Minamata Initial Assessment Report for Zambia

June 2017

ONE ZAMBIA ONE NATION

ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY

Managing our environment securing our future

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GLOSSARY

CFLs	-	Compact Fluorescent Lamps
CSO	-	Central Statistical Office
CSOs	-	Civil Society Organisations
EAs	-	Enabling Activities
EMA	-	Environmental Management Act, 2011
ERB	-	Energy Regulation Board
ESP	-	Environmental support Programme
GEF	-	Global Environment Facility
GRZ	-	Republic of Zambia
Hg	-	Mercury
HS	-	Harmonised Systems codes
ICTs	-	Information and Communication Technologies
MFNP	-	Ministry of Finance and National Planning, 2006
MIA	-	Minamata Initial Assessments
NCS	-	National Conservation Strategy
NEAP	-	National Environmental Action Plan
NPE	-	National Policy on Environment
NTEs	-	Non-Traditional Exports
NWASCO	-	National Water and Sanitation Council
UNEP	-	United Nation Environmental Program
ZRA	-	Zambia Revenue Authority

FOREWORD BY GOVERNMENT OFFICIAL

Mercury is a chemical of global concern due to its long-range atmospheric transport, persistence in the environment, ability to bio-accumulate in ecosystems and its significant negative effects on human health and the environment. The importance of human health and environmental protection was reaffirmed at the 21st United Nations Environment Programme (UNEP) Inter-governmental Conference in 2001. In particular, Decision 21/5 recognised the need for mercury assessment to be undertaken at global level.

In 2013, the Minamata Convention on Mercury was adopted as a global treaty to protect human health and the environment from adverse effects of mercury. In addition, Sustainable Development Goals (SDGs) recognise the importance of promoting good health and well-being in general and particularly SDG No. 12 on sustainable consumption and production emphasizes sound chemicals management including safe disposal of toxic waste and pollutants.

UNEP has undertaken various interventions aimed at promoting mercury management. These include the global mercury assessment, preparation of a legally-binding mercury agreement and promoting enforcement of environmental monitoring. The goal is to eliminate and phase down mercury from products and processes.

At national level, the Government of the Republic of Zambia (GRZ) signed the Minamata Convention on Mercury in 2013 and ratified it in 2016. The Environmental Management Act No. 12 of 2011 ("the EMA") is the principal legislation in Zambia on environmental management in general and pollution prevention and control. Part IV of the EMA makes provision for chemicals management. In addition, the Environmental Management (Licensing) Regulations No. 112 of 2013 have a direct relevance to the management of mercury, mercury compounds and waste containing or contaminated with mercury or mercury compounds. The Regulations also provide for the licensing and management of Pesticides and Toxic Substances (PTS). Further, there are other pieces of legislation such

as the Water Resources Management Act, the Factories Act, the Public Health Act, The Food and Drugs Act and the Mines and Minerals Act that have a bearing on hazardous chemicals management.

Government through the Zambia Environmental Management Agency (ZEMA) has implemented various projects aimed at improving mercury management in the country. These include; Mercury Release Inventories in Africa, Minamata Initial Assessment and Development of the National Action Plan on the use of mercury in Artisanal and Small-Scale Gold Mining in Zambia.

Studies conducted through these projects have identified mercury sources in Zambia from both natural and anthropogenic sources. Primary metal production, consumer products and waste incineration and deposition have been identified as major contributors to mercury emissions and releases in the country.

In response to these sources, government remains committed to implementing interventions aimed at reducing and where feasible to eliminate the use of mercury and mercury compounds in the country. Government is therefore, confident that these measures will enhance mercury management and sound management of chemicals in the country.

Dr. Dennis Wanchinga, M.P.,

MINISTER OF WATER DEVELOPMENT, SANITATION AND ENVIRONMENTAL PROTECTION

EXECUTIVE SUMMARY

Introduction

Mercury is a naturally occurring heavy metal and exists in three forms; elemental mercury, organic mercury and inorganic mercury. It is of global concern due to its toxic nature, trans-boundary movement and its potential to bio-accumulate and bio-magnify. Mercury emitted into the air can travel thousands of miles in the atmosphere before it is eventually deposited back to the earth through rain or in dry gaseous form.

The Minamata Convention on mercury is a global treaty to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The Global Environment Fund (GEF) provided funding and technical assistance to the Zambian government to conduct Minamata Initial Assessment (MIA). The main objective of the MIA was to facilitate ratification and early implementation of the Minamata Convention by use of scientific and technical knowledge. In recognition of the importance of the Minamata Convention and to contribute to global efforts on reducing the use of mercury, the Government of the Republic of Zambia (GRZ) became a signatory on 10th October 2013 at the Diplomatic Conference held in Kumamoto in Japan and finally became a party in 2016.

During the MIA process, a multi stakeholder approach was used to engage stakeholders. A national coordinating committee was constituted, and sector based working groups were formed namely: Mining and Metal Production, Waste, Consumer Products and Energy. Data was collected in these sectors by the members of the working groups and was eventually used to compile the Zambia MIA report.

Background

The population of Zambia increased from 13 million in 2010 to 15.5 in 2015 representing an increase of 18.3 percent. An estimated population accounting for 60.5 percent live in rural areas and are dependent on subsistence agriculture for their livelihood. The population distribution by gender shows that in all provinces, the population of females was higher than that of males. The national female-male gender distribution was 51.3 and 48.7 percent respectively. It is projected that Zambia's population will reach 26.9 million by 2035. This will ultimately, lead to an increased demand for economic opportunities, basic social services, infrastructure, and natural resources.

Zambia has had a growing economy for the past ten years, with real Gross Domestic Product (GDP) growth averaging at 6.7% per annum. The country's' economy has mainly been driven by sustained expansion in agriculture, construction, manufacturing, transport, communications and mining.

Mercury Sources

Mercury sources include both natural and anthropogenic. In Zambia, the major anthropogenic sources of mercury emissions and releases include primary metal production, energy consumption, waste incineration and burning, waste disposal, land filling and waste water treatment. Others are fuel refinery, cement production, use and disposal of mercury-containing products, production of recycled metals, crematoria and cemeteries. Other anthropogenic emissions and releases include; medical products and devices, cosmetics and artisanal small-scale gold mining. From the MIA, it was revealed that intentional use of mercury by industry in Zambia exists but has not been fully quantified due to scarcity in data.

Results of the Mercury Inventory

The total mercury release was recorded at 127.84 tonnes. Out of the total, primary metal production contributed 93.7 tonnes which translates to 76 percent, consumer products contributed 12.86 tonnes accounting for 11 percent, waste incineration and burning contributed 12.81 tonnes amounting to 10 percent and waste deposition and waste water treatment contributed 8.47 tonnes translating to 5 percent.

With regards to releases to **air,** primary metal production recorded the highest followed by waste incineration and burning. Consumer products was third whilst the other sources took up the remainder.

The mercury releases to **water** were mainly from industrial processes. The highest mercury releases to water was primary metal production followed by waste deposition and waste water treatment. Others were product/process use and consumer products.

Mercury releases to **land** was mostly from primary metal production which accounted for 59% of the total followed by waste deposition and waste water treatment at 26%. Consumer products were at 14% and the other sources were at 1%.

The highest mercury releases to **General Waste** were from consumer products which accounted for more than 90% followed by other products and process uses within industry.

In the **waste treatment** source category, mercury releases were also largely from primary metal production which was over 99% and the other sources accounted for 1%.

In the **energy and fuel consumption** source category, mineral oil refinery was the highest followed by biomass. It is worth noting that mineral oil is imported and not extracted. Further, the country is yet to explore geo-thermal power.

Under the primary metal (virgin) production source category; revealed that there was Gold extraction with mercury amalgamation processes; however, information gaps exist for quantification of mercury use in this source category. Further, there was no Lead, Zinc and Aluminium extraction at the time of conducting the Inventory.

Data on general consumption of mercury in products as metal mercury and as mercury containing substances was also analysed and revealed that the implementation of a project to replace incandescent bulbs with Compact Fluorescent Lamps (CFLs) has resulted in an increase in the importation and use of CFLs. Electrical switches and relays with mercury accounted for the largest number followed by light sources with mercury.

Policy, Regulatory and Institutional Assessments

The growing population has resulted in increased pressure on the environment and its natural resources. Various institutional and legal frameworks have been put in place to guide environmental management in the country. These include; the National Constitution, National Policy on Environment, the National Conservation Strategy (NCS), Environmental Management Act, Water Resource Management Act, Public Health Act among others. The NCS of 1985 was fundamental to the development of environmental law in the country. NCS identified key issues and recommended policies, programmes and actions to address them. It was through this strategy that the Environmental Protection and Pollution Control Act (EPPCA), Cap 204 of 1990 was enacted and the subsequent establishment of the Environmental Council of Zambia (ECZ) in 1992.

In 1994, a National Environmental Action Plan (NEAP) was formulated to integrate environmental concerns into the social and economic development planning process. In 2007, Government formulated a National Policy on Environment (NPE) as an umbrella policy for the welfare of the country's environmental sustainability.

The Vision 2030 aspires Zambians to live in a strong and dynamic middle-income industrial nation that provides opportunities for improving the well-being of all, embodying values of socio-economic justice, underpinned by the principles of: (i) gender responsive sustainable development; (ii) democracy; (iii) respect for human rights; (iv) good traditional and family values; (v) positive attitude towards work; (vi) peaceful coexistence and; (vii) private-public partnerships.

In order to implement the Minamata Convention on mercury and to manage mercury in an environmentally sound manner, it is imperative that the Zambian legal framework provides for management of mercury. Zambia practices dualism in implementing international law obligations. This means that once Zambia has ratified an international convention or treaty, it must proceed to enact enabling domestic legislation to implement its obligations.

Environmental Legislation

The principal legislation in Zambia on environmental management in general and pollution control is the Environmental Management Act No. 12 of 2011 (EMA). The EMA repealed and replaced the EPPCA of 1990.

The EMA provides among others for integrated environmental management, protection and conservation of the environment; and the prevention and control of pollution and environmental degradation. Notably, the EMA makes provision for the sound management of chemicals through their life cycle.

Part IV of the EMA makes provision for sound chemicals management. Section 65 specifically provides for the control of manufacture, import, export, storage, distribution, transportation, blend, process, re-process or changing the composition of a pesticide or toxic substance or of persons intending to reprocess an existing pesticide or toxic substance for a significantly new use. Under Section 66 of the EMA, ZEMA has the mandate to oversee chemical management.

The EMA further provides for a control system for substances that deplete or are likely to deplete the ozone layer. Section 31(2) of the EMA obligates any person dealing in any substance that depletes or is likely to deplete the ozone layer to obtain a licence from ZEMA.

Furthermore, the Environmental Management (Licensing) Regulations No. 112 of 2013, have a direct relevance to the management of mercury, mercury compounds and waste containing or contaminated with mercury or mercury compounds. Mercury and mercury compounds being toxic substances are provided for under Part V of the Licensing Regulations.

Zambia currently does not have adequate facilities to deal with hazardous waste and as such, the wastes are usually exported to countries where there are facilities as required by the Basel Convention on the Control of Transboundary Movement of Hazardous waste and other wastes of 1989. The transboundary movement (export and transportation) of waste including articles contaminated or containing mercury requires licensing to ensure controls and protection of the environment.

Public awareness and Training

Environmental awareness of the citizenry is an important way of enlisting active participation in protecting Zambia's natural resources. Effective public awareness results in good environmental practices, sound chemicals management and an informed and a healthy population. This entails a wider stakeholder participation including government departments, private sector, academia, Civil Society Organisations (CSOs) and the media.

Awareness levels on chemicals management in Zambia are generally low across sectors (ECZ, 2002). Though there are several CSOs active in the environmental sector, none of them have a specific focus on chemicals management in general and mercury and mercury Compounds in particular. However, various communication strategies developed from previous projects have significantly contributed to increased knowledge levels and awareness on chemicals management in the country.

Further, several chemical safety trainings are provided by various institutions such as research, academia and chemicals association.

CHAPTER 1: NATIONAL BACKGROUND INFORMATION

1.1 Introduction

The Minamata Convention on Mercury is a global treaty to protect human health and environment from anthropogenic emissions and releases of mercury and mercury compounds. The Convention was adopted in January 2013 and Zambia joined the rest of the world in signing the Convention on 10th October 2013 at a Diplomatic Conference held in Kumamoto, Japan. Zambia became a party to the Convention after ratification in May 2016.

In order to facilitate the said ratification and early implementation of the Minamata Convention, the Global Environment Facility (GEF) provided funding to the Government of the Republic of Zambia (GRZ) to undertake the Minamata Initial Assessments (MIAs). The United Nations Environment (UN Environment) being one of the Implementing Agencies of the GEF provided technical assistance. The main objective of the MIA was to facilitate ratification and early implementation of the Minamata Convention by use of scientific and technical knowledge and tools by national stakeholders. These Enabling Activities (EAs) were aimed at strengthening national decision-making towards ratification of the Minamata Convention on mercury and building national capacity for implementation of future obligations.

The MIA project involved the following components:

i. Establishment of coordination mechanism and organization of the process;
ii. Assessment of the national infrastructure and capacity of the management of mercury;
iii. Development of a mercury inventory using the UN Environment Toolkit;
iv. Identification of challenges, needs and opportunities to implement the Minamata Convention;
v. Preparation and validation of the MIA reports; and
vi. Implementation of awareness raising activities and dissemination of results.

A multi-sectorial and multi-stakeholder approach was used to implement the project. An inception workshop was held where relevant national stakeholders were engaged and a national coordinating mechanism was established involving stakeholders from different sectors. The stakeholders formed Working Groups (WGs) namely; Mining and Metal

Production, Waste, Consumer Products and Energy. The WGs were responsible for implementation of various project activities including conducting inventory, review of the legal and institutional framework, development of a Communication Strategy and validation of all project reports.

Mercury is a naturally occurring heavy metal and exists in three forms namely elemental, organic and inorganic. Mercury is of global concern due to its toxic nature, trans-boundary movement and its potential to bio-accumulate and bio-magnify. Sources of mercury are both natural and anthropogenic. Natural sources of mercury include volcanic eruptions and emissions from the ocean. Anthropogenic emissions include mercury that is released from fuels or raw materials, or from uses in products or industrial processes. Some of these industrial processes are hydroelectric, mining and pulp and paper industries. Incineration of municipal and medical waste and emissions from coal powered plants also contribute to high levels of mercury. When emitted into the air, mercury can travel thousands of miles in the atmosphere before it eventually deposits back to the earth.

Mercury is one of the most toxic chemicals that threaten both the environment and human health especially when metabolized into methyl mercury. Methyl mercury accumulates in sediments and can persist in the environment and bio-magnify in the food chain posing high risks to human health (Jensen, et al., 2006). Consumption of food stuffs contaminated with mercury such as fish, may pose a risk to populations that depend on consumption of fish on a regular basis. According to Jensen, et al. (2006), exposure to mercury and mercury compounds has mutagenic as well as teratogenic effects.

Mercury may be fatal if inhaled and harmful if absorbed through the skin. Mercury vapor is absorbed in the blood through the lungs and may cause harmful effects to the nervous, digestive, respiratory and immune systems and to the kidneys, besides causing lung damage. Adverse health effects from mercury exposure can be: tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, and attention deficit and developmental delays during childhood.

1.2 Location of Zambia in Africa

Zambia is land linked and surrounded by eight countries namely Angola to the west, Democratic Republic of the Congo and Tanzania to the North, Malawi and Mozambique to the East, Zimbabwe, Botswana and Namibia to the South and South-West respectively. The country lies between 8^{O} -18^{O} South and 22^{O} – 34^{O} East with a land area of 752, 614 km^2.

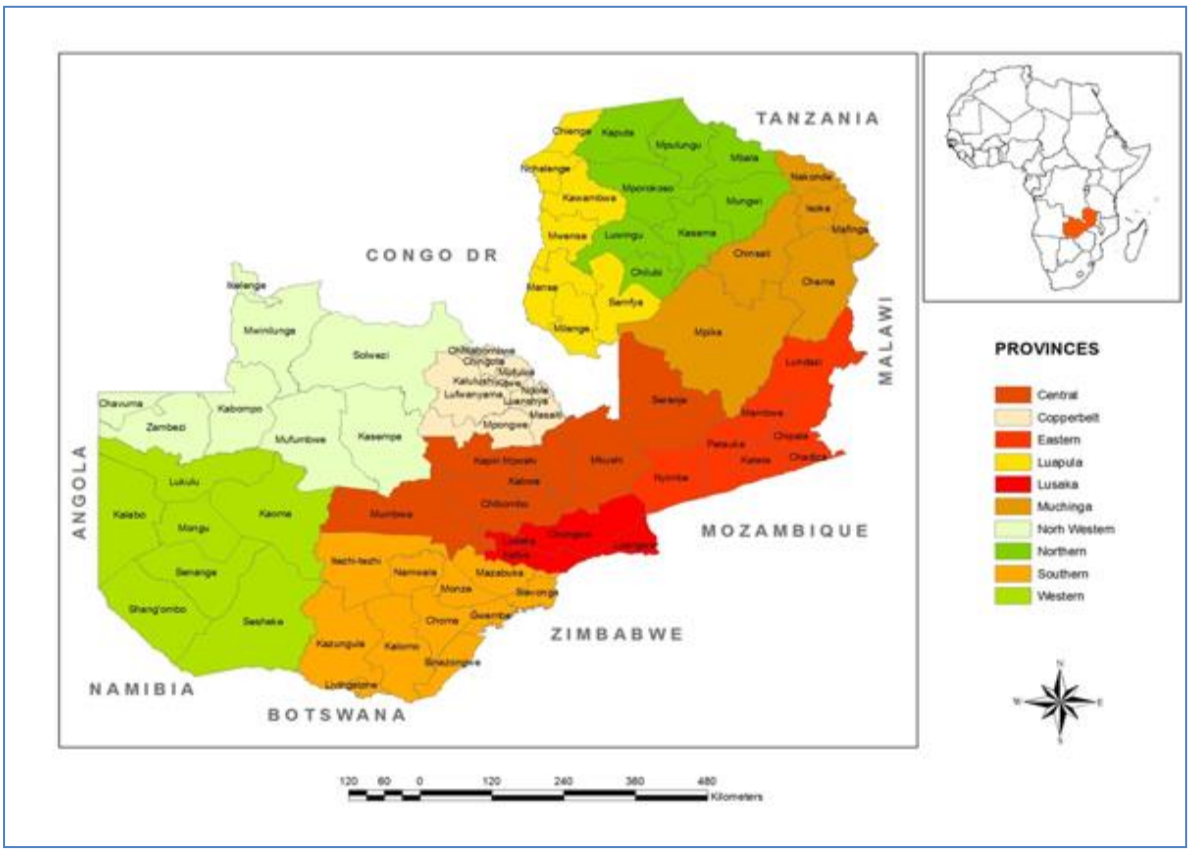

Figure 1. 1:Map of Zambia and Locations in Africa

1.3 Geography

Zambia lies within the tropics and much of the country enjoys a subtropical climate because of the high altitude. There are three seasons namely; a Cool Dry Season from May to August, a Hot Dry Season from August to October and a Warm Wet Season from November to April. Annual temperatures average between 18 ^{O}C and 20 ^{O}C, the maximum annual average temperatures being 32 ^{O}C in October/November and minimum being about 4 ^{O}C in June/July. The highest rainfall is received in the northern half of the country with an annual range of 1,100mm to over 1,400mm while the southern half receives rains ranging from 600mm to

1,100mm in the valley areas of the Zambezi and Luangwa Rivers, and the plateau areas, respectively.

Zambia's major river systems is formed by the Zambezi and its tributaries, Luangwa, Kafue Chambeshi, and Luapula Rivers. The Zambezi forms a boundary with Namibia, Botswana and Zimbabwe and is home to the Victoria Falls. The Kafue, Luangwa and Chambeshi form major inland rivers. Major lakes include Tanganyika, Mweru, Bangweulu and the Kariba.

1.4 Population

The population of Zambia has been increasing in the past decades especially during the period under review. The population increased from 13 million in 2010 to 15.5 in 2015 representing an increase of 18.3 percent (CSO, 2016). The majority of the population accounting for 60.5 percent live in rural areas and are dependent on subsistence agriculture for their livelihood (CSO, 2012). Table 1.1 shows trends in population growth from 2011 to 2015. The population distribution by gender shows that in all provinces, the population of females was higher than that of males. The national female-male gender distribution was 51.3 and 48.7 percent respectively. It is projected that Zambia's population will reach 26.9 million by 2035. This will ultimately, lead to an increased demand for economic opportunities, basic social services, infrastructure, and natural resources.

The official is English and major local languages spoken in Zambia include; Bemba, Kaonde, Lozi, Lunda, Luvale, Nyanja and Tonga.

Table 1. 1: Demographic Trends, Zambia, 2011-2015

Year	**2011**	**2012**	**2013**	**2014**	**2015**
Total population (millions)	13.72	14.15	14.58	15.02	15.47
Urban population (% total population)	40.6	40.9	41.2	41.5	41.8
Children (0-14, % total population)	46.6	46.4	46.3	46.2	46.1
Youth (15-24, % total population)	20.4	20.5	20.6	20.7	20.7
Population growth rate (%)	3.1	3.0	3.0	3.0	2.9

Source: *Central Statistical Office ,2016*

1.5 Political Profile

Zambia is a democratic republic presided over by an Executive President with the government comprising of three independent organs; the Executive, Legislature and Judiciary. The Executive formulates and articulates policies and implements laws, whilst the Legislature headed by the Speaker enacts laws. The Judiciary is headed by the Chief Justice and is responsible for interpreting laws and administering justice. The President appoints cabinet ministers from among members of Parliament. In addition, the President appoints Constitutional office bearers such as the Attorney General, Solicitor General, Director of Public Prosecutions and Permanent Secretaries.

In 1991, there was a change from one party state to multipartyism. Further in 2011, the Patriotic Front (PF) took charge of government and changed the approach towards the governance in line with its policies and manifesto. The PF manifesto recognizes that the country's development should be governed by safeguarding the environment through sustainable use of natural resources. The participation of all stakeholders including local communities, in collaboration with the private sector will ensure a more sustainable approach to environmental protection.

1.6 Economic Profile

Zambia is a member of the two regional economic communities; the Southern African Development Community (SADC) and Common Market for Eastern and Southern Africa (COMESA).

Zambia's economy has been one of the fastest growing economies in the world. The country's economy has mainly been driven by sustained expansion in agriculture, construction, manufacturing, transport, communications and mining (AfDB, 2012).

The economy during the period 2000 and 2005 grew at average rate of about 5.8 percent and 6.9 percent between 2006 and 2015 (GRZ, 2018). Real Growth Domestic Product (GDP) growth averaged 6.7 percent per annum and slowed down to an estimated 3 percent in 2015. This was attributed to falling copper prices, reduced power generation and depreciation of the local currency. Figure 1.11 presents GDP between 2007 and 2015. Further, the economy came under strain in 2015 and 2016 as external headwinds and domestic pressure intensified. Lack of economic diversification and dependency on copper as its sole major export makes it vulnerable to fluctuations in the world commodities market.

Figure 1. 2: Zambian GDP 2006 – 2016

Source: tradingeconomics.com, World Bank (2016)

1.7 Seventh National Development Plan

Following the expiry of the Revised Sixth National Development Plan (R-SNDP) in 2016, the Government spearheaded the formulation of the Seventh National Development Plan (7NDP) which covers the period 2017 to 2021. The Plan departs from sectoral-based planning to a multi-sectoral approach under the theme "Accelerating development efforts towards Vision 2030 without leaving anyone behind". The multi-sectoral approach recognises the multi-faceted and interlinked nature of sustainable development which calls for interventions to be tackled simultaneously through a coordinated approach to implementing development programmes.

The goal of the 7NDP is to create a diversified and resilient economy for sustained growth and socio-economic transformation driven by agriculture, among others. Other sectors include mining, energy, manufacturing and tourism. In addition, the 7NDP responds to the Smart Zambia transformation Agenda 2064 and embeds in it, the economic recovery necessary for the actualisation of a Smart Zambia.

1.8 Economic Sectors

The country's economic growth has been largely powered by developments in the mining sector. In line with the 7NDP, Government's policy is to diversify the economy in the other sectors such as agriculture, manufacturing, tourism and industry. This section highlights

economic sectors that the Government is targeting in its endeavor to uplift the peoples' standards of living.

1.8.1 Agriculture, Livestock and Fisheries

Zambia has a landmass of approximately 752,614 square kilometers, of which 56 percent is arable land (42 million hectares). In addition, about 35 percent of the fresh water resources in the SADC region are in Zambia, which if well nurtured, could make agriculture the main stay of the economy (MFNP, 2006).

The agricultural sector continues to be the backbone of the Zambian economy as it contributes to the growth of the economy and exports. Primary agriculture contributed about 35 percent to the country's total Non-Traditional Exports (NTEs) and 10 percent of the total export earnings for the country. The sector also provides employment to 70 percent of the labor force. As such, the sector has continued receiving priority attention by government, through increased budget support aimed at increasing productivity, income generation, creation of employment opportunities and poverty alleviation. By far the majority of Zambians (about 60%) live in the rural areas where agriculture and fisheries are the main economic activities.

The agricultural sector has however, been characterized by fluctuating growth trends with negative growth rates registered in 2010 and 2013 at -1.7 and -7.4 per cent respectively. Positive growth was recorded in 2011, 2012 and 2014 at 8.0, 6.8 and 6.5 per cent respectively. The steep contraction in agricultural production in 2013 was largely due to a very poor harvest caused by bad weather conditions and an army worm outbreak.

1.8.2 Energy

Energy is an important element in the development of various industries in the country. Table 1.2 shows energy sources in comparison to total energy demand.

Table 1. 2: Energy Sources in Zambia

Source	**Percentage**
Electricity	14
Petroleum	12
Coal	2
Biomass	70
Renewable Energy	2

With rapid economic growth and new mines development in the country, there has been a 36 percent demand increase for power which has resulted in 26 percent of Zambia being affected by load shedding usually at peak times in the last decade.

Hydropower is the primary electricity supply mode for Zambia accounting for 95 percent power production. In order to accelerate the development of the electricity sub-sector, Government adopted an Electricity Strategy Paper that identified the key issues affecting the sector ranging, among other things; power deficit, increased demand, lack of new investment in the sector, low tariffs, poor state of transmission and distribution infrastructure and financial viability of the Utility.

Furthermore, the country's growing economy has also led to an increase in the demand for other forms of energy such as petroleum and coal, as these are key factors of production and operations in most economic sectors. There has also been significant growth in renewable energies in recent years as the market explores alternative sources of energy, with renewable energies proving to be a viable alternative.

1.8.3 Mining

Zambia has predominantly mined copper and cobalt. The economy has historically been based on the copper-mining industry, which contributes around 10 percent to Zambia's GDP and 60 percent of total exports. In 2013, Zambia was estimated to rank eighth in the world in the production of copper ore and sixth in the production of cobalt ore. Zambia is an internationally significant producer of semiprecious gemstones. Significant quantities of selenium and silver together with uranium, gold and platinum group elements are produced as important by-products of the copper mining and processing in some cases. Copper production reached its peak (700,000 tons) in the 1970s. However, annual production levels dropped to about 200,000 tons in the late 1990's due to lower prices and production inefficiencies.

In 2013, the preliminary value of exports and imports of minerals was estimated to be about USD10 billion and USD9 billion, respectively. Exports increased by about USD1 billion owing to an increase in metal exports to China, India, Japan, Switzerland, and the United Arab Emirates. The value of copper exports was estimated to be about USD7 billion in 2013, when copper exports accounted for an estimated 68 percent of Zambia's merchandise exports. The value of exports of cobalt was estimated to be USD138 million (1.3% of the preliminary value of Zambia's exports in 2013.

1.8.4 Manufacturing

The manufacturing sector accounts for an estimated 11 percent of the country's GDP and has been growing at an average annual growth rate of three percent between 2008 and 2013. Growth in the manufacturing sector is largely driven by the agro-processing (food and beverages), textiles and leather subsectors. Secondary processing of metals is another main activity in the sector, including the smelting and refining of copper, leading to the manufacturing of metal products. Fertilizers, chemicals, explosives and construction materials such as cement are also produced in the sector. Other activities include wood and paper products

The development of the rural areas will be encouraged through infrastructure development that will support rural industrialization. Local and foreign investment in rural based industries will be promoted to facilitate on-site agro-processing and establishment of linkages between farmers, industrial estates and out-grower schemes.

1.9 Environmental Overview

Zambia's population has been growing resulting in increased pressure on the environment and its natural resources. The National Conservation Strategy (NCS) of 1985 provided an overview of the status of environmental resources in the country. It also identified key issues and recommended policies, programmes and actions to resolve the issues. It was through this strategy that the Environmental Protection and Pollution Control Act (EPPCA), Cap 204 of 1990 was enacted and the subsequently, established the Environmental Council of Zambia (ECZ).

Further development on environmental issues saw the National Environmental Action Plan (NEAP) launched in 1994 whose objective was to integrate environmental concerns into the social and economic development planning process. Five priority areas were identified namely: water pollution and inadequate sanitation, soil erosion, air pollution, wildlife depletion and deforestation. The Government formulated the National Policy on Environment (NPE) in 2007 which is aimed at creating an umbrella policy for the welfare of the country's environmental sustainability. The NPE, however, is not explicit on issues pertaining to mercury management but does provide principles for human health and environmental protection.

In 2011, the EPPCA was repealed and replaced with the Environmental Management Act No. 12 of 2011 which resulted in the re-naming of ECZ to the Zambia Environmental Management Agency (ZEMA) and the broadening of its mandate.

1.10 Mercury Management

Literature review revealed inadequate information on mercury and limited studies to establish the status of mercury sources, contamination in the environment and exposure risk factors. For this reason, GRZ through ZEMA with support from UN Environment undertook a national mercury inventory between 2011 and 2012. The objective of the inventory was to identify the various anthropogenic mercury sources and quantify their respective emissions and releases to the environment.

The study was conducted using a UNEP Mercury Toolkit Level 1 and established preliminary indications of anthropogenic mercury sources, emissions and releases into the environment. Various sources of mercury release into the environment identified using this Tool Kit included; energy consumption, fuel refinery, primary metal production, cement production, use and disposal of mercury-containing products. Others were recycling of iron and steel, waste incineration, waste disposal, land filling, waste water treatment, crematoria and cemeteries (ZEMA, 2012).

Having identified the various sources of emissions and releases of mercury in the environment, Zambia undertook another technical study in 2014 on the management of mercury. The study revealed that Zambia faces a number of challenges in the management of mercury which included; inadequate legal framework and data sharing among stakeholders and insufficient awareness among workers and staff in various institutions. Furthermore, inadequate equipment to use in assessing levels of mercury in the environment and insufficient awareness programmes on mercury and its effects were also identified as gaps.

The major contributors to mercury emissions sources in 2012 study were primary metal production and metal smelting, waste deposition/landfilling and waste treatment, waste incineration, and products with mercury content. An approximated 260 tonnes of mercury was recorded to have been released. Primary metal production contributed 240 tonnes, 11.8 tonnes from waste deposition/landfilling and waste treatment, 4.7 tonnes was from waste incineration and 2.3 tonnes from use and disposal of products with mercury content. The rest were in smaller quantities as shown in the Figure 1.3.

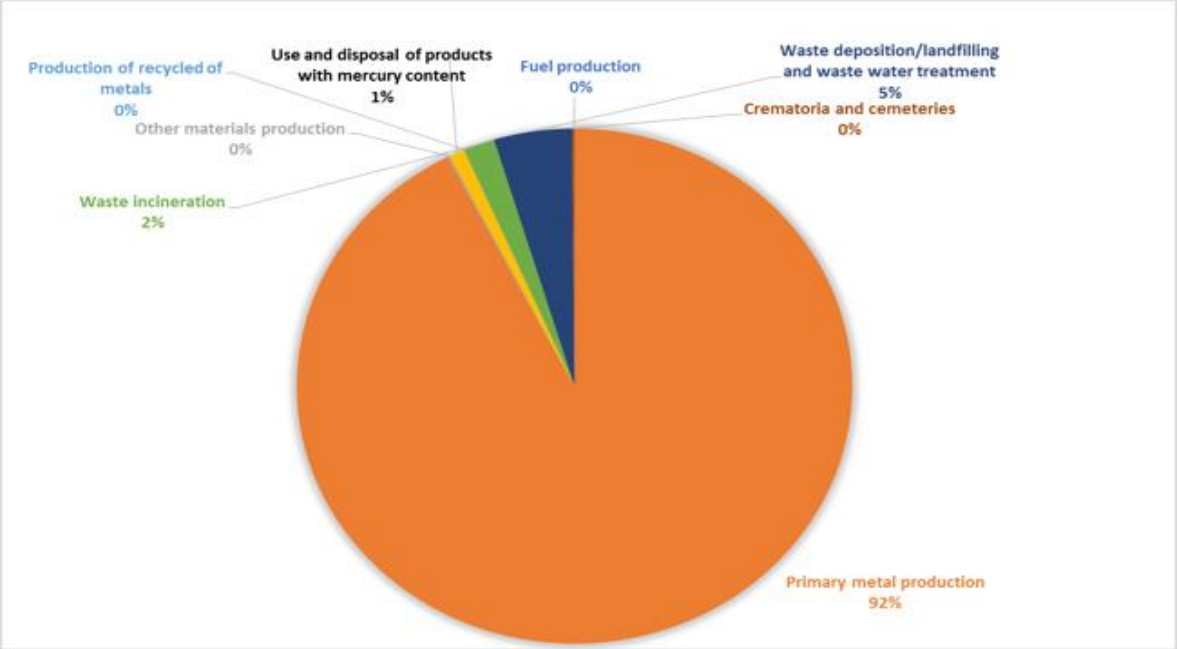

Figure 1. 3: Mercury Emissions

Source: ZEMA, 2014

CHAPTER 2: MERCURY INVENTORY AND IDENTIFICATION OF EMISSIONS AND RESOURCES

The UNEP Level 2 Toolkit is designed to produce a simple methodology and accompanying database to enable assembly of consistent national and regional mercury inventories. It comprises a UNEP-recommended procedure for the effective compilation of source and release inventories of mercury. Comparable sets of mercury source release data enhance international co-operation, discussion, goal-definition and assistance.

The Toolkit is adaptable, a screening tool, not an exhaustive registry, and ensures positive identification of significant sources of mercury. It also highlights the pathways of mercury within society, and into the environment and other receiving media. Further, it provides a methodology, associated input factors and output distribution factors that can be used to estimate mercury releases into air, water, land, products and wastes.

In developing this report, stakeholders collected both primary and secondary data from internal and external sources such as the United Nation International Trade Statistics Database ("COMTRADE"), United States Geological Survey (USGS), Government and industry. Based on the ToolKit, emission sources of mercury to air and release sources of mercury to land and water are discussed in this chapter. The chapter also provides an overview of the inventory of mercury in the categorized as follows:

i. Stocks of mercury and/or mercury compounds including an assessment of current storage conditions as well as an evaluation of potential storage needs in the future once the Convention is implemented;
ii. Supply of mercury including sources, recycling activities and quantities;
iii. Relevant sources of mercury emissions and releases;
iv. Sectors that use mercury or mercury compounds and the amount per year, including in manufacturing processes and for the production of mercury added products, Artisanal and Small-scale Gold Mining (ASGM); and
v. Trade of mercury and mercury containing compounds as well as the import and export of mercury-added products.

2.1 Summary of mercury releases, supply and trade.

Table 2.1 shows the mercury release from all the identified source categories and their calculated mercury releases in Zambia. The total mercury release was recorded at 123 tonnes

as indicated in Table 2.1. Primary Metal Production contributed 93.7 tonnes which translates to 76 percent, Consumer Products contributed 12.9 tonnes accounting for 11 percent, Waste Incineration and Burning contributed 12.8 tonnes amounting to 10 percent and Waste Deposition and Waste Water Treatment contributed 8.5 tonnes translating to 5 percent as shown in figure 2.1.

Table 2. 1: Summary of source categories and their calculated mercury output

No.	Source category	Calculated Hg output, Kg/y						
		Air	Water	Land	By-products and impurities	General waste	Sector specific treatment/ disposal	Total releases by source category
1	Extraction and use of fuels/energy sources	99	0	-	-	1	5	105
2	Primary (virgin) metal production	14,705	1,719	13,976	30,196	-	33,174	93,770
3	Production other minerals and materials*1	166	-	-	71	-	-	237
4	Intentional Hg in industrial processes	-	-	-	-	-	-	-
5	Consumer products (whole lifecycle)	3,164	288	3,219	-	6,190	0	12,861
6	Other product/process use*2	68	459	3	-	394	389	1,314
7	Production of recycled metals	36	-	37	-	36	-	109
8	Waste incineration and burning	12,815	-	-	-	-	-	12,815
9	Waste deposition + waste water treatm.*3*4	813	1,165	6,258	-	121	121	8,477
10	Crematoria and cemeteries	0	-	141	-	-	-	141
	SUM OF QUANTIFIED RELEASES*3*4	31,865	3,229	17,537	30,267	6,742	33,689	123,330

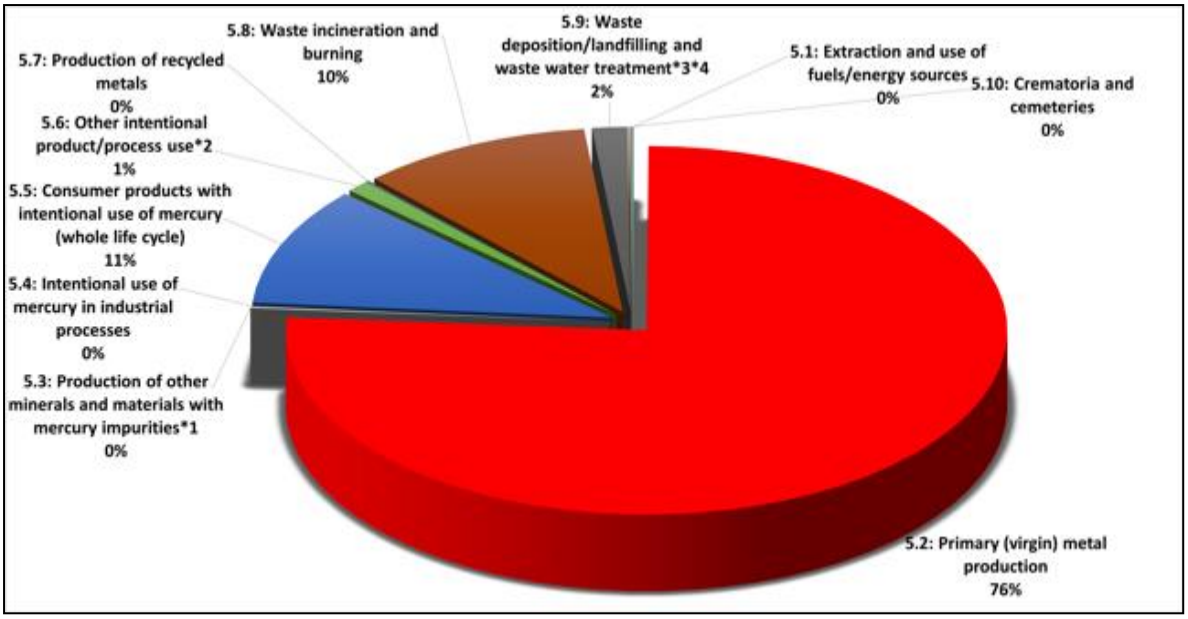

Figure 2. 1: Total mercury Release per category in Zambia.

2.1.1 Mercury Release Source Types Present

An analysis was conducted for mercury release source types in the country. Table 2.2 shows the identified release sources and also shows the release sources that were present, absent and those that were possible but not positively identified.

Table 2. 2: Mercury release sources

Source category	Exists? (y/n/?)
Source category: Extraction and use of fuels/energy sources	
Coal combustion in power plants	Y
Coal combustion in coal fired industrial boilers	Y
Other coal use	Y
Mineral oils - extraction, refining and use	Y
Natural gas - extraction, refining and use	N
Other fossil fuels - extraction and use	N
Biomass fired power and heat production	Y
Geothermal power production	N
Source category: Primary (virgin) metal production	
Mercury (primary) extraction and initial processing (a	N
Gold (and silver) extraction with mercury amalgamation processes	?
Zinc extraction and initial processing	N
Copper extraction and initial processing	Y
Lead extraction and initial processing	N
Gold extraction and initial processing by methods other than mercury amalgamation	Y
Aluminium extraction and initial processing	N
Other non-ferrous metals - extraction and processing	?
Primary ferrous metal production	N
Source category: Production of other minerals and materials with mercury impurities	
Cement production	Y
Pulp and paper production	N
Production of lime and light weight aggregates	Y
Source category: Intentional use of mercury in industrial processes	
Chlor-alkali production with mercury-technology	N
VCM production with mercury catalyst	N
Acetaldehyde production with mercury catalyst	N
Other production of chemicals and polymers with mercury	N
Source category: Consumer products with intentional use of mercury	
Thermometers with mercury	Y
Electrical switches and relays with mercury	Y
Light sources with mercury	Y
Batteries with mercury	?
Polyurethane with mercury catalysts	N
Biocides and pesticides with mercury	?
Paints with mercury	?
Pharmaceuticals for human and veterinary uses	N
Cosmetics and related products with mercury	?
Source category: Other intentional product/process use	
Dental mercury-amalgam fillings (b	Y
Manometers and gauges with mercury	Y
Laboratory chemicals and equipment with mercury	?
Mercury metal use in religious rituals and folklore medicine	?
Miscellaneous product uses, mercury metal uses, and other sources	?
Source category: Production of recycled metals ("secondary" metal production)	
Production of recycled mercury ("secondary production")	N
Production of recycled ferrous metals (iron and steel)	Y
Production of other recycled metals	?
Source category: Waste incineration*3	
Incineration of municipal/general waste	N
Incineration of hazardous waste	N
Incineration of medical waste	Y
Sewage sludge incineration	N
Informal waste burning	Y
Source category: Waste deposition/landfilling and waste water treatment	
Controlled landfills/deposits*3	Y
Diffuse disposal under some control	N
Informal local disposal of industrial production waste	N
Informal dumping of general waste*1*3	Y
Waste water system/treatment*2	Y
Source category: Crematoria and cemetaries	
Crematoria/cremation	Y
Cemeteries	Y

Note: Y: Present; N: Absent; ?: Not sure.

2.1.2 Summary of Mercury inputs to Society for all Categories

A summary of mercury inputs to society for all categories identified is presented in Table 2.3. The largest contributions to mercury inputs to society were from Copper Extraction and initial processing at 78.2 tonnes; Gold Extraction and Initial Processing by methods other than Mercury Amalgamation at 15.5 tonnes; and Informal Waste Burning which was 12.7 tonnes.

Table 2. 3: Calculated Mercury input to Society

Source category	Calculated. Hg input to society (Kgs)
Source category: Extraction and use of fuels/energy sources	
Coal combustion in power plants	9
Coal combustion in coal fired industrial boilers	42
Other coal use	18
Mineral oils - extraction, refining and use	5
Natural gas - extraction, refining and use	0
Other fossil fuels - extraction and use	0
Biomass fired power and heat production	32
Geothermal power production	0
Source category: Primary (virgin) metal production	
Mercury (primary) extraction and initial processing (a	0
Gold (and silver) extraction with mercury amalgamation processes	0
Zinc extraction and initial processing	0
Copper extraction and initial processing	78242
Lead extraction and initial processing	0
Gold extraction and initial processing by methods other than mercury amalgamation	15529
Aluminium extraction and initial processing	0
Other non-ferrous metals - extraction and processing	0
Primary ferrous metal production	0
Source category: Production of other minerals and materials with mercury impurities	
Cement production	229
Pulp and paper production	0
Production of lime and light weight aggregates	8
Source category: Intentional use of mercury in industrial processes	
Chlor-alkali production with mercury-technology	0
VCM production with mercury catalyst	0
Acetaldehyde production with mercury catalyst	0
Other production of chemicals and polymers with mercury	0
Source category: Consumer products with intentional use of mercury	
Thermometers with mercury	862
Electrical switches and relays with mercury	780
Light sources with mercury	3

Batteries with mercury	11185
Polyurethane with mercury catalysts	0
Biocides and pesticides with mercury	0
Paints with mercury	0
Pharmaceuticals for human and veterinary uses	0
Cosmetics and related products with mercury	31
Source category: Other intentional product/process use	
Dental mercury-amalgam fillings (b	1297
Manometers and gauges with mercury	17
Laboratory chemicals and equipment with mercury	0
Mercury metal use in religious rituals and folklore medicine	0
Miscellaneous product uses, mercury metal uses, and other sources	0
Source category: Production of recycled metals ("secondary" metal production)	
Production of recycled mercury ("secondary production")	0
Production of recycled ferrous metals (iron and steel)	109
Production of other recycled metals	0
Source category: Waste incineration*3	0
Incineration of municipal/general waste	0
Incineration of hazardous waste	0
Incineration of medical waste	113
Sewage sludge incineration	0
Informal waste burning	12702
Source category: Waste deposition/landfilling and waste water treatment	
Controlled landfills/deposits*3	51
Diffuse disposal under some control	0
Informal local disposal of industrial production waste	0
Informal dumping of general waste*1*3	7621
Waste water system/treatment*2	805
Source category: Crematoria and cemeteries	0
Crematoria/cremation	0
Cemeteries	141
SUM OF QUANTIFIED INPUTS AND RELEASES *1*2*3*4	**111391**

2.1.3 Summary of Mercury Releases to Air

A summary of total mercury release to air is presented in Figure 2.2 Primary metal production had the highest contribution of 14.7 tonnes (46 percent), followed by waste incineration and burning at 12.8 tonnes (40 percent) and consumer products contributed 3.2 tonnes (10 percent). The rest source categories contributed 4 percent.

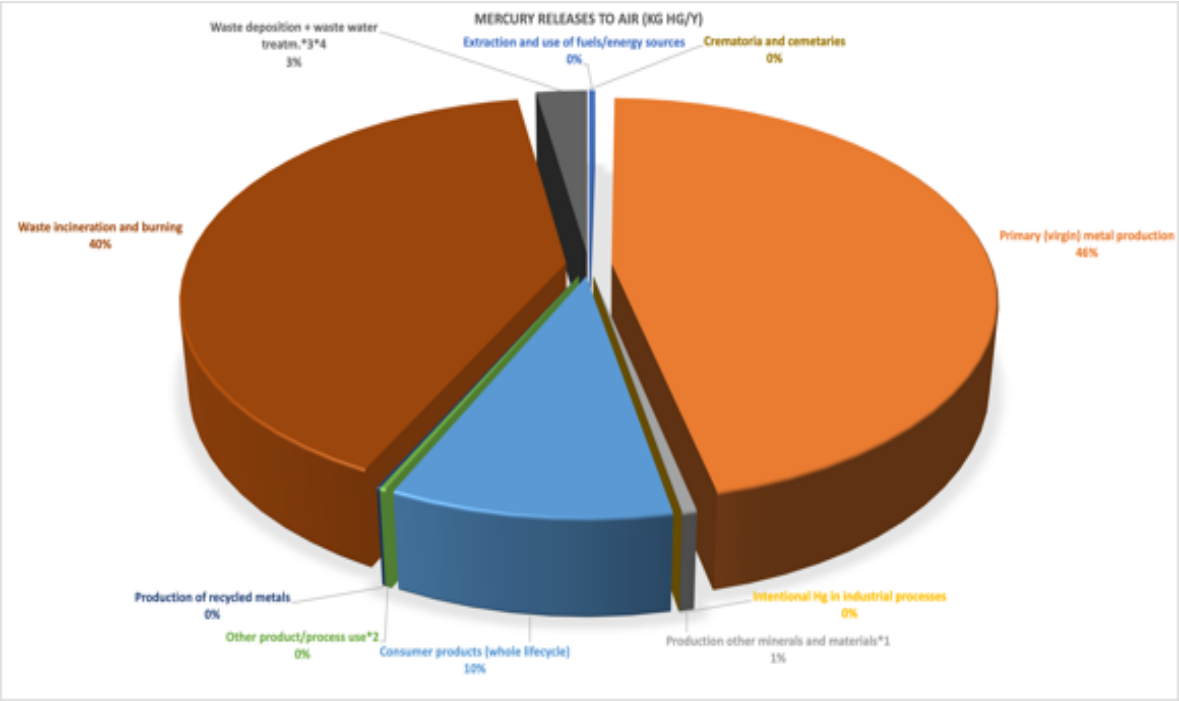

Figure 2. 2: Mercury Releases to Air

2.1.4 Summary of mercury releases to Water

A summary of total mercury release to water is presented in Figure 2.3. Primary metal production had the highest contribution 1.7 tonnes (47 percent), followed by Waste deposition and waste water treatment at 1.2 tonnes (32 percent), other intentional products/process use contributed 0.5 tonnes (13 percent) and consumer products had 0.3 tonnes (8). The rest source categories contributed below 1 percent.

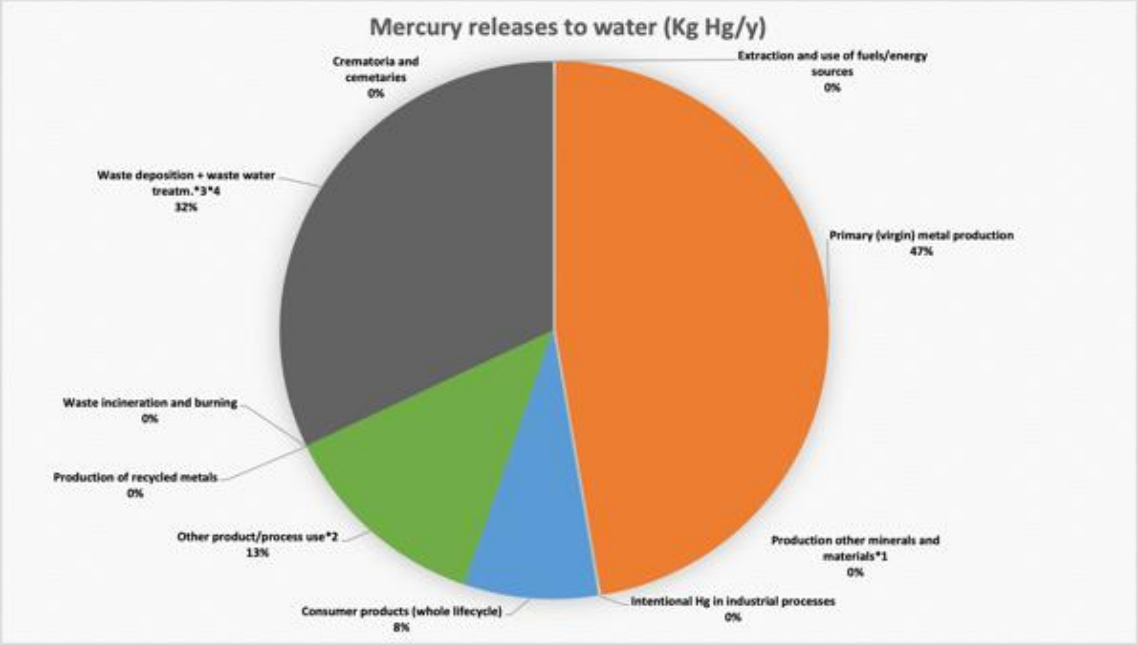

Figure 2. 3: Mercury release to Water

2.1.5 Summary of Mercury Releases to General Waste

Consumer products with intentional use of mercury had the highest contribution at 6.2 tonnes (92 percent), followed by other intentional product/process use which had 0.4 tonnes (6

percent) and waste deposition contributed 0.1 tonnes (2 percent). The rest source categories contributed below 1 percent. The details of the findings are presented in Figure 2.4

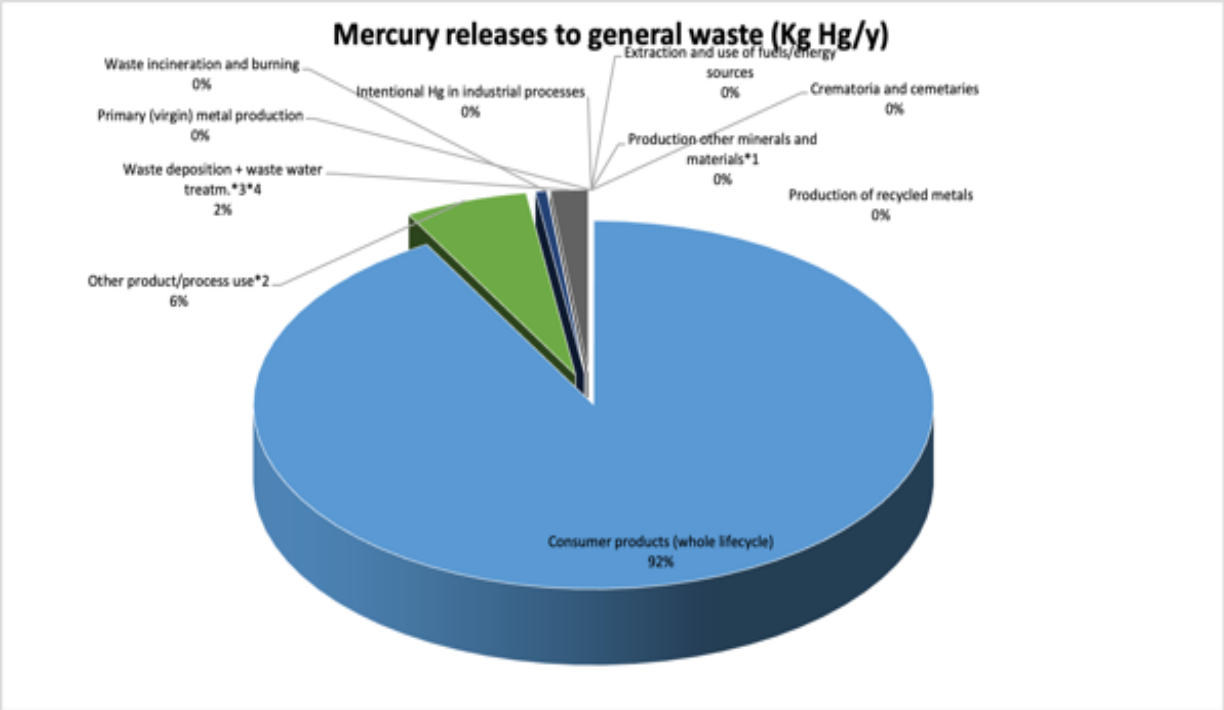

Figure 2. 4: Mercury Releases to General Waste

2.1.6 Summary of Mercury Releases to Land

The highest contribution of mercury releases to land was from primary metal production which accounted for 14 tonnes (59 percent) followed by waste deposition and waste water treatment at 6.3 tonnes (26 percent), Consumer products contributed 3.3 tonnes (14 percent) and crematorium and cemeteries 0.1 tonnes (1 percent). The rest contributed less than 1 percent. The details of the findings are presented in Figure 2.5.

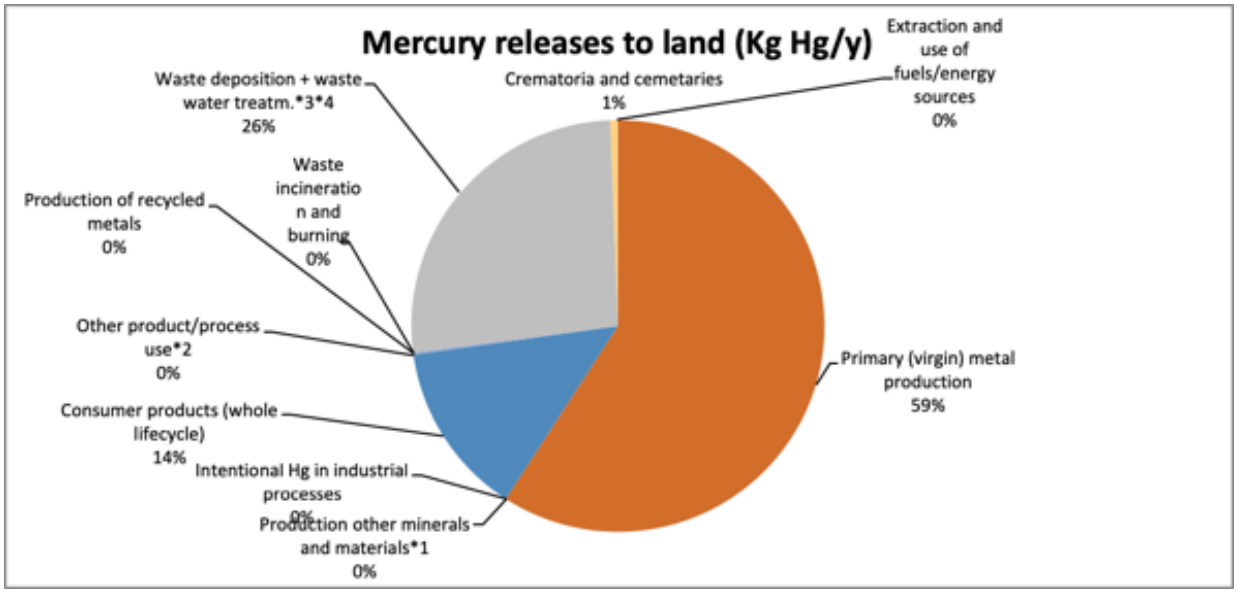

Figure 2. 5: Mercury Release to Land

2.1.7 Summary of Mercury Releases to sector specific Waste Treatment Disposal

Figure 2.6 shows the total mercury release to sector specific waste treatment from the identified source categories. Primary metal production contributed approximately 33.2 tonnes (99 percent) and approximately 0.4 tonnes (1 percent) came from other intentional products/process use.

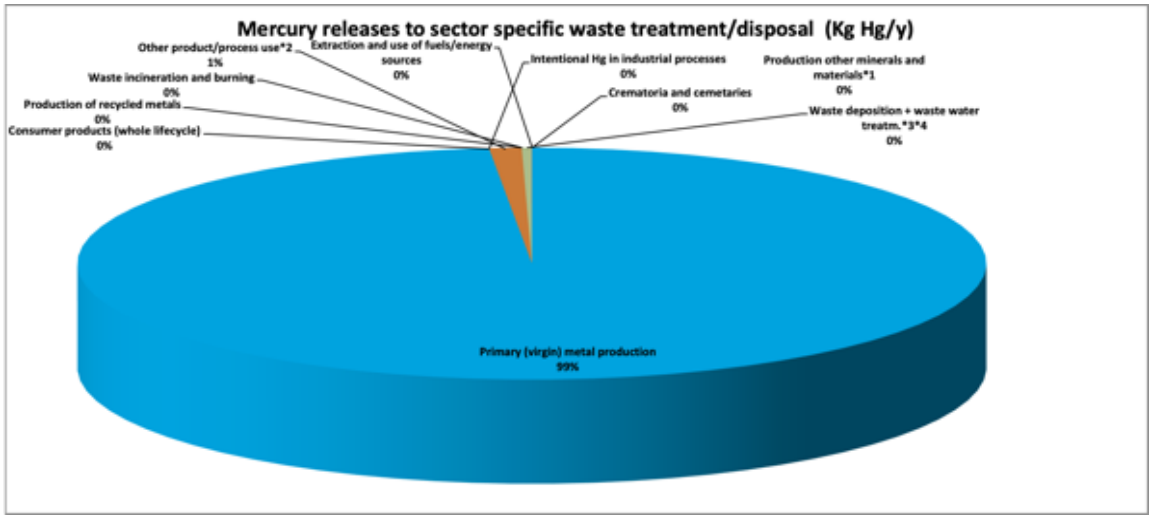

Figure 2. 6: Mercury Releases to sector specific Waste Treatment/ Disposal

2.2 Data and Inventory on Energy and Fuel Consumption

The data for the inventory on energy and fuel consumption was obtained from various sources including Local Authorities and government agencies. Data on coal was obtained from the Zambia Revenue Authority (ZRA) and was based on the import quantities by various companies in Zambia and their use in industrial processes. In terms of mineral oils, data was obtained from Energy Regulation Board (ERB). Production data for biomass was also obtained from end-user industries. All figures were averages for periods ranging 2011 to 2016. Figure 2.7 shows the consumption levels for all energy and fuel categories.

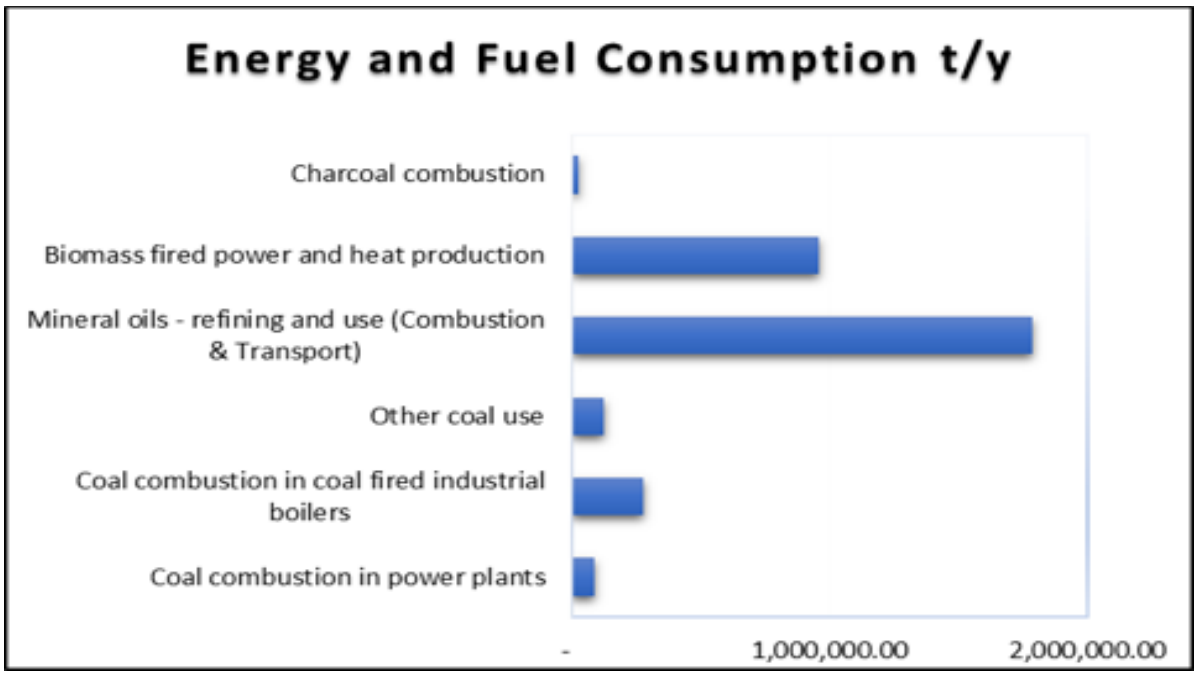

Figure 2. 7: Energy and Fuel Consumption in tones per year

Mineral oil was the highest followed by biomass categories. Zambia does not extract mineral oils or produce geothermal power.

2.3 Data and Inventory on Domestic Production of Metals and Raw Materials

The inventory revealed information gaps regarding the prevelance of domestic production of metals and raw materials in this sector. It was reported that gold extraction with mercury amalgamation processes exist.However, there was no Lead, Zinc and Aluminium extraction during the period under review. Figure 2.8 presents the domestic production of metals and raw materials.

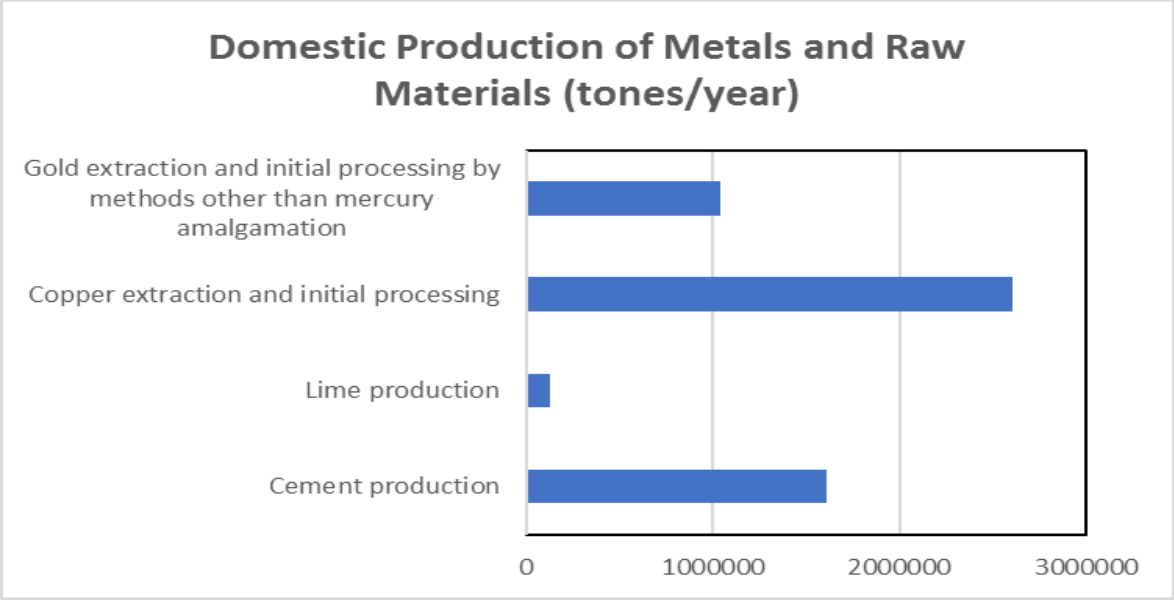

Figure 2. 8: Domestic metals and raw materials production

Copper extraction and initial processing was the highest followed by cement production. Gold extraction and initial processing by methods other than mercury almalgation was third with lime production being the least.

2.4 Data and Inventory on Waste Handling and Recycling

In the waste handling and recycling sector, the highest volume of waste generated was in waste water systems and treatment followed by informal waste burning as presented in Figure 2.9. The calculations for the waste generated was based on the population and the generation rate of 0.5 kgs/person per day. It was noted that 60 percent of waste generated was not deposited at the landfill.

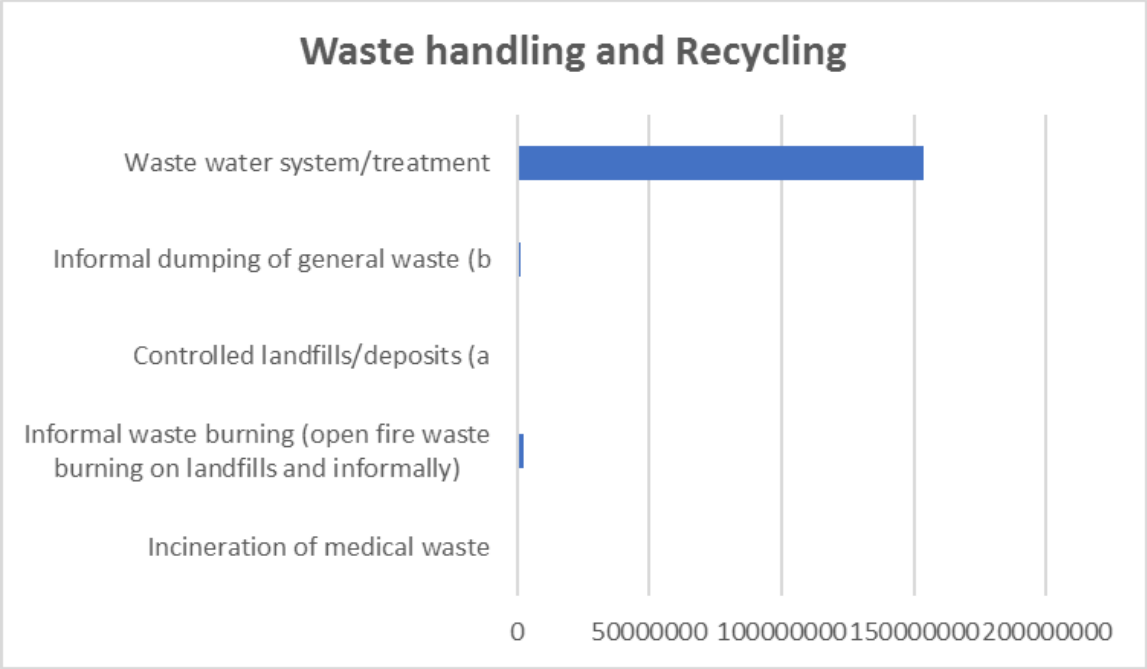

Figure 2. 9: Waste Handling and Recycling

2.5 Data and Inventory on General Consumption of Mercury in Products, as Metal Mercury and as Mercury Containing Substances

Data for thermometers and batteries imported was obtained from COMTRADE, 2015. Figure 2.10 presents the inventory on general consumption of mercury in products, as metal mercury and as mercury containing substances. Electrical switches and relays with mercury were the highest followed by light sources with mercury.

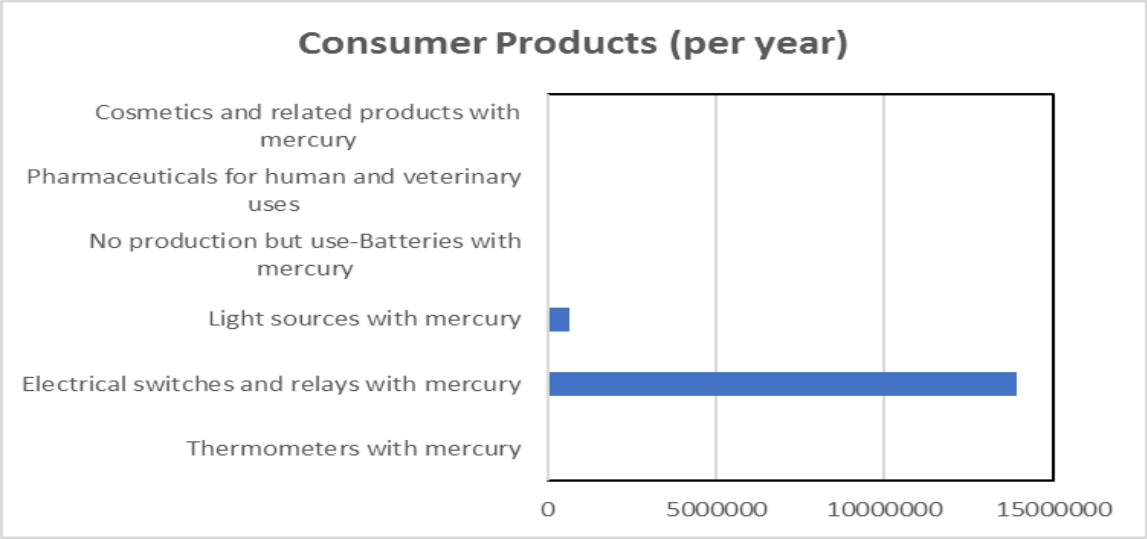

Figure 2. 10: Consumer Products per year

In 2013, Zambia carried out a project funded by the World Bank to replace incandescent bulbs with CFLs with the view of conserving energy. This action stimulated the increase in the importation and use of CFLs in the country.

Consequently, the government established a joint venture between Zesco Limited and Electrometer Limited to locally manufacture single end Compact Fluorescent Lamps (CFLs) at a rate of 2000 CFLs/day for 5 days in a week. The amount of mercury in CFLs per year was calculated as:

2000CFL X 5 days X 4 weeks X 12 months X 4 mg (Hg)/CFL = 1, 920,000 mg/year (1.92 tonnes/year).

2.6 Data and Inventory on Crematoria and Cemeteries

Data from Crematoriums and Cemeteries obtained was based on average death rates for the period 2011 to 2015. A summary of data of the inventory on Crematoria and Cemeteries is presented in Figure 2.11.

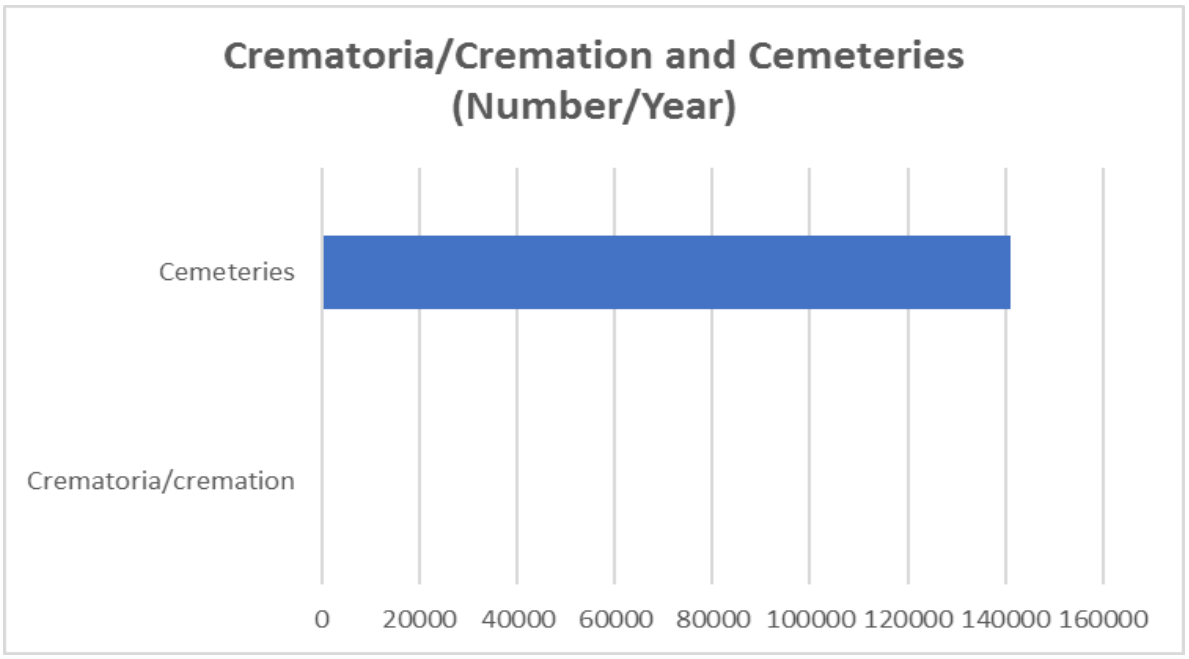

Figure 2. 11: Inventory on Crematoria and Cemeteries (number/year)

In Zambia, burial in cemeteries is more predominant than cremation. This explains the huge difference between the two forms of human disposal.

2.7 Impacts of Mercury on Human Health and the Environment

Mercury is one of the most toxic substances that threatens both human health and the environment especially when it breaks down into methyl mercury. Exposure to elemental and methylmercury may have adverse effects on the central and peripheral nervous systems. In addition, inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. Exposure is mainly through inhalation of Mercury vapour and through ingestion. Mercury vapour is more lethal because it easily enters the bloodstream to the brain. Comparatively, ingestion leads to minimal risks than inhalation since the body does not easily absorb elemental Mercury.

Further, Mercury biomagnification and accumulation presents another significant risk. This phenomenon includes Methylmercury concentrations in fish, leading to predatory birds and eventually mammals such as humans who eat the fish.

Chapter 3: Policy, Regulatory and Institutional Framework Assessment

3.1 Policy Framework

This section presents a brief synopsis on the policy framework relevant to environmental management in Zambia.

3.1.1 National Policy on Environment

The National Policy on Environment (NPE) is the main policy document on the environment and was adopted by Government in 2007. The NPE was designed to create a comprehensive framework for the welfare of the nation's environment so that socio-economic development would be achieved effectively without damaging the integrity of the environment or its resources. The NPE does not directly cover mercury but does provide for sound environmental management and indirectly chemicals management. The NPE was developed and adopted without considering issues relating to mercury as these were still emerging issues in chemicals management at both local and global levels. Notwithstanding the foregoing the NPE provides for a comprehensive framework for sustainable development and natural resource management.

3.2 The Vision 2030

The Vision 2030 is a government policy document that reflects the country's collective understanding, aspirations, and determination of the Zambian people to be a prosperous middle-income nation by 2030. The Vision 2030 provides that "Zambians, by 2030, aspire to live in a strong and dynamic middle-income industrial nation that provides opportunities for improving the well-being of all, embodying values of socio-economic justice, underpinned by the principles of: (i) gender responsive sustainable development; (ii) democracy; (iii) respect for human rights; (iv) good traditional and family values; (v) positive attitude towards work; (vi) peaceful coexistence and; (vii) private-public partnerships"[1].

Industrial development does come with increased exploitation of natural resources and use of chemicals in the process of development. It goes without saying that where chemicals are not properly managed the consequences can be dire. Mercury is not directly mentioned in the Vision. However, fundamental principles anchoring Vision 2030 such as sustainable

development, respect for human rights, fostering family values and gender provide a frame for environmental management in general and Mercury management in particular, in relation to human health and the environment.

The Vision particularly provides that the development of policies shall be done in such a manner that the same are consistent with sustainable environment and natural resource management principles. Environmental Management principles are articulated in the Constitution and the Environmental Management Act, No. 12 of 2011(EMA). Examples of principles relevant to sound chemicals management with direct bearing on mercury management include inter alia the polluter pays principle, the precautionary principle, the substitution principle and the principle of sustainable development.

3.2.1 Other Policies

Other policies with relevance to environmental management and chemicals management in particular include the agriculture policy, lands policy, water policy, gender policy, energy policy, mining policy and health policy.

3.3 Legal and Regulatory Framework

This section presents a discussion on the legal and regulatory framework with regard to environmental management in general and chemicals management in particular. The section will also present a summary of other legislation with a bearing on environmental management in Zambia. An analysis in the context of mercury is also presented.

3.3.1 Environmental Legislation

In order to implement the Minamata Convention on mercury and manage mercury in an environmentally sound manner, it is imperative that the Zambian legal framework provides for management of mercury as well as the implementation of the provisions of the Convention. Zambia practices dualism in implementing international law obligations. This means that once Zambia has ratified an international convention or treaty, it must proceed to enact enabling domestic legislation to implement its obligations. This section assesses the current legal framework relating to mercury with a view to determining whether the current legal framework provides for sound management of mercury as required under the Convention.

Subject to the national Constitution, the principal legislation on environment in general and pollution control in particular is the Environmental Management Act No. 12 of 2011. The EMA

repealed and replaced the Environmental Protection and Pollution Control Act No. 12 of 1990 ("the Repealed Act") which was the first comprehensive piece of legislation on environmental protection and pollution control in Zambia[2]. The EMA makes provision that where there is any inconsistency between the provisions of the EMA and the provisions of any other written law, except the Constitution of Zambia, relating to environmental protection and management, the provisions of the EMA shall prevail to the extent of the inconsistency[3]. The EMA provides among others for integrated environmental management, the protection and conservation of the environment; and the prevention and control of pollution and environmental degradation. Most significantly, the EMA provides for a life cycle approach for sound [4]. It is worth noting that there are other pieces of legislation in the country that have a bearing on chemicals management. This position is presented in the table below.

3.3.2 Relevant Pieces of Legislation

A summary of relevant pieces of legislation with regard to environmental management in Zambia including their bearing on the management of mercury is presented in Table 3.1.

[2] The Repealed Act had a number of secondary or subsidiary legislation which were relevant to the management of POPs; namely the Water Pollution Control Regulations, 1993; the Waste Management Regulations, 1993; the Pesticides and toxic Substances Regulations, 1994; the Air Pollution Control Regulations, 1996; the Environmental Impact Assessment Regulations, 1997; the Ozone Depleting Substances Regulations, 2001 and the Hazardous Waste Management Regulations, 2001. With the exception of the Environmental Impact Assessment Regulations, all these Regulations have since been repealed following the enactment of the Environmental Management (Licensing) Regulations Statutory Instrument No. 112 of 2013.

[3] Section 3.

[4]This includes a chemical such as mercury and other heavy metals.

Table 3.1 1: Relevant Pieces of Legislation on Mercury Management in Zambia

S/N	Legal Instrument	Relevance	Gap(s)
1	The Constitution, Chapter 1 of the laws of Zambia	This is the supreme law in Zambia which provides an enabling framework for environmental management through the Preamble and Part of the Constitution aforesaid.	The Constitutions does not directly provide for the right to a clean environment but obligates citizens to protect and conserve the environment and utilise natural resources in a sustainable manner. The Constitution also obligates citizens to maintain a clean and healthy environment. It also gives guidance on the management of the environment and natural resources in general. The principles enunciated in the Constitution such as the polluter pays principle and the precautionary principle are relevant to the sound management of chemicals and their waste.

Name of Legislation	Relevance	Gap(s)
The Water Resources Management Act No. 21 , 2011	This Act among other things provides for the management, development, conservation, protection and preservation of the water resource and its ecosystems and sustainable utilization of the water resource. Part V of the Act has direct relevance to the management of chemicals in general. Section 48 (1) criminalises the discharge or disposal of any organic or inorganic matter, including water containing such matter, into a water resource, whether directly or through drainage or seepage, so as to cause pollution of the water resources. Sections 44, 45 and, 46 and 47 are also relevant.	This Act does not directly mention the management of chemicals particularly heavy metals. Act reduces the likelihood of duplicity and conflict between this Act and the EMA.

The Fisheries Act No. 22, 2011	This Act among other things provides for promotion of the sustainable development of fisheries, aquaculture and a precautionary approach in fisheries management, conservation, utilization and development. Section 4 provides for sustainable management of fisheries resources which requires that impact of chemicals on the management of fish resources must be reduced or eliminated. Section 12 also provides for prevention of pollution which is relevant to Mercury and other pollutants. There is however, no direct link to management of Mercury and other heavy metals. Sections 39[5] and 43[6] are also relevant.	This Act does not specifically make reference to heavy metals such as mercury. The Act does not cross reference the EMA thereby presenting a possibility of conflict and duplicity especially in enforcement.

[5]For example, Paragraph (d) of Section 39 provides for the protection of fisheries resources and their environment from destruction, degradation, pollution and any other adverse impacts through human activities that threaten their health and viability.

[6] Paragraph (J) of Section 43 requires that a Licence include a condition that provides for prohibiting or controlling the use of any chemical or pharmaceutical preparation, drug or antibiotic, in an aquaculture facility.

The Zambia Wildlife Act No. 14 of 2015	This Act among other things provides for control and management of National Parks and for the conservation and enhancement of wildlife eco-systems, biodiversity, and of objects of aesthetic, pre-historic, historical, geological, archaeological and scientific interest in National Parks; and for the promotion of opportunities for the equitable and sustainable use of the special qualities of National parks; to provide for the establishment, control and management of Game Management Areas; to provide for the sustainable use of wildlife and the effective management of the wildlife habitat in Game Management Areas. Section 16 of the Act provides for the enjoyment of mining right within a national park provided an environmental impact assessment (EIA) is undertaken. Through the EIA process the control of chemicals in general and mercury in particular can be achieved. Other Sections with relevance to management of mercury though indirect include sections 20[7], 38[8]	

[7]Section 20 (1) and (2) prohibits the use of poison in the hunting of wild animals. Poison may include mercury and mercury compounds.

The Forests Act No. 4 of 2015	This Act provides for the establishment and management of National Forests and Local Forests; to make provision for the conservation and protection of forests and trees and also provides for the licensing and sale of forest produce. Section 23 (i) of the Act prohibits the dumping of waste in a national forest. This section has relevance to the management of mercury and mercury compounds especially when there is waste arising from mercury. Suffice to mention that the provisions of the Act relating to fires have relevance to pollution control. The Act cross references the EMA.	This Act does not directly provide for pollution control
The Urban and Regional Planning Act No. 3 of 2015	Provides for urban and regional planning and development control. Relevant in the area of environmental impact assessment. (Zoning, planning permission)	

[8]Section 24(2) provides that without prejudice to the generality of the powers to impose conditions under that section, the Authority may impose conditions as to the exercise of any mining rights in accordance with the measures specified under an environmental impact assessment approved to be employed within a National Park and the conditions to be observed by such persons. As indicated EIA is a tool that can be relied upon in the management of POPs and other chemicals.

The Prohibition of the Development, production, stockpiling and use of Chemical weapons Act No. 2 of 2007	This is an Act to establish the Zambian National Authority on the Chemical Weapons Convention and define its powers and functions; to prohibit the development, production, stockpiling and use of chemical weapons; to provide for the destruction of chemical weapons; This Act has three schedules which list chemicals that are controlled.	There is no gap per se save to say that there is need to cross reference with the EMA

The Biosafety Act No. 10 ,2007	This is an Act to regulate the research, development, application, import, export, transit, contained use, release or placing on the market of any genetically modified organism whether intended for use as a pharmaceutical, food, feed or processing, or a product of a genetically modified organism; ensure that any activity involving the use of any genetically modified organism or a product of a genetically modified organism prevents any socio-economic impact or harm to human and animal health, or any damage to the environment, non-genetically modified crop and biological diversity; set and implement standards for the assessment, evaluation and management of any potential risk involving the use of any genetically modified organism or product of a genetically modified organism; establish the National Biosafety Authority and prescribe its powers and functions; provide for the establishment of the Scientific Advisory Committee; provide for public participation, information and consultation in the field of biosafety; provide for a mechanism for liability and redress for any harm or damage caused to human and animal health, non-genetically modified crop, socio-economic conditions, biological diversity or the environment by any genetically modified organism or a product of a genetically modified organism; provide for the formation and registration of institutional biosafety committees. Part IV of this Act provides for risk assessment which involves assessments of risks associated with chemicals including mercury and other heavy metals.	This Act is relevant in the area of environmental management and risk assessment.

The Standards Act Cap 416 of the Laws of Zambia	This Act among other things provides for standards[9] of quality control for certain commodities. In other words, the Act Provides for development of national standards covering a wide range of areas. The Standards developed also includes those relating to management of chemicals in general and those related to mercury. The National Standard on the Globally Harmonised System for the classification and labelling of Chemicals ZS 708 was developed under this Act.	This Act compliments the EMA as the development of standards for efficient implementation of the EMA is done under the auspices of this Act
The Public Health Act Cap 295 of the Laws of Zambia	This is an Act that provides for the prevention and suppression of diseases and generally regulates all matters connected with public health in Zambia. Part IV of the Act provides for the prevention and suppression of infectious diseases. The prevention and suppression incorporate methods that depend on chemicals for effective disinfection. Part XI Section 71 provides for prevention of pollution of water sources and places an obligation on local authorities to ensure that measures are put in place to prevent pollution. Measures may include use of chemicals. There is no direct reference to mercury or other heavy metals.	The Act does not clearly indicate management options for chemicals where chemicals are used for prevention of nuisances. There is need to review this Act to being it in sync with the EMA

[9]Standard is defined in Section 2 as a specification or code of practice designed to regulate-

(a) the nature, strength, purity, composition, quantity, dimensions, weight, grade, durability, origin, age or other characteristics of a commodity; or

(b) … the material or substance from which a commodity may be produced, manufactured, processed, treated or finished;

The Water Supply and Sanitation Act No. 28 of 1997	This is an Act to establish the National Water Supply and Sanitation Council and define its functions; to provide for the establishment, by local authorities, of water supply and sanitation utilities; to provide for the efficient and sustainable supply of water and sanitation services under the general regulation of the National Water Supply and sanitation Council There is no specific mention of chemicals in general or mercury in particular. However, relevance to chemicals management lies in the fact that this Act provides for regulation of water quality through NWASCO[10].	
The Local Government Act Cap 281	This is an Act to provide for an integrated three tier local administration system and to define the functions of local authorities among others. There is no direct mention of mercury in this Act. However, the Act confers on Local Authorities the function of establishing and maintaining environmental health services[11].	The There is need for harmonisation and cross referencing with the EMA to avoid duplicity and conflict

[10]Water Utilities use chemicals to treat water and sewage and some of these chemicals may contain mercury and other heavy metals.
[11]Paragraph 40 of the Second Schedule

The Mines and Minerals Development Act of 2015	This an Act that provides for prospecting for, mining and processing of minerals. This Act also provides for environmental protection and the need for environmental impact assessments for activities related to mining.	Potential conflict and duplicity especial in environmental impact assessment
The Plant Pests and Diseases Act Cap 233	This Act provides for the eradication and prevention of the spread of plant pests and diseases in Zambia. Eradication of pests and diseases may be done using chemicals.	The chemicals used for control of pests are controlled under the EMA. Need for ZEMA to work closely with the responsible Agency in the Ministry of Agriculture
The Food and Drugs Act Cap 303	The Act provides for the protection of the public against health hazards and fraud in the sale and use of food, drugs, cosmetics and medical devices.	Mercury is not covered per se! Need for regulation of mercury in products.

The Medicines and Allied Substances Act No. 3 of 2013	This Act, among other things, provides for the registration and regulation of pharmacies, health shops and agro-veterinary shops; provide for the registration and regulation of medicines and allied substances; provide for the regulation of the manufacture, importation, exportation, possession, storage, distribution, supply, promotion, advertising, sale and use of medicines and allied substances; provide for the regulation and control of clinical trials;	Regulation of mercury in products. ZEMA could work with ZMRA in the regulation of mercury in products
The Energy Regulation Act Cap 436	The Act provides for the licensing of undertakings for the production of energy or the production or handling of certain fuels.	
The Animal Health Act, No. 27, 2010	Provides for the prevention and control of animal diseases and quarantine of animals	
The Agricultural (Fertilizers and Feed) Act Cap 226	Provides for the regulation and control of the manufacture, processing, importation and sale of Agricultural fertilizers and farm feed. Fertilizers are chemicals.	

The Mosquito Extermination Act	Provides for the prescription of measures for the extermination of mosquitoes.	

3.4 ANALYSIS

3.4.1 The Constitution of Zambia

The Constitution is the supreme law of the Land and every law that is inconsistent with it is void to the extent of the inconsistency. The Constitution of Zambia has made provision for environmental protection. In Article 43, citizens have a duty to protect and conserve the environment and utilise natural resources in a sustainable manner as well as maintain a clean and healthy environment. Further, under Articles 255 to 257, the Constitution provides guidance on environment and natural resources. Some of the principles covered by the Constitution include:

(a) the polluter pays principle where the person responsible for polluting or degrading the environment is responsible for paying for the damage done to the environment;
(b) the precautionary principle which provides that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;
(c) the conservation and protection of ecologically sensitive areas, habitats, species and other environment shall be done in a sustainable manner;
(d) respect for the integrity of natural processes and ecological communities;
(e) benefits accruing from the exploitation and utilisation of the environment and natural resources shall be shared equitably amongst the people of Zambia;
(f) saving of energy and the sustainable use of renewable energy sources shall be promoted;
(g) reclaiming and rehabilitation of degraded areas and those prone to disasters shall be promoted;
(h) unfair trade practices in the production, processing, distribution and marketing of natural resources shall be eliminated.

The principles embody the principle overall of ensuring that the integrity of ecological systems is maintained. The principles provide a good platform for chemicals management. With regard to waste management, the State is obliged to:

(a) implement mechanisms that minimize waste;

(b) promote appropriate environment management systems and tools;

It can be concluded that the provisions of the constitution provide a bedrock on which to develop legislation that ensures that the environment and natural resources are protected.

3.4.2 The Environmental Management Act

As indicated earlier, the EMA is the principal environmental management legislation in Zambia subject to the Constitution. The EMA provides a platform upon which mainstreaming of general environmental issues can be built. In particular, the EMA provides a foundation for protecting the Zambian environment from environmental destruction arising from chemical pollution. For instance, Section 22 of the EMA provides that within three years of its commencement, every government ministry must prepare and submit to ZEMA, an environmental management strategy.

The strategies are meant to provide a framework of how the identified Ministries would go about attending to environmental issues including management of mercury. For example, the Ministry responsible for Water Development and sanitation oversees the regulation of water supply and sewerage services. Some of the water treatment systems have technologies containing mercury. If the Ministry responsible for Local Government develops an Environmental Management Strategy, the said Strategy would then take into consideration the management of chemicals including mercury. Similarly, the Ministry responsible for Health would also be required to incorporate strategies for the management of products containing mercury such as Blood Pressure Gauges.

Part IV of the EMA makes provision for chemical management. Section 65 specifically provides for the control of manufacture, import, export, store, distribute, transport, blend, process, re-process or change the composition of a pesticide or toxic substance or of persons intending to reprocess an existing pesticide or toxic substance for a significantly new use. Under Section 66 of the EMA, ZEMA has the mandate to oversee chemical management.

With regard to hazardous waste, the legal and regulatory framework is also found within the principal legislation i.e. the EMA. However, it must be noted that mercury contaminated soils or substances are principally a waste and as such must be disposed of as hazardous waste in accordance with the provisions of the Environmental Management (Licensing) Regulations

Statutory Instrument No. 112 of 2013. In terms of Section 55(2) the EMA provides thus:

The Agency may, upon application, issue a hazardous waste Licence to a person to allow the person to—

(a) generate, pre-treat or treat hazardous waste;

(b) handle, transport or store hazardous waste;

(c) dispose of hazardous waste; or

(d) transit, trade in or export hazardous waste.

The EMA further provides for a control system for substances that deplete or are likely to deplete the ozone layer. Section 31(2) of the EMA obligates any person dealing in any substance that depletes or is likely to deplete the ozone layer to obtain a licence from ZEMA. In general terms, licensing is an important tool especially when it comes to movement or transportation of hazardous waste or waste containing or contaminated with mercury. Zambia currently does not have adequate facilities to deal with hazardous waste and as such the wastes are usually exported to countries where there are facilities as required by the Basel Convention on the Control of Transboundary Movement of Hazardous waste and other wastes of 1989. The Transboundary movement (export and transportation) of waste including articles contaminated or containing mercury would require licensing to ensure controls and protection of the environment.

3.4.3 THE ENVIRONMENTAL MANAGEMENT (LICENSING) REGULATIONS

The Environmental Management (Licensing) Regulations, 2013 (hereinafter referred to as "the Licensing Regulations") were passed in 2013 following the enactment of the EMA in 2011. The Licensing Regulations provide a framework for licensing and other procedures required under the EMA that are incidental to licensing. The Licensing Regulations have a direct relevance to the management of mercury, mercury compounds and waste containing or contaminated with mercury or mercury compounds. Part V of the Licensing Regulations provide for the licensing and management of pesticides and toxic substances. Mercury is also a subject of monitoring by the Agency when it comes to effluent. The Licensing Regulations under Part II provide for licensing of discharge of effluent. One of the parameters controlled under the Second Schedule is mercury.

With regard to the management of mercury, Regulation 40 of the Licensing Regulations is particularly relevant. Regulation 40(1) provides that the Minister may, on the advice of the Agency, ban, severely restrict or restrict the use or production of a pesticide or toxic substance where the Minister determines that the unregulated use or production of the pesticide or toxic substance is or is likely to be harmful to human health, animal or plant life or the environment.

Under Sub-section (2) the Agency is required to publish a list of the banned, restricted and severely restricted pesticides and toxic substances in a daily newspaper of general circulation in Zambia within seven days of the ban or restriction. With regard to management of mercury, Regulation 40 of the Licensing Regulations can be relied upon. Mercury could be added to the list either as a banned, restricted or severely restricted chemical as envisaged under Regulation 40. However, it may still be necessary to amend existing legislation to provide for specific procedures for handling and management of mercury and mercury compounds.

3.5 The Institutional Framework

There are number of Government ministries, private institutions and cooperating partners that play a role in the management of Mercury in Zambia. The key institutions are as follows:

3.5.1 Ministry of Lands, Natural Resources and Environmental Protection

The Ministry of Water Development, Sanitation and Environmental Protection (MWDSEP) is the lead Ministry responsible for sustainable management of the environment. MWDSEP is able to carry out part of its functions through ZEMA, a statutory body mandated to control pollution and protect the environment. ZEMA carries out this function through the enforcement of the EMA, No. 12 of 2011.

At national level, ZEMA provides the technical guidance and competence base for information exchange with international, regional, sub-regional, national and local stakeholders. ZEMA performs the role of Secretariat on programmes relating to management of chemicals. Table 4.1 is a list of line ministries and other institutions with their respective roles in management of chemicals.

Table 4. 1: *Line ministries and other institutions and their roles in sound management of chemicals*

Line Ministries and other Institutions	**Role of Institutions**	**Responsible Institution**
MWDSEP	• Development of legislation related to sound management of chemicals • Regulation of the development, manufacture, distribution, utilization and disposal of chemicals.	ZEMA
Ministry of Agriculture and Livestock (MAL)	• Controls the importation and use of fertilizers • Prevents the spread of plant pests and diseases	Zambia Agriculture Research Institute (ZARI), Golden Valley Agriculture Research Trust (GART), Zambia Institute of Animal Health, Seed Certification and Control Institute (SCCI), Department Of Agriculture, Veterinary Department
Ministry of Education, Science, Vocation Training and Early Education (MESVTEE)	Research for development of new and improvement of old technology	National Institute for Scientific and Industrial Research (NISIR), National Science and Technology Council (NSTC)

Ministry of Local Government and Housing (MLG)	Management of both general and hazardous waste in the Districts Prevent and suppress diseases through the use of chemicals	Local Authorities,
Ministry of Health (MOH)	Regulates and promotes health in the country, ensures occupational Health Safety Act is complied with enforcement of the Public Health Act including case management of accidental chemical poisoning	Radiation Protection Authority, Zambia Medicines Regulatory Authority (ZMRA), Food and Drugs Control Laboratory, Medical Stores, Occupational Health and Safety Institute
Ministry of Transport, Works Supply and Communication (MTWC)	Regulates transportation of Goods as well as road safety.	National Airports Corporation, Department of Civil Aviation, Department of Maritime and Inland Waters, Road Transport and Safety Agency (RTSA), Tanzania Zambia Railways (TAZARA) and Zambia Railways (ZR)
Ministry of Commerce, Trade and Industry (MCTI)	Develops and maintains standards of quality for numerous analytical processes and finished products	Zambia Bureau of Standards (ZABS) Competition and Consumer Protection Commission (CCPC)
Ministry of Home Affairs (MHA)	Regulation of crime prevention, maintenance of peace and security.	Zambia Police (ZP), Zambia National Service (ZNS), Zambia Air Force (ZAF) and Drug Enforcement Commission (DEC)
Ministry of Mines Energy and Water Development (MMEWD)	Regulation of the mining and Energy sectors in relation to chemicals use and management.	Energy Regulations Board (ERB), TAZAMA, National Water and Sanitation Council (NWASCO) Mines Safety Department (MSD), Geological Survey Department (GSD)
Ministry of Labour and Social Securities (MLSS)	Protects workers against occupational accidents and diseases.	Workers Compensation Fund Board (WCFB), Occupational Safety and Health Department (OSHD)
Ministry of Foreign Affairs (MFA),	The focal point for Chemical Weapons Convention.	Ministry of Foreign Affairs (MFA),
Ministry of Justice	Responsible for domestication of conventions that the Zambian government is party to.	Ministry of Justice
Ministry of Finance and National Planning	Monitors and controls the importation and exportation of goods including chemicals. Responsible for mainstreaming chemicals management in national development plans	Zambia Revenue Authority (ZRA)
Zambia Association of Manufacturers	Promotes the manufacturing sector through policy advocacy, dialogue, lobbying and technology upgrading of the production process as a way of improving productivity and competitiveness in industry.	Zambia Association of Manufacturers (ZAM)

Zambia Consumer Association	Promotes consumer advocacy in the country. Its campaign areas include fair trade, health and chemical safety.	Zambia Consumer Association
United Nations	Development of Multilateral Environmental Agreements on Chemicals Management.	United Nations Institute for Training and Research (UNITAR) UNIDO World Health Organisation (WHO) United Nations Environment Programme (UNEP)

CHAPTER 4: IDENTIFICATION OF POPULATIONS AT RISKS AND GENDER DIMENSIONS

This section discuses populations at risk from mercury exposure and identifies the gender differences to exposure.

4.1 Preliminary review of potential populations at risk and potential health risks

Before identifying the populations at risk to mercury exposure, it is important to discuss routes of exposure and health effects.

4.1.1 Routes of Exposure

Mercury is a toxic, persistent pollutant that bio-accumulates and biomagnifies through food webs. The inventory showed that primary metal production, consumer products, waste management, and mercury in products are the major sources of mercury releases in Zambia. The mercury released from the above sectors eventually finds itself in air, land and water. As such people may be exposed to both elemental and organic (methylmercury) forms of mercury. Exposure to methylmercury is mainly through diet, especially through the consumption of freshwater fish and consumption of other animals that consume fish.

People can also be exposed to elemental or organic mercury through inhalation of ambient air during occupational activities. Occupational exposures in Zambia can be due to among others mercury-based small-scale gold mining, open burning of waste and dental clinics with poor mercury handling practices. Further, exposure can occur due to use of some skin lightening creams and soaps and various accidental mercury spills in homes, schools or other locations.

4.1.2 Health Effects

All humans are exposed to some levels of mercury due to its natural occurrence and releases from anthropogenic activities. According to UNEP (2008), factors that determine the adverse health effects of mercury include age or developmental stage of the person exposed, duration of exposure, and route of exposure. These routes include inhalation, ingestion, and dermal

contact. Dietary patterns can increase exposure to a fish-eating population when fish is contaminated with mercury.

Primary health effects of exposure to mercury and mercury compounds have been reported on the nervous system; kidneys; and the cardiovascular system. It is generally accepted that developing organ systems (such as the fetal nervous system) are the most sensitive to toxic effects of mercury. Other systems that may be affected by mercury toxicity include the respiratory, gastrointestinal, hematologic, immune, and reproductive systems (UNEP, 2008).

4.1.3 Potential Populations at Risk

UNEP 2008, reported two types of populations at risk to mercury exposure; namely those who are more sensitive to the effects of mercury and those who are exposed to higher levels of mercury.

4.1.4 Susceptible Populations

Children, pregnant women and individuals with different ailments are more sensitive to the effects of mercury exposure.

i. Children and Pregnant Women

The fetus, newborn and children are especially susceptible to mercury exposure because of the sensitivity of the developing nervous system and consuming mercury contaminated breast milk. According to Central Statistical Office (CSO) 2010, the general fertility rate is higher in rural areas (178) than in urban areas (109). Thus, new mothers, pregnant women, and women who might become pregnant should be particularly aware of the potential danger of methylmercury.

ii. Ailments

Studies have shown that individuals suffering from diseases affecting the liver, kidneys, the nervous system and lungs, when exposed to mercury, are at high risk of having their conditions worsened (UNEP, 2008).

4.1.5 Populations exposed to high levels of mercury

Another category of the population with a high risk of exposure [exposed] to methylmercury includes populations with regular consumption of fish; populations that use dental amalgam and consumer products containing or contaminated with mercury and populations in occupational activities.

i. Fish Consumption

60.5 percent of the population in Zambia resides in rural areas and 39.5 percent reside in urban areas (CSO, 2010). Fish generally constitute the main diet of both populations. A screening study of the Kafue River showed some presence of mercury in fish and sediment (ZEMA, 2014). Therefore, the population in the areas where fish is consumed are at high risk of exposure to methylmercury.

ii. Dental Amalgams

The inventory results showed that dental amalgam is practiced in Zambia and as such some individuals may be exposed to vapour mercury. UNEP (2008), reported that individuals with dental amalgams generally have greater exposure to elemental mercury than those who do not. There is need to conduct an in-depth study of this mercury source category.

iii. Occupational activities

Workers in industry such as base metal mining and processing, dentistry, crematoria and other mercury releasing activities are at high risk to exposure. Based on the inventory, occupational exposures in Zambia could be attributed to among others, primary metal production, mercury-based artisanal and small-scale gold mining and open burning of waste activities.

iv. Consumer Products

In Zambia, consumer products containing mercury include skin lightening creams, thermometer, dental amalgams, CLFs and batteries. The use of these products increases chances of exposure to mercury. Out of the total of 13 million people, 50.7 percent are female and 49.3 percent are male and that 50.7percent of the female reside in urban areas whilst

50.3 percent reside in rural areas. The use of skin lightening products is widely spread among the female population than male.

4.2 Assessment of Potential Gender Dimensions related to the Management of Mercury

Gender refers to the socially constructed rather than biologically determined roles of men and women as well as the relationships between them in a given society at a specific time and place (UNDP 2007).

The 2010 Census of Population and Housing, reported that the country's population stood at 13, 092,666, with females accounting for 50.7 percent of the total population and males accounting for 49.3 percent. The Census also showed that more males are employed in the formal sector than females. Further, 60.5 percent of the total population reside in rural areas while 39.5 percent reside in urban areas.

It has been noted that efforts to ensure sound management of chemicals (SMC) within a context of sustainable development, have important gender dimensions. This is so because men, women, and children are exposed to different kinds of chemicals in varying concentrations. The level of exposure to toxic chemicals as well as the resulting impacts on human health are determined by social as well as biological factors.

4.2.1 Gender Dimension in the Management of Mercury

Several factors, including differences in occupational roles, household responsibilities, and biological susceptibility, have been reported to impact gender differences in exposure to toxic chemicals in general and mercury in particular.

i. Occupational

The level and kind of chemical exposures at the workplace may differ by gender because women and men generally work at different tasks. Depending on social circumstances in particular communities, men may be at greater risk of exposure to mercury used for instance in artisanal gold mining which is predominantly male. On the other hand, women may be at risk from mercury exposure in handling mercury in products. For instance, in the healthcare sector, women generally represent the majority of the workers (e.g., nurses, pharmacists),

which increases their chances of exposure to mercury in products such as thermometers and pressure gauges.

ii. Household

Products that contain mercury such as batteries, skin lightening creams and soaps, and light sources are used at household level. Men, women, and children are exposed to these products alike. However, women and girls tend to use more cosmetics and personal care products than men.

iii. Physiological susceptibility

Men, women, and children vary in their physiological susceptibility to the effects of exposure to mercury. Children are generally at greater risk of health damage from mercury exposures because the sensitivity of the developing nervous system and consuming contaminated breast milk.

Women often experience relatively higher physiological susceptibility to the impacts of mercury exposure, especially in connection with reproduction. Pregnant women's exposure to mercury can affect the nervous system of the developing fetus and mercury can be passed on to the child through breast milk (UNEP, 2008).

Men also have unique vulnerabilities based on their physiology and the types and frequency of chemical exposure they typically encounter in the workplace. Individuals with diseases of the liver, kidney, nervous system, and lung are also at higher risk of suffering from the toxic effects of mercury. In many societies, it is generally accepted that men can be asked to perform jobs than women that are likely to expose them to chemicals in general and mercury in particular (WHO, 2004).

CHAPTER 5: AWARENESS ON MERCURY RELATED MATTERS

Environmental awareness of the citizenry is an important way of enlisting active participation in protecting Zambia's natural resources. Improved public awareness results in sound environmental management practices and programme implementation including sound management of chemicals. This calls for wide stakeholder participation including government departments, private sector, academia, Civil Society Organisations (CSOs) and the media.

It is important to enhance the capacity of these stakeholders in understanding sound management of chemicals and sources of mercury releases and its effects on human health and the environment in order to take necessary precautions.

5.1 Situation Analysis on Awareness Raising

Awareness levels on chemicals management in Zambia are generally low across sectors. Although there are a number of CSOs active in the environmental sector, none of them have a specific focus on mercury and mercury compounds.

Various communication strategies are in use in the country to improve levels of knowledge and awareness on mercury and mercury compounds among stakeholders and the general public. These include the use of media, production of educational materials and school and community targeted programmes.

5.2 Media Programmes

In Zambia, television is relatively well diffused and watched in all the provinces of the country. A number of television channels have been established which provide citizens with news. These include; Zambia National Broadcasting Corporation (ZNBC), MUVI, Mobi, Prime TV, Trinity Broadcasting Network (TBN) and Diamond TV.

Radio has the widest coverage in the country. The number of radio stations, in particular, community radio stations (Figure 5.1) has steadily increased over the years. It is by far the most accessible medium in Zambia, with over 65 radio stations covering community, commercial and church-owned stations dotted around the country.

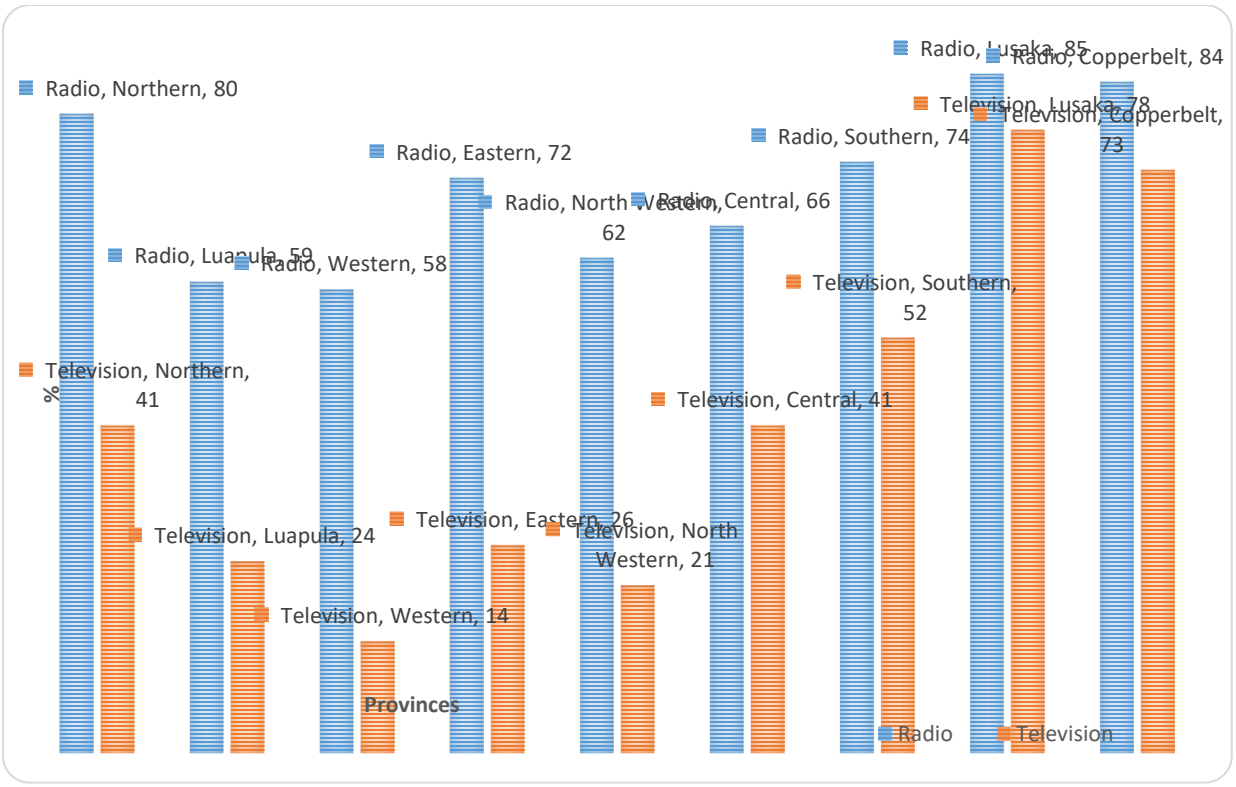

Figure 5. 1: Provincial Access to Radio's and Television ***Source**: Audience Scapes, 2010*

5.3 Training and Sensitization

A number of institutions carry out in-house training on chemicals management which differs in extent and content depending on the level of staff, material covered and emphasis. Such training programmes are however, not specific to mercury management. It was also noted that, there is no institution that is spearheading training in sound management of chemicals. As part of project implementation however, ZEMA has been conducting stakeholder sensitization meetings on mercury and its effects on the environment.

In line with this, the media has been identified as a vehicle for information dissemination as it can create an atmosphere where society can effectively relate to particular issues. In 2003, ZEMA commissioned a study whose main objective was to assess the extent of media coverage of environmental issues and evaluate its impact on public opinion and awareness in Zambia. This was a build-up on the results and recommendations of an earlier study that was carried out in 1999 through the Environmental Support Programme (ESP), which had a similar objective.

Both studies recommended training for journalists in specific environmental concerns as a basis for providing knowledge, stimulating interest as well as creating a more receptive atmosphere to stories on particular issues, as well as the environment in general.

In addition, ZEMA and stakeholders hold an annual environmental awards ceremony where individual journalists and institutions are rewarded for their excellence in development and environmental reporting.

5.4 Awareness Raising Targeting Learning Institutions

The goal of the learning institutions targeted programmes is to stimulate interest by creating awareness on mercury issues among school children in order to develop a future population that is aware of, and concerned about mercury and mercury compounds and their associated impacts.

5.5 Printed Materials

Printed materials include newspapers, magazines, brochures, flyers, posters and banners which are used for awareness raising.

5.6 Social Media Networks

Zambia has also embraced advances in Information and Communication Technologies (ICTs) and the opportunities they present for information generation and dissemination. In line with this, websites and social media platforms among them Facebook and Twitter are used as channels of communication.

5.7 Exhibitions

A number of exhibitions are organized in various parts of the country and have been used as a means to disseminate information on chemicals management in general and mercury related issues. These include the; Copperbelt Mining Agriculture and Commercial Show, Agritech Expo, Zambia Agricultural and Commercial Show and World Day for Health and Safety at the Workplace.

CHAPTER 6: IDENTIFIED GAPS

This section presents the gaps identified in the management of mercury in Zambia during the inventory. These included:

i. limited or no information about the mercury levels in environmental matrices and biota in the country;
ii. lack of information regarding sites contaminated with Mercury and Mercury compounds;
iii. inadequate information on quantification of mercury use;
iv. inadequate capacity with respect to mercury management in Zambia;
v. insufficient funding for management of chemicals;
vi. poor or absence of infrastructure for mercury management (equipment and facilities);
vii. insufficient legal framework that does not adequately address key issues and impacts of mercury.
viii. lack of formally established institutional frameworks with respect to management of mercury;
ix. inadequate information management systems on chemicals management in general and mercury in particular;
x. inadequate data sharing among various stakeholders with regard to chemicals;
xi. poor coordination among government institutions resulting in duplication of efforts;
xii. insufficient education awareness programs on mercury and its effects;
xiii. inadequate national accredited laboratories with equipment for analytical and monitoring of mercury and mercury compounds;
xiv. insufficient training for technical and support staff in analysis and monitoring of mercury
xv. lack of research in Zambia on diseases and symptoms related to mercury exposure and its effects on humans;
xvi. there is need to conduct detailed Mercury assessment;
xvii. lack of information on levels of mercury contained in consumer products such as creams and soaps;
xviii. lack of default factors that are specific for the African environment for use in the inventory Toolkit; and

xix. lack of Harmonised Systems Codes (HS) for specific mercury containing products.

CHAPTER 7: RECOMMENDATIONS

The following are the recommendations:

i. There is need for research to collect data on mercury levels in environmental matrices and biota in the country;
ii. An assessment should be carried out to determine contaminated sites from releases of mercury and mercury compounds;
iii. There is need for capacity building with respect to mercury management in Zambia;
iv. There is need to develop infrastructure for mercury management (equipment and facilities);
v. There is need to develop sufficient legal framework that adequately address key issues related mercury management.
vi. An institutional framework should be formally established with respect to management of mercury
vii. Information management systems on Mercury should be established;
viii. A national coordination steering committee should be established among government institutions in order to improve data sharing among various stakeholders;
ix. There is need for education and awareness programs on mercury and its effects;
x. There is need to accredit laboratories with equipment for analytical and monitoring of mercury and mercury compounds;
xi. Research should be carried out to establish if there are symptoms of the mercury related diseases in Zambia;
xii. A detailed Mercury assessment should be carried out for the whole country in order to establish information on mercury in all sectors;
xiii. Research should be conducted to establish levels of mercury contained in consumer products such as creams and soaps;
xiv. Research should be conducted to establish default factors specific for the African environment for use in the inventory Toolkit;
xv. There is need to split harmonised Systems Codes (HS) to make them specific to mercury containing products; and

xvi. There is need to integrate chemicals management in general and mercury in particular in the school curricula.

ANNEXES

Annex I: Stakeholder Engagement Process

No	Name	Organisation	Contact No	Email address
1	Jean Mukombi	University Teaching Hospital	0977 678694	jeankapakele@gmailcom
2	Chisha Mzyece	National Institute for Scientific Research	0976 281799	chischo83@yahoo.com
3	Kapeshi Christopher	Zambia Dental Association	0977 728576	chrisr0021221@yahoo.co.uk
4	Nelson Banda	Energy Regulation Board	0965 203508	nbanda@erb.org.zm
5	Jack Munthali	ZESCO Concerns Solutions	0966 116090	jmunthali@zesco.co.zm
6	Lydia Chibambo	Network Environment	0979 940747	ngo.necosinfor.necos@gmail.com
7	Patricia Chilaisha	Ministry of Labour Social Security	0977 854233	patriciachilaisha@gmail.com
8	Lawerence Musalila	Ministry of Energy Water Development	0971 880896	imusalila@gmail.com
9	Hiloyasu Kikloka	Japanese Embassy	0978 675004	hiroyasu.kirioka@nota.go.jp
10	Wilson Shane	Lusaka Water Sewerage Company	0968 440148	wshane@lwsc.co.zm
11	Nchimunya Milambo	Indeni Oil Refinery	0977 596789	nchimunyam@indeni.com.zm
12	Obed C Kawanga	Central Statistics Office	0965 782860	okawanga2001@yahoo.com

13	Kachiwala Sapala	Kalumbila Minerals Limited	0967 208469	kachiwala.sapalo@fqml.com
14	Shiichi Sakakibara	Embassy of Japan		
15	Evaristo Mwale	Zambia Revenue Authority	0977 323826	evamwale@yahoo.com
16	Robert Chimambo	Zambia Climate Change	0955 880441	kchimambo@gmail.com
17	Arnold Malambo	Kansanshi Mining plc	0969 456306	arnold.malambo@fqml.com
18	Alexi Mpishi	Mopani Copper Mines	0961 341553	aleximpishi@mopani.com.zm
19	James Nyirenda	University of Zambia (Natural Sciences)	0966 937568	nyirendaj@unza.zm
20	Jimmy Luo	Zambia Metal Recycling Association	0979 977192	zmrateam@gmail.com
21	Edgar Habusongo	Zambia Metal Recycling Association	0966 594224	zmrateam@gmail.com
22	Chola Musonda	Ministry of Commerce Trade & Industry	00260 2269540 964605704/0968356725	cholamusondac@gmail.com
23	Lennox Kalonde	Ministry of Lands Natural Resources and Environmental Protection	0211 251927	
24	Kalaba Lawerence	Geological Survey Department	0979 510253	lawerencekalaba@yahoo.com
25	Mutengo Sindano	Ministry of Lands Natural Resources and Environmental Protection	0976 068837	msindano@mlnrep.gov.zm

26	Maxwell Nkoya	Zambia Environmental Management Agency	0977 855212	mnkoya@zema.gov.zm
27	David Kapindula	Zambia Environmental Management Agency	0977 822306	dkapindula@zema.org.zm
28	Humphrey K Mwale	Zambia Environmental Management Agency	0966 917615	hkmwale@zema.org.zm
30	Chris Kanema	Zambia Environmental Management Agency	0977 747106	ckanema@zema.org.zm
31	Peter Malopa Mwanza	Zambia Environmental Management Agency	0977 614401	pmwanza@gmail.com
32	Perine Kasonde	Zambia Environmental Management Agency	0955 387112	pkasonde@zema.org.zm
33	Irene L Chipili	Zambia Environmental Management Agency	0977 744299	igchipili@zema.org.zm
34	Winnie Dzekedzeke	Zambia Environmental Management Agency	0977 844826	wdzekedzek@zema.org.zm
35	Wilson Phiri	Zambia Environmental Management Agency	0955 750946 0977 606239	nchisenga@zema.org.zm
37	Chibesakunda Kelvin	ZANIS	0962 072602	chibesakundakm@gmail.com
38	Alvin Chinga	Daily Mail	0964 355878	achinga@yahoo.co.uk

39	Tony Nkhoma	ZANIS	0975 484845	tonynkhoma@gmail.com
40	Arthur Siamboole	ZANIS	0965 504936	
41	Doreen Liwanga	Roots FM Radio	0968 456001	doreennamatama@yahoo.com
42	Phyliss Sitengo	Moon Newspapers	0978 950255	phylisssitengo@gmail.com
43	Tizzie Chayinda	ZNBC	0977 486052	chayindatizzie.@yahoo.com
44	Muyinda Mwangala	New Vision	0977 326490	muyundapm@gmail.com
45	Arthur Sikopo	Zambezi FM Radio	0977 691133	adsikop@gmail.com
46	Maudy Chilongo	Hot FM	0971 838644	Bothamambwe@gmail.com
47	JubielM Zulu	AMA Radio	0975 094700	jubielzulu@gmail.com

Annex II: UNEP Toolkit Calculation Spreadsheet

submitted as a separate Excel file

References

- **Minamata Convention Website:**

http://www.mercuryconvention.org/

- **Minamata Convention Text**

http://www.mercuryconvention.org/Convention/tabid/3426/Default.aspx

- **Materials developed by the interim secretariat of the Minamata Convention**

http://www.mercuryconvention.org/AwarenessRaising/Resources/tabid/3873/Default.aspx

  - Becoming a Party to the Minamata Convention on mercury (FACT SHEET)
  - Minamata Convention on mercury at a glance (FACT SHEET)
  - Overview of the negotiations process (PPT)
  - Overview of the Minamata Convention on mercury (PPT)
  - Provision of the Convention on financial and technical support (PPT)
  - Practical steps of the ratification, acceptance, approval or accession processes and notifications under the Minamata Convention (PPT)

- **Toolkit for Identification and Quantification of Mercury Releases (UNEP)** http://www.unep.org/chemicalsandwaste/Metals/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx
- **MercuryLearn Platform (UNITAR/UNEP)** http://mercurylearn.unitar.org/
- **List of Country Mercury Release Inventories (UNEP)** http://www.unep.org/chemicalsandwaste/hazardoussubstances/Mercury/Informationmaterials/ReleaseInventories/tabid/79332/Default.aspx
- **Checklist of legal authorities to implement Minamata Convention on Mercury [Natural Resources Defense Council - NRDC]** http://docs.nrdc.org/international/files/int_15101301a.pdf
- **Minamata Convention on Mercury - Ratification and Implementation Manual[Zero Mercury Working Group, Natural Resources Defense Council, Ban Toxics]** http://www.zeromercury.org/phocadownload/Developments_at_UNEP_level/minamatamanual_eng_january%202015%20final.pdf

- **Guidance for identifying populations at risk from mercury exposure (WHO/UNEP)** http://www.who.int/foodsafety/publications/risk-mercury-exposure/en/
- **Developing a National Action Plan to Reduce, and Where Feasible, Eliminate Mercury Use in Artisanal and Small Scale Gold Mining (UNEP, 2015)** http://www.unep.org/chemicalsandwaste/NationalActionPlan/tabid/53985/Default.aspx
- **Chemicals Management: The why and how of mainstreaming gender (UNDP, 2007)** http://www.undp.org/content/undp/en/home/librarypage/environment-energy/chemicals_management/chemicals-management-the-why-and-how-of-mainstreaming-gender.html
- **Draft guidance on identification of individual stocks of mercury or mercury compounds exceeding 50 metric tons, as well as sources of mercury supply generating stocks exceeding 10 metric tons per year** http://www.mercuryconvention.org/Portals/11/documents/meetings/inc7/English/7_4_e_stock.pdf