the discharge of effluent, conduct effluent analysis and provide standards for limits for effluent and waste water discharged into the aquatic environment.

NWASCO established by an Act of Parliament of 1997 issues operating licences to all water supply and sanitation service providers in Zambia. Alongside the licensing, guidelines giving certain minimum requirements of service are issued.

4.4 Conclusion

Water resources continue to play an important role in the sustenance of a healthy environment. The quantity of water available for direct human use or to support aquatic ecosystems depends on the availability and sustainability of the resource. Rainfall, surface flows and ground water recharge are intimately linked in hydrological cycle and need to be managed accordingly. Commercialisation of water supply has contributed to improved access of water resources and they are crucial to sustaining improvement in service delivery in urban areas. Practical implementation of IWRM requires a sustained combination of technology, legal and institutional frameworks and where feasible, market driven approaches.

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CHAPTER 5
BIODIVERSITY

Zambia is one of the most biologically rich countries with 14 different ecosystems. Biodiversity[7] plays a critical role in the healthy functioning of ecosystems and provides an important basis for economic growth. These roles include nutrient and water cycling, land protection from erosion, climate stabilization through carbon sequestration and the production of crops through pollination. Plants also play a crucial in regeneration of plant through seed dispersal and germination.

Source: James Phiri

Biological resources support livelihoods of the majority of the rural population in Zambia. Forests provide ash fertilizer for shifting cultivation, timber, energy, household tools and construction materials. Wild plants and animals are important sources of food, medicines and other valuable chemical products. However, demographic changes and the growth of industries such as tourism and agriculture continue to exert pressure on the country's biological resources.

The contribution of agriculture, forestry and fishing to GDP was 15 percent in 2004, 14.2 percent in 2005 and 13.8 percent in 2006 (CSO; 2006). Nevertheless, the intrinsic value of biodiversity is not reflected in national accounts. A sector-based analysis shows that biodiversity utilisation plays a significant role in the national economy. For example, the charcoal industry employs about 450,000 people in production, distribution and marketing (Masinja. A, 2001).

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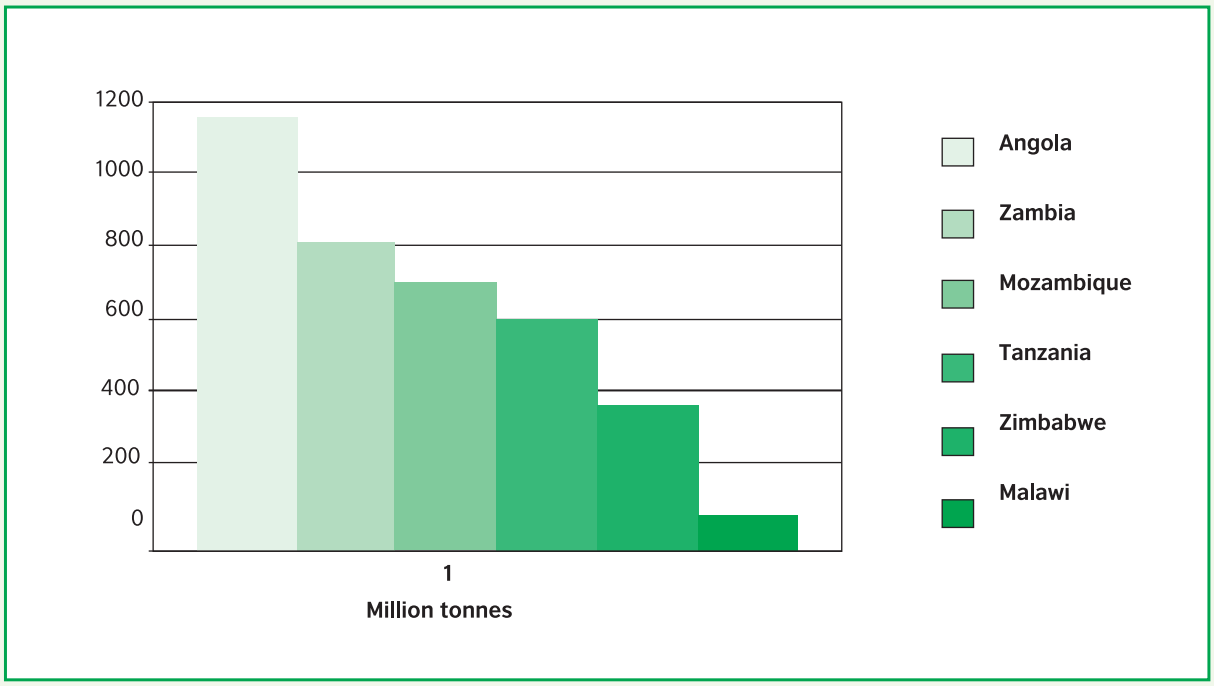
[7] Living organisms from all sources including inter alia, terrestrial marine and aquatic ecosystems and the ecological complexes of which they part, this include diversity within species between species and of ecosystem. (UNEP; 1992)

Total variety of all living organisms , including their genetic, inert relationship habitat together with ecosystem and landscapes of which their part (NPE; 2006)

Forests are an important sink for carbon dioxide. Within the Southern African region, Zambia has one of the highest pool of carbon in its forests/woodlands as shown in Figure 5.1.

Figure 5.1: Value of forests as carbon sinks in Southern African Countries



Source: WCMC (1993)

Savanna is the major terrestrial biome[8] in Zambia. This biome is characterized by annual mean temperature of 20-30°C and rainfall range of 500-1500 mm from south to north. The biome lies between the rain forest conditions in the northwest and semi desert conditions in the southwest. The savanna biome consists of the woodland and grassland types of vegetation.

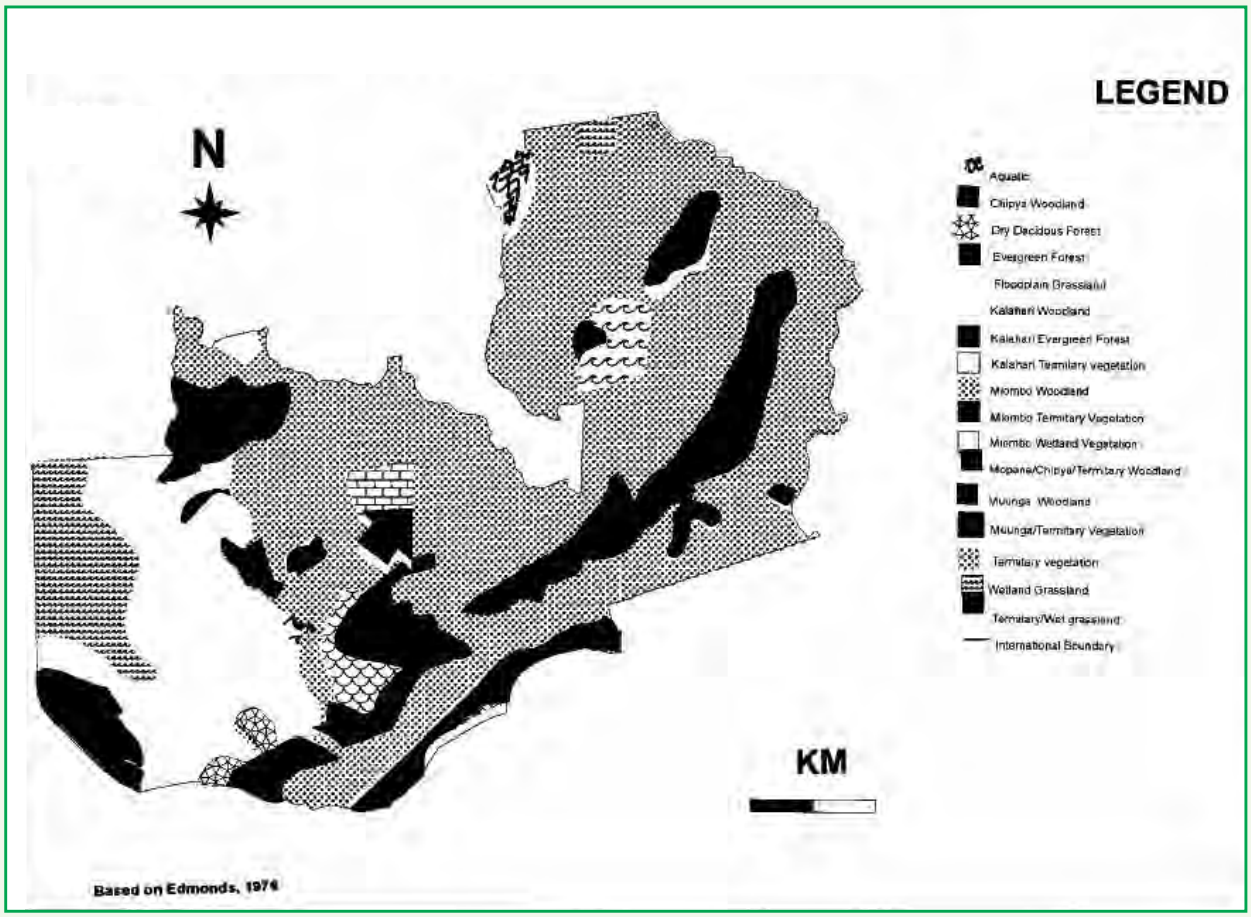
Zambia has 14 ecosystems based on vegetation types (Fanshawe, 1971). These fall into four main divisions which are:

1. Closed Forest;
2. Woodland or Open Forest;
3. Anthill; and
4. Grassland.

In addition Zambia also has fresh water ecosystems and anthropic land cover types as shown in Figure 5.2 and Table 5.1.

[8] Biome is defined as a major portion of the living environment of a particular region characterized by its distinctive vegetations and maintained by local climatic conditions. (WWF, 1994)

Figure 5.2: Distribution of Ecosystems in Zambia



Anthropic ecosystems or land use/land cover types range from cropland to fallow, tree plantations, and the built-up environments.

Zambia has also identified agricultural biodiversity as an important form of biodiversity upon which more than 600,000 households depend directly for their livelihood. Agro-biodiversity in this respect is defined as the variation between and within crop and livestock species. This diversity is affected by historical factors, differences in farming systems, agro-ecological and socio-economic conditions. Closed forest types are 8 types and these are: Parinari, Marguesia, Crytosepalum, Baikiaea, Itigi or Itigi Thicket, Montane, Swamp and Riparian forests.

The greater part of Zambia is covered by plateau miombo which is a two storey woodland with an open and semi- evergreen canopy 15-20 m high. The principal trees are always Brachystegia, Julbernadia and Isoberlina species. Soils in miombo are generally poor, shallow and slightly acid, having quartz rubble or laterate underneath. Other woodland types include: Hill miombo, Kalahari, Mopane, Munga or Savannah, Lake Basin Chipya and Kalahari Sand Chipya.

Anthill or Termitaria support a community of plants which is usually different from the surrounding forest or woodland due to such factors as raised elevation, higher clay and

mineral content of the soil, high pH, higher moisture content of the soil and greater biological activity. Anthill are scarce in the dry evergreen forest types but are frequent in Miombo, Mopane, Kalahari and Munga woodlands sometimes being as many as one per hectares. Anthills in each of these four woodland types support a different vegetation, but species of Boscia, Strychnos, Diospyros and Sterculia are common to all four. They are more numerous on the dambo edges in Munga and Mopane woodland than on those in Miombo woodland.

Grasslands are found in places with a permanently high water table and includes dambos, flood plains and the margins of pans, swamps and lakes. (Regional Soil Conservation Unit; 1995)

Table 5.1: Coverage of Ecosystems in Zambia

Biome	Ecosystem	Approximate extent	
		Km^2	%
Forest	Dry evergreen	15,835	2.10
	Deciduous	6,735	0.90
	Thicket	1,900	0.25
	Montane	40	0.01
	Swamp	1,530	0.20
	Riparian	810	0.11
Woodland	Chipya	15,560	2.07
	Miombo	294,480	39.13
	Kalahari Sand	84,260	11.20
	Mopane	37,010	4.92
	Munga	30,595	4.06
	Termitaria	24,260	3.22
Grassland	Dambo	75,760	10.07
	Floodplain\Swamp	129,075	17.15
Aquatic	Lakes and rivers(15)	10,500	1.40
Anthropic	Cropland and fallows, Forest plantations and built up areas	24,210	3.21
Total		**752,578**	**100**

Source: ECZ, 2000

The present distribution of ecosystems in the country is a consequence of the prevailing rainfall pattern and may change in response to climatic conditions. The most important determinant of ecosystem diversity in Zambia is latitude (MTENR, 1998a).

Species diversity: a country study listed a total of 8 017 species of organisms that occur in Zambia (ibid, 1998b). Of these, micro-organisms constitute 8 percent, plants 47 percent and fauna 45 percent of biodiversity. There are a total of 316 endemic, 174 rare and 31 endangered/vulnerable species of plants and animals. These figures may be under-estimations because data about most species is incomplete.

The biodiversity comprises of various species including:

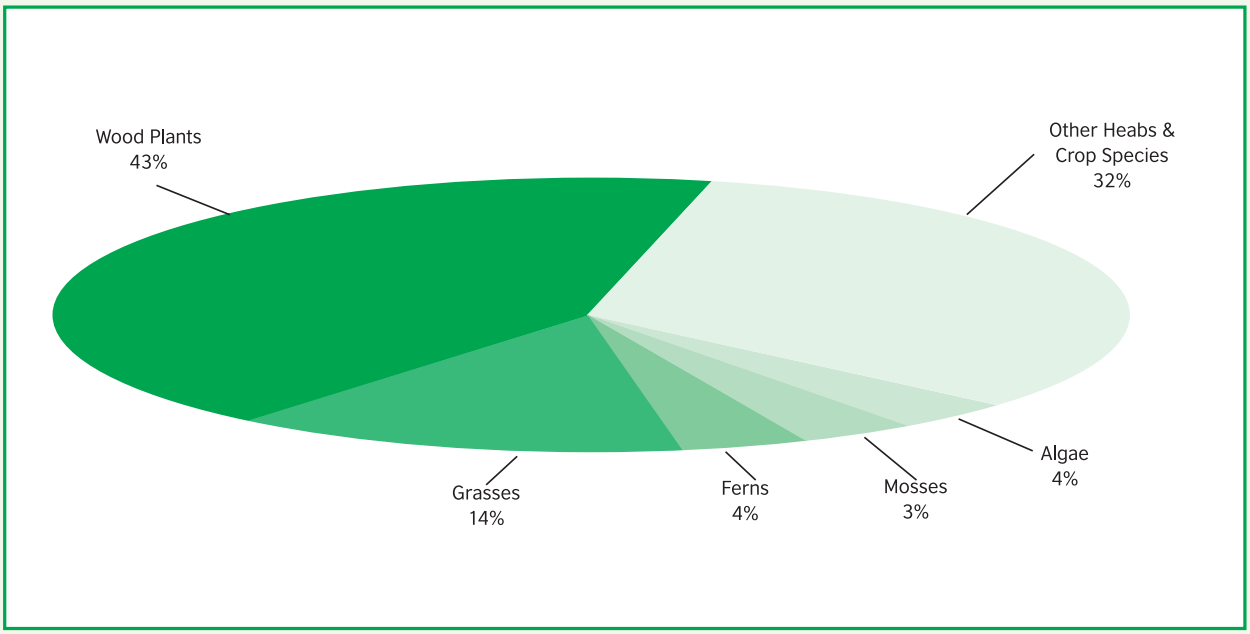
1. Micro-organisms;
2. Invertebrates;
3. Botanical and Forest Reserves;
4. Fish;
5. Birds;
6. Mammals; and
7. Agricultural biodiversity.

Of these, the following are under increasing threats from habitat alternations, climate variability and anthropogenic activities.

a. Botanical and Forest Reserves

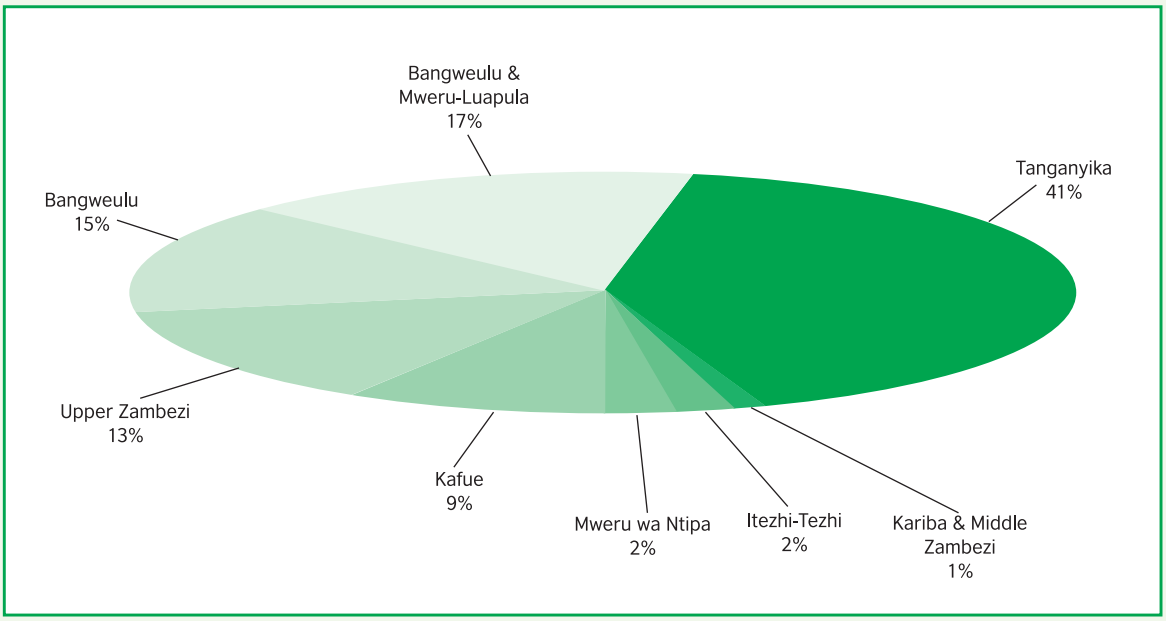
A total of 3,774 species of both lower and higher plants are found in the country. Figure 5.3 presents a detailed composition of plant species.

Figure 5.3: Inventories Species of Lower and Higher Plants



- **Fish**: Zambia's water bodies are home to about 409 species of fish. Lake Tanganyika has the highest diversity with 62 percent of the 409 total fish fauna in the country while Mweru-Wantipa has the lowest fish diversity as indicated in Figure 5.4. (Mudenda H.G., 1998.)

Figure 5.4: Percentage Fish Species in Zambia's Water Resources



Demand for fish has been estimated at 100,000 metric tons\year. Total fish production has been fluctuating between 65,000 and 70,000 metric tons annually. In the 1960s, the per capita supply was as high as 16.5kg but this has dropped to about 8kg\person\year. Fish farming exists in all the agro- ecological regions of Zambia. The 6,000 small scale fish farmers' account for 75percent of fish production while the 12 commercial fish farmers account for 25percent. Aquaculture[9] in Zambia yields at 5,000 metric tones\year with most of this production coming from the 6,000 small-scale fish farmers scattered all over the country. The promotion of aquaculture is also seen as a way of making available the much needed animal protein and to improve household food security.

Indigenous species commonly cultured in Zambia include Oreochromis andersonii (Red breast) Mundile, Mpende, Chituku, Oreochromis macrochir (Green headed bream) Pale, Tilapia rendalli (Three spot) Njinji, Claris gariepinus (Barbel) mubondo, Mulonge, Mbuli, Labeo altivelis (Red nose mudsucker) Mutuba, Mpumbu, Labeo congoro (Purple mudsucker) Mucise, Mpumbu, Tilapia sparmanii (Yellow Belly) Nebwe, Nsuku, Serranochromis robustus (Branded Bream Situu, Chituku and Haplochromis mellandi (Mwango and Chilala, 2003).

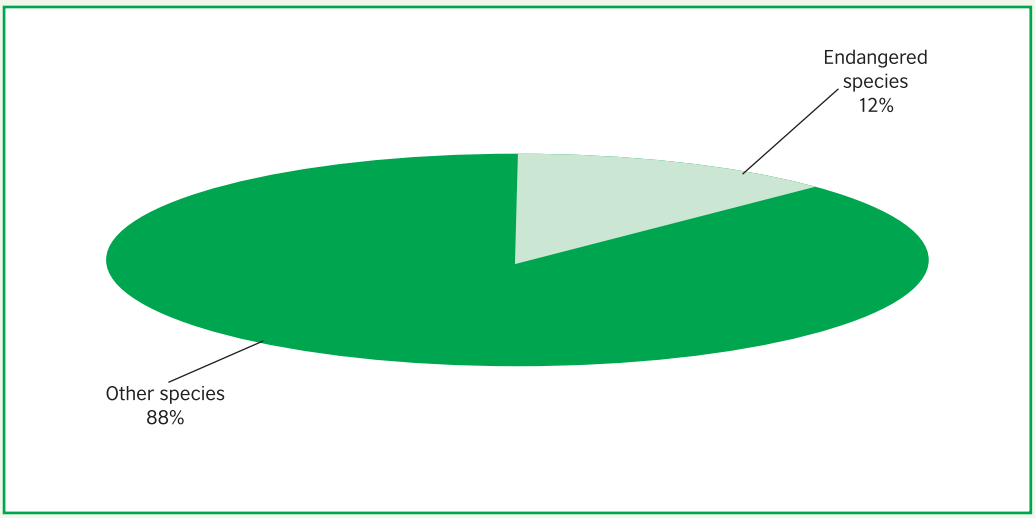
Exotic fish species include; Cyprinus carpio, Oreochromis niloticus, Ctenopharngodon idellus and Hypophthalmicthys molitrix. There is also a crustancean cray fish that is cultured by a few farmers.

[9] Aquaculture is the farming or culturing of aquatic organism or plants with a view to using them as food items or for other purposes.

Integrating fish farming with livestock e.g. Chicken, Ducks and Pigs is commonly practiced by many farmers. This method works well in ponds, where manure easily breaks down to release minerals/nutrients. Commercial farmers in Zambia use cages as a means of breeding fish e.g. this practice is prevalent on Lake Kariba for such species as Oreochromis niloticus (Mwango and Chilala, 2003) and (Utsugi, K. 2002)

Mammalian diversity in Zambia is estimated at 224. Much of the wildlife in Zambia is found in 19 National Parks and 34 GMAs.

Figure 5.5: Mammalian Biodiversity in Zambia



b. **Agricultural Biodiversity:** agro-biodiversity is defined in accordance with the Convention on Biodiversity and refers to the variability among living organisms associated with cultivated crops and domesticated animals and the ecological complexes of which they are part. About 100 cultivated plant species have been classified in Zambia as indigenous and naturalized. In addition, there are also wild species that are related to cultivated crops and these include wild species of Rice, Cowpea, Sorghum, Sesame and various cucurbit species.

   Crops with the most significant genetic diversity include cowpea (Vigna unguiculata), sorghum (Sorghum bicolor), bambara groundnuts (Vigna subterranea), beans (Phaseolus vulgaris) and maize (Zea mays). Crop genetic diversity is generally higher under traditional farming systems than under commercial farming.

   The majority of domesticated animals are cattle while chickens dominate the birds. The main crops grown for food include maize, sorghum, cassava, sweet potatoes and ground nuts.

5.1 Biodiversity Management

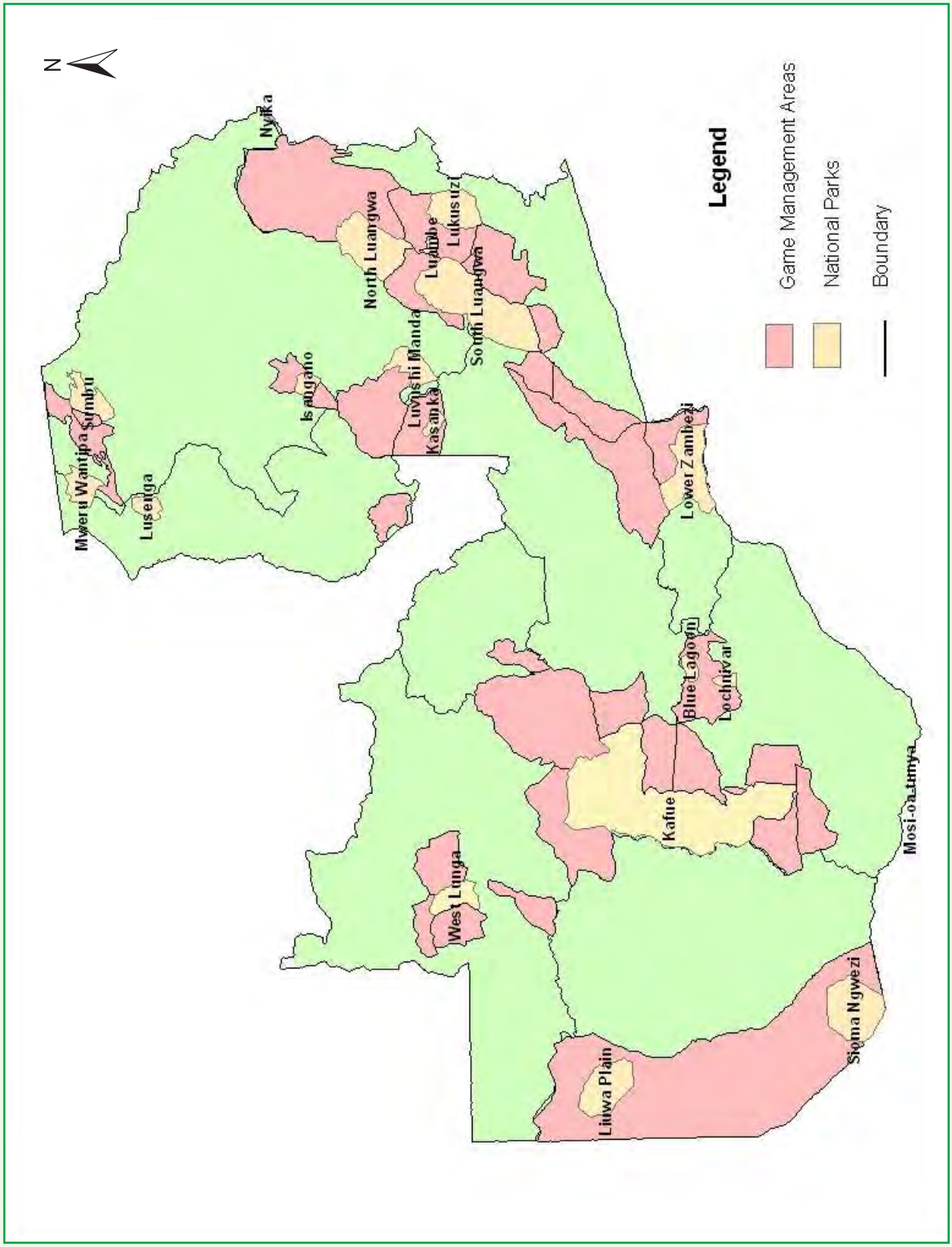
There are three ways in which biodiversity is managed in Zambia: Protected areas and in-situ conservation, ex-situ and indigenous conservation.

5.1.1 Protected areas and in-situ conservation:

The protected area system in Zambia consists of National Parks, bird sanctuaries, GMAs, game ranches, national heritage sites, forest and botanical reserves. There are 19 national parks in Zambia and these cover a total area of 6, 358 million ha. Bird sanctuaries have the same status as National Parks but are usually smaller in size. There are two bird sanctuaries in the country namely Chembe Bird Sanctuary located in Kalulushi and Nchete Wildlife Sanctuary and Sekulu island Bird Sanctuary located in Sinazongwe on Lake Kariba Islands. There are 34 GMAs in Zambia which cover a total of 16.57 million ha. Unlike national parks, GMAs allow for other forms of land use such as settlements and agriculture. Game ranches support both consumptive and non-consumptive uses of wildlife. Currently, the number of game ranches in the country stands at 72. While game ranching is an important aspect of the wildlife industry as it compliments government efforts in conserving wildlife, in situ monitoring of these ranches is critical for the achievement of conservation of biodiversity. (ZAWA, 2005)

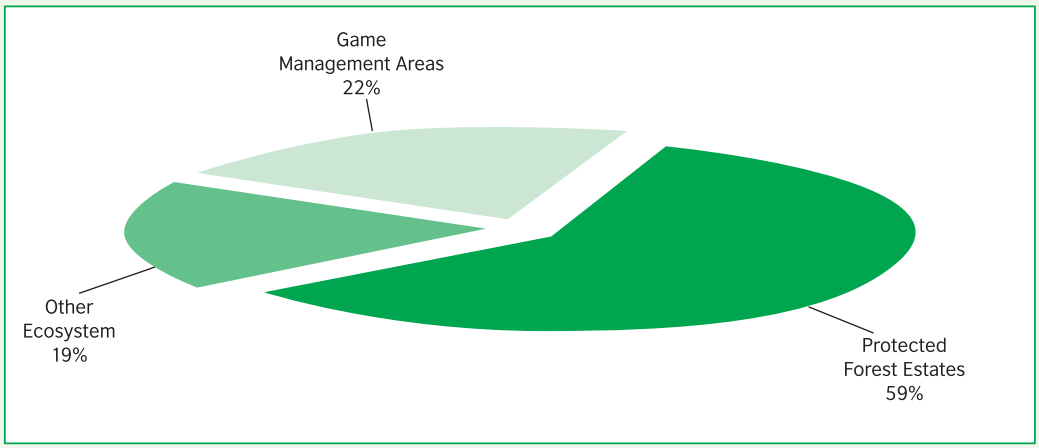
Source: Zambia National Tourist Board

Figure 5.6: Protected Areas in Zambia



Source: ECZ

Figure 5.7: Forest and Wildlife Ecosystems



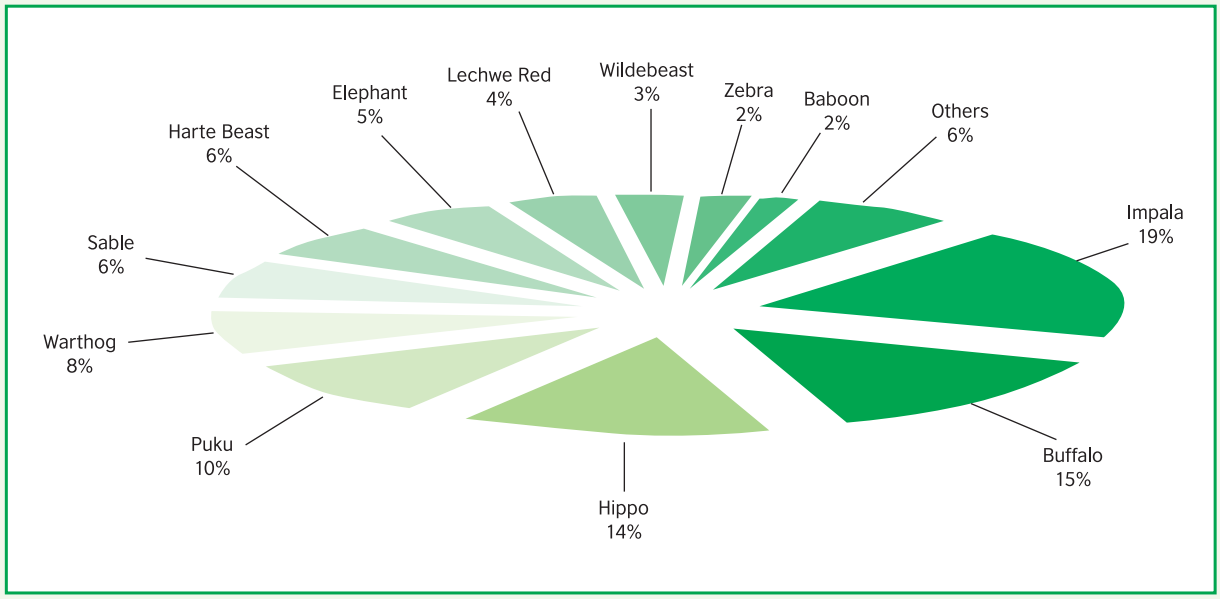
Forests in Zambia cover an area of 44.6 m hectares representing 60 percent of the total land area. (Masinja, 2001). Forests have been identified as a valuable environmental and economic resource for supporting natural systems and improving peoples' livelihood. Despite their importance in sustainable development of the country, the Zambian forests are fragile and vulnerable to both natural and anthropogenically induced pressures. The number of forest estates countrywide remained at 489 covering an area of 7.4m hectares. However following the degazettion and excision of 6 and 12 forest reserves respectively, on Copperbelt, Eastern and Southern provinces, gazetted forest area coverage were reduced by an area equal to 50,156 hectares. Out of the 489 forest estates, 170 are heavily encroached and 109 are partially encroached representing 61 percent an 39 percent respectively (Forestry Department, 2005).

Table 5.2: Estimated Area of Forest Estate by Province

Province	Total Land Area Hectares	National Forest		Local Forests		Total Forest Estate		% of Total Land Area
		No.	Hectares	No.	Hectares	No.	Hectares	
Central	9,439,448	16	289,953	22	192,043	38	481,996	51
Copperbelt	3,101,400	43	474,324	12	42,787	46	517,111	16.7
Eastern	6,881,451	14	680,584	64	206,747	78	887,331	12.9
Luapula	5,056,681	09	680,584	19	200,490	28	413,037	8.2
Lusaka	2,890,571	01	212,547	07	26,992	08	27,360	1.2
Northern	14,793,870	23	368	47	335,434	70	1,137,026	7.7
Northwestern	12,582,000	34	801,592	28	390,924	62	2,802,889	22.3
Southern	8,525,293	7	2,411,965	26	433,429	33	644,681	7.6
Western	12,638,595	35	211,252	83	346,930	118	913,499	6.4
TOTAL	**75,243,400**	**180**	**5,181,503**	**300**	**2,175,770**	**480**	**7,357,279**	**9.6**

Source (Masinja, 2001)

Figure 5.8: Percentage Species of Wildlife Populations



5.1.2 Ex-situ Conservation:

The approach to ex-situ biodiversity conservation in Zambia has involved the establishment of botanical gardens, herbaria and gene banks. There are 59 botanical Reserves in Zambia which cover a total area of 148,000 hectares. These include Munda Wanga, Mount Makulu National and SADC gene banks, University of Zambia and Kitwe Forestry Department herbaria. The Mt Makulu Genetic Bank was established to promote the conservation of plant genetic resources at national level and has total of 4,570 seed samples from different parts of the country.

5.1.3 Indigenous Conservation Practices:

Traditionally, customary laws enabled people to develop management systems that acted as controls in the exploitation of natural resources. For instance, most tribes in Zambia believed in the preservation of vegetation surrounding traditional burial grounds as a way of respecting the dead. As a result such pieces of land were left almost undisturbed and thus host a diversity of biological resources. Seasonal bans in exploitation of resources especially fish, birds and animals were imposed in almost all the cultures, based on the understanding of the life cycles. Thus, allowing time for breeding to take place in order to sustain the productivity of these resources. Traditional conservation and practices were supported and enforced by traditional institutions and political systems. The most important being the institution of chiefs, village headmen and heads of family households.

5.1.4 Deforestation and Habitat Destruction:

are some of the threats to biodiversity management in Zambia. Deforestation is caused by over exploitation as well as conversion of forests to other land uses. These are driven by population growth, economic development and the necessity to meet basic needs of the people. Approximately 45 percent of the Zambian population lives in urban areas; this skewed

population distribution mainly concentrated in the immediate hinterlands has contributed to over-exploitation of forests. Excessive cutting for wood fuel has led to increased degradation of woodlands. Due to the continuous over-exploitation, the harvesting cycle is shortened and late fires become more frequent leading to changes in species composition and threatening the regeneration of the forest and the threshold to convert depleted forests. Fuel-wood and charcoal have remained the major primary source of energy in most households 95 percent of rural people depend on fuel-wood and 90 percent of urban households depend on charcoal. The high consumption of wood fuel demands has contributed to deforestation in the country (Chindumayo, 1996). In addition to demand for fuel wood, the pressure to convert forests in open areas to agricultural land is high. In areas where enough land is not available in open areas, forest reserves are used because these are often considered as abandoned or communal land and therefore are more easily exploited.

Most wild fires that damage forest areas are caused by human beings. Timing and frequency of fires determine the effect of fire on the ecosystem. Severe fires, caused by late burning, are destructive to forests. In the natural state most forests and woodland vegetation types have a closed canopy. Over-exploitation changes the light conditions of the forest and accelerates grass growth, which provides fuel for late fires. Frequent late fires prevent regeneration of fire-intolerant species and thus change species composition. The result is an open type Chipya vegetation and ultimately grassland.

The most affected plant groups from habitat destruction include mosses and hydrophilous orchids and ferns whose habitats are destroyed by drought, cultivation and fire. In some parts of the country, conversion of peat bogs to cultivation has permanently destroyed orchids and their habitats. Saprophytic fungi and flora are usually dependent on humus for establishment and maintenance. Conversion of dry land ecosystems to cultivation and livestock grazing destroys the humus layer on the soil which triggers the disappearance of saprophytic organisms in the ecosystem. Similarly, epiphytic plants are destroyed due to deforestation and selective cutting of trees.

Biodiversity management continues to be a challenge in the country. Land use conflicts and threats to ecosystems are more prevalent in GMAs than in national parks. Activities such as human settlements, road construction and mining result in the fragmentation of ecosystems and habitats and obstruct migratory routes to breeding and feeding grounds used by wildlife. Human encroachments are associated with cultivation, livestock grazing and deforestation.

Fish diversity have also been affected by damming which regulates the normal river flow. This regulation favours lacustrine fish fauna which replace riverine species. This has occurred at Lake Kariba where the lacustrine green headed bream (Oreochomis macrochir) has replaced most of the riverine cyprids and characids (Harding, 1964).

In addition, the advancement of technology has also contributed to inequity in sharing of benefits arising from the use of biodiversity. This inequitable sharing of benefits tends to promote opportunistic over-exploitation of resources by local communities.

Historically in Zambia, formulation of laws followed a sectoral approach to deal with different sectors such as forests, wildlife, land, water and fisheries. The first attempt to coordinate

these various laws was the formulation of the National Conservation Strategy (NCS) of 1985 whose aim was to ensure sustainable use of renewable natural resources, maintain biological diversity and essential process and life-support systems. The NPE of 2007 aims to harmonise sectoral strategies, rationalise regulation that concern the use and management of land, water and other natural resources in order an integrated approach to development. The draft National Policy on Biological Diversity will ensure the conservation, sustainable use of biodiversity, genetic resources and related knowledge and technologies. Table 5.3 discusses various legal instruments dealing with biodiversity.

Source: Chama Mwansa

Source: Chama Mwansa

Table 5.3: Legal instruments dealing with Biodiversity

Statutory Instrument	Implementing Institution	Main Purpose	Comment
Natural Resources Act CAP 315	Natural Resources Department defunct	Provided for the establishment of the Natural Resources Advisory Board whose main functions were to ensure the proper use, conservation and improvement of natural resources	It is dormant though some activities being performed by ECZ.
Town and Country Planning Act CAP 475	Ministry of local Council and infrastructure	Came into force in 1962 and provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land. The Act does not however apply to Trust Land and land in Reserve and Mining Areas which fall under regional plans	Active
Forest Act CAP 199	Forestry Department	Provides for the establishment and management of National and Local forests, conservation and protection of forests and trees, and licensing and sale of forest products.	Active
Water Act CAP 312	Department of Water Affairs	Enacted in 1949 and provides for the control, ownership and use of water excluding that of the Zambezi, Luapula and Luangwa rivers which form borders with other countries. The Act establishes the Water Board and regulates the use of public water including protection against pollution.	Active
Fisheries Act CAP 314	Fisheries Department	Enacted in 1974, the Act provides for the development of commercial fishing, control of fishing and the registration of fishermen and boats	Active
National Parks and Wildlife Act no. 12 of 1998	ZAWA	Passed in 1991 and provides for the establishment, control and management of National Parks; conservation and protection of wildlife and objects of interest in National Parks; the establishment of Game Management Areas; the licensing of hunting; control of possession of trophies and control of bush fires.	Active
Tourism Act	Tourism Department	Enacted in 1979, and amended in 1985, the Act provides for the control of tourism enterprises. The Act though making no direct reference to environmental protection does provide for appeals against authorization of tourism projects which are deemed to negatively affect Zambian tourism which is basically natural resource based	Active
Plumage Birds Protection CAP 203	ZAWA	Passed in 1915, the Act prohibits dealing in plumage of wild birds except for scientific or educational purposes.	repealed in 1998
Noxious weed Act CAP 343	MACO	Enacted in 1953, the Act provides for the declaration and eradication of noxious weeds	Active
Lands Conversion of Titles Act	Lands Department	Enacted in 1975 and amended in 1990. The Act provides for the alienation, transfer, disposition and charge of land. Although the Act does not refer to matters of conservation this Act is important in that land is one of the basic natural resources.	Active
Agriculture (Fertilizers and Feed) Act CAP 226	Department of Agriculture	became effective in 1990 and provides for the regulation and control of the manufacture, processing, importation and sale of fertilizers and feeds. It also provides for ensuring minimum standards of effectiveness of fertilizers and feeds.	Active
EPPCA No.12 CAP 204	ECZ	Established whose main functions constitutes the protection of the environment and control of pollution in particular so as to provide for the health and welfare of persons, animals, plants and the environment in general	Active
The Zambezi River Authority Act	The Zambezi River Authority	Signed in 1987, the Act provides for the interstate agreement between Zambia and Zimbabwe relating to the utilisation of the Zambezi river.	Active
Agricultural Lands Act, CAP 292	Department of Agriculture	This Act was passed in 1960 and provides for the protection and alienation of land for agricultural purposes only.	Active
National Heritage Conservation Commission Act,	National Heritage Commission	Enacted in 1989, the Act provides for the conservation of ancient, cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archeological or scientific interest.	Active
Biological Diversity Bill 2006	Institution yet to be decided	An Act to ensure the conservation, sustainable use of biodiversity and genetic resources and related knowledge and technologies.	Being enacted

Community Based Natural Resources Management (CBNRM) for wildlife, joint forest management and Co-management in fisheries are some of the positive aspects of indigenous conservation practices being emphasized and promoted. It is based on a number of principles which are as follows:

- Common ownership based on community membership.
- Local communities are the primary stakeholders to natural resources found in the area.
- Benefits arising from natural resources should go to producer communities.
- Local communities know their natural resources better.
- Planning for the sustainable use of natural resources is a given area should be the responsibility of local communities.

Joint Forest Management (JFM) is a new approach in the forest sector aimed at increasing the rights of local communities in managing and benefiting from forests and areas around them. Through the JFM programmes, the government seeks to engage local communities in a more defined manner in the sustainable management and use of forest resources. Areas such as local forests and customary lands can be declared under JFM.

In addition, the Forestry Department supports entrepreneurship development at community level through community capacity building activities to implement micro-projects. the department has also embarked on developing a monitoring system on Integrated Land Use Assessment (ILUA) in order to determine the extent of the forest resources.

In the fisheries sector, the co-management concept is being promoted and structures have been put in place for increased stakeholders participation.

On the regional and international platform, several agreements to which Zambia is a party have been reached. Among these are interalia:

1. Southern Africa Biodiversity Support Programme: involves 10 SADC countries namely Angola. Botswana, Namibia, Lesotho, Mozambique, Swaziland, Zambia, Malawi, South Africa and Zimbabwe. The objective of this initiative is to promote regional cooperation and collaboration in the conservation and sustainable utilisation of biodiversity in the region and more recently to deal with the control of Invasive Alien Species (IAS) and application CBNRM principles.
2. Convention on Sustainable Management of lake Tanganyika involves 4 riparian countries: DRC, Burundi, Tanzania and Zambia and provides the legal framework for the protection and conservation of biodiversity of the lake and avoid potential conflicts among the countries DRC.
3. Convention Biological Diversity (CBD): is an international convention whose objective are the conservation of biological diversity , sustainable use of its component and equitable sharing of benefits from the use of genetic resources. The convention stresses the need to promote regional and global cooperation on biodiversity conservation issues.
4. Convention to Combat Desertification (CCD) whose objective is to mitigate the effects of drought in countries experiencing serious droughts and/or desertification particularly in Africa at all levels supported by international co-operation and partnership arrangement.

CCD encourages improved productivity of land and rehabilitation, conservation and sustainable management of land and water resources.

5. Ramsar Convention on Wetlands: Zambia has 8 sites designated as wetlands of international importance , representing a total surface area of 4, 030,500 hectares.

5.2 Conclusion

The need to conserve biodiversity in Zambia is therefore significant for the reason that unless degradation and over exploitation are controlled, the livelihood of a large section of population will decline further due to falling productivity of biodiversity.

Biodiversity underlies the provision of a large variety of benefits, including goods and services. Zambia's biodiversity offers many opportunities to support development.

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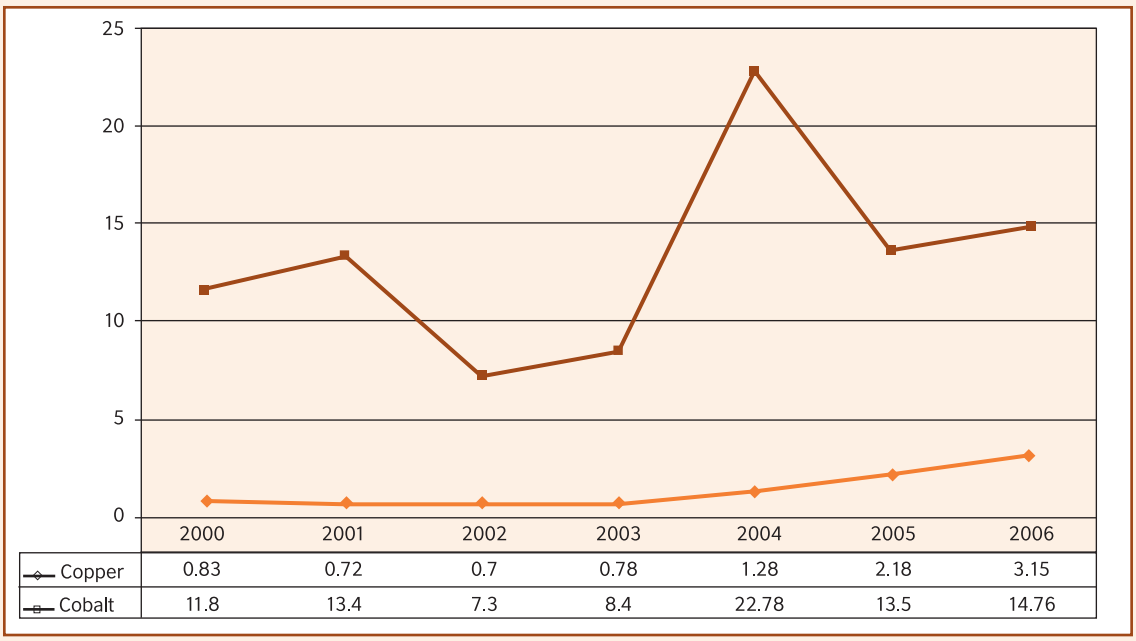
CHAPTER 6
MINERAL RESOURCES

The Mining Industry has played a pivotal role in the social and economic development of the country. Zambia's mineral wealth includes metals, gemstones, industrial, agro, building and energy minerals. The most developed is the metallic group dominated by copper and cobalt with a mining history spanning over ninety years. The exploitation of other minerals is variable, though rarely, on a large scale.

In 2000, Zambia was ranked as the world's fifth largest producer of cobalt, twelfth of copper, and one of the top producers of gem-quality emeralds. By 2006, due to increased metal prices, Zambia's production significantly increased. Besides copper and cobalt, Zambia produces other minerals such as gold, selenium and silver as by products of copper refining. It also produces a variety of industrial mineral commodities and coal. The increase in metal prices (e.g. copper prices with the highest ever, at about $8,000/tonne in 2006 translating to $3.63/pound) led to overwhelming mineral exploration by private companies and an increase in illegal copper dealings. In addition, Gemstones, mostly emeralds, recorded significant earnings. For instance, Kansanshi Mine in Solwezi begun full production of copper and gold whereas Lumwana Mine to the west is in expected to be one of the largest copper mines in Africa once operational. (AMCL, 2006). This chapiter focusses on mineral exploration and exploitation issues in the country.

The main driver for the mining sector in Zambia has been attributed to the increased demand for metals particularly copper on the world market. This is due to industrial developments in Asia (especially in China) and the western world which have resulted in increased copper prices. Consequently, the high copper and cobalt prices (Figure 6.1) have triggered an increase in mining activities in Zambia. This has seen an increase in the sector's contribution to GDP from around 8percent in 2000 to 11.8percent in 2006 (MoFNP, 2006) employing over 50,167 people (MSD, 2006).

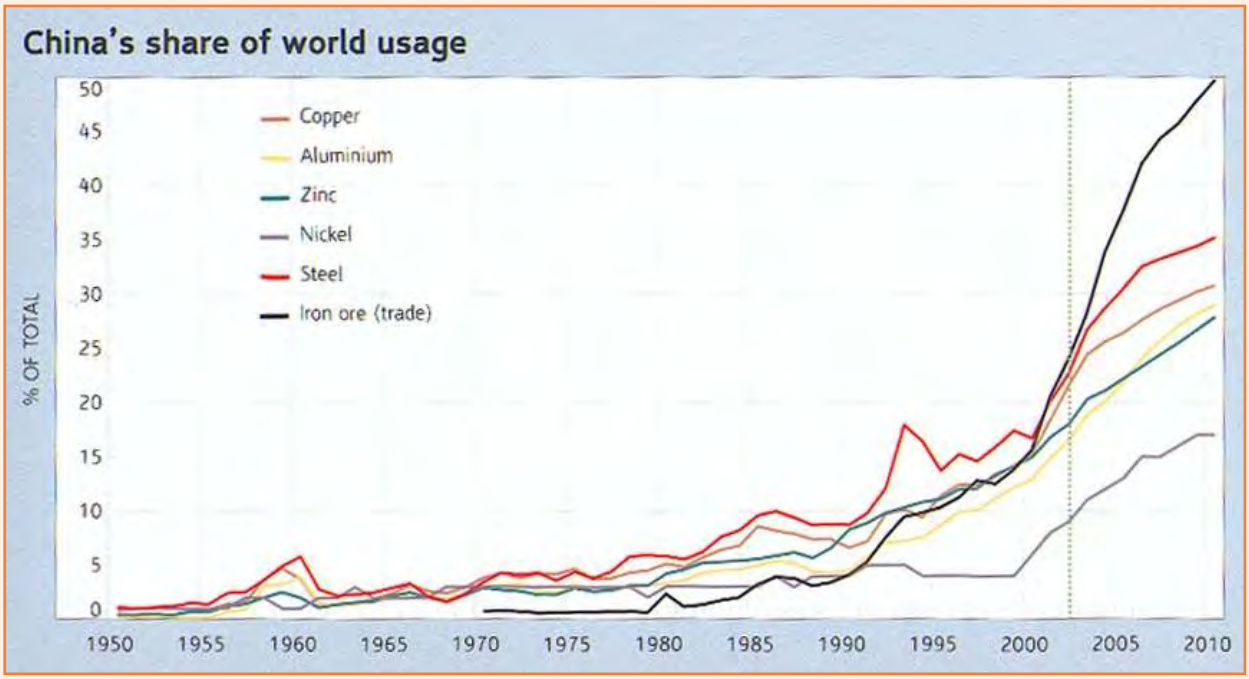
Figure 6.1: Copper and cobalt prices on World Market



	2000	2001	2002	2003	2004	2005	2006
Copper	0.83	0.72	0.7	0.78	1.28	2.18	3.15
Cobalt	11.8	13.4	7.3	8.4	22.78	13.5	14.76

Source: MMMD, 2005

Figure 6.2: China's share of the world usage of metals



Source: Raw Materials Data, Stockholm 2004 and Sames

Figure 6.2 shows a projection of China's metal consumption beyond 2010

6.1 Mineral Exploration

Zambia is underlain predominantly by Archaian to Neoproterozoic age rocks, which contain vast mineral resources. Neoproterozoic rock assemblages of the Lufilian Arc, a large arcuate, northward-convex geological structure, dominates the geology of northwestern Zambia and extends into southern Democratic Republic of Congo (DRC). The most important of these are the Katangan rocks which yield the copper and cobalt ores exploited on the Zambian Copperbelt and Northwestern Provinces (Figure 6.3).

In the eastern part of the country, pre-Katangan rocks are explored for various minerals including gemstones of aquamarines and others. Similar rocks in southern Zambia are explored for amethyst, tin and other minerals. Areas of occurrences include Lundazi, Mkushi, Itezhi-tezhi, Kalomo, Ndola rural, western and northwestern Zambia. However, occurrences of precious and semi-precious minerals in Zambia are not confined to these areas and are scattered sporadically throughout the country. Various deposits of Uranium have been located in Northwestern, Eastern, Southern and Copperbelt provinces.

Prospects for exploration of large iron deposits exist in various parts of the country i.e. Northwestern, Central, Luapula, Southern and Lusaka Provinces. Coal-bearing rocks of the are explored for in rift valley basins, the main ones being the mid-Zambezi and Luangwa valleys in the southern and eastern parts of the country , as well as in other basins such as the Barotse in Western Zambia. These are currently explored for coal, coal bed methane and uranium.

Zambia's vast potential for mineral resources is due to its unique geographic location between the massive Kasai Craton to the west and the Zimbabwe-Kaapvaal ('Kalahari') and Tanzania cratons to the south and north respectively. Inter-cratonic dislocations and the buttressing effects of these stable blocks have exerted considerable control on the geological evolution of the country. However, availability of exposed, accessible and near surface mineral deposits are increasingly becoming scarce requiring more expensive equipment to locate deeper buried ore deposits. Existing mines are becoming more costly to mine as they become deeper with declining mineral reserves. Known prospects and mineral occurrences in Zambia that require further exploration include:

a. **Gold:** There are more than 300 gold occurrences mainly in Mumbwa, Rufunsa and Kabwe areas.
b. **Copper**: Further exploration of some copper prospects include Kalaba and Kalumbila in Northwestern Province and Mumbwa which has estimated reserves of 16,000 tons of ore (Brandt, 1954, Exploration Consultants Ltd., undated).
c. **Lead and Zinc:** Almost 11 million tonnes of Zinc-Lead ore have been produced from the Kabwe Mine. A number of similar deposit-types, some copper-rich, have been identified throughout the Kabwe area and northwards as far as Kapiri Mposhi and south-eastern Zambia (Exploration Consultants Ltd., Undated)
d. **Nickel:** Nickel exploration have been undertaken in the Zambezi Belt to the south and east of Lusaka (Munali Nickel, about 64km from Lusaka)
e. **Diamonds, Kimberlites and Lamproites:** Although no reserves are known, these occur in various parts of the country including: Nchelenge in Luapula Province; Chosi River, Shiwa Ngandu, Kabale, Mpika Luwawala and Mafinga in Northern Province, Panela in Eastern Province, Musondweji in North-Western Province, Chipili, Kafwala and Kela near Mumbwa in Central Province and Kataba, Nawinda, Loazamba and Lusu in Western Province.
f. **Iron:** there are many recorded occurrences of iron-ore in Zambia with an abundant evidence of the use of its ores by indigenous inhabitants. Majority of known ore deposits, lie within a radius of about 150km from Lusaka such as Nambala Group near Mumbwa and Lubungu, north-west of Mumbwa. Others are Kasempa Group in North-west, Kampumba at the edges of Luano-Lukusashi Valley, and Chibote near Nchelenge in Luapula Province.

g. **Tin and Tantalite:** Occurs in the 'Tin Belt' of the Southern Province extending from Chirobi Mine to the Muzuma Mine. Annual production by small-scale workers has been low and has fluctuated with the price of tin. Currently, there is no serious exploitation of tin though the entire tin belt has been issued with mining rights. Anticipated increase in tin price is expected to increase the activities in the tin belt.

h. **Gemstones:** Zambia is endowed with numerous pegmatites containing high quality gemstones including amethyst, emerald, aquamarine, tourmaline, garnet, citrine, quartz, fluorite, chrysoberyl, epidote, dioptase, diopside, topaz, zircon, spinel, apatite, calcite, feldspar, rutile, kyanite, spodumene, sillimanite and diamond. Of these, only amethyst, emerald, aquamarine, tourmaline, garnet, citrine and quartz are produced commercially

i. **Energy minerals (coal, oil, gas and uranium):** Coal and coal bed methane are found in a number of localities in Zambia with exploration targeted at Karoo basins. Exploration drilling in the northern part of the Luangwa Valley revealed only gas-prone rocks but reservoir modelling demonstrates that there is potential for oil at greater depth. Uranium resources have been explored for in the mid-Zambezi Valley and North-Western Province and proven reserves have been reported (MoFNP, 2006).

j. **Industrial and chemical minerals:** Zambia is endowed with a lot of industrial minerals spread all around the country including; building materials, dimension stones (gabbros, granites, marbles),chemical raw materials (limestone, fluorite, phosphates),consumer and industrial products (silica sand, gypsum, ceramic clays, feldspars, etc), and metal manufacturing and shaping (refractories- dolomite, fire clays, moulding materials – foundry sand and gypsum).

However, exploration of industrial minerals in the country does not have a close relationship to the development of related industries. Patterns of exploitation are related to geographical location, development of infrastructure, economy and governance issues. Lusaka and Copperbelt are the main consumer markets of building materials due to construction and other maintenance activities in the building.

As a result of this mineral potential, investors are increasing exploration activities leading to demarcation of most parts of the country for mineral rights (Figure 6.3). By 2006, Zambia had issued an accumulated 2,647 mining rights (Figure 6.4) broken down by year as shown in Figure 6.7.

Figure 6.3: Map showing mineral rights in Zambia as at 31st December, 2006 with insert showing numerous emerald licence areas in Ndola Rural

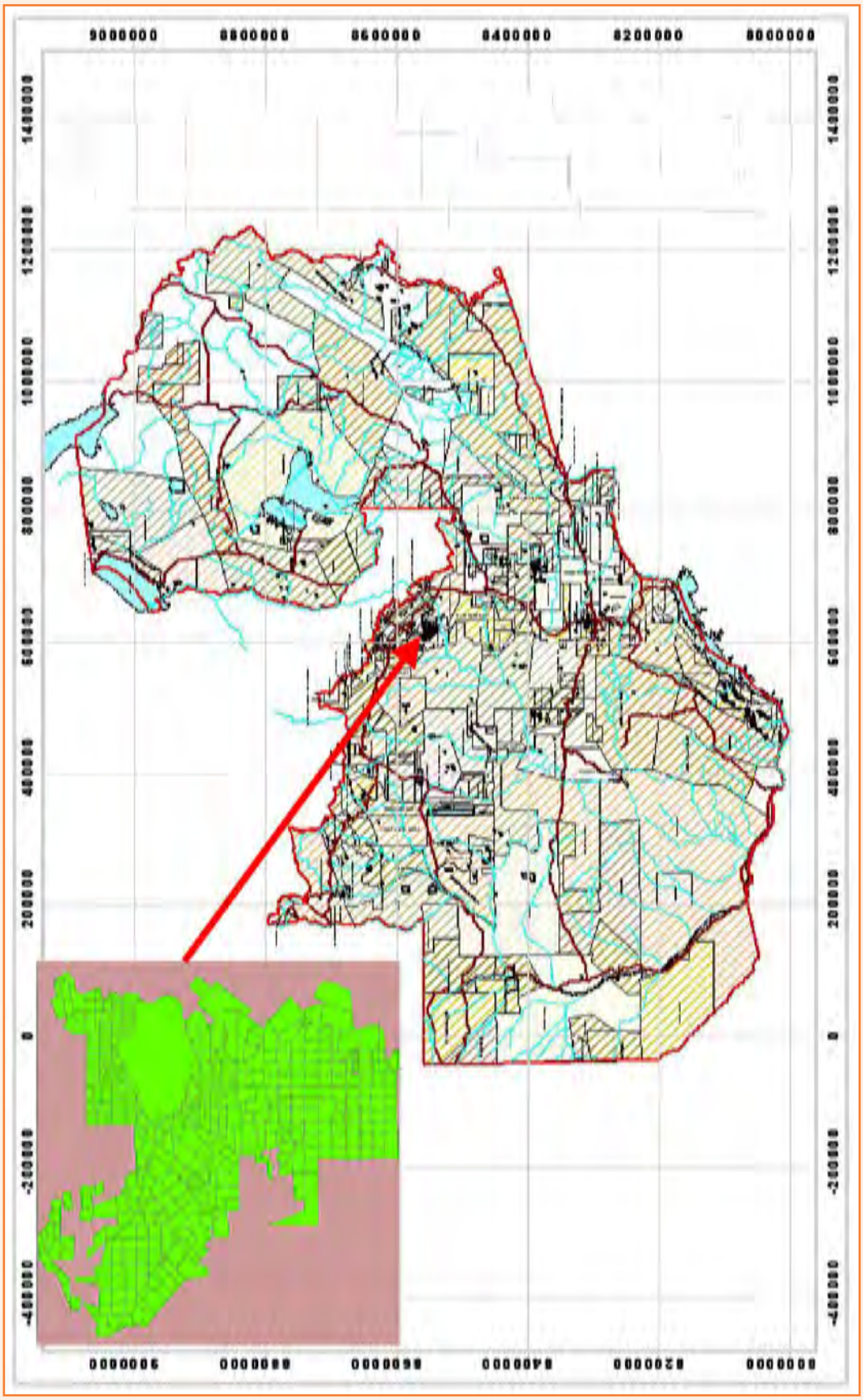
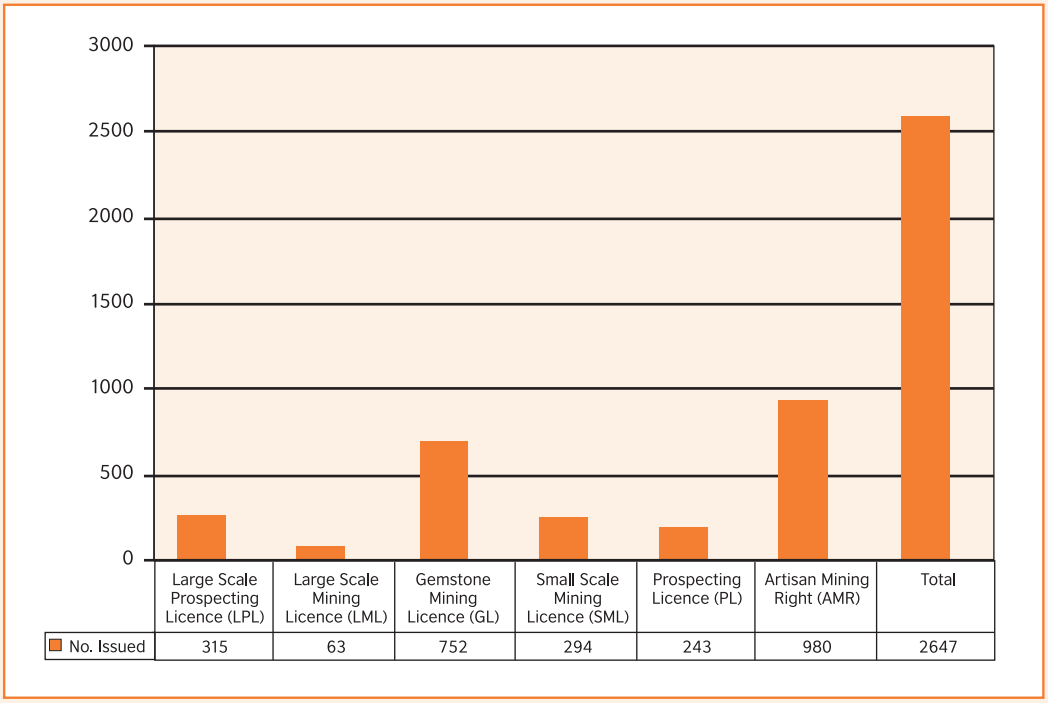
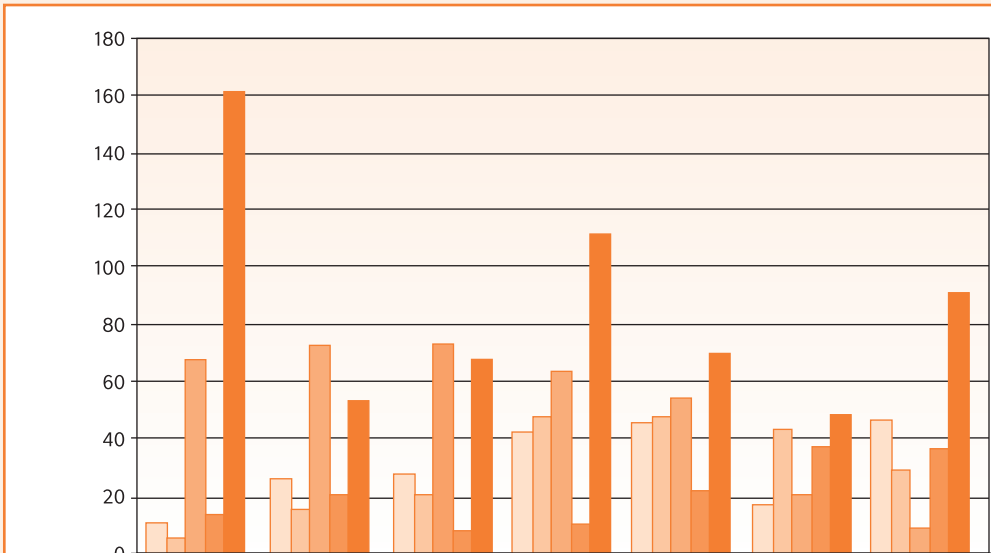


Figure 6.4: No. of accumulated mining rights licences by type issued by 2006 in Zambia



	Large Scale Prospecting Licence (LPL)	Large Scale Mining Licence (LML)	Gemstone Mining Licence (GL)	Small Scale Mining Licence (SML)	Prospecting Licence (PL)	Artisan Mining Right (AMR)	Total
No. Issued	315	63	752	294	243	980	2647

Figure 6.5: Number of licences by type issued by year from 2000 to 2006



	2000	2001	2002	2003	2004	2005	2006
SML	12	27	29	44	47	18	48
PP	7	17	22	49	49	45	31
GL	69	74	75	65	56	22	10
LPSL	15	22	9	12	23	39	38
AMR	163	55	69	113	72	50	92

For meaning of abbreviations see Figure 6.6.

Mineral exploration has contributed to the economy through employment creation. Despite the country being covered by exploration activities, environmental impacts are minimal in comparison to mining activities. Some of the impacts include deforestation, water pollution, land degradation, disturbance of flora and fauna and noise pollution. In addition, an abundance of exploration pits exist. At exploration level, the law does not require Environmental Management Plans (EMPs). Legislation specific to exploration and prospecting demands an Environmental Project Brief (EPB) which proposes rehabilitation plans. There is however need to strengthen monitoring of exploration activities in the country.

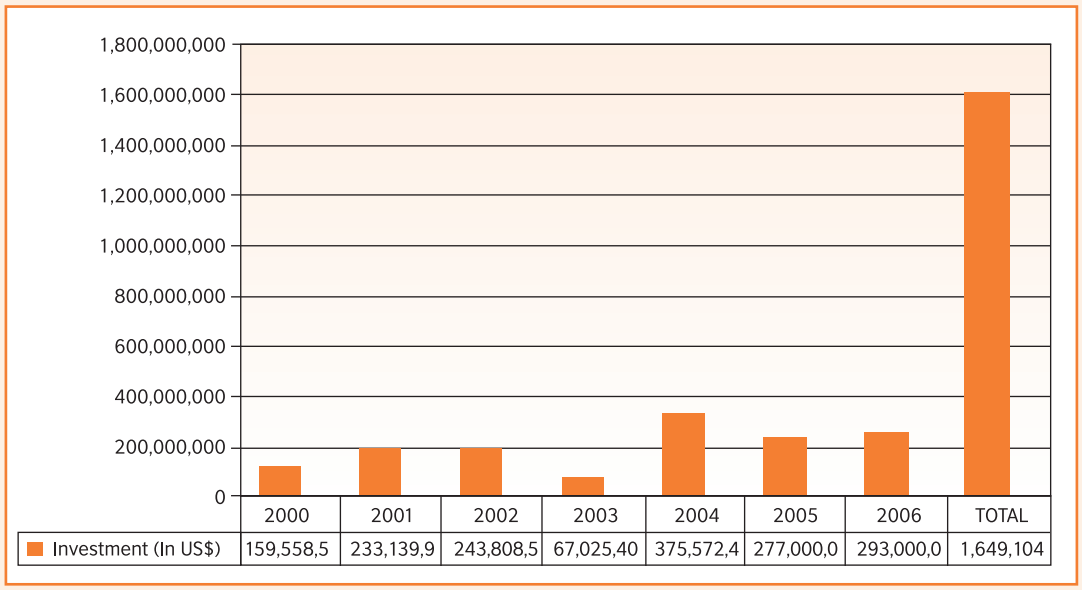
6.2 Mineral Exploitation

The Katangan- aged rocks that are known for containing copper-cobalt deposits are exploited on the Copperbelt and Northwestern Provinces. Lead and Zinc have been historically exploited in Kabwe area. Manganese, silver and gold are mined in small quantities at various localities around the country. In addition up to 2000, gold, selenium, nickel and silver were produced as by-products of copper-cobalt mining in the Copperbelt.

Emeralds are largely exploited by small-scale miners on the Copperbelt. They are exploited for semi-precious minerals such as aquamarines, tourmalines and garnets. Similarly, the southern part of the country in the Mapatizya area is host to amethyst. Coal is exploited at Maamba and Collum mines in mid-Zambezi Valley in the Southern Province.

Similar to mineral exploration, mineral exploitation is driven by world market demands. The overall increase in price and demand for minerals not only for copper has necessitated diversification in Zambia's mining sector. This diversity, though skewed towards copper has resulted in an increase in the issuance of Large and Small Scale Mining Licences at 63 and 294 respectively up to 2006 (Figure 4. 5). The level of investment in the mining sector has continued to expand due to capital investment.

Figure 6.6: Level of investment in the mineral sector in Zambia

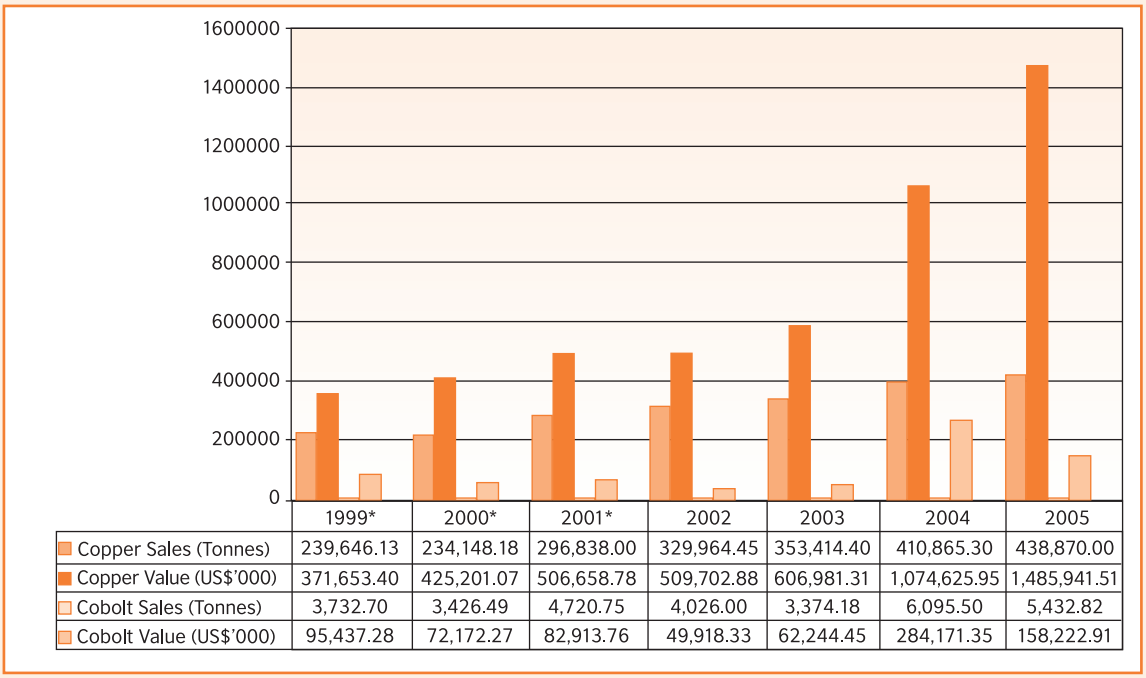


	2000	2001	2002	2003	2004	2005	2006	TOTAL
Investment (In US$)	159,558,5	233,139,9	243,808,5	67,025,40	375,572,4	277,000,0	293,000,0	1,649,104

Source: MMMD

The increased investment has in turn increased the annual sales volume (in metric tonnes) and earnings from 1999 to 2005 as shown in Figure 6.6.

Figure 6.7: Copper and cobalt sales and value from 1999 to 2005.

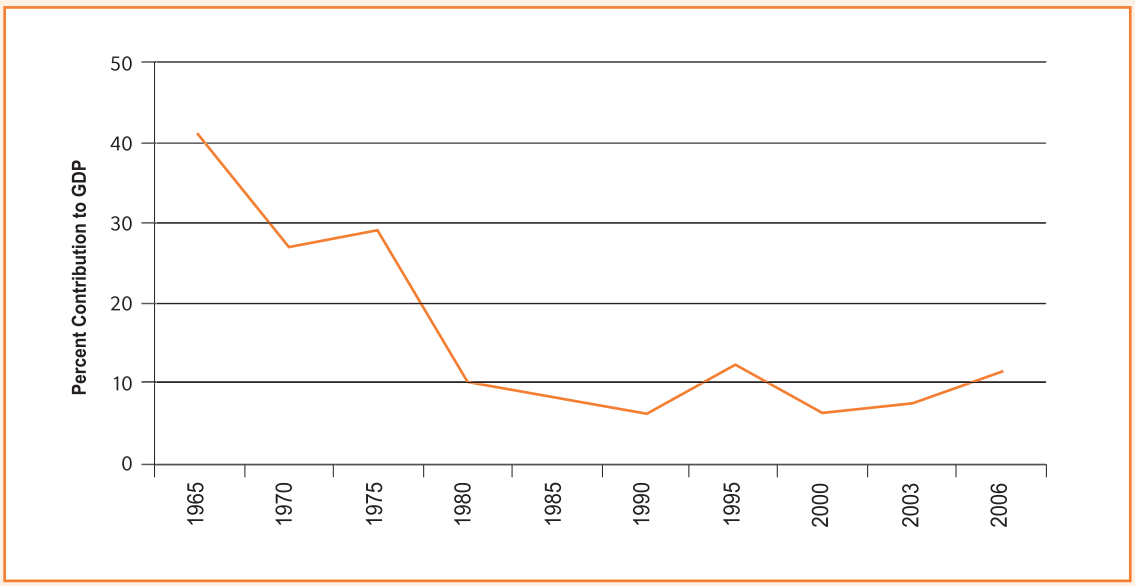


	1999*	2000*	2001*	2002	2003	2004	2005
Copper Sales (Tonnes)	239,646.13	234,148.18	296,838.00	329,964.45	353,414.40	410,865.30	438,870.00
Copper Value (US$'000)	371,653.40	425,201.07	506,658.78	509,702.88	606,981.31	1,074,625.95	1,485,941.51
Cobolt Sales (Tonnes)	3,732.70	3,426.49	4,720.75	4,026.00	3,374.18	6,095.50	5,432.82
Cobolt Value (US$'000)	95,437.28	72,172.27	82,913.76	49,918.33	62,244.45	284,171.35	158,222.91

* denotes data excludes NFC Africa Mining Plc, Kansanshi Mining Plc and Luanshya Copper Mining Plc (Chambishi Metals)

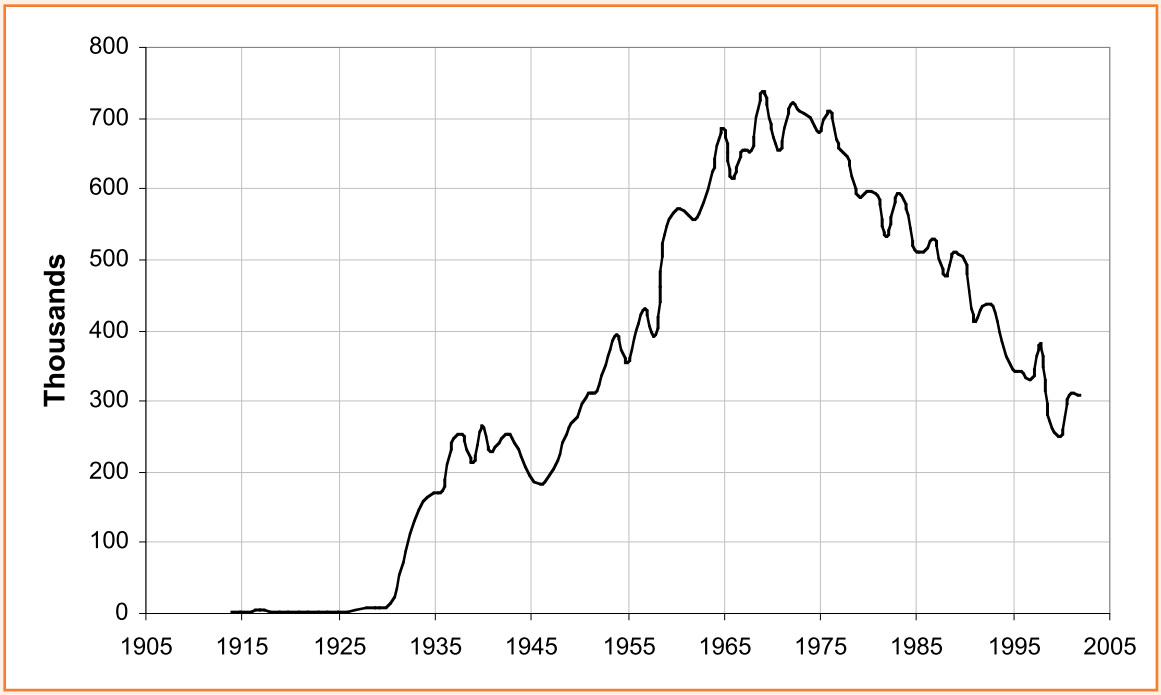
The mining industry was the main contributor to the country's GDP, contributing an average of 35 percent between 1965 and 1970), which significantly reduced to an average 8percent during the period 2000 to 2005. In 2006, this rose to 11.8percent (Figure 6.8).

Figure 6.8: Percent Contribution of Mining to GDP



Source: CSO, 2006

Figure 6.9: Copper production 1914-2002



Source: Nyambe and Kawamya, 2005

6.2.1 Large-Scale Mining

Large-scale mining is mainly from copper-cobalt mining in Copperbelt and Northwestern Provinces of Zambia and coal mining in Southern Province of Zambia. Ownership status of copper mines in Zambia is given in Table 6.1.

Table 6.1: Ownership of Copper Mines in Zambia.

Zambian Company	Location	Controlling Company	Country
Mopani Copper Mines Plc (MCM), Nkana and Mufulira Mines	Kitwe and Mufulira	Glencore (Swiss 73%) /Xstrata/First Quantum (13percent)/ ZCCM-IH (GRZ)	Switzerland /Canada-Australia / Zambia
Konkola Copper Mines Plc (KCM), Konkola, Nchanga, Nampundwe	Chililabombwe Chingola and Mumbwa	Vedanta / ZCCM-IH (GRZ)	India / UK / Zambia
Bwana Mkubwa Mining Ltd (BMML) Bwana Mkumbwa / Lonshi	Ndola	First Quantum Minerals Ltd (FQM)/ ZCCM-IH (GRZ)	Canada-Australia/ Zambia
Chibuluma Mines Ltd. Chibuluma South and West	Kalulushi	Metorex / ZCCM-IH (GRZ)	South Africa / Zambia
Non Ferrous Metals Africa Mining plc (NFC). Chambishi Mine	Chambishi	NFC / ZCCM-IH (GRZ)	China / Zambia
Luanshya Copper Mines PLC Chambishi Metals	Luanshya Chambishi	J and W / ZCCM-IH (GRZ)	Switzerland/India/ Zambia
Kansanshi Mine	Solwezi	First Quantum Minerals Ltd (FQM)/ ZCCM-IH (GRZ)	Canada-Australia/ Zambia
Lumwana Mine	Solwezi	Equinox Resources Ltd	Australia
Albidon Mine	Mazabuka	Equinox Resources Ltd	Australia

Most of Zambia's mining exports are raw. Copper and Cobalt ores are processed to produce products such as copper /cobalt slimes and copper / cobalt cathodes.

Table 6.2: Smelters in Zambia

Smelter	Owner	Status
Luanshya	J+W	Non Operational
Mufulira	Glencore/ Xstrata and ZCCM	Operational
Nkana	Sterlite/Vendata, ZCCM	Operational
Chambishi	J+W	Operational
Chambishi Copper	NFC Africa Mining	Under Construction
Nchanga Smelter	Sterlite/Vendata, ZCCM	Under Construction

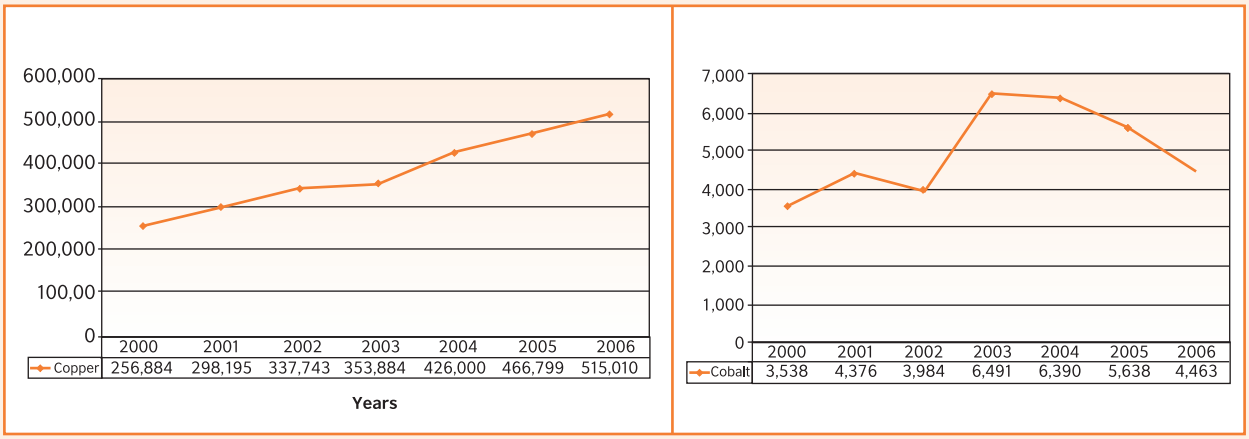
Table 6.3: Refineries in Zambia

Refinery	Owner	Status
Mufulira	Glencore/ Xstrata and ZCCM	Largest in Africa with capacity of 250 000MT/pa
Nkana	Sterlite/ Vendata	Operational
Chambishi	J & W	Operational
Chambeshi	Sino Metals	Operational
Nchanga	Sterlite/Vendata/ZCCM IH	Operational
Solwezi	FQM / ZCCM IH	Operational

Prior to privatization, copper slimes were processed to recover gold, silver and selenium as by-products of copper at the defunct Ndola Precious Metal Processing Plant. However, since the collapse of the plant, these by-products are no longer recovered but are exported. In 2004 Mopani Copper Mines Plc (MCM) exported 366.771 tones of Copper slimes (MCM, 2004).

Although copper mine production continued to decline from 1969 to 2000 (Figure 6.10), the focus of the new mine owners has been on mine and plant rehabilitation based on a review of company plans. Production levels are closely related to the capacity of mineral processing plants and smelters, whose capacities are variable. These plants and smelters have a greater impact on the environment due to abundant tailings produced which require large areas of land for their disposal.

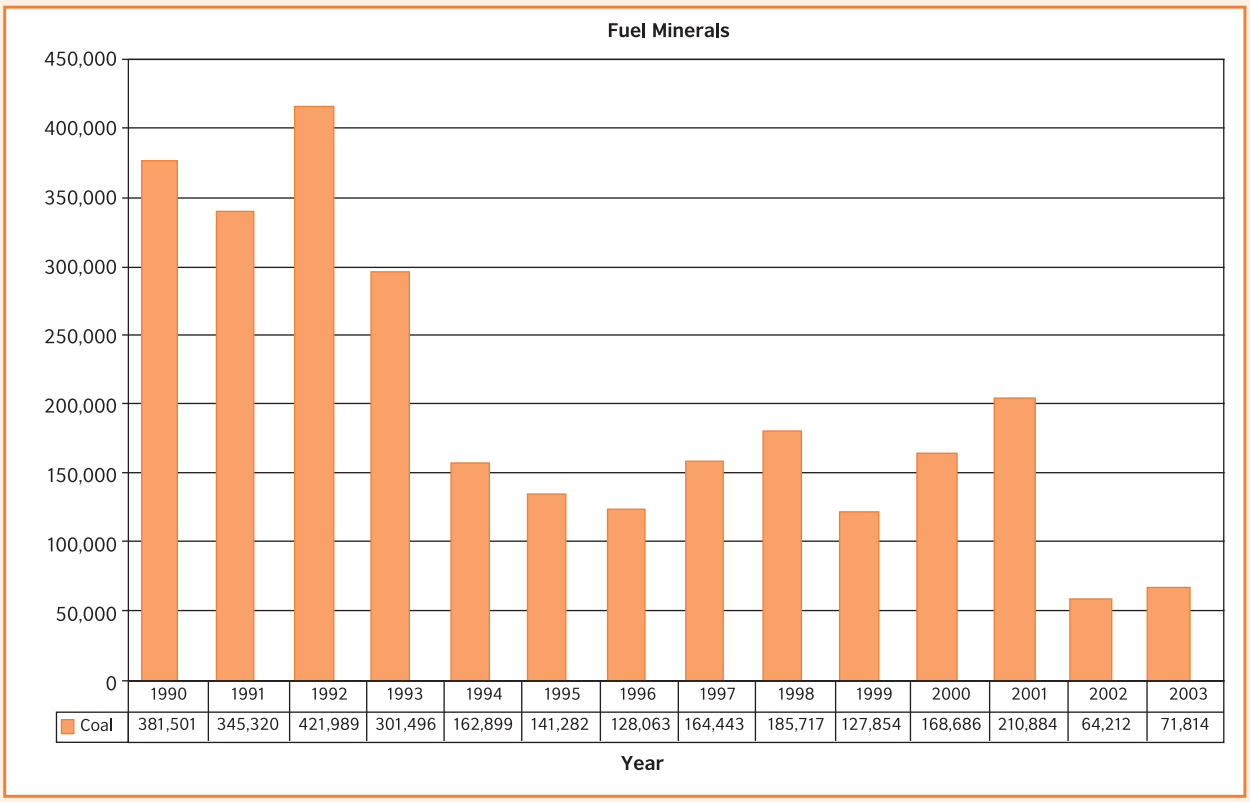
Figure 6.10: Copper and cobalt production in 2000 – 2006



Source: MMMD, 2006

Other activities outside copper include coal mining at Nkandabwe (2003) and Maamba (1969) mines. Production of coal has greatly declined to below 100,000 tonnes following the decline in copper production, lack of capital re-investment and failure to attract credible investors. Expansion in mining activities and energy requirements, have resulted in increased exploration and exploitation works for coal and coal bed methane.

Figure 6.11: Coal Production from Maamba Mine, 1990-2003



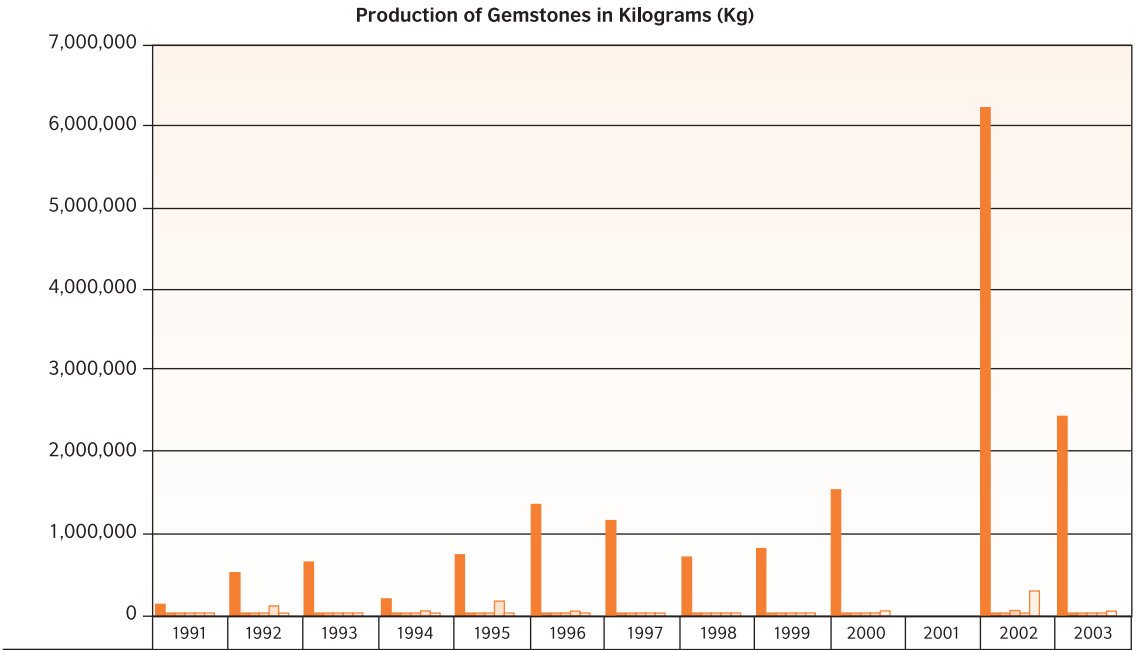
Source: MMMD, 2004

6.2.2 Small Scale Mining and Gemstone Industry

In Zambia, small-scale mining covers a wide spectrum of activities ranging from highly mechanized operations to individuals working informally and usually regarded as illegal miners. Women play a significant role in small-scale mining operations in Zambia accounting for approximately 30 percent of the workforce and mine ownership.

Mining activities in Luanshimba stream

Figure 6.12: Production of Gemstones in Zambia, 1991-2003.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Amethyst	139,95	512,27	650,25	188,61	746,41	1,359,7	1,149,0	717,06	794,94	1,537,4		6,267,6	2,436,2
Aquamarine	0	65	113	188	365	866	575	200	6	19,552		19,636	16,782
Beryl	0.1	1.5	0.2	0.9	0.5	2.1	3.3	4.1	20.3	12,795		21,789	15,024
Emerald	618	2,647	666	438	639	1,181	1,047	1,933	1,831	7,162		7,296	13,640
Garnets	4	91,827	1,685	26,192	177,04	26,624	16,100	2,212	4,016	2,723		5,386	1,639
Tourmaline	46	34	994	537	1,454	1,175	5,764	6,253	17,299	27,967		300,85	27,752

Source: MMMD (Figures for 2001 were not available)

The up-swing in the small-scale mining and gemstone industry is clearly demonstrated in the rising number of mineral rights issued in all categories. In addition, an accumulated total of 487 Reconnaissance licenses, and 1,136 Gemstone selling certificates were issued by 2005

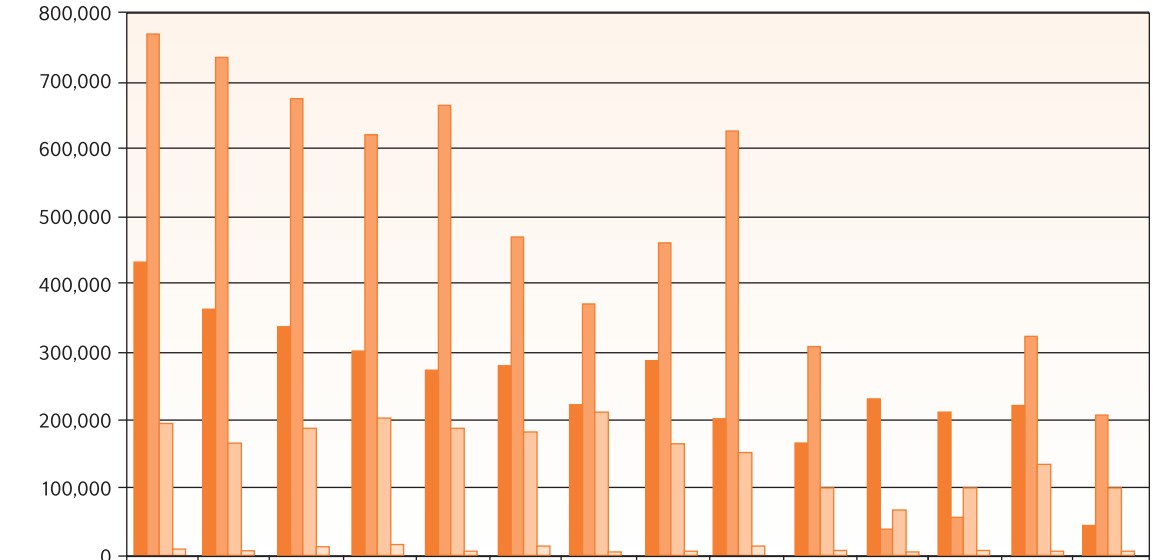
(MMMD, 2006). Their activities are conducted at three levels:

(i) Artisanal mining: This is smallest operation, an informal enterprise characterized by the use of simple tools and is labour intensive. In most areas where this type of mining is being undertaken, women and children are actively engaged in manual crushing and digging.
(ii) Traditional small-scale mining which is carried out by a registered and licensed enterprise undertaking non-mechanized or semi-mechanized mining operations. An individual or a group of entrepreneurs in the form of a cooperative usually own the operation with a basic management structure.
(iii) Mechanised small-scale operation.

The first two usually lack financial resources as well as appropriate management and technical skills to conduct their activities. As a result, mining is done haphazardly with little or no technical input and regard for the environment. It is estimated that, mechanized small-scale mines constitute about 5 percent of the registered mining operations whereas the number of unregistered operations range from 200 to several thousand. This sector is not adequately monitored.

Limestone exploitation (Figure 6.13) for cement and lime manufacturing are significant in Lusaka and Copperbelt in response to their demand but cause significant problems of dust in their areas of operation. Other small-scale mining activities such as quarrying for limestone/marble, gravel, sand, although of less significance, do provide informal employment to communities due to their proximity to cities and towns.

Figure 6.13: Industrial and Building Materials production in tonnes 1990-2003



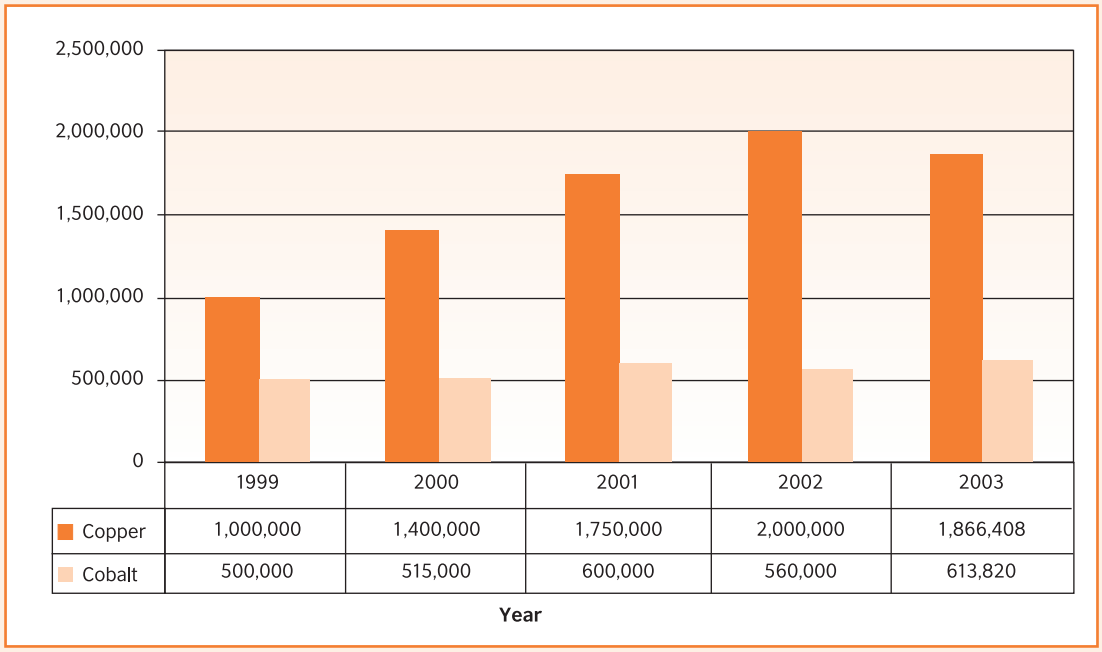
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cement	437,421	366,914	346,741	307,789	279,518	285,881	229,856	292,610	206,266	171,833	236,765	215,470	230,379	48,552.00
Limestone	772,318	738,727	677,243	626,964	668,233	475,157	379,371	464,901	629,343.44	313,231.30	41,474	61,539	329,915	214,790.00
Lime Quick Lime	199,508	171,267	193,224	205,549	194,508	186,613	215,246	173,707	157,758	107,498	70,818	106,479	140,495	101,236.00
Lime Hydrated L	14,292	12,517	18,441	21,306	15,668	16,365	13,848	9,632	16,601	11,229	8,282	11,068	10,443	11,712.00

Source: MMMD

6.3 The Link between Mineral Resources and the Environment

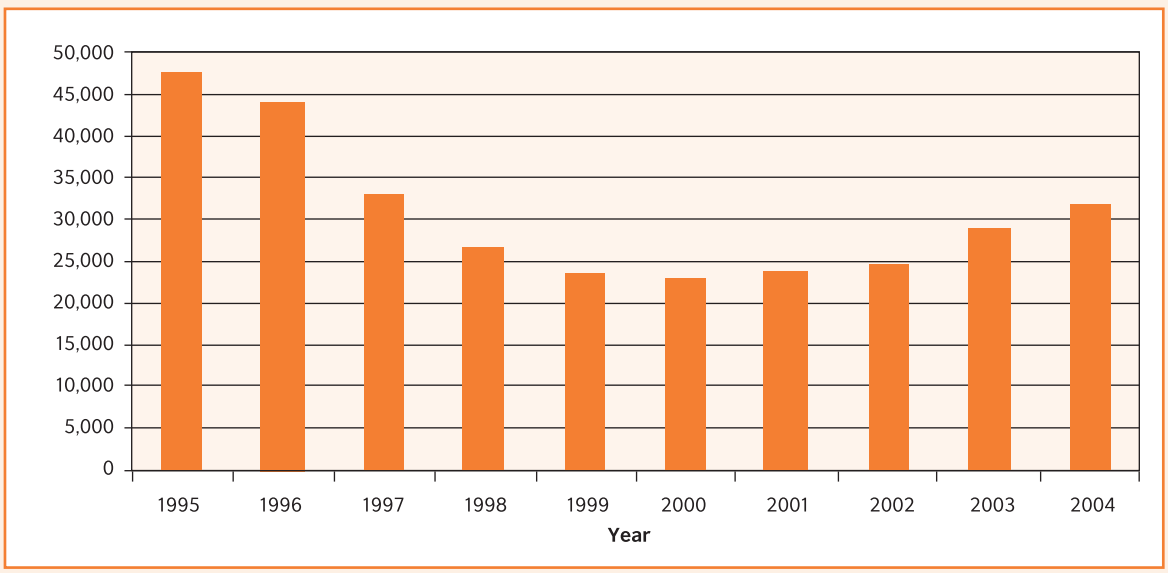
There has been an increase in Copper and cobalt exports which has resulted in a significant rise in employment levels (Figure 6.17) Over US$ 1.6 billion investment in Zambia's mineral exploitation industry occurred after privatisation of the mines.

Figure 6.14: Copper and Cobalt Export 1999 – 2003 K'm



Source: CSO

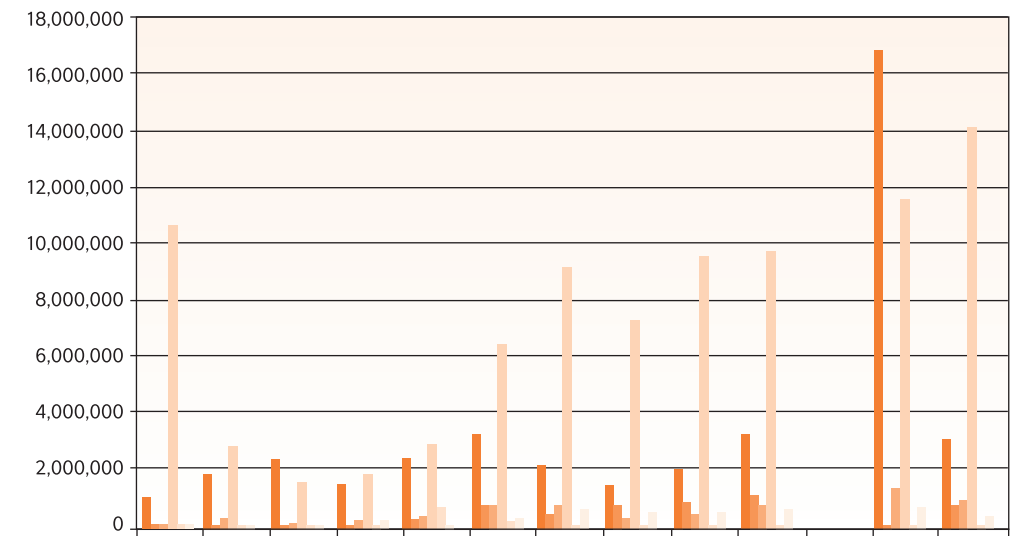
Figure 6.15: Mining Sector employment: 1995-2004



(Source: MMMD, note: data excludes Small-scale mining sub-sector).

The mining sector continues to contribute to the socio-economic development of the country. Emeralds contributed about 80 percent of the total national gemstone earnings as indicated in Figure 6.16.

Figure 6.16: Export Value of Gemstones in US$, 1991-2003.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Amethyst	1,049,3	1,868,1	2,377,1	1,501,4	2,401,1	3,200,8	2,139,4	1,439,9	2,071,8	3,254,9		16,882	3,062,0
Aquamarine	0	37,197	40,737	105,03	298,15	722,73	465,38	782,85	835,14	1,086,6		44,552	755,65
Beryl	40,130	242,94	66,547	200,14	380,79	722,73	760,75	281,23	464,70	736,45		1,359,2	896,47
Emerald	10,687	2,838,8	1,556,1	1,821,5	2,874,8	6,477,1	9,201,2	7,263,0	9,567,5	9,795,5		11,596	14,179
Garnets	652	1,943	32,771	54,624	665,99	169,46	33,775	76,270	32,011	31,911		18,774	49,165
Tourmaline	21,911	23,665	59,023	146,84	59,869	293,67	606,50	481,69	488,41	577,75		673,37	318,21

Source: MMMD (Figures for 2001 were not available)

Mining activities, especially large-scale open pit mining has negatively impacted on the environment. Some of the prominent open pit mines include Nchanga, Kansanshi and Maamba Collieries. There are also a large number of abandoned pits by small-scale operators in gemstone mining, prominent in areas such as Ndola Rural and Mapatizya.

(a) Nchanga Open Pit on the Copperbelt and (b) abandoned pits in the Mapatizya Amethyst area (Source Nyambe, 2006)

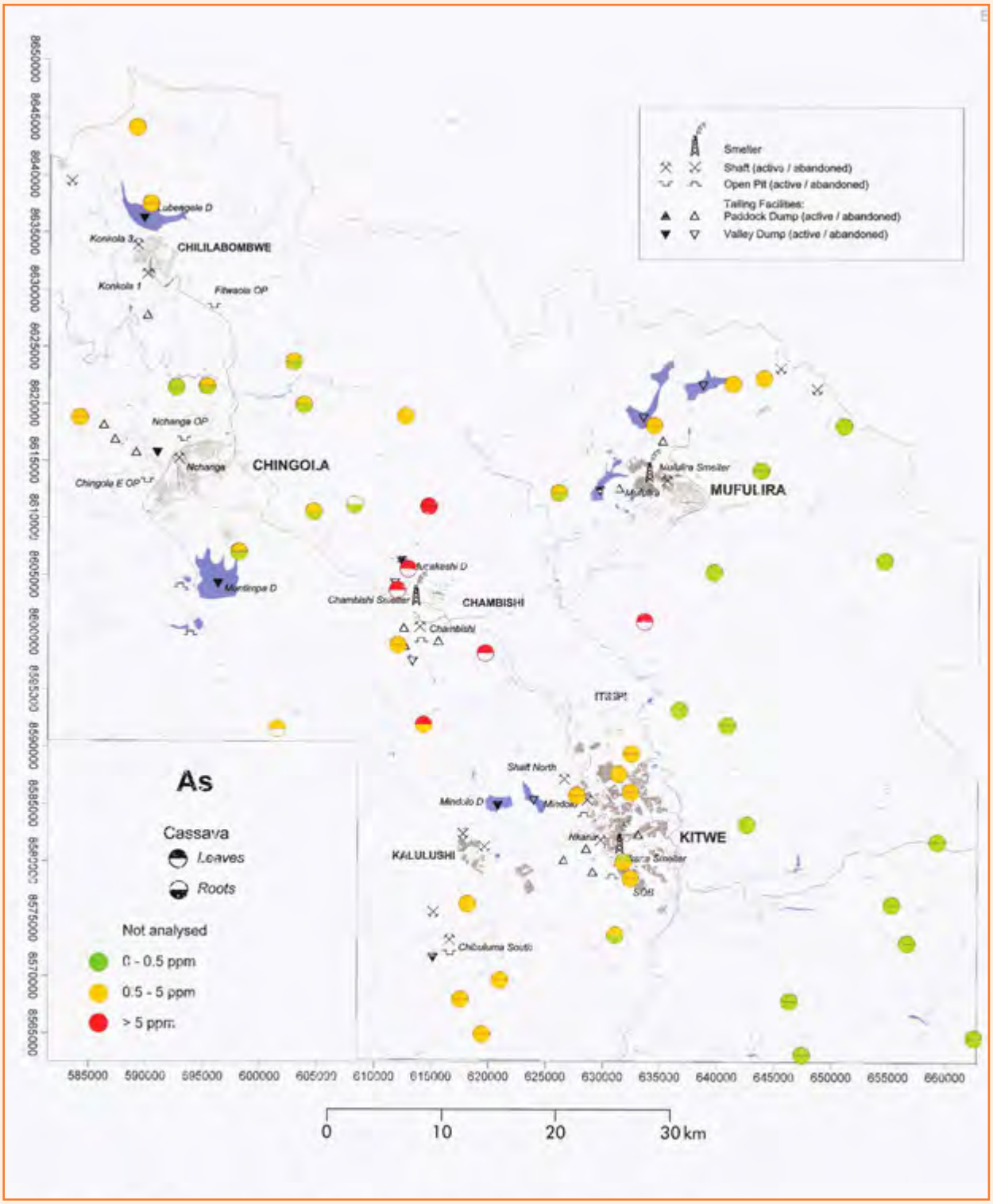
6.4 Environmental impacts due to mining activities

Open-cast operations have a high tonnage of overburden. There are 32 overburden dumps in Zambia's mining industry containing 1,899 million tonnes and covering an area of approximately 206,465ha. There are 21 waste rock dumps with approximately 77 million tonnes generated from underground shaft mining covering an area of 388 ha. There are 9 slag[10] dumps containing 40 million tonnes of waste covering an area of 279 ha. In addition, 45 dams containing 791 million tonnes of tailings cover an area of approximately 9,125ha (NSWMS, 2005). A total of 216,257 ha were covered by overburden, slug, tailings and waste rock dumps occupying land that could otherwise be used for other purposes. On the other hand uunderground mining operations have also impacted on the environment affecting an area of 4,000 ha that is prone to subsidence and thus protected.

The contamination of terrestrial systems (soils and vegetation including agricultural products) is mostly ascribed to dust fall-out. Studies have shown that contents of arsenic in fresh agricultural products of cassava (Figure 6.19) and sweet potato leaves reach as much as 7 ppm, cobalt 18.9 ppm, copper 253.8 ppm, nickel 3.4 ppm, lead 5.04 ppm and zinc 161 ppm. High contents of trace elements in soils together with emissions of sulphur oxides are responsible for a sharp decline in agricultural production in the polluted areas.

[10] Slag is waste material produced from smelting of concentrates. It is delivered for disposal in molten or granulated state.

Figure 6.17: Contents of arsenic in fresh agricultural products of cassava.



In Southern Province, open pit coal mining has negatively affected a large portion of land (with spontaneous combustion affected vegetation westwards.

Overburden consisting mainly of carbonaceous and coaly mudstone showing spontaneous combustion affecting vegetation to the west, northwest and north in Izuma area, Maamba Mine area (Photo courtesy of Nyambe, 2007).

The process of smelting concentrates and the production of acid emit sulphur oxides into the atmosphere. Smelters with emissions of Sulphur Dioxides (SO2) containing on average up to 70 _g.m-3 annually have adversely affected vegetation and property in prone areas (ECZ, 2000; Kibek and Nyambe, 2005). These emissions range from 300,000 to 700,000 tons per year (ZCCM, 2002). Some of the severely affected areas are Kankoyo and Wusakili townships in Mufulira and Kitwe respectively. Deposition of particulates from stacks affect soils and ecology within the deposition zone and is evident on the Copperbelt where smelters exist. In order to reduce SO2 emissions, acid plants are operated parallel to smelting units to capture emissions from smelters and converting it to Sulphuric Acid (H2SO4), hence reducing its impact on the environment.

(a) General view of Nkana Smelter (b) How Sulphur Dioxide emissions from Mufulira Smelter has affected Kankoyo Townships houses and surroundings (Photos courtesy of Nyambe, 2005).

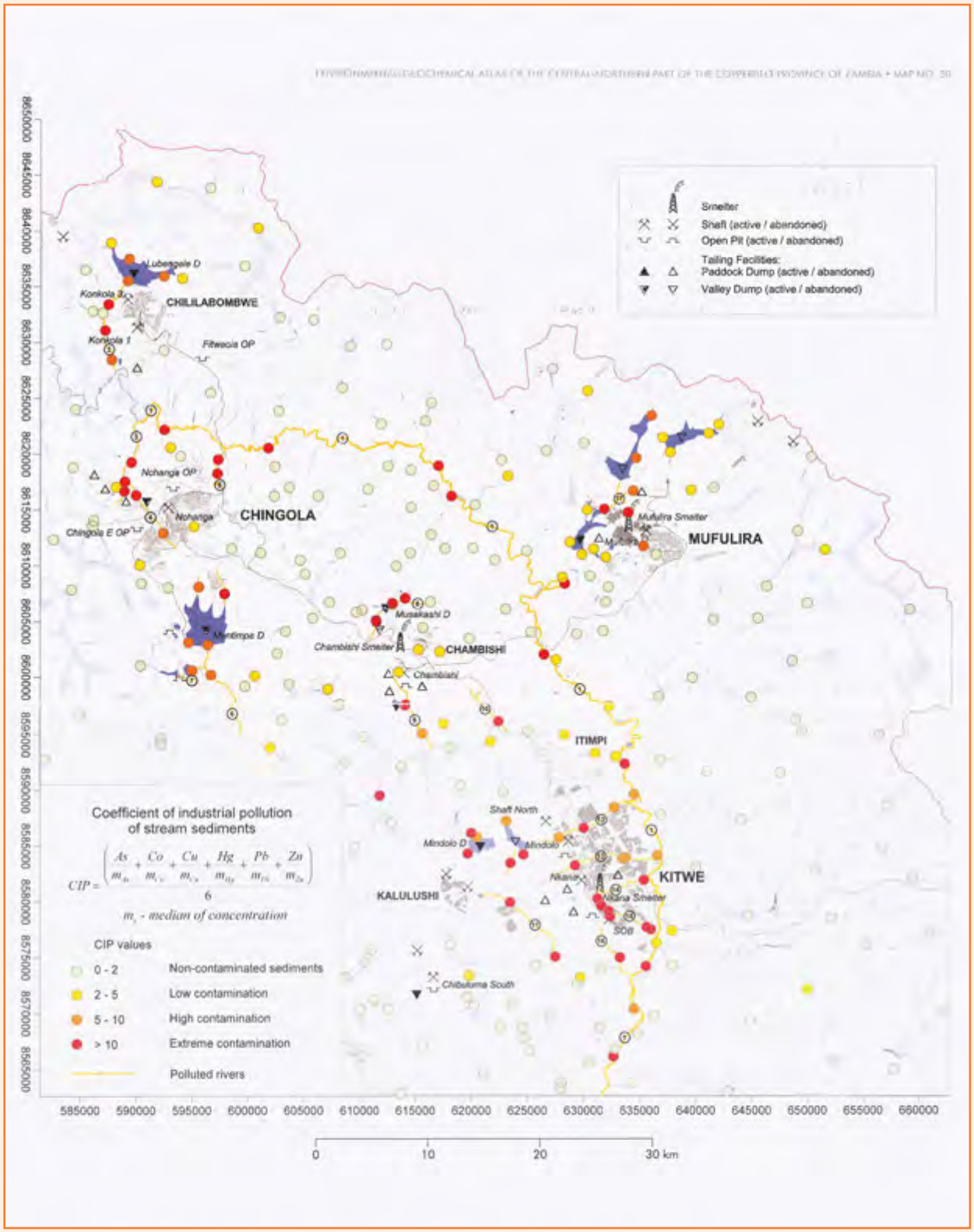
Tailings dams are a source of dust from dry and bare sections which affect surrounding environments. Dust aerosols in the environs of smelters contain as much as 0.108 _g. Cu per m3 of air, 0.008 _g.m-3 Co, 1.09 _g.m-3 Zn, 0.498 _g.m-3 Pb (To check that they are abbreviated) and a range of other toxic metals (Kibek and Nyambe, 2006).

Tailing impoundment (a) – wet part; (b) dry part providing dust fallout affecting plant leaves (Photos courtesy of Nyambe, 2005)

Contamination of surface and ground water is mainly due to underground mining operations and metallurgical processing plants. Major contaminants of surface water on the Copperbelt are cobalt, copper, manganese, sulphates, calcium, iron and magnesium surface. Contamination can be attributed to the following:

- siltation is as a result of spillages and overflows from the washing of ore and washout of fine particles from dumps and ore-processing plants.
- Spillage and overflow of reagents and used water into drains
- Mine water discharges and poor control of tailing dams may contain suspended and dissolved solid loads that can impact watercourses.
- Storage, transport and use of oils, reagents etc result in potential for contamination of soils and groundwater.
- Run off from plant sites can lead to polluted discharges to water courses. Possible failures of pipelines leading to tailing release.
- Use of tailing ponds for water supply, fishing and growing crops on the tailing surface has the potential to cause health impacts.

Figure 6.18: Concentration of Cu in stream sediments.



Note that high values are related to mining areas with a maximum up to 65 460 ppm Cu.

The acid buffer capacity of river sediments and riverbed rocks is mainly accelerated by adding of lime in watercourses in mining areas and therefore significantly decreases downstream contamination of water sources.

The liming scenario is well illustrated by the pH of sub-surface soils which shows acidic pH values outside mining areas and alkaline values in mining areas. pH of sub-surface soils on the central part of the Zambian Copperbelt (after Kribek et. al., 2007). Note the neutral to alkaline values of pH in mining areas attributed to liming by the mining companies and the acidity outside mining e.g. south of Mufulira in a forest area.

Others sources pollution indirectly associated with mining are manufacturing and chemical industries and motor vehicle traffic operating in the mining areas.

The growing mining sector requires corresponding improved management in the regulation and monitoring of mining industry. Government has continued with implementing mining policies and fiscal regime that encourages private investment in the sector. Some of the programmes implemented relate to:

a) identifying and highlighting significant mineral deposits;
b) completion of privatization of all remaining mining assets of the ZCCM with the exception of Maamba Collieries Limited and Ndola Lime;
c) setting up an Environmental Management Facility (EMF) to take ownership of all environmental liabilities of the now defunct ZCCM.
d) implementing the Mining Sector Diversification Programme
e) providing incentives to private and foreign investment in the sector,
f) revising existing legislation to improve management of the sector and
g) improving the infrastructure service provision to support investment.

In order to strengthen regulation and monitoring of the sector, relevant legislation among them

a) the EIA SI No 28 of 1997 and the Mines and Minerals Regulation.
b) all large mining operations are required to have approved Environmental Management Plan (EMPs) which are audited periodically.
c) New mines submit EIAs for approval by ECZ and Mine Safety Department (MSD).
d) Mines obtain licences to discharge into the environment and are required to address environmental issues as per EIA/EMPs

Box 6.1: Management of Lead Pollution in Kabwe

The Kabwe Scoping and Design Study (KSDS) is a component of the Copperbelt Environment Project (CEP), a multilaterally funded programme initiated in 2001 by the GRZ with financial assistance from the World Bank. The CEP aims to address environmental liabilities retained by ZCCM-IH following the privatization of Zambia's state mining interests in 2000. These include; a range of defunct mine installations in the former ZCCM production divisions on the Copperbelt, and the lead-zinc mining and mineral processing complex in Kabwe.

Kabwe Mine is located approximately 130 km north of Lusaka and was once southern Africa's largest producer of lead (Pb) and zinc (Zn) for almost a century prior to its closure in 1994. On closure, a significant legacy of environmental impacts remained, the most critical being Pb contamination. The KSDS was incorporated into the CEP to fully define this hazard, and formulate a plan for rehabilitation of the mine site in compliance with ZCCM-IH's legal commitments under national environmental legislation.

Area of project coverage: Phase 1 of the KSDS was executed during the period July 2004 to June 2005. It involved an evaluation of the effects of historical mining activities on environmental quality in all of Kabwe's principal residential areas. Obvious areas of concern included the former mine townships of Chowa and Kasanda (located adjacent to the mine site), in addition, areas of low density housing more distant from the mine, such as Luangwa, were also included in the investigations. Large unplanned settlements have evolved to the east (Katondo) and west (Makululu) of the mine, together accounting for one third of Kabwe's total population. These areas were considered as key focus area for the KSDS due to their size and level of inherent vulnerability.

Status of environmental contamination in Kabwe: Surveys were undertaken to define spatial trends of contamination by Pb and a range of other metals in Kabwe's soils, areas of mine waste deposition, surface water, groundwater, domestic and market crops and atmospheric particulates. These surveys essentially provided the database which permitted clarification of the relative significance of different environmental media as sources of Pb exposure to Kabwe's residents.

Soil contamination: Results indicated that soils over a substantial area were highly contaminated with Pb. Median concentrations of Pb in soils in Kasanda (3,008 mg/kg), Makandanyama (1,613 mg/kg), Chowa (1,233 mg/kg), Mutwe Wansofu (1,148 mg/kg), Makululu (870 mg/kg) and Luangwa (507 mg/kg) all exceeded levels generally regarded as acceptable by international standards.

Monitoring of the concentration of Pb in atmospheric particles of a size sufficiently small to be inhaled (PM10) confirmed the presence of dust hazards in several locations. The highest atmospheric Pb concentrations were recorded in Kasanda due to close proximity to the mine.

Contamination of crops: The results of crop analyses demonstrate that crops grown in the Kabwe area tend to contain Pb concentrations which are in excess of the typical global range. Human exposure to Pb through consumption of locally produced crops is therefore likely to be more strongly influenced by the method of preparation (thoroughness of washing) than by provenance.

In certain areas, re-habilitation through re-vegetation of tailing dumps has been undertaken

Rehabiltation through re-vegetation of old tailing dumps in Kitwe south-west area.

Source: Imasiku Nyambe

There has been increased public awareness on the potential benefits and impacts of mining operations. This is evidenced by the increased public outcry in the vicinity of certain mining operations e.g. due to periodic discharge of effluent leading to contamination of watercourses.

6.5 Conclusion

Zambia has abundant mineral wealth which include metals, gemstones, industrial and energy minnerals. Copper and cobalt have continued to dominate the mining sector. The sector has continued to record postive contibution to the national economy as evidenced in GDP and export earnings. The impacts of mining on the environment include water contamination, air pollution and land degradation. As a result, there is need to strenghtehn the regulatory framework and environmental management in order to promote sustainable deveelopment.

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CHAPTER 7
SETTLEMENTS

A settlement is a place where people live which could be a homestead, village or town. These places can be classified into rural and urban. Most rural areas are characterized by huts lying apart from each other in what could be described as dispersed settlements while urban areas have improved housing units and other infrastructure and are usually nucleated or clustered (Richard, W 1980).

The main issues in Zambia associated with settlements are migration, housing, waste management and sanitation. They pressures and drivers for settlements are poverty, population growth and income levels. Specific drivers related to migration are urbanisation11, industrialisation and socio-economic opportunities.

7.1 Migration

Migration is the movement of people from place to place and across administrative boundaries for the purpose of changing their previous place of residence (CSO, 2004). It is generally associated with higher income and literacy, improved health and quality of life, and other benefits. These benefits, however, are accompanied by environmental and social impacts ranging from lack of access to clean drinking water to pollution.

Table 7.1 shows the surveyed reasons for individual migration according to age groups.

Reason For Migrating	Age Group									
	0-11	12-19	20-24	25-29	30-39	40-49	50-59	60-64	65+	All Zambia
For School	2	6	4	3	1	1	0	10	4	3
Back From School/Studies	0	1	2	1	0	0	0	0	0	1
To Seek Work/Business	1	2	7	17	5	10	18	3	0	5
To Start Work/Business	2	2	6	12	11	13	9	19		6
Transfer Of Head Of Hhd	34	24	16	18	21	25	22	7	15	25
The Hhd Could Not Keep Him	5	8	3	2	1	0	0	3	40	5
Death of Guardian	5	8	3	1	1	2	5	0	5	4
Got Married	0	4	10	9	3	1	0	0	0	4
New Household	3	2	7	4	2	2	2	5	0	3
Retirement	0	0	0	0	0	0	3	4	1	0
Retrenchment	0	0	0	1	1	0	0	0	0	0
Decided To Resettle	17	17	18	15	22	21	16	24	4	18
Acquired Own /Different Accommodation	4	5	5	7	8	7	5	0	1	6
Found New Agric Land	5	3	6	3	9	1	1	18	0	5
Other	20	19	13	8	15	15	20	6	30	17
All Zambia	100	100	100	100	100	100	100	100	100	100

*Source: CSO 2006 (*hhd Household)*

[11] Urbanization is a process by which the world is progressively becoming a more urban society with a shift from more rural and agricultural forms of living (Hebert 1972).

People migrate for different reasons and these may vary from place to place. In 2006, 25 percent of people migrated because the head of the household was transferred, 18 percent because of resettlement while retirement and retrenchment were the least as indicated in Table 7.1.

A comparison with 2004 statistics also showed that most people migrated owing to the transfer of the head of household accounting for 25 percent, whereas, the number of people migrating because of resettlements increased from 16 percent in 2004 to 18 percent in 2006. The age group 0-11 were more affected due to dependency on their head of household.

Further analysis showed that Copperbelt Province had the highest proportion of households that moved from one urban area to another at 77 percent while Western Province had the least at 10 percent. The proportion of rural to rural migration of households was highest in Eastern Province with 57 percent, whereas Copperbelt Province recorded the lowest at 5 percent. Table 7.2 presents details of Rural/Urban Households migration in Zambia.

Table 7.2: Rural/Urban Household Migration, Zambia, 2006

Direction of Migration (Moved From)	Province								
	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	North Western	Southern	Western
Rural to rural	39	5	57	33	6	46	17	50	51
Rural to urban	28	7	18	44	8	34	29	26	29
Urban to Rural	10	11	8	9	18	6	25	7	10
Urban to urban	23	77	18	14	68	15	29	17	10
All Zambia	100	100	100	100	100	100	100	100	100

Source: CSO, 2004

Despite the number of people who migrate seeking economic opportunities such as employment, the formal sector is unable to absorb the influx of people leading to a substantial number engaging in subsistence activities or informal jobs. The high unemployment levels contribute to social vices such as increased crime, drug abuse and prostitution.

Increased urban population to proportions beyond the absorptive capacities of urban areas has contributed to inadequacies in the country's provision of basic services such as housing, education, health, energy and other services. Increased demand for land also encourages encroachment into forests and other protected areas. In addition, changes in consumption patterns resulting in increased generation of waste which is not marched with infrastructure to manage the waste exacerbates the spread of communicable diseases such as cholera, dysentery and typhoid.

7.2 Housing

Adequate and decent housing plays a fundamental role in health promotion and the quality of life of humans. The shortage of housing and urban services has persisted as the country continues facing effects of urbanisation. Out of the total housing stock in Zambia, only 31 percent meet the minimum development and health standards. 69 percent is non-compliant to housing standards and are poorly serviced.(MoH, 2001)

Houses in a peri-urban area

Source: NWASCO

The prevailing levels of poverty in the country have not enabled many to afford decent housing structures. The biggest share of the urban population resides in the low-cost (20 percent) and peri-urban areas (60 percent). In rural areas, some settlements have been developed in disaster prone areas e.g. over-flooding, persistent drought or destruction of crops by wild animals and therefore increase the possibilities of environmental hazards and risks. (MoH, 2001)

In 1991, the total national housing stock was estimated at 1,501,898 and increased to 2,311,988 in 2001. This reflects dismal performance in the distribution of housing stock which shows that more houses are in informal, poorly serviced or not areas not serviced at all as highlighted in Table 7.3.

Table 7.3: National Housing Stock

Housing Type	1991		2001
	No. of Houses	percent of total stock	No. of Houses
Traditional	988,249	65.8	1,527,301
Squatter	160,703	10.7	242,771
Site and Service	58,574	3.9	87,743
Low cost	241,806	16.1	381,498
Medium cost	24,532	1.7	32,369
High cost	26,034	1.8	39,306
Total	**1,501,898**	**100**	**2,311,988**

Source: NHA, 2001

The most common type of housing are traditional huts at 46 percent followed by improved traditional and detached houses at about 20 percent each. The development of housing in

the country has been underplayed by inadequate government investment in the sector, particularly low cost housing and few programmes are available to facilitate access to low interest housing loans. In addition, the following characterise the sector:

a. Due to the high levels of poverty, majority of Zambians cannot afford decent housing, resulting in the proliferation of unplanned settlements.
b. Low cost housing has been regarded as high risk business both in transferability and in security of tenure;
c. The insufficiency in the housing stock has resulted in residents renting out rooms on a large scale which has led to mushrooming of informal structures, often built on reserved space between premises (service lanes);
d. Inadequate planning for settlements has resulted in inadequate infrastructure for services such as WSS, roads, storm water drainage, electricity, etc.

7.3 Waste Management

Waste, as defined under the EPPCA, is garbage, refuse, sludge, and other discarded substances resulting from industrial, commercial, domestic and community activities.

Box 7.1: Classes of Waste

Waste that does not pose an immediate threat to man or the environment, i.e. household waste, construction and demolition, garden waste and certain dry industrial and commercial waste. It may, however, with decomposition, infiltration and percolation, produce leachate with an unacceptably high pollution potential.

Types of General Waste
General waste may be divided into the following main categories:

1. Municipal Solid Waste
   a) **Domestic waste:** comprises mainly of wastes that are generated from household activities. This normally includes such materials as waste paper, plastics, and wood off cuts, kitchen waste and yard waste.

   b) **Commercial waste:** is generated from commercial and business houses and normally consists of such materials as discarded office paper, cardboard, plastic and general packaging waste.

2. Industrial Waste
   This is generated from industrial production processes. Types in this category include such wastes as industrial sludge from factories, manufacturing facilities, refineries; food processing waste, and water treatment filter cake sludge, from industrial combustion processes and waste from mining activities. The subtypes associated with mine waste are Overburden, Waste Rock, Tailings and Slag.

3. **Hazardous waste:** Waste that can, even at low concentrations have a significant, adverse effect on public health and/or the environment. This may be because of their inherent physical and chemical characteristics, such as toxicity, corrosiveness, carcinogenic, flammability, explosive, poisonous.

   These include waste such as wastes containing heavy metals like lead and chromium, polychlorinated biphenyls (PCBs), asbestos and ink sludge. Other types include, lead acid batteries, waste oils, certain waste streams from health care facilities and agricultural waste, which basically consists of pesticide-containing wastes remains.

The rapidly increasing quantities of waste generated due to industrialization, population growth and inadequate investment in infrastructure has become a major concern for the country. The introduction of new consumer products on the market has also contributed to the problem of waste management in Zambia.

Waste generated in a community

Annual general waste generation in Zambia, as at December 2006 was estimated at 2,000,000tonnes with about 20percent of the waste generated was disposed of at designated disposal sites. (Source: 0.5kg/capita/day SoE, 2000). The number of disposal sites licensed by ECZ increased from 18 in 1994 to 125 in 2006 as shown in Table 7.4. Out of the country's 72 Districts, only a total of 16 districts had licensed municipal waste disposal sites. This situation indicates that waste management is still a challenge for LAs. However, despite this trend, other district councils such as Lusaka City Council (LCC) improved waste management e.g. the amount of waste disposed of at designated sites increased from 15percent in 2003 to 40percent in 2006.

Table 7.4: Licensed Transporters of Waste and Operators of Waste Disposal Sites (Hazardous and General waste) from 1994 -2006.

Year	No. of licensed General waste Transporters	No. of licensed General disposal sites	No. of Hazardous Waste Transporters	Hazardous Waste Disposal Sites/Generation/ Storage/ Treatment	Total No. of licences issued
1994	43	18	-	-	61
1995	78	56	-	-	134
1996	54	68	-	-	122
1997	86	100	-	-	186
1998	62	62	--	-	124
1999	88	67	-	-	155
2000	102	65	-	-	167
2001	127	103	-	-	230
2002	131	92	06	05	234
2003	111	106	06	14	237
2004	132	102	25	33	292
2005	132	137	43	98	410
2006	150	125	48	164	378

Source: ECZ, 2006

Four main methods of waste disposal are practiced by households in Zambia and these are: waste collected through municipal waste management systems; indiscriminately disposal; waste disposed of in pits; open burning of waste and other methods such as recycling and reuse. The common methods used in the disposal of waste per household are shown in Table 7.5.

Table 7.5: Percent Distribution of Households by main Type of Waste Disposal, Rural/Urban Stratum and Province, 2004

Residence/Stratum /Province	Refuse Collected	Pit	Dumping	Burning	Other	Total number of Households
All Zambia	4.8	59.8	33.6	1.5	0.4	2,110,640
Rural	1.5	56.5	39.6	1.9	0.5	1,288,064
Urban	10.1	64.9	24.1	0.8	0.1	822,575
Stratum						
Rural Small Scale	1.5	56.2	39.9	1.8	0.5	1,155,838
Rural Medium Scale	1.6	71.2	24.3	2	0.9	43,311
Rural Large Scale	4.5	64.9	24.4	5.5	0.7	3,569
Fish Farming	-	88.5	11.5	-	-	1,620
Rural Non Agric	0.9	52.8	43.7	2.4	0.2	83,726
Urban Low Cost	8.5	62.7	27.8	0.9	0.1	593484
Urban Medium Cost	12.2	71.3	16	0.3	0.2	143,394
Urban High Cost	17.4	70.1	11.5	0.9	0	85,697
Province						
Central	2.4	68.7	26.9	1.8	0.1	207194
Copperbelt	10	64.9	23.7	1.2	0.1	311,712
Eastern	2	53.5	42.3	1.4	0.8	290,224
Luapula	1.3	70.6	27	1	0.1	171,659
Lusaka	12.4	57.4	29.3	0.9	0.1	309,949
Northern	2.5	74.9	21.5	0.6	0.4	275,266
North Western	2.4	57.4	38.6	1.5	0.1	125,814
Southern	2.5	47.9	47.1	1.7	0.9	252,423
Western	1.2	36.9	57	4.3	0.6	166,219

Source: CSO, 2004

Table 7.5 indicates that the management of waste in the country remains a big challenge. Scavenging and open air burning of waste is a common scenario in many districts. The number of disposal sites has not matched the amount of waste generated by many LAs in the country. Table 7.6 shows the distribution of solid waste disposal sites in the country as at 2006.

Table 7.6: Licensed Waste Disposal Sites as at 2006

Owner of Facility	Location	Type of Waste
Konkola Copper Mines (Nampundwe)	Mumbwa	Industrial Waste
Mopani Copper Mines	Mufulira	Industrial Waste (TD3 sinkhole)
Mopani Copper Mines	Mufulira	Municipal Solid Waste and In dustrial Waste (TD11)
Chambeshi Metals	Chambeshi	Industrial Waste
Copperbelt Forestry Company	Kitwe	Industrial Waste, Kafubu plant
		Industrial Waste, Kariba plant
Copperbelt Solid Waste Management	Chingola	Municipal Solid Waste
Company	Chililabombwe	Municipal Solid Waste
	Mufulira (Airport Road)	Municipal Solid Waste
	Luanshya	Municipal Solid Waste
	Ndola	Municipal Solid Waste
	Kalulushi	Municipal Solid Waste
	Kitwe	Municipal Solid Waste
NFC	Chambeshi	Industrial Waste
Kansanshi	Solwezi	Industrial Waste
Chilanga Cement	Ndola	Industrial Waste
Chilanga Cement	Kafue	General waste
Tap Zambia Limited	Kafue	Hazardous waste (Asbestos waste)
King Quality Leather	Kafue	Industrial Waste
Lusaka City Council	Lusaka	Municipal Solid Waste
Livingstone City Council	Livingstone	Municipal Solid Waste
Siavonga District Council	Siavonga	Municipal Solid Waste
Serenje District Council	Serenje	Municipal Solid Waste
Kalomo District Council	Kalomo	Municipal Solid Waste
Choma District Council	Choma	Municipal Solid Waste
Monze District Council	Monze	Municipal Solid Waste
Sesheke District Council	Sesheke	Municipal Solid Waste
Zambia Sugar Limited	Mazabuka	Municipal Solid Waste and Industrial Waste
Mediterranean Mining Limited	Chongwe	Municipal Solid Waste and Industrial Waste
ZESCO Limited	Kafue	Municipal Solid Waste

Source: ECZ, 2006

ECZ regulates management of waste generated by mining companies with a total of 69 decommissioned, 45 active and 5 inactive waste disposal sites being licensed in 2006. These included tailings dumps, waste rock dumps, slag dumps and overburden dumps.

In order to promote the potential value of waste, recycling of waste such as paper, metal and plastics has been taking place. However, the quantities of waste recycled remain marginal. Table 7.7, indicates quantities of paper and plastic recycled in Zambia in 2005 and 2006. Note that a significant percentage of waste collected for recycling was exported to Zimbabwe and South Africa.

Table 7.7: Quantities of Plastic and Paper waste Recycled in Zambia, 2005-2006

Type of Material	Amount Recycled	Material Destination
Paper	2005 (2400 tonnes	75percent exported for recycling (ZIM. & RSA)
	2006 (4800 tonnes)	90percent exported for recycling (ZIM. & RSA)
Plastic	2006 (72 tonnes)	All consumed locally
Total Waste Recycled		

Source: ECZ, 2006, Unpublished

With regards to hazardous waste, a total of 212 licenses for facilities generating, storing, transporting, exporting and/or operating hazardous waste disposal sites in Zambia (ECZ, 2006).

Health Care Waste (HCW), which includes certain streams of waste generated by health-care facilities, research facilities and laboratories, has become another concern for the country. It includes waste originating from "minor" or "scattered" sources such as that produced in the course of health care undertaken in the home (dialysis, insulin injections, etc.). The different HCW streams generated in Zambia are summarised in Table 7.8.

Management of HCW continues to be a challenge

Table 7.8: Types of Health Care Waste Generated in Zambia

Type of waste	Description
Chemical waste	Waste containing chemical substances such as laboratory reagents, film developer, expired disinfectants or those, which are no longer needed.
Genotoxic waste	Waste containing properties of genotoxic chemicals and cytotoxic drugs (used in cancer therapy).
Infectious waste	Waste suspected to contain pathogens such as laboratory cultures, waste from isolation wards, tissues/swabs, and equipment that have been in contact with infected patients (usually account for 15-20percent hospital waste).
Non hazardous waste	Waste containing domestic substances such as paper, leftover foodstuff and this usually account for 80percent of hospital waste.
Pathological waste	Waste-containing human tissues or fluids such as body parts, blood and other body fluids, sharps (needles, infusion sets, scalpels, knives, blades and broken glass).
Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceuticals that are expired or no longer needed items contaminated by or containing pharmaceuticals (bottles, boxes).
Pressurized containers	Gas cylinders, gas cartridges and aerosol cans.
Radioactive waste	Waste containing radioactive substances such as unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, absorbent paper, saws, urine, vomitus and excreta from patients treated with unsealed radio nuclides and sealed sources.
Sharps	Needles, infusion sets, scalpels, knives, blades and broken glass.
Waste with high content of heavy metals	Waste inclusive of batteries, broken thermometers, residues from dentistry and blood- pressure gauges.

Source: WHO, 1999

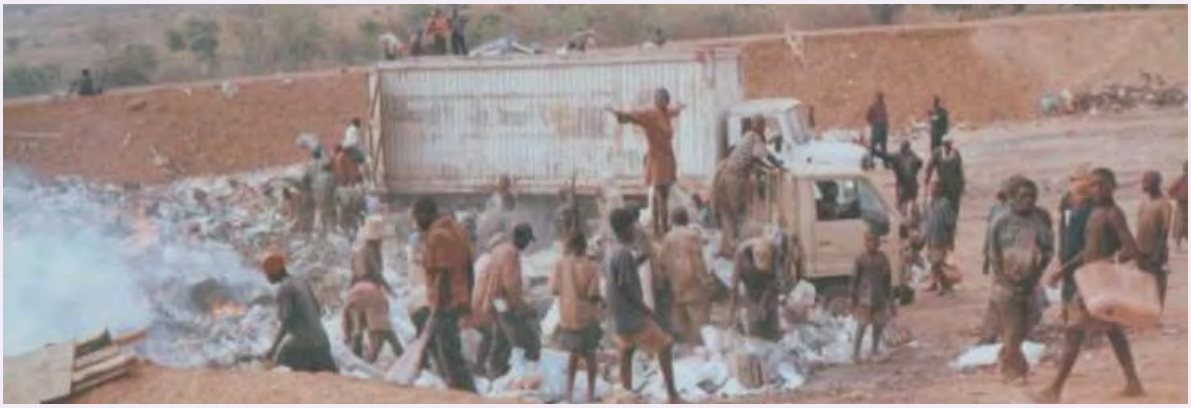
Table 7.9: Estimate of HCW Generation

Type of health care facility	No. health care facilities	No. of beds per each type of health care facility	National estimated waste generation in kg/ patient day		
					Total estimated waste
Big and specialized hospitals	9	16,988			42,470
Small or medium size clinics	1187	11,502			23,241.4
Total	**1196**	**28,490**			**65,711.4**

Source: MoH, 2004

Table 7.9 shows that approximately 66,000 tons of both HCW and general/communal waste is generated daily countrywide (MoH, 2004). The bulk of this waste is disposed of indiscriminately. This is due to low levels of awareness of related infections, especially during disposal. Further, facilities available for disposal of this waste are either inadequate or the technology inappropriate.

Scavenging of waste disposal sites is a common practice in Zambia.



Source: Musonda, A

The disposal of wastes at dumpsites may result in contamination of soil and ground water from leachate produced as waste materials decay as it contains heavy metals and ammonia. Pollutants in the leachate such as nitrates may cause eutrophication of surface waters in surrounding areas.

These sites also generate toxic and hazardous gases as a result of the biodegradation of organic matter. Methane, one of the main components of landfill gases, is explosive at higher concentrations in air. Other gases such as hydrogen sulphide are toxic. Two key landfill gases (Carbon dioxide and Methane) also contribute to the greenhouse effect.

Indiscriminate and open air burning of waste in Lusaka

Source: ECZ

Figure 7.1 refers to the WMDs. However, as at 2006, only 40 percent of waste is collected, this reflects high levels of illegal disposal.

Box 7.2: Management Waste in Lusaka City

The general trend has been that it is the responsibility of the Government through its local government system to provide the service of waste collection. However, there has been a paradigm shift as the private sector has joined in the provision of this service as an inducement of the demand-driven type of service. Lusaka, for example, recorded collection levels of 29 972 tonnes by the local authority and 49 341 tonnes by franchise contractors for the period January to December 2005. (WMU, 2006) This in essence indicates that the role being played by the private sector is highly significant.

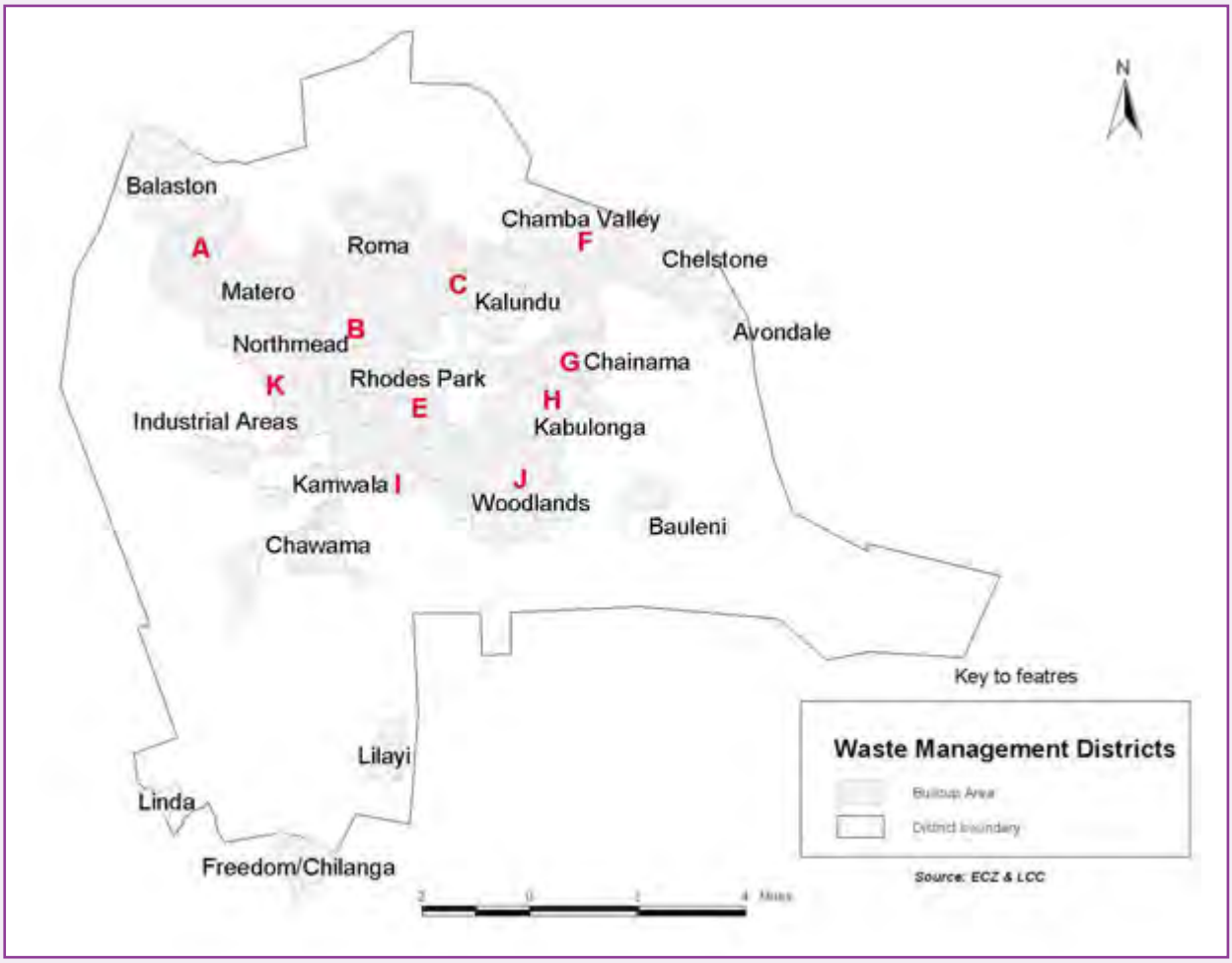
In addition, there have been new approaches in the peri urban areas of Lusaka where Community Based Enterprises have been established to assist with primary collection of waste. Secondary Collection is done by the LA through modern equipment procured with the assistance of DANIDA. In the peri-urban areas, waste collection is conducted using different waste collection systems. LCC has been encouraging the formation of Waste Management Committees

to be responsible for the day to day management of the waste management system in that area. In 2003, LCC produced a Strategic Plan for Municipal Solid Waste Management for the City. Through this plan, two new waste management systems were developed to serve the conventional and peri-urban areas. To support the new waste management system, the LCC elaborated the Municipal Waste Management By-Law. Under this law, all waste generators in the city have to register with their respective waste management companies, utilize their services and pay the corresponding fee.

For conventional and commercial areas, LCC entered into partnership with private waste management companies. This has resulted in division of the city into 12 waste management districts given below and illustrated in figure.9.3 below:

A Barlestone, Matero, Lilanda
B Emmasdale
C Chudleigh, Kalundu, Olympia Park, Olympia Extension, Roma
D Kamwala Commercial Area, Central Business District, Thorn Park, Villa Elizabetha
E Longacres, Northmead, Rhodes Park
F Chamba Valley, Chelstone, Chudleigh
G Avondale, Chainama, NRDC
H Handsworth, Ibex Hill, Kabulonga, Sunningdale, Helen Kaunda
I Arakan, Kabwata, Kamwala, Libala, Madras, Ridgeway, UTH, Chilenje
J Nyumba Yangam, State House, Woodlands, Woodlands Extension, Industrial areas (Light and Heavy)
L Barclay, Lilayi, Makeni

Figure 7.1: Designated Waste Management Districts in Lusaka



Waste Collection Truck in Lusaka

Source: ECZ

Construction of an Engineered Sanitary Landfill in Lusaka

LCC has developed a waste management system which includes the construction of a sanitary landfill with a life span of over 20 years

Construction of the Lusaka Sanitary Landfill

Source: ECZ

Chunga Landfill in Lusaka

Source: ECZ

7.4 Sanitation

Sanitation is the process of collection, treatment, and disposal of human excreta and domestic waste, in a safe and hygienic manner, which is affordable and sustainable. (ECZ,2001). It has been estimated that approximately 80percent of preventable diseases in Zambia are related to poor sanitation (MoH, 2001).

Whilst there are piped water supply systems that are operational in most parts of the country, this is not the case for sewerage systems. Many off-site sanitation systems, are either in poor condition or non-functional. It should be noted, however, that these functional and non-functional systems only serve a minority of the total urban population. The Zambia Demographic and Health Survey (ZDHS) report of 2002 revealed that most households in Zambia (53 percent) use traditional pit latrines. Flush toilets are mainly found in urban areas and are used by 42 percent of households compared with 2 percent in rural areas. Table 7.10 summarizes the Percentage Distribution of Household Sanitation according to Residence.

Table 7.10: Percentage Distribution of Household Sanitation according to Residence

Sanitation Characteristics	Urban Coverage (%)	Rural Coverage (%)	Total (%)
Flush Toilets	42.3	1.9	15.7
Traditional Pit latrine	49.9	54.6	53
VIP	2.5	1.0	1.5
No facility/Bush/Field	4.9	42.5	29.6
Other	0.1	0	0
Missing	0.3	0	0.1

Source: CSO 2004

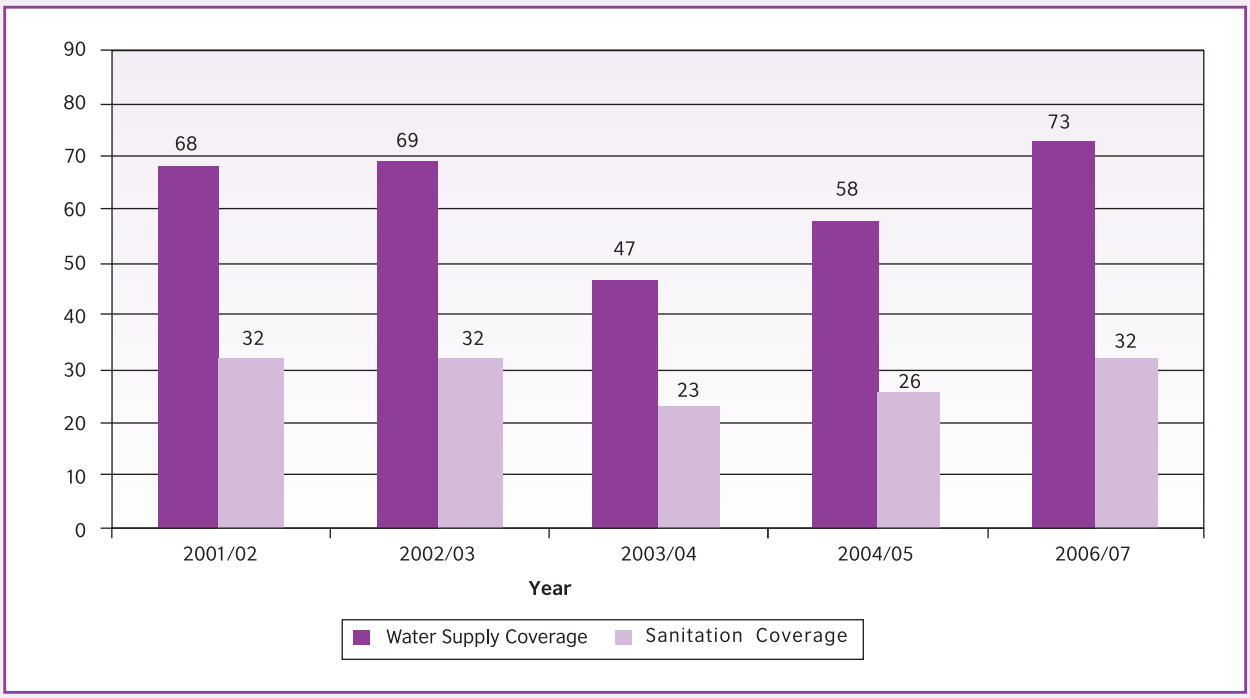
On-site sanitation is the most common form of excreta disposal in many areas. However, most houses in low density residential areas are connected to either the sewer line or to individual/communal septic tanks. In general, households in Zambia do not consider improvements to sanitation as much a priority as access to safe drinking water. (NWASCO, 2005)

There is a direct relationship between domestic water supply and sanitation. About 85 and 39 percent have access to safe water supply in urban and rural areas respectively (CSO, 2004). Although, Northern Province has a good network of rivers, access to safe water is still very low at 32 percent because the water supply infrastructure is not fully developed. The rate of water supply and sanitation coverage has remained quite low especially in peri-urban areas where 50 to 70 percent of the people in urban areas live. The national average of people with access to a pit latrine per household is 56 percent, 7.3 percent used communal latrines and 20 percent did not have any toilet facilities (CSO, 2004). Provinces with proportion of households with low access to water i.e. Eastern (26.4percent) and Southern (24.7percent) have the lowest sanitation coverage of 29.1 percent for Eastern and 27.4 percent for Southern.

Sanitation continues to be poor in many areas in Zambia

Source: NWASCO

Figure 7.2: Water Supply and Sanitation Coverage for urban and peri-urban areas (%)



Source: NWASCO, 2005

Figure 7.2 shows the trends in water supply and sanitation for urban and peri-urban areas from 2001/02 to 2005/6. These figures do not include rural areas. This presents challenges to provision of water supply and sanitation services particularly that the Vision, 2030 targets 100 percent coverage.

Sanitation coverage has remained low due to lack of investments and commitment to sanitation issues by service providers. Indicative figures and approaches show that there is more emphasis on water supply than on sanitation. Table 7.11 gives a summary of disparities that exist in commercial utilities in water supply and sanitation coverage.

Table 7.11: Water and Sanitation Coverage by Commercial Utilities

Commercial Utility	Water Supply (%)	Sanitation (%)
AHC-MMC	92	86
Lusaka Water and Sewerage Co.	79	9
Kafubu Water and Sewerage Co.	93	66
Northern Water and Sewerage Co.	62	41
Southern Water and Sewerage Co.	63	23
Mulonga Water and Sewerage Co.	86	85
Western Water and Sewerage Co.	47	26
North Western Water and Sewerage	15	14
Chambeshi Water and Sewerage Co.	39	10
Chipata Water and Sewerage Co.	69	30
Weighted Average	**58**	**32**

Source: NWASCO 2005

Many diseases are spread directly through contact with human excrement, indirectly through water, food and soil, or via carriers and vectors like flies, cockroaches etc. Research has shown that where proper excreta disposal is practised there is reduced incidence of diseases like Cholera, Typhoid and Paratyphoid fevers, Dysentery, Diarrhoea, hookworm disease, Bilharzia, and other similar intestinal infections and parasitic infections (WHO, 1958). Inadequate sanitation coupled with poor hygiene significantly contributes to the increase in environmental health related diseases as evidenced by outbreaks of Cholera (MOH, 2001).

Almost all-major urban centres in the country rely on outdated master plans which neither reflect what is obtaining on the ground nor provide the vision and framework for future development. The lack of up to date plans has resulted in uncoordinated and disorderly development and contribute to the establishment of unplanned settlements. To address these problems, the Town and Country Planning Act has been amended. The amendment simplifies the planning process and makes it responsive to the needs of the LAs. In place of master plans, there has been an introduction of structure plans which are strategic in character, less resource and time consuming to prepare and responsive to robust development trends. In line with this, Integrated Development Plans (IDPs) have been developed for Kafue, Mazabuka, Lusaka, Ndola and Luanshya. Other Interventions include:

1. Rural resettlement scheme aimed at improving service delivery to the people and creation of new settlements;
2. Reclassification of city boundaries;
3. MLGH has embarked on the process of upgrading unplanned settlements meeting the criteria for legislation under the Housing (Statutory and Improvement) Act Cap 194;
4. A National Housing Policy was adopted in 1996 with the overall aim of providing adequate and affordable housing to all income groups in the country. To this end, the Government liberalized the housing sector and provided an enabling environment to stimulate private investment in housing in order to provide more housing units to satisfy the ever increasing demand. Table 7.12 shows housing projects undertaken by the National Housing Authority and Zambia Low Cost Housing Development Fund Trust (ZLCHDFT)

Table 7.12: Housing Projects Development 2002-2004

Year	NHA	ZLCHDFT	MLGH
2002	413	176	-
2003	265	212	-
2004	186	-	21

Source: MoFNP, 2005

5. Regulatory Framework: EPPCA provides the requirements for handling waste through licensing the collection, transportation, treatment and disposal of waste. Subsequently, the Waste Management Statutory Instrument No. 71 and Hazardous Waste management regulations Instrument No. 125 were promulgated in 1993 and 2001 respectively. Other pieces of legislation which provide for legislation of waste management in Zambia include; Public Health Act of 1978, Local Government Act of 1991 and Mines and Minerals Act of 1995.

Although these pieces of legislation exist, the country faces a challenge of enforcement of these regulations. There is therefore, need to strengthen the capacity of the various institutions mandated with the responsibility of managing waste in Zambia.

6. The country has also ratified two international conventions on waste management. These are the Basel and Bamako Conventions. The Basel Conventions controls the trans-boundary movement of hazardous waste. The Bamako Convention bans the importation of hazardous waste into Africa and controls the trans-boundary movements and management of hazardous wastes within Africa. Other conventions ratified are the Stockholm and Rotterdam and the Montreal protocols on Ozone depleting substances.
7. In 2005, approximately 5 tonnes of PCB waste belonging to two (2) mining companies were transported for disposal to the Republic of South Africa.
8. The SADC PCB Project was implemented to facilitate a greater awareness of PCB issues within the SADC region and to catalyze efforts by enhancing national capacities for the environmentally sound management of Persistent Organic Pollutants (POPs).
9. A Strategic Approach towards International Chemicals Management (SAICM) has been developed. It provides a framework to achieve a stakeholder support effort to reducing dangers arising from chemicals and waste;
10. ECZ has been training industry in Cleaner Production (CP) by promoting the sound use of waste management practices. More than 140 personnel from industry in CP technologies and the dissemination of information to stakeholders who included decision makers from selected industry and government institutions (Table 7.13).

Table 7.13: Cleaner Production Success in Zambia's Industry

Training Programme	Number of Companies	Participants			Average Costs (USD)	Average Savings (USD)
		Institutions	ECZ staff	Industry		
CP1 (1998)	8	5	3	29	50,000	530,000
CP2 (1999)	16	2	4	30	450,000	1,180,000
CP3 (2000)	11	3	3	24	27,000	63,000
CP4 (2001)	9	3	2	21	47,000	65,000
CP5 (2002)	8	2	2	23	45,000	251,000
CP6 (2004)	5	2	2	16	5,000	12,000
CP7 (2004)	14	3	5	21	8,000	84,000
Total	**71**	**15**	**21**	**143**	**632,000**	**2,185,000**

Source: ECZ 2006

11. Encouraging community participation in waste management through new approaches such as establishment of Community Based Enterprises (CBEs) to assist with primary collection of waste has been conducted;
12. The National Solid Waste Management Strategy (NWMS) for Zambia has been developed to integrate approaches to addressing the problem of poor waste management in Zambia;
13. Development of Waste Oil Standard which incorporates the producer responsibility in managing waste oil generated in Zambia. This would result in Oil Marketing Companies (OMC's) bearing the responsibility of the waste oil that results from the use of their

products and also enable these OMC's to consider setting up recycling and or blending facilities in the country;

14. Development of the Technical Guidelines on the Sound Management of Health Care Waste (HCW) and Minimum Specifications for Health Care Waste Incineration to guide Health Care Facilities in managing health care wastes;
15. The government developed an Environmental Sanitation Strategy for Rural and Peri-urban areas in 1998 whose main objective is to improve national access to appropriate, acceptable and affordable excreta and domestic waste disposal facilities through sustainable approaches that are demand driven and promote hygiene behavioural changes that bring about health and the well being of the people;
16. The MLGH was restructured and a Department of Infrastructure and Support Services (DISS) established to look into infrastructure investment needs at national level for improved water supply and sanitation service delivery;
17. The Water Supply and Sanitation Act was enacted in 1997 which provided for the establishment of NWASCO. It provides for the establishment of sanitation utilities by LA's and also provide for the efficient and sustainable sanitation services under the general regulation of NWASCO. In addition, Ten commercial utilities were established by 2004 and performance indicators in the sub-sector are rising constantly;

7.5 Conclusion

Zambia is experiencing rapid urban growth which is placing a strain on infrastructure and other services such as housing, Water Supply and Sanitation (WSS) and land use patterns. Rural-urban drift is largely a result of urbanization. Industrialization has led to the transference of large numbers of people from rural to urban areas which are characterized by activities such as mining, manufacturing and trading.

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CHAPTER 8
EMERGING ISSUES

8.1 GENETICALLY MODIFIED ORGANISMS

Genetically Modified Organisms (GMOs) are organisms or cells whose genetic material has been deliberately manipulated to make them capable to produce new substances or perform new functions they would otherwise not do. Genetic material is material of plant, animal, microbial or other organisms containing functional units of heredity. Genetic engineering or recombinant deoxyribonucleic acid (DNA) technology is used to alter the genetic material. DNA is the molecule that generally encodes all genetic (hereditary) information. Advances in genetic engineering allow scientists to change the characteristics of living organisms or cells by transferring the genetic material from one organism and across species boundaries. As such, DNA technology allows the transfer of genetic material between organisms that would under normal circumstances, not be able to breed in any natural or laboratory setting. For instance, genetic material from humans has been inserted into a bacterium, Escherichia coli, so that the latter can produce human insulin. On the other hand, genetic material from fish (the winter flounder) has been inserted into tomatoes so that they can grow in colder conditions.

Central to the discussion of GMOs is the concept of biotechnology. This is defined as "the integration of biological and bioengineering sciences in order to enable the use of organisms, cells, enzymes and other derivatives". In addition, the Convention on Biological Diversity (CBD) defines biotechnology as “-any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or process for specific use”. There are three major concerns about the application of GMOs. These are:

i. the manner by which GMOs are produced or nature of genetic engineering itself;
ii. the acquired characteristics expressed by GMOs; and
iii. the consequences of releasing GMOs to the environment.

This is further compounded by limited knowledge and experience with GMOs. While genetic engineering promises benefits to society, its very nature raises ethical, social, environmental and developmental concerns. It also poses new regulatory challenges.

Proponents for genetic engineering are of the view that technology does not pose any significant risks or even any risk at all. Genetic engineering can contribute to increased food production through the development of food crops and animals with desirable properties such as pest resistance, herbicide resistance, drought tolerance, salt tolerance, improved nutritional profiles and the ability to manufacture chemicals more economically. GMOs can contribute to improved human and animal health through the production of inexpensive pharmaceutical and veterinary products, diagnostics, vaccines and other products to administer and deliver drugs. In addition, micro-organisms can be genetically engineered to breakdown wastes such as crude oil accidentally introduced to the environment and to purify water for both domestic and industrial use.

They can also be used to process mineral ores and to recover minerals from mine dumps.

Some public interest groups and scientists have highlighted the potential risks of genetic engineering. The main issues are related to conservation and sustainable use of biodiversity,

food safety, fair and equitable sharing of benefits from biodiversity and intellectual property rights. Biotechnology may also have implications for the ownership of food production and distribution systems and subsequently placing them under the control of a few industries.

Currently, there is insufficient data to adequately show the effects of GMOs on the environment. GMOs released to the environment could have adverse effects on biological diversity. Biological diversity is the basis of ecological stability which has been eroded due to industrialisation, urbanisation and over exploitative agricultural practices. The addition of novel adaptive traits to "wild-type organisms" could give some of them a competitive advantage and cause them to over-run natural communities of plants and animals, thus reducing both biological diversity and agro-biodiversity. Genetically modified plants may, for example, transfer genetic material and associated traits to wild relatives of traditional varieties, creating weeds thus threatening ecosystems and harming biological diversity. There is a risk that GMOs may reproduce to become dominant and displace others, thereby reducing the diversity of the breeding stock.

It is possible that genetic engineering will facilitate an even more rapid rate of loss of global agricultural and biological biodiversity. These impacts are of special concern to some developing countries, which are home to a large share of the world's biodiversity, an asset that, among other things, promises significant economic benefits. Most GMOs, especially crops are proprietary, and are owned almost exclusively by the private sector in industrialised countries. Many developing countries are concerned that companies from industrialised countries are patenting genetic material sourced from developing countries without sharing the benefits as required by the objectives of the CBD.

Modern plant and animal breeders including GMO development very often rely on the genetic diversity found in traditional varieties and breeds. These are selected, nurtured and conserved by people who know the unique qualities they possess. However, the contribution to commercial seed hybrids by indigenous varieties has not been rewarded or acknowledged.

Genetically engineered crops are herbicide resistant, as a result there is a tendency to use chemicals to kill weeds but this may cause harm non-target organisms. While these GMOs are promoted as a way to increase crop yields, they may reduce crop diversity by promoting monocultures. A number of concerns have also been raised with regards to the movement of genetic material across species boundaries. For instance when animal genes are placed in plants, it raises ethical concerns of vegetarians eating vegetables with animal genetic material.

Genetic modification may change the toxicity, nutritional value of food, and antibiotic resistance with implications for human and animal health. The safety of GMO food and feed has not been ascertained while the testing of GMO products is complex and expensive. Zambia does not have the required capacity for determining the safety of GMO food and feed. Genetically modified seeds and the associated herbicides are proving to be expensive and, consumers in developed countries indicate preference for non-genetically modified varieties.

In response to the to challenges posed by GMOs, a number of international and national instruments have been put in place to address this issue.

8.1.1 Agenda 21 (Earth Summit of 1992)

Chapter 16 of Agenda 21 recognises that biotechnology can not solve all the fundamental problems of environment and development. However, it could contribute to the sustainable development through increased food and feed production, health care and environmental protection. The chapter also recognises that maximal benefits from modern biotechnology can only be realised if it is developed and applied judiciously. It advocates for safety in biotechnology development, applications, exchange and transfer through international agreements based on risk assessment and management principles.

Principle 15 of the Rio Declaration states that "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". This is referred to as the "Precautionary Principle".

Box 8.1: Zambia Reaction to GMOs

Some countries in Southern Africa including Zambia experienced food shortages in 2001/2002 due to reduced harvest of food crops as a result of the reduced rainfall. In responding to the food crisis, the World Food Programme (WFP) offered Zambia food aid in form of maize. However, it was reported that some of the maize was GE and this was subsequently confirmed by WFP leading the Zambian Government to reject maize because of associated environmental concerns.

In order to advise the government on the issue of GE food aid, national consultation was spearheaded by three institutions namely the National Institute for Scientific and Industrial Research (NISIR), the National Science and Technology Council (NSTC) and the Ministry of Agriculture and Co-operatives (MACO). This culminated into a national public debate on GE foods and subsequently, a report recommending that the Zambian government should not accept GE food aid was produced. In addition, Zambian scientists undertook a fact-finding mission to the USA, South Africa, United Kingdom, Netherlands, Norway and Belgium and still recommended that the government employs the Precautionary Principle as provided in the Cartagena Protocol.

Article 11.8 of the Cartagena Protocol states that "Lack of scientific certainty due to insufficient relevant scientific information and knowledge regarding the extent of the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party of import, taking also into account risks to human health, shall not prevent that Party from taking a decision, as appropriate, with regard to the import of that living modified organism intended for direct use as food or feed, or for processing, in order to avoid or minimize such potential adverse effects."

Since Zambia, like most African nations, currently has no regulatory system and appropriate infrastructure to cope with the scientific assessment that is required before the deliberate introduction of GE products, the government was mindful of the uncertainty surrounding the safety of GE foods with regard to both human and animal health.

The health concerns were that GE foods might contain new food toxins, or new allergens and might increase antibiotic resistance because of the widespread use of antibiotic resistance marker genes in GE products. The environmental considerations were based on the concern of genetic contamination of traditional varieties as some recipients of the GE food aid would save some of it for planting since it came in the of form of grain. This could lead to the loss of agricultural diversity in Zambia. In addition, there were other mitigating factors, such as the worry that the Zambian agricultural exports to the world market could be adversely affected.

8.1.2 The Convention on Biological Diversity

Article 19 paragraph 4 of the Convention provides for Parties to "consider the need for and modalities of a protocol, including Advance Informed Agreement (AIA) in particular, to ensure the safe transfer, handling and use of Living Modified Organisms (LMOs) derived from modern biotechnology that may have an adverse effect on biological diversity and its components". LMOs referred to in the protocol are broadly equivalent to GMOs. This article was the basis of the negotiations that led to the adoption of the Cartagena Protocol on Biosafety.

Article 8 (g) of the Convention states that “each contracting Party shall, as far as possible and as appropriate establish or maintain means to regulate, manage or control the risks associated with the use and release of LMOs resulting from modern biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking into account the risks to human health”. This article requires Parties to the CBD to have national biosafety frameworks.

8.1.3 The Cartagena Protocol on Biosafety

The protocol is a legally binding international instrument that mandates Parties to establish national biosafety regulatory framework. The objective of the Protocol as stated in Article 1 is, “to contribute to ensuring an adequate level of protection in the fields of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements”. The Protocol sets out guidelines in the use of LMOs, with specific focus on transboundary movements. It features a set of procedures including one for LMOs that are to be intentionally introduced into the environment called the AIA procedure, and one for LMOs intended for use directly as food or feed or processing. In addition, Parties to the Protocol must ensure that LMOs are handled, packaged and transported under conditions of safety. Furthermore, the shipment of LMOs subject to transboundary movement must be accompanied by appropriate documentation specifying, among other things, identity of LMOs and contact point for further information. These procedures and requirements are designed to provide importing Parties with the necessary information needed for making informed decisions about whether or not to accept LMO imports and for handling them in a safe manner.

8.1.4 Biosafety Regulatory Frameworks

The government of the Republic of Zambia adopted the National Biotechnology and Biosafety Policy in August 2003 to guide the judicious use and regulation of modern biotechnology for the sustainable development of the nation with minimum risks to human and animal health as well as the environment. The policy is built on the Precautionary Principle and upholds the philosophy of case-by-case assessment of each application before the introduction of GMOs in line with AIA. Enactment of relevant legislation will establish a National Biosafety Authority (NBA) and Biosafety Advisory Committee(s) (BAC) and will constitute the institutional framework for the national decision-making and international co-operation on Biosafety.

8.1.5 International Trade and Genetically Modified Organisms

International trade is governed by agreements of the World Trade Organisation (WTO) aimed at reducing tariffs and subsidies in various sectors. Among the WTO Agreements is the "Application of Sanitary and Phytosanitary Measures (SPS Agreement)" which has a bearing on GMOs and international trade.

The SPS Agreement establishes that countries retain their right to ensure that the food, animal and plant products they import are safe. It also states that countries should not use unnecessarily stringent measures disguised as barriers to international trade. The SPS Agreement states that countries should use internationally agreed standards in establishing their requirements for sanitary and Phytosanitary measures. To meet this objective, three international standard-setting bodies are identified in the SPS Agreement. These are the Codex Alimentarius Commission for Food Safety, the International Office of Epizootics (OIE) for animal health and the International Plant Protection Convention (IPPC) for plant health. By using standards, countries can reach the level of protection needed to protect human, animal or plant life or health.

8.1.6 SADC Advisory Committee on Biotechnology and Biosafety

The Southern African Development Community (SADC) established an Advisory Committee on Biotechnology and Biosafety (SABBAC) with the aim of SABBAC of assisting Member States develop their capacity to detect and monitor GMOs. Recommendations on handling of food aid, policy and regulations, capacity building, public awareness and participation have been made.

8.2 INVASIVE ALIEN SPECIES

Zambia has a rich biodiversity comprising wildlife, plant, bird and fish species. However, biodiversity conservation is under threat from habitat destruction and Invasive Alien Species (IAS). IAS can be defined as species introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish themselves, invade, out compete natives and take up the new environments (UNDP 2001). They cause, or have the potential to cause, harm to the environment, economies and human health (McNeely et al. 2001)

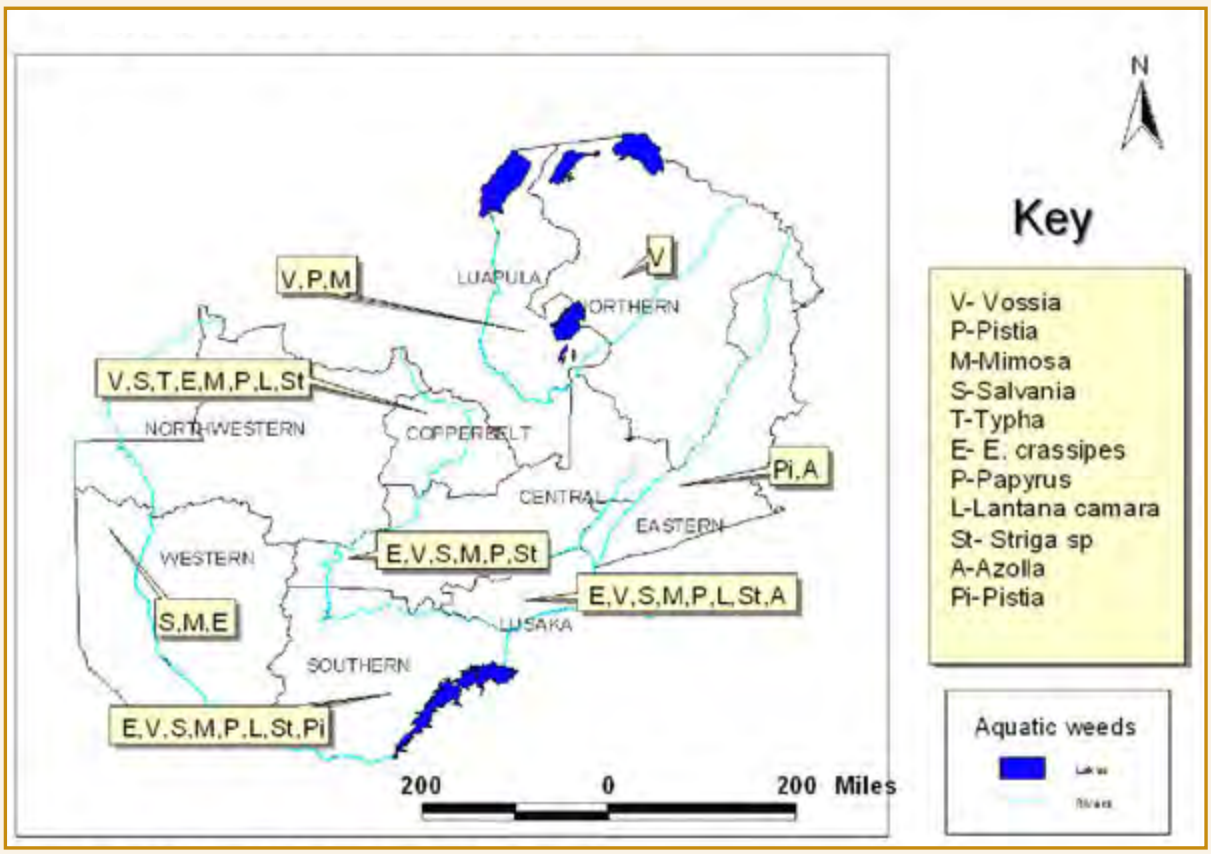
Figure 8.1 and Table 8.1 show the distribution of invasive plants in Zambia. Notable among these are aquatic and terrestrial species like Eichhornia crassipes, Salvinia molesta, mimosa pigra and lantana camara (NBSAP; 1999). The Kafue weed (Eichhornia crassipes) commonly known as the water hyacinth is the most problematic in Kafue River, Kafue flats and Maramba River (Livingstone) while Mimosa pigra is a threat at Chunga Lagoon in Lochnivar National Park covering 24percent of the area (Thomas 2007). The Kariba weed (Salvinia molesta) is problematic on Lake Kariba and Kafubu River in Ndola.

Table 8.1: distribution of invasive plants in Zambia

Water body	Aquatic weeds observed	Location
Lake Mweru	Vossia cuspidata	Luapula Province
Lake Mweru Wantipa	Vossia cuspidata	Northern province
Lake Tanganyika	Vossia cuspidata	Northern Province
Lake Bangweulu	Vossia cuspidata	Luapula Province
Luapula River	Vossia, Pistia, Mimosa	Luapula Province
Kafubu River	Vossia, Salvinia, Typha	Copperbelt Province
Kafue River	E. crassipes, Vossia, Salvinia, Mimosa pigra, Papyrus, Lantana camara, Striga sp	Copperbelt, Central, Southern, and Lusaka Provinces
Lukanga Swamps	None	Central Province
Mufulira Stream	E. crassipes	Copperbelt Province
Chongwe Stream	Azolla	Lusaka Province
Zambezi flood plains (near Mongu)	Salvinia, Mimosa pigra	Western Province
Zambezi River	E. Crassipes (in some areas	Western and Southern Provinces
Luangwa River	Pistia, Azolla Leuceana sp	Eastern Province
Luena River	Salvinia	Western Province
Maramba Stream	E. crassipes, Pistia, Azolla	Southern Province
Lake Kariba	E. crassipes	Southern Province
ZCCM Sewage ponds in the Copperbelt towns	E. Crassipes	Copperbelt Province
Water body	Aquatic weeds observed	Location
Lake Mweru	Vossia cuspidata	Luapula Province

(ECZ, 2001)

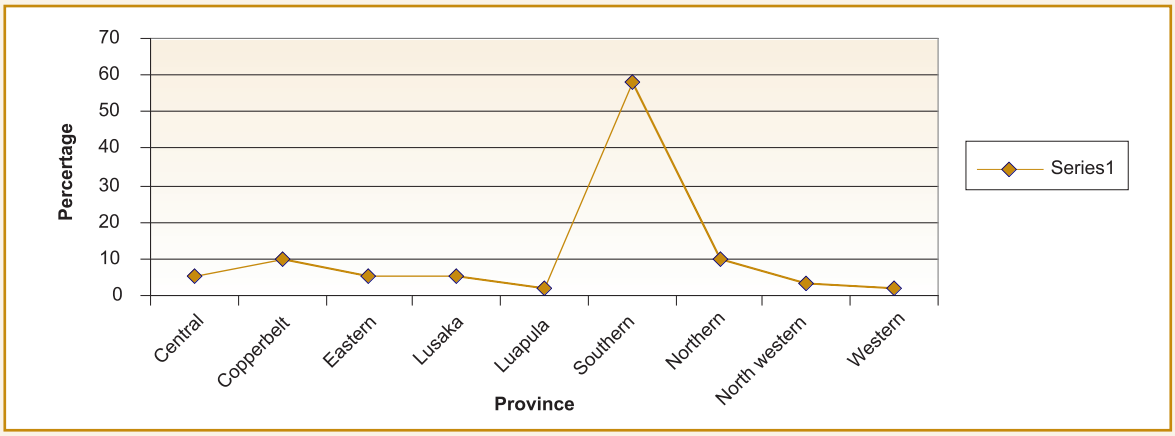
Figure 8.1: Aquatic weed distribution in Zambia



Source: ECZ

It is important to note that native species have the potential of becoming invasive as well. This usually occurs under altered environmental conditions such as overgrazing, presence of fires, changes in nutrient regimes and colonization by an invasive species. In many Zambian water bodies, the native water plant hippo grass (Vossia cuspidata) and the bulrush (Typha sp) and some acacia species have become invasive. The illustration in Figure 8.2 shows that 60percent of the infestation in Zambia occurs in Southern Province. This could be attributed to various factors ranging from eutrophication, persistent droughts and unsustainable agriculture practices.

Figure 8.2: Distribution of IAS in Zambia



(ECZ, 2006)

Fish introduction is a potential threat to local fish fauna, especially when introductions are unintentionally introduced through aquaculture. Although the impacts of this unintentional introduction have not been assessed, there are concerns regarding the potential effects as the species on the native aquatic biodiversity. Other IAS include Red Locust and Larger Grain Borer.

The driving forces of the proliferation of IAS are associated with pollution, desire for ornamentals resulting into intentional introductions. Table 8.2 outlines some of the pathways for the introduction of IAS.

Table 8.2: Some pathways for the introduction of IAS

Intentional Introductions		Unintentional Introductions Vessels/aircrafts/vehicles/trains, etc.
Direct Introductions into the Environment	Introductions into Captivity/Containment	
1. Agriculture 2. Forestry 3. Soil improvements 4. Horticulture (ornamentals, nursery stock, house plants, etc.) 5. Conservation 6. Fishery releases 7. Hunting and fishing 8. Biological control 9. Aid trade 10. Smuggling 11. Aesthetics 12. Medicinal 13. Religious	1. Botanical and private gardens 2. Zoos 3. Farmed animals 4. Beekeeping 5. Aquaculture 6. Pet trade 7. Aquarium and horticultural pond trade 8. Research 9. International mail	1. Sea cargo 2. Sea containers 3. Personal baggage/equipment 4. Agricultural produce 5. Seed contaminants 6. Soil, gravel, sand, etc. 7. Timber 8. Packaging material 9. Dirty equipment, machinery and vehicles 10. Aquaculture parasites and diseases) 11. Cut flowers stalks 12. Nursery trade

Kamweneshe: 2006

The spread of IAS in Zambia create complex and far reaching challenges that threaten biodiversity, food security, health and economic development. Direct and indirect effects are increasingly serious and the damage to nature is often irreversible.

8.2.1 Water Hyacinth

Water hyacinth proliferation on the Kafue river is attributed to a number of factors from surrounding areas such as runoff from agricultural estates; discharge of industrial effluent and sewage. This is further compounded by the lack of flushing of the river system at Itezhi tezhi dam due to low water levels and the absence of biological controls available in their natural environment. Water hyacinth forms a dense, impenetrable mat that clogs waterways and hydroelectric intakes, impacting on transportation, fisheries and many other water uses (Center et al. 2002).

Water losses through the evapotranspiration process are translated into lost water for power generation at Kafue Gorge and eventually into lost revenue for ZESCO. The 1750mm of water lost every year is equivalent to about US$15 million (estimated at US Cent 1.5/kwh at average local energy sale price). This means that on a monthly basis ZESCO was losing in excess of US$1 million due to the presence of this weed in the reservoir (Mwelwa. E. 1998).

Kafue Weeds

Mimosa Pigra

Source: ECZ

In Zambia Mimosa pigra has covered about 2 900 Hectares (6percent) of the Lochinvar National Park. Field observations also indicate that isolated pockets of colonization have spread across the entire Kafue flats wetland ecosystem, which is a Ramsar Site, an important bird area.

Drying up lagoon because of Mimosa invasion -LNP-2006 (Photo - Mauremootoo John)

Source: ECZ

The continued spread of the weed on the Kafue flats had significant impacts on biodiversity as well as tourism and livestock grazing. Most affected are the indigenous mammals and birds of the flood plain especially the Kafue Lechwe, an endemic marsh antelope that feeds primarily on the vegetation of the flats. The threatened Wattled Crane, which has its largest breeding population on the Kafue Flats has also been affected through the denial of access to vegetation by the mimosa invasion.

Mimosa has also had significant impacts on tourism in Lochinvar National Park by restricting access to the area, altering the scenery and reducing wildlife population in infested areas. (Shanungu. G. 2007).

The estimated cost to clear 2,900 hectares of Mimosa Pigra is estimated at ZMK2.5billion or US$625,000 in clearing of the IPS (ECZ; 2006). The nation would have saved resources and otherwise use it to other competing social sectors like health and education etc, if preventative measures were taken.

8.2.2 Lantana Camara

The problem of Lantana Camara was associated with urbanization and European settlements and farms in the 1950s.). Lantana disrupts access of livestock to grazing and water, interferes with farming and forestry activities and increases the intensity of bushfires. In Livingstone, lantana is displacing indigenous vegetation in the Mosi-oa- tunya National Park and affecting the aesthetic value of the Victoria Falls and surrounding gorges (SABSP;2004).

8.2.3 Red Locust

Red Locust invasions have devastating impact on the ecosystem and are a threat to food security. Locusts are capable of eating their own weight, in food, each day and a swarm can destroy up to 80,000 metric tone of food. The total economic cost of control campaigns are estimated around US$400 million for the country. Such extensive control campaigns centred on the use of large volumes of chemical pesticides have a multiplier effect as broad-spectrum chemical pesticides can kill a wide range of non-target organisms, including freshwater life and birds. Storage of these toxic compounds also presents hazards to farmers, livestock and the national at large.

8.2.4 Larger Grain Borer

The larger grain borer (LGB) beetle (Prostephanus truncatus) is a major pest of staple food commodities-especially maize grain and dried cassava. It causes huge losses at national and household level. It was introduced accidentally into Africa in the late 1970s and has had a major impact on food security. The earliest confirmed recordings of LGB in Zambia were in 1993 in the wider environment of Nakonde district on the border with Tanzania (Sumani; 1998). Apart from their devastating effect on maize grain, the inadvertent introduction of the LGB has had an economical and food security impact by reducing considerably the maize stocks. In addition the use of pesticides to control LGB also has negative impacts on the human health and environment.

Several responses to address the increasing effects of IAS in Zambia have been initiated and carried out. These include the use of biological, chemical and mechanical measures to control and manage IAS by a wide range of institutions among them Plant Quarantine and Phytosanitary Services (PQPS), ECZ, Forestry Department (FD), Zambezi River Authority (ZRA) and ZESCO Ltd.

In further responding to challenges of IAS management, a number of legal instruments to deal with this issue are in place. These include: the Forestry Act, Zambia Wildlife Act, Plant Pests and Disease Act, EPPCA, Noxious Weeds Act, Water Act, National Heritage Act, Fisheries Act, Local Government Act, and some international conventions/agreements where Zambia is party.

8.2.5 Conclusion

Given the high complexity of IAS issues in Zambia, the involvement of all relevant stakeholders is essential. There is pertinent need to intensify prevention, monitoring, mitigation and management measures. An integrated management approach to IAS involving a combination of mechanical, chemical and biological control measures is most appropriate.

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CHAPTER 9
SCENARIOS AND POLICY OPTIONS

The future is inherently uncertain and unpredictable. Despite the uncertainty of outcomes, forward looking analyses can be conducted. Scenarios are indispensable tools for environmental management that focus on large-scale, long-term interactions between development and environment (UNEP; 2006, 412). They are an outline of a natural or an expected course of events and are neither predictions nor forecasts. Rather, each scenario is one alternative image of how the future might unfold. Scenarios will vary considerably with the intended uses. They are useful tools for assessing either the future implications of current environmental problems or emergence of new problems. Scenarios have two particular advantageous qualities:

1. They provide a coherent framework for analysis of how various issues or sectors impinge on one another or interact and;
2. They serve as tools to foster creativity, stimulate discussion and focus attention on specific points of interest for policy on environment and development and for opening up a constructive analysis of future problems. (UNEP;2006, 412).

For these reasons, it is important that society considers the range of policies available and possible outcomes associated with alternative policy paths.

This chapter discusses possible scenarios within the context of thematic areas which are; Atmosphere, Biodiversity, Land, Mineral Resources, Socio-economics and Water Resources. The base year used for this report is 2000 and the time horizon is 2000 to 2030 in line with the country's Vision 2030.

The chapter provides qualitative and quantitative analysis using three scenarios namely the; (i) Business As Usual (ii) Policy Reform and (iii) Investment Scenarios.

In the **Business as usual Scenario,** an analysis of the current situation for each thematic area has been conducted using baseline data. The scenario recognises the various current interventions being undertaken to achieve sustainable development. Further, analyses of the consequences of not taking appropriate actions and their impact on the environment have been discussed.

The **Policy Reform Scenario** recognises that in order to achieve sustainable development in the country, there is need to develop policies that support economic growth and appropriate levels of service delivery. It proposes policies that need to be put in place and implemented to address specific and probable problems that arise in the various sectors. These include policies that support improved planning, service delivery, compliance to set regulations and leadership in environmental management. This scenario also acknowledges the need for active participation of stakeholders in national development.

In response to issues and policies identified in the Business As Usual and Policy Reform Scenarios, the **Investment Scenario** proposes investments required in the identified sectors to improve the country's socio-economic status. This scenario recommends economic and industrial growth, technological innovation, value addition and improved provision of resources as key elements to sustainable development.

9.1 Socio-economics

Scenarios for socio-economics focus on the following key issues: population growth, economic growth, provision and investment in basic services such as education, health, water and sanitation.

The size and growth rate of a population are an interplay of three main demographic factors namely fertility, mortality and migration. Other demographic factors such as marriage and social mobility also play significant roles in population and development (Population Policy; 2007). In addition, other emerging issues among them rapid urbanisation, gender inequalities, brain drain and HIV/AIDS are major obstacles to ensuring improved quality of life of the population.

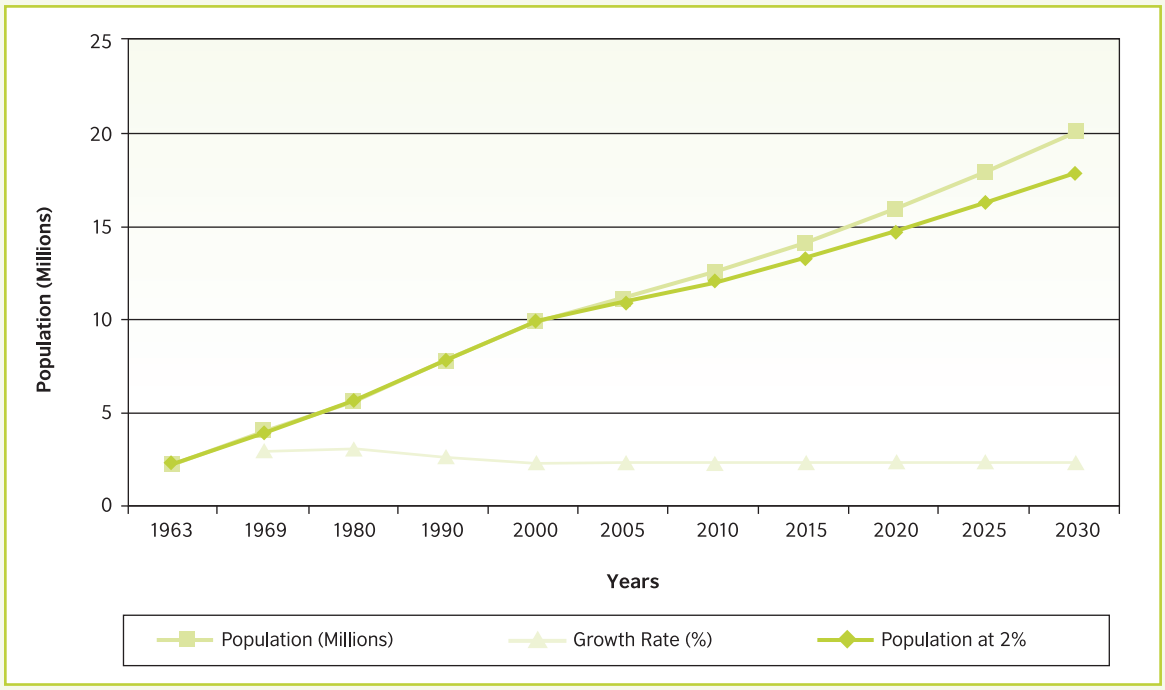
In Zambia, factors responsible for fertility level include cultural and institutional factors such as low age at marriage, low literacy levels particularly among females and high levels of infant and child mortality. Migration constitutes another important aspect of population growth. Rural-urban migration has been predominantly in response to perceived and actual employment opportunities in the cities and is selective with most migrants being young people.

Zambia's economic growth trends can be segmented into pre-market reform (1965-1992) and post-market reform (after 1993) eras. During the pre-market era, the economy grew at an average annual rate of 1.7 percent. The main sources of growth were industry, services and agriculture at 0.87, 0.58 and 0.27 percentage points respectively. In the post-market era, the economy grew at an average annual rate of 1.6 percent. The main sources of growth during the period were services, which accounted for 0.74 percentage points, industry at 0.52 percentage points and agriculture at 0.27 percentage points. In addition, provision of basic services i.e. education, health and clean water supply and sanitation has been inadequate particularly in the rural areas. For instance, access to clean water supply and sanitation at national level has been below 40 percent. The country also faces a challenge of brain-drain which has had a negative impact on delivery of services.

9.1.1 Business as usual Scenario

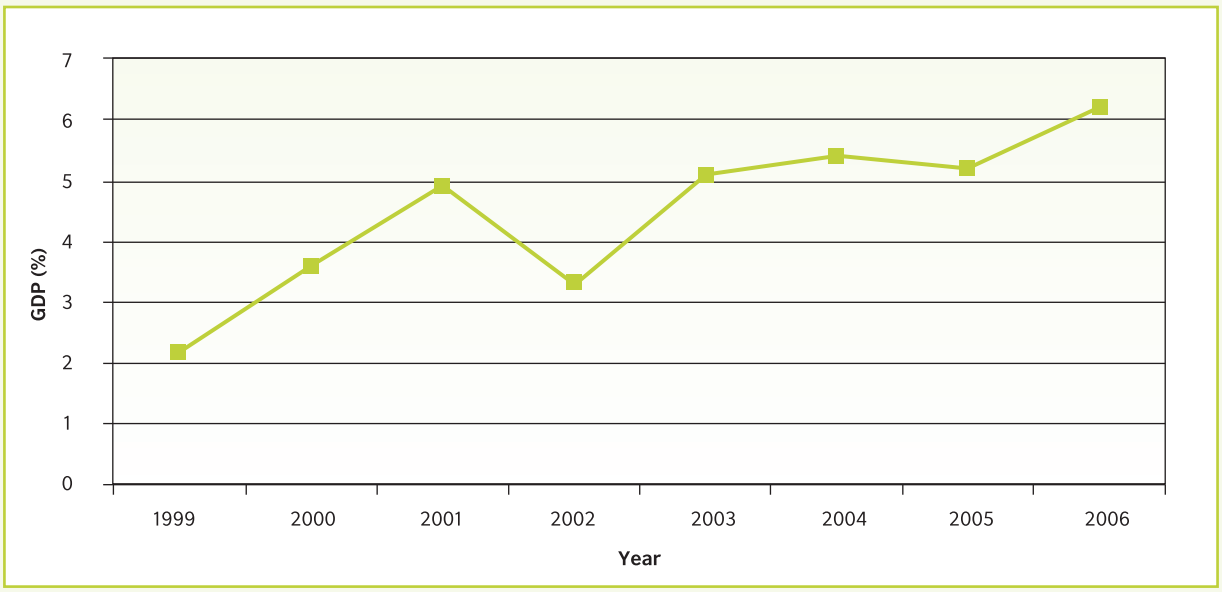
The population has been increasing. The growth rate was 3.1 percent between 1969 and 1980, 2.7 percent between 1980 and 1990 and 2.4 between 1990 and 2000 as shown in Figure 9.1. With an annual growth rate of 2.4 percent in 2000, the population was 9.9 million and is projected to increase to 14.1 million in 2015 and 20.2 million in 2030.

Figure 9.1: Population Growth for Zambia



The country has been experiencing low growth since the mid 1970s. This was largely due to the global economic slow down arising from oil crisis which affected production levels in advanced markets and consequently, reduced international copper prices. Zambia being a primary producer and exporter of copper was largely affected. After 1995, the economy underwent restructuring resulting in increased private sector participation in economic activities. The economic growth between 2000 and 2006 was at an average annual rate of 4.8 percent.

Figure 9.2: GDP Growth Rate



Zambia's major export commodity is copper, accounting for an average of 67 percent of annual total export receipts between 2002 and 2005. Copper prices have recorded an upward trend from US$0.61 per pound in 2002 to US$3.63 per pound in 2006. World commodity prices have been extremely unstable. Non-Traditional Exports (NTEs) are increasingly becoming an important source of Zambia's foreign exchange, employment and income for many rural households. However, value addition as a whole has been low.

In 2006, 64 percent of Zambians were classified as poor compared to 68percent in 2004. Amongst these, 51percent were extremely poor in 2006 while in 2004, the figure stood at 53 percent. Extreme poverty is more prevalent among female-headed households than poor male headed households. There was a drastic decline in urban poverty rate from 53 percent in 2004 to 34 percent in 2006. (LCMS;2006).

In the health sector, life expectancy at birth stood at 50years having dropped from 57years in 1990 and to 37years in 2006. This has been largely attributed to the high levels of HIV/AIDS in the country. Further, Infant mortality rate stood at 70 per 1000 in 2007, 95 per 1000 in 2002, a decline from the 1992 figure of 107 per 1000 and was at 109 in 1996. Maternal Mortality increased from 649 deaths per 100,000 in 1996 to 729 deaths per 100,000 births in 2002 and has reduced to 449 in 2007. The decrease has been attributed to a strong supportive environment for maternal health such as scaling up of the Prevention of Mother to Child Transmission (PMTCT), roll back Malaria programme and strengthened partnerships with communities in the provision of health care.

Malaria remains a leading cause of mortality and morbidity in the country. Incidence rate for malaria stood at 377 per 1000 in 2002 as compared to 255 per 1000 in 1990. However, mortality from malaria reduced from 48 per 1000 in 1996 to 42 per 1000 in 2002. Malaria is endemic throughout the country and continues to be a major public health problem especially among pregnant women and children below the age of five. In addition, HIV/AIDS has exacerbated mortality and morbidity in Zambia. The prevalence rate of 14.3 percent is high, and particularly affected is the age group between 15 to 49 years. The infection rate is higher in urban areas at 20 percent and 10 percent in rural areas. Similarly, the infection rate is higher among women at 16 percent as compared to men at 12percent.

With regards to education, an estimated 28.1 percent of the population has had no formal education. Of the total population, 2.5 percent completed Bachelor's degree or above, 10.9 percent senior secondary, 12.2 percent junior secondary, 24.5 percent upper primary and 21.6 percent completed lower primary. Further, 29.5 percent of females were currently not in school or have not had any formal education compared to 26.6 percent males. In addition, more males attained secondary school level or above than females (LCMS; 2006).

Access to safe and adequate water supply at national level remains a challenge. In 2006, 60 percent of households had access as compared to 57 in 1998 and 56.9 in 2004. Accessibility has been higher in urban areas than rural areas.

In the Business As Usual Scenario, it can be observed that the population is growing and putting pressure on the provision of basic services. Moreover, the high dominance of young persons in the nation's population poses economic challenges on the family and provision

of basic services in the nation. Despite the economic growth experienced from 2003, the current GDP growth rate is however less than the 7percent needed to make a significant impact on poverty reduction.

Trends in recent years indicate that although progress is being made in the provision of basic social services, there still exist disparities in service provision between urban and rural areas. Poverty levels are still high particularly in rural areas despite various interventions. It has also been observed that life expectancy of people has reduced, and this is largely attributed to high levels of HIV/AIDS, Malaria and other optimistic infections especially among pregnant women and children below the age of five. Provision of educational facilities remains poor due to increased pressure on education infrastructure, poor maintenance and increase in the number of school-going population as well as limited investment.

Therefore, it is vital that necessary interventions are put in place to improve the socio-economic status in the country.

9.1.2 Policy Reform Scenario

In order to support socio-economic development in the country, there is need to develop policies that will support sustainable economic growth and appropriate levels of basic service delivery.

In order to address population growth, there is need for policy direction aimed at improving quality of life of people through achievement of population trends commensurate with socio-economic development i.e. to attain and maintain a population growth rate that is at least three times lower than the rate of economic growth. As indicated in Figure 9.1 and in line with the Vision 2030 target, if the population grows at a rate of 2 percent per annum, the population is estimated to be 13.3 million in 2015 and 17.9 million in 2030. There is need to reduce the proportion of adolescents having children from 25 percent to 12.5percent by 2030 especially that the dependency ratio is highest among those aged 15 and below.

To improve the GDP per capita and improve the socio economic status of the country, the strategy should include a shift from a low income to medium income status. To achieve this, a targeted annual real GDP of at least 7 percent should be attained. In addition, it will be necessary to pursue prudent fiscal and exchange rate policies that are consistent with the nation's growth objective. The policies should be carefully coordinated and tailored to pro-poor growth associated with the development of agriculture, agro-processing, light manufacturing, tourism and small scale gemstone mining and processing. Export diversification and value addition in these sectors should be promoted.

In an effort to reverse the downward trend in health care service delivery, Government should continue with health reforms, which emphasize decentralization to the district level and introduction of the "Essential Health Care Package", which defines key interventions that the public health system should provide within available resources. Programmes aimed at reducing incidences of diseases such as Malaria and HIV/AIDS should be strengthened. In view of this, the country should address inadequacies in human resources and infrastructure particularly

in rural areas. Further, there is need to develop a strategy for training, recruitment and retention of health personnel in the sector.

In the education sector, 2.5 percent completed Bachelor's degrees or above which demands a deliberate policy for financing and provision of tertiary education. There is need for more investment in tertiary education in the country to increase the percentage to above 5 percent by 2030. This gap could be filled by establishment of more public and private universities and colleges. However, quality of education in tertiary institutions needs regular monitoring and improvement. In addition, to reduce the gender disparity in the education sector, specific strategies aimed at increasing girls' enrolment and retention in the education system especially at higher levels should be enhanced.

To address the issue of access to safe and adequate drinking water, there is need for strategies aimed at improving access to clean water supply to 80 percent by 2015 and 100 percent by 2030. There is need for improved co-ordination of institutions in the water supply and sanitation sector in order to strengthen provision of these services.

The proposed policies in this scenario if implemented would result in improved provision of basic social services and livelihood of people.

9.1.3 Investment Scenario

In line with issues and policies identified in the Business As Usual and Policy Reform Scenarios, the Investment Scenario has been proposed to improve the socio-economic status in the country.

There is need to improve funding to social sectors e.g. increase investment in the education sector from 19.6 percent in 2006 to 25 percent in 2015. Similarly, funding to the health sector should be increased to 15 percent in 2015 from the 9 percent released in 2006. The increased funding will result in increased literacy rates and provision of health care services such as family planning services which will consequently lead to a decline in population growth rate.

In order to increase the economic growth rate, there is need for investment in regulatory, institutional and structural reforms that will promote increased private sector involvement and reduce the cost of doing business. Rapid economic growth is premised on increased investment in the public and private infrastructure. Hence, there is need to develop and maintain productive and social infrastructure and services such as roads, storage facilities, rail network, energy, communications systems, public utilities and other services. In terms of the road infrastructure, an investment of 5 percent and 0.5 percent for telecommunications of the annual budget is required to make significant improvements. Additionally, to improve service delivery, there is need for government to invest in upgrading existing schools and public tertiary institutions.

To address issues raised in the various sectors, there is need to invest in social capital through enhancing provision of basic services such as education, health, water and sanitation. The Investment Scenario when implemented will enhance the socio-economic status and contribute to sustainable development.

9.1.4 Conclusion:

In the Business As Usual Scenario, it is clear that the increase in population has not been matched with corresponding expansion of basic social services such as education and health. There is a disparity in provision of basic services and development of the urban and rural areas. Moreover, the current GDP growth rate of below 7 percent is insufficient to have meaningful impact on the socio-economic status of the population.

Measures must be put in place to address the identified gaps and promote investment particularly in rural areas. Implementation of measures discussed in the Policy Reform and Investment Scenarios will result in economic development and improved provision of basic social services.

9.2 Settlements

The issues considered in the settlements scenarios are: housing, waste management and sanitation.

The patterns of settlements in Zambia have been influenced by major economic activities such as agriculture, mining and tourism. The concentration of urban population is highest in Lusaka and Copperbelt Provinces.

The provision of decent housing is fundamental in the promotion of quality life for all. At least 56 percent of Zambia is faced with a shortage of housing and a housing backlog dating back to the pre-independence era. This shortage of housing especially in urban areas has persisted mainly due to urbanisation. It is estimated that 45 percent of the total population in Zambia resides in urban areas of which, 60 percent reside in peri-urban areas (CSO, 2004). Of the total housing stock in Zambia, only about 31 percent meets the minimum development and health standards and about 69 percent is informal or non-compliant to housing standards, poorly serviced and made of inappropriate materials, overcrowded and often chocking due to poor sanitary conditions (MoH, 2001). In addition, lack of adequate finance and poor land delivery systems have contributed to the problem of housing.

Management of waste in the country continues to be a challenge. Industrial activities and population growth has resulted in subsequent increase in quantities and composition of waste generated. Further, improved production, changes in consumption patterns and the introduction of new consumer products on the market have adversely contributed to the problem of waste management. The main methods of waste disposal being practiced by households in Zambia are: collection through municipal waste management systems, indiscriminate disposal, pits and open air burning. Other methods include recycling and reuse. In addition, scavenging of waste is a common practice in many districts.

The rate of water supply and sanitation coverage has remained quite low especially in peri-urban areas. Pit latrines are widely used in all provinces except in Copperbelt and Western Provinces. The national average of people using their own pit latrine is estimated at 56 percent. Flush toilets are most commonly used among medium and high cost households in urban areas.

9.2.1 Business as Usual

In 2006, a total of 349,660 migrated from one area to another. Of these, rural to rural migration accounted for 36 percent whilst urban to urban migration was 31 percent. Further, rural to urban migration was 21percent whilst urban to rural migration accounted for 13 percent as outlined in Figure 9.3.

Figure 9.3: Percentage of Persons who migrated in Zambia in 1998, 2004, 2006

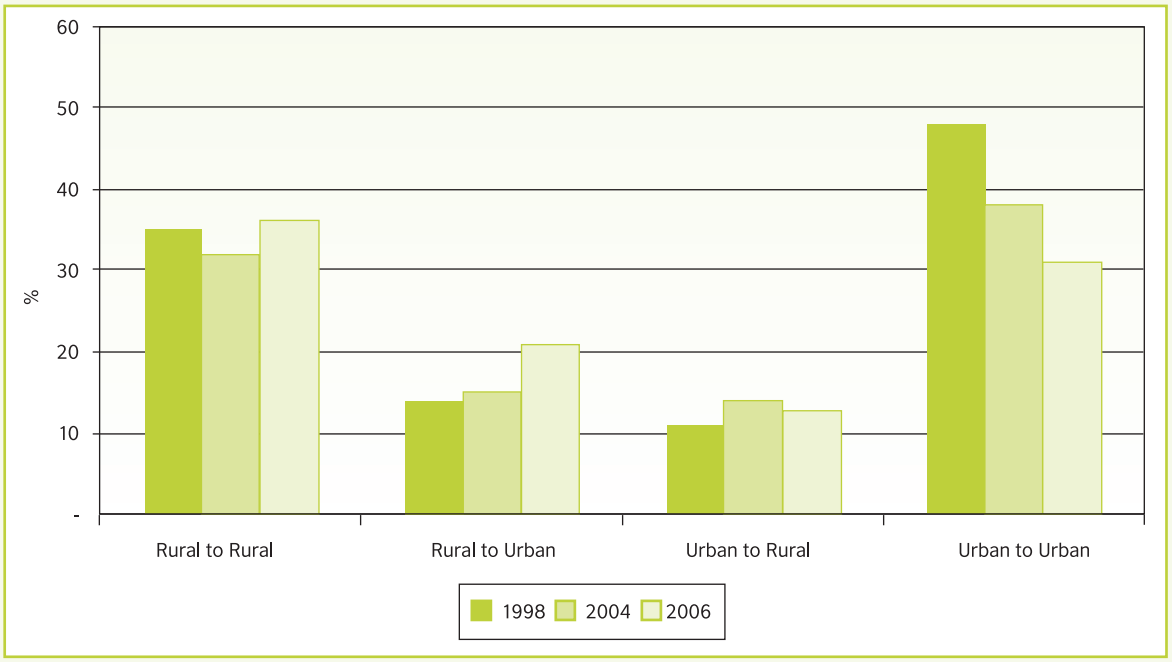


Figure 9.3, further shows that there was more urban to urban migration and rural to rural migration than rural to urban migration. This trend is probably due to low industrial productivity in some towns after privatization. However, urban to urban migration has been declining. There were more migrants in the age range 20-29 compared to the older age groups. Additionally, there were more female migrants at 52percent as compared to 48percent for male migrants in 2006.

As regards housing, the most common type of housing occupied by households was traditional housing at 66 percent. The rest were conventional housing commonly available in urban areas. Majority of Zambians cannot afford to pay the economic rent or price for a decent house. The housing stock expanded from 1.3 million units in 1990 to 1.77 million units in 2000, of which 598 000 units were in urban areas. Further, there has been increased private sector participation in housing development. However, access to housing loans to enable the construction of decent housing is still low and the slow land delivery system for housing development have restricted private sector participation. Another problem that has retarded housing development is lack of infrastructure and services such as water supply, sanitation, roads, storm water drainage, electricity and others.

Currently, the quantities of waste generated in the country remain unknown. The annual general waste generation in country by 2006 was estimated at 2 million tonnes. Of the total waste generated, about 20percent is disposed of at designated sites. By 2006 only 16 districts out of the country's 72 Districts, had designated municipal waste disposal sites. This situation indicates that waste management is still a challenge for LA's as disposal sites are either non-existent or are poorly managed. However, some LA's such as Lusaka City Council (LCC) increased the amount of waste collected from 15percent in 2003 to 40percent in 2006. Others types of waste such as industrial, mining and Health Care Waste (HCW) have also been increasing. This can be attributed to increased mining, manufacturing and health care facilities.

Provinces with proportion of households with low access to safe water have the lowest sanitation coverage. These are Eastern, Southern and Western with 29.1 percent, 27.4 percent and 55 percent of the households with no sanitation facilities respectively. In both rural and urban areas, pit latrines are commonly used with 76.8 percent and 59.8 percent of households using them respectively. The estimated sanitation coverage is 33 percent in urban areas and 4 percent in rural areas (LCMS, 2006)

In the Business as Usual Scenario, it is evident that settlement patterns are likely to be affected by migration. This will in turn affect the population composition and subsequently increase the demand for housing, sanitation and provision of waste management services. Despite the increase in housing stock from 1.3million units in 1990 to 2.28million units in 2006, the increase is insufficient to meet the rising population's housing needs. There is also a backlog of housing units estimated at one million. The amount of waste generated by many LA's in the country has not matched the number of designated municipal waste disposal sites. This situation indicates that waste management is still a challenge for LA's as disposal sites are either non-existent or poorly managed. Sanitation coverage has remained low due to lack of sufficient investment in the sector. There has been more emphasis on water supply than on sanitation.

9.2.2 Policy Reform Scenario

The country may continue to experience an increase in population growth which will continue to exert pressure on the provision of social services.

To address this problem, deliberate policy to develop particularly the rural areas should be promoted. Urban centres in the country have outdated master plans which neither reflect what is obtaining on the ground nor provide the vision and framework for future developments. Integrated Development Plans (IDPs) should be promoted in order to provide a sound basis for district planning and development. In line with this, resources should be allocated to LAs for undertaking planning and effective implementation through stringent development control.

To address the problem of housing, there is need to review the National Housing Policy, encourage public-private partnership in the provision of housing and provide serviced land for housing development. In addition, an affordable and accessible financing system for housing development should be promoted. Furthermore, there is need to upgrade unplanned settlements so as to improve the living conditions in the said areas.

Waste management can be improved through strengthening of the institutional and legal frameworks at both national and district levels. The National Waste Management Strategy (NWMS) should be implemented to improve the quality of the environment, through development and implementation of an efficient and sustainable waste management system.

9.2.3 Investment Scenario

In order to address the current housing shortage approximately 220,000 dwelling units are required annually to clear the existing backlog for the next ten years and to satisfy new demand for houses countrywide. The majority of these should be affordable low cost housing. Accessible housing loans to enable the construction of decent housing should be made available. Furthermore, investment in the construction industry should be undertaken in order to encourage private sector manufacturing of affordable building materials.

There is need for LA's to designate at least one disposal site per district as well as upgrade the current open dumps to engineered landfills. This will require capacity building of LA's through human resource development and resource allocation. To improve management of certain types of waste such as Hazardous and HCW, development of specialised infrastructure is required.

Infrastructure investment is required for improved water supply and sanitation for service delivery. Recapitalisation of commercial utilities responsible for provision of sanitation services in order to extend the coverage of the services will be required.

9.2.4 Conclusion

The urban to urban migration may continue to increase because industrial activity in some towns has been revitalized. This will exert increasing pressure on provision of basic services such as water, sanitation, waste generation and housing which are inadequate as discussed in the Business as Usual Scenario. Execution of the measures discussed in Policy Reform and Investment Scenarios will enhance the quality of settlements in the country. This must however be matched with the corresponding provision of sufficient institutional and legal frameworks as well as effective coordination among the institutions. Institutions identified to be pivotal to the successful attainment of policies aimed at supporting the development of planned settlements in the country are key stakeholders which include government, private sector, civil society and the public.

9.3 Water Resources

The main issues discussed in the water sector scenarios are water availability, accessibility, and quality.

Zambia has vast water resources in form of rivers, streams, lakes and ground water. However, declining rainfall patterns over the years have had a significant impact on the country's water resources. Surface water resources are estimated to cover 45,000km2 accounting for 6percent of the total land area. However, accessibility of surface water is low. The total ground water storage is estimated at 1,740,380 mcm/year. In Zambia, geological conditions for accessing

groundwater with regard to depth, storage capacity, available yields and exploitation potential are favourable.

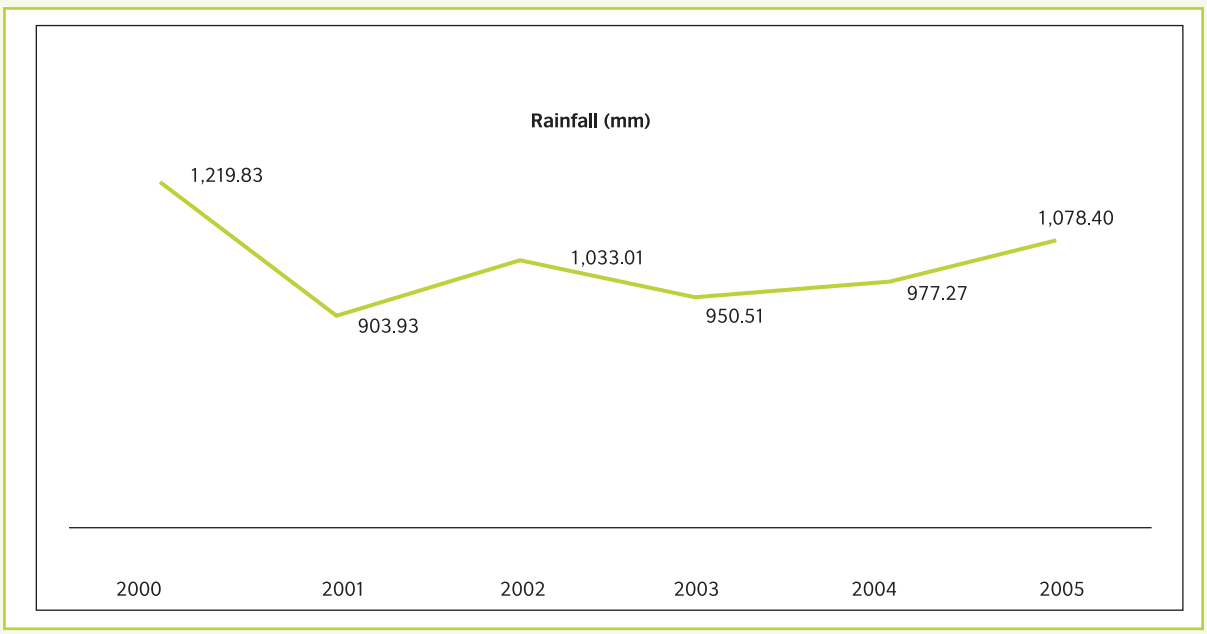
In 2006, 58 percent of households at national level had access to safe water supply. The rural/urban comparison showed that, 43 percent of rural households had access to safe water supply compared to 88 percent of their urban counterparts. The largest proportions of households accessing safe water supply are in Lusaka, Copperbelt, Southern and Central provinces.

Some of the challenges facing water resources management emanate from economic activities such as mining, agriculture as well as solid waste management. Much of the water consumed in Lusaka and the Copperbelt is obtained from the Kafue River in which much of the effluent from the mines and other industries is discharged. Consequently, the quality of water has been lowered, as demonstrated by the proliferation of water hyacinth near points of sewerage and industrial effluent discharge on the river. In addition riverine cultivation and poor land use practices have contributed to pollution and siltation of rivers and reservoirs in other areas.

9.3.1 Business as Usual

The country receives moderate rainfall ranging from 680mm in the south to over 1,400mm in the north with an annual average of about 1000mm. Droughts and floods of varying proportions have been experienced periodically. During the period 2000 to 2005, normal to above normal rainfall was received in many parts as shown in Figure 9.4.

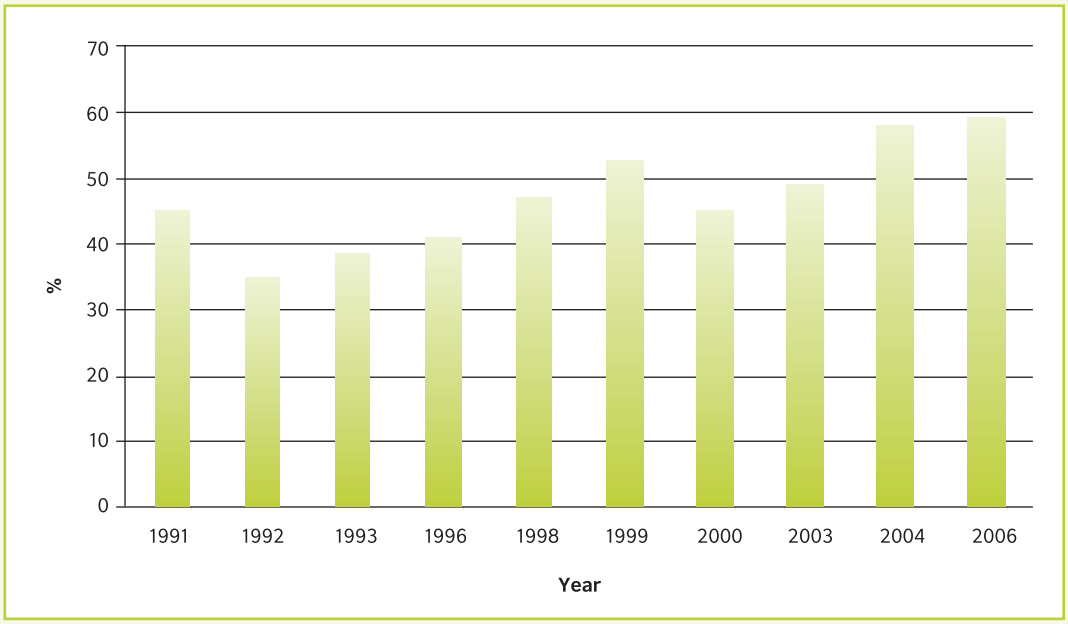
Figure 9.4: Rainfall trends from 2000 to 2005



As at 2005, the estimated annual water resources potential was 186.65 Km3 but less than 0.5percent of the available water was being exploited. The major uses of water in the country remains for non consumptive use and water demand for consumptive use has remained at less than 3Km3. Water demand accounts for about 40Km3 of the annual available surface water resources most of which is used for hydro power generation, agriculture and mining.

During the period 1991 to 2006, the number of the households in Zambia with access to safe drinking water has been increasing as shown in Figure 9.5 (CSO, 2006). Access in urban areas is estimated at 86percent and for rural areas at 30percent.

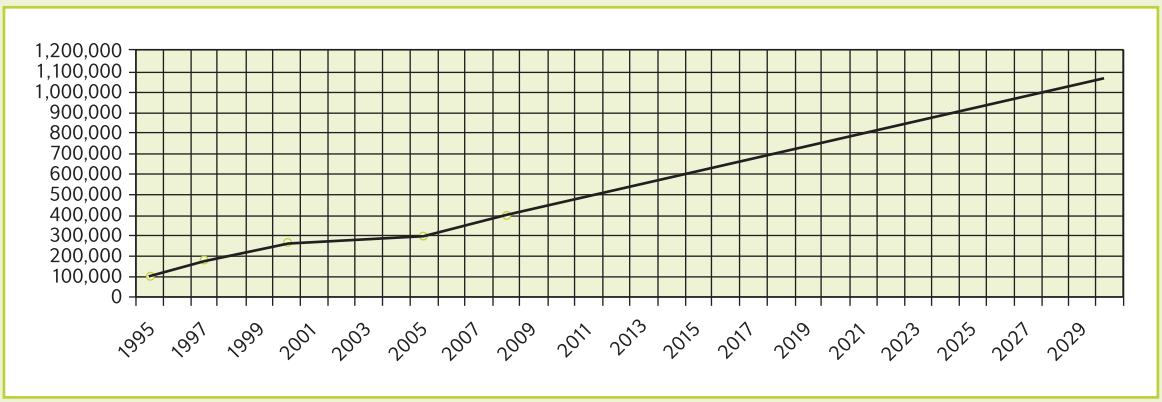
Figure 9.5: Percentage of Households with access to safe drinking water



Organic pollution has increased mainly due to poor waste management and faecal contamination, which can be attributed to the 52percent usage of pit latrines in urban areas. The non expansion of sewage network and treatment plants has contributed to the problem of water pollution as most people continue to rely on pit latrines and septic tanks. This poses a risk to groundwater pollution particularly in large settlements. Water borne diseases like Cholera are usually closely linked to the quality and quantity of available water resources. Most of the affected are peri-urban and rural areas with low access to water and sanitation facilities. In addition, financial resource allocation to carry out effective development and management of water resources has been inadequate. From 1996 to 2000, the financial target to water and sanitation was only 2.08percent of the total 36.16percent targeted for social sectors. (MEWD 2004).

Box 9.1: Water Supply in Lusaka City

In 1993, the total water supplied to Lusaka by Lusaka Water and Sewerage Company (LWSC) was approximately 210 000m^3 per day. The company was still supplying the same quantity by 2005. The estimated average daily water demand in Lusaka in 2000 was 287 825m^3 approximately 80 000m^3 per day in excess of supply, as metered by LWSC. It has been estimated that 56 percent of the water produced is unaccounted for and probably lost through such means as leakages in distribution.



Using the estimated demand for water from 1995 to 2008, demand for the subsequent years up to 2030 were extrapolated. By 2008, water demand for Lusaka is expected to be 400,000m^3 per day. This therefore means that Lusaka has a water supply deficit. The expected increase is due to population and economic growth. by 2015, water demand is expected to be 600,000 m^3 per day and 1,000,000 m^3 per day in 2030. At the current supply, the water supply deficit will be about 400,000 m^3 per day in 2015 and 800,000 m^3 per day in 2030.

A high number of households do not have access to safe drinking water especially in rural areas. Low access to safe drinking water in provinces such as Luapula and Northern can be attributed to limited infrastructure. An analysis of water supply was conducted in Chipata using a standard of 1 water point per 250 people. Findings revealed that rural water coverage was 1 water point per 360 people and showed that 69.5percent had access to safe water. Whilst these figures might be encouraging, the situation on the ground was quite different because approximately 130 water points were not accessible to the general community as they were located in places such as schools and health centres.

In 2006, 34 percent of the total facilities licenced by ECZ for the discharge of effluent into the environment were in Class I. Categories of licences are issued in accordance with the levels of pollution, Class I being the highest polluter. The implication of this is that water quality will continue to be affected as long as the number of industries in Class I remains high.

Table 9.1: Discharge of Effluent Licences for 2006

License Category	Facilities (%)
Class I	34
Class II	4
Class III	10
Class IV	52
Total	100

Source: ECZ, 2006

Arising from the issues discussed, it is clear that the availability, quality and access to water do not match the increase in the population and economic activities in many parts of the country.

9.3.2 Policy Reform Scenario

To improve the availability of water, there is need for policy on harnessing both surface and ground water. The current legal and institutional framework should be strengthened in order to enhance stakeholder coordination in the water sector, and to address overlapping roles and responsibilities. In addition, there is need to strengthen regulatory agencies such as ECZ, NWASCO and LAs in monitoring activities that affect water quality and ensuring that industries comply with set standards in the sector.

Provision of sanitation facilities in the country should be enhanced to avoid pollution of ground water resources. To do this, identification and improvement of the planning and development of settlements to protect and preserve ground water recharge areas is required.

Implementation of proposed strategies discussed in the Policy Reform Scenario will result in improved infrastructure for water supply, access to safe drinking water, enforcement and compliance to water standards by industry.

There should be a policy to enhance access to existing water points, particularly in rural areas. Additional water points in both urban and rural areas should be established.

9.3.3 Investment Scenario

To cope with population growth in urban areas, water reticulation networks should be expanded to meet the demand for water supply. There is need for government to invest and build capacity in water utility companies to improve water supply coverage. This should include development of new treatment plants for both water and sewer systems in areas not connected to the network, development of boreholes, control and protection of the existing boreholes. Improved investment in infrastructure will result in reduction of waterborne diseases such as Cholera which are prevalent in areas with poor water supply and sanitation.

Harvesting of water resources through construction of dams and other water abstraction schemes should be promoted. Further, available water resources should be exploited in order

to develop other economic sectors such as tourism from which revenue can be generated. Government needs to continue promoting irrigated crop production as a priority that will contribute to the country's food security and wealth creation. To do this, dependency on rain fed agriculture should be reduced. There is need to invest in low cost, appropriate and sustainable technologies in order to provide affordable and economical tariffs for water. Government should promote private participation in the sector though provision of incentives on cleaner technologies

9.3.4 Conclusion

The Business As Usual scenario is not desirable. Although sufficient quantities of water are available, quality and access to safe drinking water in some parts of the country is low. Water will continue to play a major role in the socio economic development of the country. The Policy Reform and Investment Scenarios propose measures required to improve water resources management. A combination of these two scenarios is the preferred in addressing the identified issues in the water sector.

9.4 Land

Critical issues related to land are tenure, access and use. Scenarios under land will focus on these three issues.

Zambia is endowed with abundant arable land and water resources. Out of the country's landmass of approximately 752,614 km2, 56 percent is arable land representing 42 million hectares. The country is still dominated by vast open areas of natural vegetation. Major land uses are agriculture and forestry. Demand for land in both rural and urban areas has been increasing. Some factors causing increased demand for land include urban migration, population and economic growth.

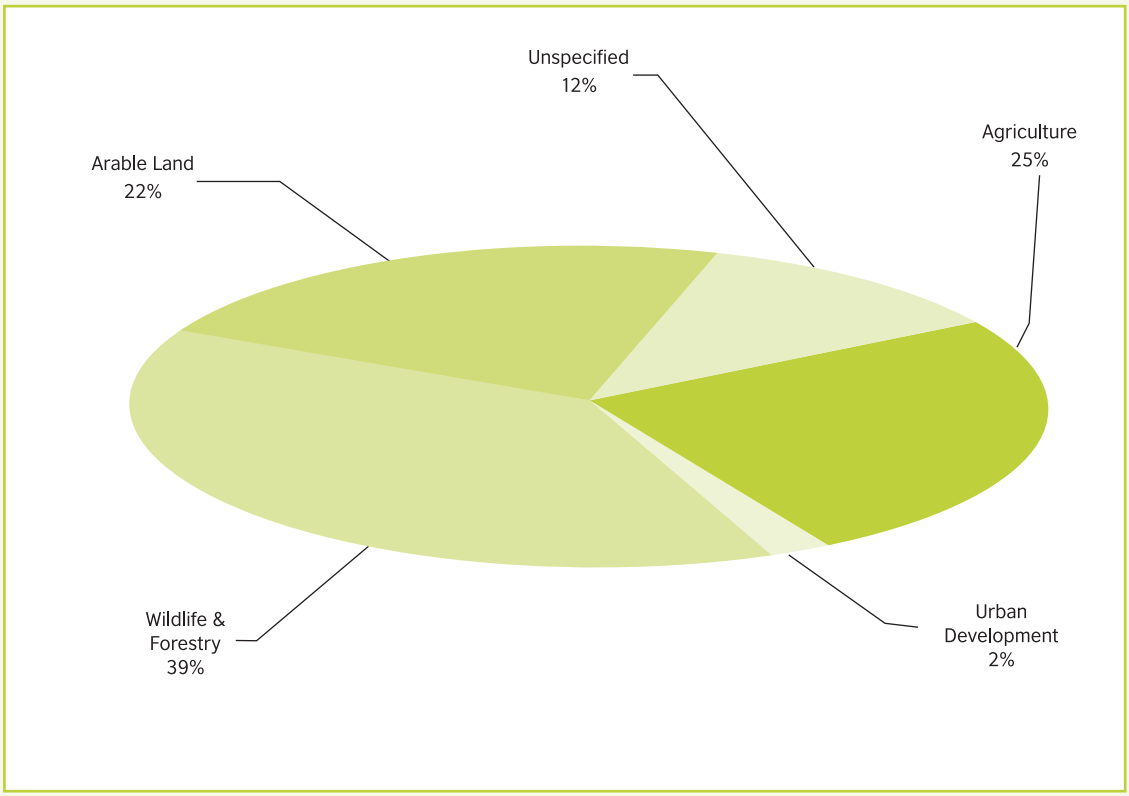
There are two land tenure systems in Zambia, customary and leasehold. Customary land is controlled by the chiefs and their headmen but act with the consent of their people. Leasehold tenure covers 7 percent of the total area of Zambia and is referred to as state land. Such land is acquired from the President through the Commissioner of lands and is limited to a specified period. There are imbalances in land ownership involving men and women. There has been recognition of the fact that women still lack access to land in comparison to their male counterparts. This can be attributed to customary practices that encourage male dominance and socio-economic obstacles.

9.4.1 Business as Usual Scenario

Customary and leasehold land tenure systems account for 93 percent and 7 percent of the total land area respectively. Due to limited state land, there is considerable pressure in conversion of customary land to leasehold tenure for development purposes. This conversion of customary land to state land has however created conflicts in many rural areas of Zambia. Agriculture, mining, tourism and housing developments have led to expansion in areas which were previously undeveloped. For instance, it has been observed that in some areas converted for tourism purposes, local people have lost access to the common pool resources upon

which they had depended for their livelihood. The major land uses are described in Figure 9.6

Figure 9.6: Major Land uses



Agricultural activities form the major component of land use in rural areas. In addition, the increase in mining activities in the country continues to exert pressure on demand for land. Zambia has also witnessed a steady increase in the import and use of different types of pesticides for both agriculture and public health. In 2005, 46,050 litres herbicides in liquid form were imported as compared to 175,814.7 litres in 2006 (ECZ, 2006).

Furthermore, unclear institutional roles at local level have contributed to tenure insecurity. The high placement of authority for land allocation to traditional leaders is a threat to the transparent and equitable distribution of land in the country. It can also be observed that women's access and control of land is limited.

Free access to resources provided by customary tenure provides limited incentives for individuals to invest in the management of these common resources such as pasture improvement. As a result, there is overuse and severe degradation of the environment.

The main contributors to land degradation include deforestation, quarrying, waste disposal and soil degradation. The rapidly increasing quantities of waste generated due to industrialization and population growth during the last few decades has become a major concern for Zambia's environment. The accumulation of plastics and other recyclable waste presents a challenge on the productive utilisation of land.

With the increase in crop production in the country, resulting impacts include soil degradation through acidification, nutrient loss, deterioration of structure, erosion and salinization. Deterioration of the environment will continue if necessary measures such as grazing management, improved waste management and sanitation in the country are not addressed. Other factors that impact negatively on land are demographic in nature and include poverty.

9.4.2 Policy Reform Scenario

In view of the fact that 93 percent of land is under customary tenure and there is increasing demand for land in the country, there is need to convert customary land into state land to meet the demand for land for various developments. There is need for sensitisation of traditional leaders on the importance of releasing land for development. In addition, mechanisms should be developed to ensure that land allocation for both state and customary land is conducted equitably and transparently.

To sustain the country's land resource, sound management practices should be adopted for all forms of land uses such as agriculture, mining, forestry and wildlife. Improved management is required in areas where commercial agriculture and shifting 'chitemene' cultivation are practised.

To redress identified gender imbalances and other forms of discrimination in land tenure, there is be need to provide an enabling environment for women and other vulnerable groups to own land. This is necessary in meeting the 30 percent government target of land allocation to women and other vulnerable groups.

9.4.3 Investment Scenario

Investments aimed at addressing soil fertility restoration and sustainable land use practices should be strengthened.

Capacity building to enhance land administration and management at all levels should be conducted in a participatory and inclusive manner in order to strengthen enforcement and regulation. This will address concerns of equitable access to land, land use practices and increasing use of chemicals in sectors such as agriculture and mining. Strengthening the information system on land for the country will be required to provide efficient and reliable information, thus reducing opportunities for mismanagement.

To maintain local and international boundaries and prevent potential conflicts with neighbouring countries or chiefdoms, resource allocation to facilitate boundary demarcation will be required.

9.4.4 Conclusion

From the Business as Usual Scenario, it is clear that the country has vast quantities of land most of which is under customary tenure. This presents difficulties in the acquisition of land for various development purposes. This therefore means that the country should adopt proposals discussed in Policy Reform and Investment Scenarios in order to improve access and management of land in Zambia.

9.5 Biodiversity

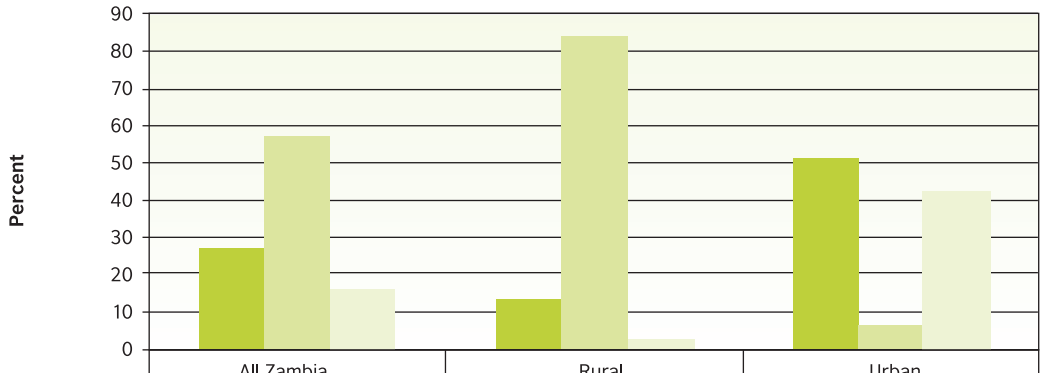
Biodiversity is critical to the development of Zambia as the economy is dependant on the exploitation of various natural resources. The major biodiversity categories of concern are forestry and wildlife. In developing biodiversity scenarios, deforestation, depletion and loss of species were considered as key issues.

Forests cover an area of about 44.6 million hectares representing 60 percent of the total land area. Despite their importance in the sustainable development of the country, Zambian forests are fragile and vulnerable to both natural and anthropogenically induced disasters. Zambia has a variety of species which are mostly found in protected areas such as National Parks, Game Management Areas (GMAs) and water bodies. There are 19 National Parks covering an estimated area of 6.4 million ha. Activities such as human settlements, road construction and mining have contributed to the fragmentation of ecosystems, habitats and obstruct migratory routes to breeding and feeding grounds used by wildlife.

9.5.1 Business as Usual Scenario

The country has an estimated 1,755 to 3,652 million cubic meters of woody biomass and a variety of ecosystems with over 3,000 different species. These occur in three main biomes, each with distinctive floral characteristics which include forests, woodlands and grasslands. There are over 8,017 different plant and animal species, of which 316 are endemic, 174 are rare, and 38 endangered. Zambia faces a challenge in the management of national parks and forest reserves mainly due to encroachment, degazzeting, forest clearance and degradation. In addition, the country has not fully explored alternative energy sources. Therefore, charcoal and wood fuel remain the major sources of energy in country. In 2006, 84 percent of the households were dependant on charcoal and wood fuel. This was higher for rural households at 98 percent as indicated in Figure 9.7.

Figure 9.7: Household Energy Sources in 2006



	All Zambia	Rural	Urban
Charcoal	27	13	51
Firewood	57	84	6
Electricity	16	2	42

The number of forest estates (local and national Forests) countrywide is 489, out of which 170 and 109 are heavily and partially encroached respectively. These cover an area of 7,361,406 ha. However, following the degazettion of six forests and excision of 12 forest reserves a total of 50,156 ha of forest cover was lost.

Wildlife resources range from birds, reptiles to mammals. There are about 733 bird species (76 rare or endangered), 150 species of reptiles and 224 species of mammals. Amongst these, 25 species of mammals, 36 species of birds and 4 species of reptiles are of international significance. Areas protected for wildlife occupy about 40 percent of the country's land surface area.

In addition to terrestrial ecosystems, Zambia's water bodies are home to about 409 species of fish of which 204 are endemic. The demand for fish is estimated at about 100,000 metric tonnes per year with total production fluctuating between 65,000 and 70,000 metric tonnes annually. This has led to the growth of fish farming industry. Fisheries in Zambia are under increasing pressure resulting from a number of factors among them unsustainable fishing practices, ecological changes, industrial and aquaculture pollution and climate change. Dam construction has also contributed to changes in fish diversity.

However, biodiversity in Zambia is under increasing threat due to population increase and unsustainable utilization. A sector-based analysis shows that biodiversity utilisation plays a significant role in the national economy. For example, the charcoal industry employs about 450,000 people in production, distribution and marketing. This high level of unsustainable charcoal production will require improved management. The total contribution of biodiversity to the Zambian economy is largely unknown as the value of most activities dependant on biodiversity is not reflected in national accounts. Although biological resources support livelihoods of the majority of the rural areas, there is unequal sharing of benefits from the use of biological resources. This disadvantages the rural areas and encourages opportunistic over-exploitation of resources by these communities.

Between 2000 and 2005, Zambia lost 2.67 million ha of its forest, the second highest total in Africa, and fifth highest in the world. Anthropogenic factors such as human settlements, agriculture and wood harvesting for timber and energy have played a significant role in altering the structure and functioning of ecosystems. Agriculture is the principal driver of deforestation, which is also exacerbated by collection of wood fuel. Reduction in forest coverage in the country is likely to continue as long as sustainable agriculture is not practiced. The low proportion of the population with access to electricity implies that more forests will be cleared to meet the demand for energy. As a consequence of inadequate forest management, there is likely to be widespread loss of productivity, erosion, siltation, and reduction in stream flow and other negative impacts in many places. Poor management of forest cover may contribute to climate change.

The wildlife resource is generally under pressure due to population growth and increase in the price and demand for wildlife products. If this development continues, it is likely to contribute to the reduction in large mammal populations and deterioration of other species. Consequently, sectors such as tourism will be affected.

From the analysis in the Business as Usual Scenario, it is clear there is need to improve management of biodiversity in the country.

9.5.2 Policy Reform Scenario

In order to promote sustainable use of biodiversity and maintain essential processes and life support systems, key environmental impacts discussed in the Business as Usual scenario need to be addressed.

To reduce further clearance of land for farming, there is need to develop policies that promote production on existing farmland. In addition, agro-forestry and afforestation programmes should be increased. In Southern Africa, Zambia has one of the highest pools of carbon in its forests/woodlands. The country should therefore, put in place measures to utilise this opportunity to gain economically from the carbon sequestration programmes.

To increase local community participation in managing and benefiting from forest and wildlife resources, joint management initiatives should be intensified. Increased public awareness in biodiversity management should be undertaken.

Additionally, there will be need to build capacity in key institutions mandated to manage biodiversity such as Fisheries and Forestry Departments and ZAWA in order to strengthen enforcement of relevant legislation.

9.5.3 Investment Scenario

Currently, the status and extent of ecosystems is unknown because surveys have been irregular. This situation demands for improved government financing to undertake regular studies and collection of accurate information on biological resources.

To reduce dependency of wood fuel, there is need to invest and encourage the use of alternative energy sources. Government should strengthen the Rural Electrification Programme and encourage private sector participation in the energy sector.

Infrastructure in most GMAs requires investment in order to effectively manage and monitor wildlife resources. There is need to encourage sustainable fishing practices. Commercial fish farming which has emerged to meet the demand for fish in the country will require sufficient control and monitoring measures.

In order to improve information provision in the country, research programmes, inventories and assessments should be conducted. Biodiversity accounting and valuation should be conducted so as to determine the contribution of the sector to national economy. There is need to increased resource allocation, strengthen human resource and institutional development to the biodiversity sector.

9.5.4 Conclusion

The growing population and the subsequent need for increased food production have

necessitated the need for large areas for agriculture. Majority of the people are likely to continue depending on forests and woodlands for their sustenance. The Business as Usual Scenario discusses some of the possible outcomes if appropriate measures to manage biodiversity resources are not put in place. On the other hand, Policy Reform and Investment Scenarios present proposals that could be implemented to prevent and control further deterioration to biodiversity. These two scenarios are therefore preferred.

9.6 Minerals Resources

Scenarios for mineral resources focus on mineral exploitation and exploration.

Mining has been a key economic sector in Zambia with exports of mineral products contributing about 70 percent of total foreign exchange earnings. During the 1980s and 1990s, copper production declined due to a number of reasons including poor re-investment, unsupportive policy and management practices. By 2006, mineral production significantly improved due to increased metal prices. Besides copper and cobalt, the country produces other minerals such as gold, iron, nickel and gemstones.

Both mineral exploration and exploitation are driven by world market demands. Almost the entire country has been covered by exploration activities. Patterns of exploitation are related to geographical location, development of infrastructure and the strength of the economy. As a result of the huge mineral potential that exists in the country, there has been an influx of investors for both exploration and exploitation activities.

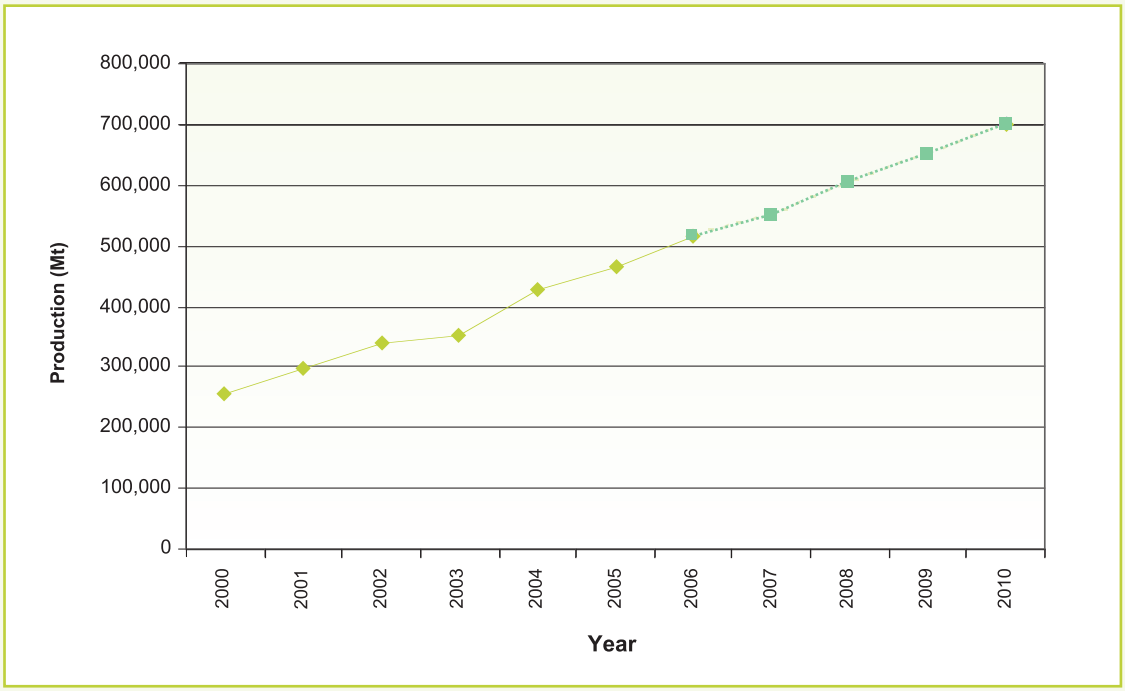
9.6.1 Business as Usual

High metal prices, increased demand for metals, a rich mineral resource base and a stable investment environment have led to the growth of the mining sector. By 2006, Zambia had given out an accumulated 2,647 mining rights, 558 prospecting licences out of which 378 were issued between 2000 and 2006.

There has been an increase in the number of licenses for small scale mining amounting to 225 licences between 2000 and 2006. However about 60 percent of these licenses are considered dormant. Entrepreneurs and mining firms lack financial resources, appropriate management and technical skills to realise their firm's full potential.

Copper and cobalt exports have improved significantly. Copper production levels have been increasing and are expected to reach 700,000mt by 2010 as shown in Figure 9.8. This has resulted in the growth of mining, processing plants and support services.

Figure 9.8: Projected Copper Production levels from 2000 to 2010



The contribution of the mining sector to the economy has increased from 8 percent in 2000 to 11.8 percent in 2006.This growth has resulted in increased employment opportunities of over 50,000 contributing to poverty alleviation. In addition, with higher copper prices, demand for coal is expected to increase and consequently put pressure on Maamba Collieries or increase exploration for coal in other areas in the country. New industries such as smelters on the Copperbelt and the growing cement industry are likely to exert more pressure on coal requirements.

The impacts of exploration and mining can be observed in areas such as the Copperbelt province. These include deforestation, land degradation, water and air pollution. The major impacts as a result of exploration are abandoned pits. Government has put in place relevant institutional and regulatory frameworks for managing this sector. However, licensing, monitoring and enforcement of mine related activities are insufficient.

Value addition in the sector has been inadequate. Few facilities are available for processing of gemstones, industrial minerals and dimension stones, for instance only a few lapidaries exist in the gemstones sector. Similarly, there is no developed industry in the processing of other industrial minerals such as dimension stones and phosphates for agricultural purposes despite their abundant occurrences.

In this scenario, it can be observed that the sector has been growing as evidenced through the increase in contribution to GDP, employment creation and issuance of licences for both small and large scale mining. Although regulatory agencies such as ECZ and MSD have been strengthened to undertake environmental management, more needs to be done to improve compliance to set standards and ensure that mining activities are conducted sustainably.

9.6.2 Policy Reform Scenario

To address some of the concerns observed in the Business as Usual Scenario, the Policy Reform Scenario proposes a number of policy options.

To ensure sustainable growth in the mining sector, the government should continue to foster polices aimed at enhancing investor confidence. The Mining Sector Diversification Programme (MSDP) should be strengthened to promote diversification into other mineral resources other than copper. Additionally, diversification into other industries such as agriculture and tourism should be undertaken to reduce dependence on the mining sector. Value addition in the sector should be promoted. To achieve this, policies aimed promoting down stream processing prior to exportation should be developed and implemented.

Strategies aimed at building the financial and technical capacity of small scale miners need to be developed and implemented. Further, awareness raising and training of small scale miners will be required in order to reduce environmental degradation caused by their activities.

To prevent and minimize environmental impacts as a result of mining, strengthening of institutional and legal framework will be required. There is need to strengthen legislation and institutional capacity of regulatory agencies such as ECZ, MSD and MMMD. Monitoring and enforcement through EIAs, EMPs and audits should also be strengthened.

9.6.3 Investment Scenario

Availability of exposed, accessible and near surface mineral deposits are increasingly becoming scarce requiring expensive equipment to locate deeper ore deposits. Mining will become costly as mines become deeper with declining mineral reserves. This situation will entail increased costs of investment.

To implement the MSDP, some identified investment programmes include:

i. exploitation of iron ore and setting up of iron and steel industries;
ii. exploration for energy minerals such as coal and uranium and setting up of industries to mine and process them;
iii. exploration and evaluation of potential for oil and gas in sedimentary basins and setting up of industries to drill and process discoveries;
iv. Further investment to promote the small scale mining sector.

The establishment of smelters and iron and steel plants will demand increased production of coal. As noted in the Business as Usual Scenario, this will put pressure on Maamba Collieries. Therefore, there will be need to recapitalize it or increase exploration for more coal in the country

Investments that promote value addition should be undertaken. In line with this, processing plants such as the defunct Ndola Precious Metal Processing Plant should be established to recover gold, silver and selenium as by-products of copper. Also, lapidaries and non-traditional mineral processing industries should be set-up.

Furthermore, investments in the Environmental Management Facility (EMF) of all environmental liabilities that were not taken by new mine owners should be continued. Improved resource allocation to regulatory agencies also needs to be improved to enhance compliance in the sector.

9.6.4 Conclusion

From the Business as Usual Scenario, prevailing high copper prices will put pressure on the production of copper and will lead to the development of other sectors of the economy such as energy and support services. This will demand improved environmental management to mitigate adverse impacts that might arise. Although improvements have been made in monitoring impacts associated with mining activities, strengthening regulatory agencies will be required.

The Policy Reform and Investment Scenarios propose measures that should be implemented to ensure sustainable management of mineral resources and increase benefits to the Zambian economy.

9.7 Atmosphere

Key issues discussed in the scenarios on atmosphere focus on ambient air quality and climate change.

In most parts of Zambia, the major problems with ambient air quality emanate from transportation, mining, industrial activities, dust from unpaved roads and bare lands. Population growth entails increased demand on sectors such as energy, transport and support services, whose operations have implications on emissions generation, climate variability and change. Between 2004 and 2006, the economy consistently registered a positive GDP implying an increase in economic activities, most of which had repercussions on generation of atmospheric emissions.

Despite, the economic growth, poverty in the country continued to be high with average poverty levels at 64percent in 2006. This has implications on the environment as activities such as slash and burn (chitemene) agriculture, charcoal burning, firewood collection are usually a common source of livelihood among the poor. For instance, in 2006, 16 percent of the households had access to electricity, the remaining 84 percent depended on non renewable energy sources such as charcoal and firewood.

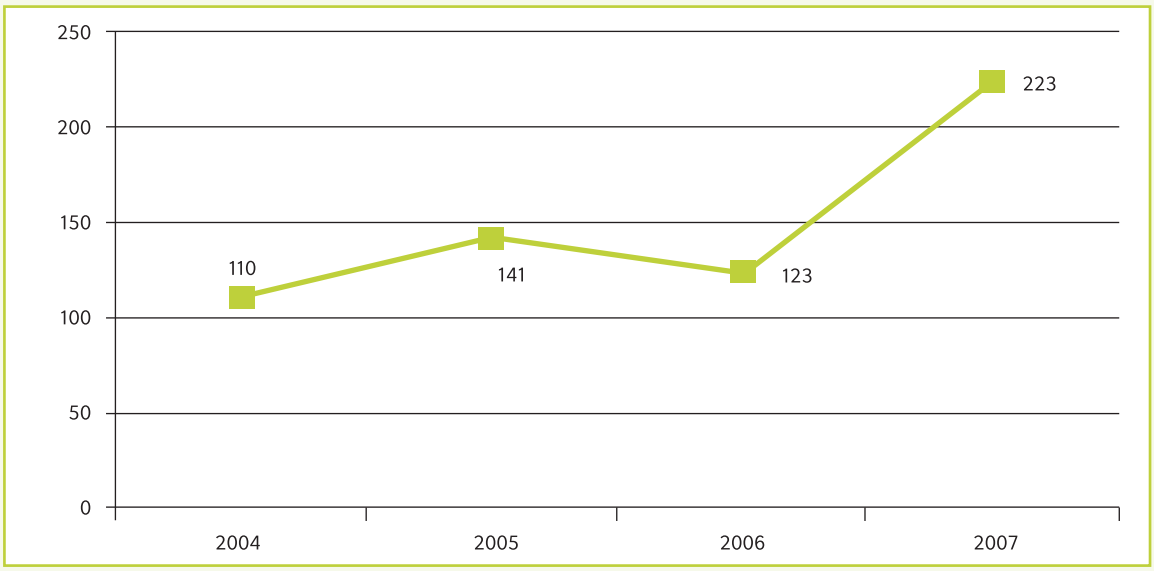
Sources of emissions that contribute to climate change are agricultural production, settlements, charcoal production and timber logging. An additional source of emissions is combustion of biomass (charcoal and firewood) from energy for household use. Although Zambia has low industrial activity, the net source of emissions arising from deforestation is of major concern.

9.7.1 Business as Usual Scenario

Inventories of 1994, 2000 and 2005 indicate that Zambia is a net source of Green House Gases (GHGs). Zambia's largest contribution emanates from landuse change and forestry with the major contributing factor being deforestation caused by agriculture, settlements, charcoal

production and timber logging. It has been observed that the level of investment in the mining and energy sectors have increased as indicated by the increase in the number of EIAs submitted as shown in Figure 9.9. As a result of this economic development, there is likely to be corresponding increase in emissions.

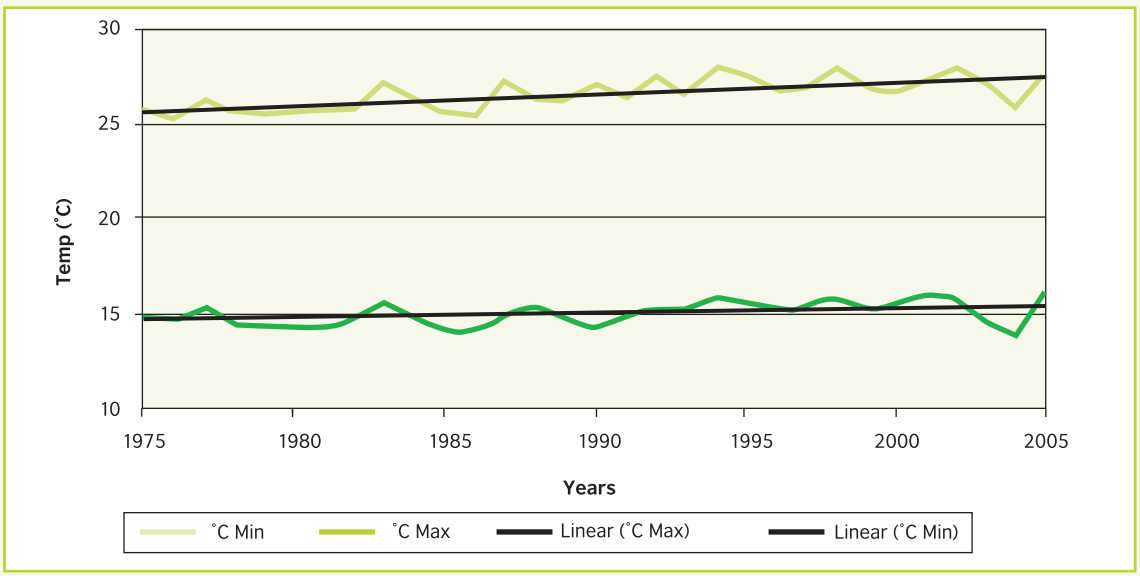
Figure 9.9: No of EIAs received and considered by ECZ



The major sinks for GHGs in Zambia are natural forest regeneration and/or re-growth of abandoned cultivated lands. The largest contribution towards uptake is managed natural forest, followed by fallow plantations.

The effects of climate change are likely to be felt most in water resources, agriculture, livelihoods, health and biodiversity. Temperature extremes depict patterns consistent with warming over Zambia and most of Southern Africa. For example, temperatures for Lusaka over the last 30 years increased by 1o C as shown in Figure 9.10.

Figure 9.10: Maximum and Minimum Temperatures from 1975 and 2005 for Lusaka



Source: ECZ, data from Zambia Metrological Department 2005

There has been progressive reduction in cumulative rainfall amounts since 1950 which can be attributed to climate change. The variations observed in rainfall patterns are due to the effects of El Nino/La Nina phenomena. During the warm phase (El Nino), much of Zambia especially the southern parts experience below normal rainfall resulting in dry years e.g. 1972/73, 1981/82, 1983/84, 1991/92, 1993/94 and 1994/95. On the other hand, during the cold phase (La Nina), most parts receive normal to above normal rainfall resulting in wet years e.g. 1973/74, 1975/76, 1977/78, 1980/81, 1988/89 and 1997/98. During the dry years, the country risks crop failure, while during the wet years, flooding was experienced in some parts resulting in destruction of infrastructure and displacement of people. During such situations, socio-economic impacts arising from floods and cyclones include shortages of potable water, food insecurity and poor health. Excessive rain in 2001 and dry spells during the 2001/02 growing season led to a major shortfall in maize production, a decrease of 42percent compared with the average yearly production.

Parts of a flooded village and campsite for displaced villagers in Kazungula District, Southern part of Zambia

As a response to droughts and floods, Government provides relief food, medicine and temporal shelter to the affected. The implication is a need to provide resources to address these issues which would otherwise be used for provision of basic services.

9.7.2 Policy Reforms Scenario

In the Business as Usual scenario, a number of issues were discussed, this scenario proposes policy reforms required to improve management of atmospheric issues. There is need for the country to develop an overall policy which should provide a harmonised and coordinated approach to management of ambient air quality and climate change.

The country should embark on developing renewable energy technologies that will be pro-poor and reduce dependence on natural resources. In addition, a deliberate programme should be undertaken to ensure that climate change issues are mainstreamed in all sectors.

With the economic growth that the country is experiencing, measures should be taken to promote cleaner technologies to ensure that GHG emissions are minimised. Training in cleaner production should be provided to industry and incentives such as reduced taxation be introduced for complying industries. Government should strengthen the management of natural forests and plantations to improve the uptake of GHGs.

There is need to identify priority sectors and technologies necessary for integrating adaptation policies into development policies. This should include improving climate prediction models, drought-resistant phenotypes and infrastructure.

Education and information dissemination should be conducted in order to raise awareness on atmospheric issues. In addition, an early warning system should be established, through which data will be communicated to decision-makers and implementers so that disaster impacts are minimised.

9.7.3 Investment Scenario

The country should invest in renewable energy technologies so as to reduce dependence on natural resources and production of GHGs.

In response to the challenge of emission generated through improper waste management, there is need to invest in modern landfill facilities countrywide in order to improve capture of GHG like CH4 which can be utilised for energy production.

Furthermore, Government should provide for adequate capacity in infrastructure and human resource development for institutions whose mandates have a bearing on ambient air quality and climate change issues. In this regard, investment in systematic observations, establishment of additional weather stations, training of staff and provision of equipment will be required. Investment in scientific research on impacts of climate change in the country should be undertaken in order to provide information for effective decision-making.

9.7.4 Conclusion

As observed in the Business as Usual Scenario, the country has been experiencing impacts from prevailing climatic conditions such as droughts and floods which continue to exert pressure on natural resources and economic development. For this reason, implementation of the Policy Reform and Investment Scenarios will enhance the country adaptation to climate change as well as improve ambient air quality.

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