


UNITED REPUBLIC OF TANZANIA
VICE PRESIDENT'S OFFICE

# MINAMATA INITIAL ASSESSMENT IN TANZANIA

*First Draft*

June, 2017

## EXECUTIVE SUMMARY

### Introduction

Mercury is one of the top ten chemicals of global public health concern owing to its long-range atmospheric transport, its persistence in the environment, its ability to bio-accumulate in ecosystems and its adverse effects on human health and the environment. Due to increasing mercury emissions and releases primarily from anthropogenic sources, it continues to be an issue of concern at national and global levels.

Consequently, the Minamata Convention was negotiated and adopted in 2013 with the objective of protecting human health and the environment to address challenges and risks posed by mercury emissions and releases from anthropogenic sources. Tanzania signed the Convention in October, 2013 and in the ratification process.

Tanzania being a signatory to the Minamata Convention was eligible for funding to implement Minamata Initial Assessment (MIA) Project with the aim, among others, to help enhance national capacity to meet future obligations of the Convention. The project was implemented for a period of two years (2017-2017). The main activities that were implemented include i) establishment of a Project Management Unit and National Steering Committee; ii) organized inception workshop for the project; iii) review of policy, legal and institutional framework; iv) undertook national mercury inventory; v) formulated National Strategy for the Identification and Assessment of Mercury Contaminated Sites; vi) prepared National Report on Identification of Challenges, Needs and Opportunities to Implement the Minamata Convention; and organized stakeholder consultation workshop to validate project outputs.

This is the final project report presenting a synthesis of situational analysis on sources, regulatory framework, population and gender dimensions, awareness and training related to anthropogenic emissions and releases of mercury and mercury compounds. The specific objectives of the report are to:

i) identify and quantify sources of anthropogenic emissions and releases of mercury and mercury compounds;
ii) assess adequacy of policy, regulatory and institutional framework in domesticating the Minamata Convention;
iii) identify population groups at risk from exposure to mercury and related gender dimensions; and
iv) indicate baseline level of public awareness and training activities

### National Background Information

Tanzania is an East African country lying just below the equator, Latitude 1º S and 12ºS and Longitude 29ºE and 41ºE. Tanzania constitutes of Mainland Tanzania and the islands of Zanzibar and Pemba, covering 945,200 $km^2$. The population of Tanzania is currently estimated to be 50.1 million. Overall life expectancy at birth was 61.8 years in 2015.

The national Gross Domestic Product (GDP) grew by 7% in 2016, the same as in 2015. This was contributed by increase in electricity generation from natural gas, industrial production and improvement in transport services. In addition, the per capita income was 2.13 million Tanzania Shillings (USD 979.1) in 2016 compared to 1.92 million Tanzania Shillings (USD

967.5), equivalent to an increase of 11.1%, which was contributed by decrease in inflation rate. The major contributing economic sectors to the national GDP in 2016 were agriculture (crop, livestock, forest and fisheries) (29.1%), construction (14%), trade and repairs (10.7%), manufacturing (5.1%) and mining (4.8%).

**Results of the National Mercury Inventory**

*a) Approach and Methodology*

A national inventory was undertaken with the purpose of assisting in the identification and quantification of sources of mercury and mercury-containing goods and materials in the country as a basis for devising strategic interventions. This inventory was carried out between December 2016 and March, 2017 (4 months). Data for the year 2016 was used as reference for the inventory. The inventory was undertaken based on MS Excel Sheet framework of the UNEP Toolkit for Identification and Quantification of Mercury Releases - Level 2 Version 1.3 (2015). The Toolkit requires input data (activity rate) for the different source categories and using default emission factors with predetermined formulae it automatically calculates individual mercury inputs and distribution in different pathways (air; water; land; by-products and impurities[1];general/municipal waste; and sector specific treatment /disposal[2]). The input data (activity rate) used for the inventory were mainly obtained from Government publications and other relevant reports and literature. In addition, a range of stakeholders were consulted for information and input data.

*b) Estimated total mercury releases*

The total national mercury emissions and releases for the baseline year 2016 was about 30.29 tonnes. The highest mercury releases were emitted to air (47% of the total national mercury emissions and releases) followed by land (35%) and water (8%) **(Figure 0-1)**. This implies that having most of mercury releases to the environment emitted to air, mercury may reach water sources and land through dry and wet atmospheric deposition and eventually affect their quality. In this regard, mercury emissions (into air) should be considered as an important source of mercury in various environment media and its role may require further assessment.

[1] *This refers to by-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases, for example, gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants.*

[2] *This refers to waste from industry and consumers which is collected and treated in separate systems, and in some cases recycled, for example, hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites.*

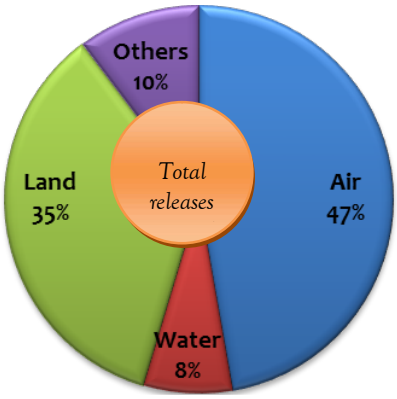


**Figure 0-1: Distribution of mercury releases to different media**

*c) Major sources of mercury releases*

An aggregated presentation of the results for main categories of mercury release sources (source categories), in terms of estimated total releases, is presented in **Table 0-1**. The dominant source categories were: primary (virgin) metal production (51%) followed by waste incineration and burning (24%); and consumer products with intentional use of mercury (9%). Specifically, *large scale (industrial) gold extraction and processing* is the leading source sub-category of mercury releases in the country due to presence of trace amounts of mercury in the gold ore. The second major source is the *gold extraction and processing using amalgamation* which primarily involves activities of artisanal gold mining. Intensive use and haphazard handling of mercury during amalgamation process to extract gold from ore results into somewhat unnecessary exposure to the miners and severe environmental pollution.

**Table 0-1: Summary of mercury inventory results**

| 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 | Percent of total releases*3*4 |
| 5.1: Extraction and use of fuels/ energy sources | 970 | 26 | 0 | 64 | 0 | 39 | 1,099 | 4% |
| 5.2: Primary (virgin) metal production | 4,774 | 870 | 9,363 | 388 | 0 | 54 | 15,450 | 51% |
| 5.3: Production of other minerals and materials with mercury impurities*1 | 645 | 0 | 0 | 211 | 0 | 211 | 1,068 | 4% |
| 5.4: Intentional use of mercury in industrial processes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0% |
| 5.5: Consumer products with intentional use of mercury (whole lifecycle) | 602 | 520 | 642 | 0 | 858 | 0 | 2,622 | 9% |
| 5.6: Other intentional product/process use*2 | 150 | 823 | 170 | 30 | 684 | 499 | 2,356 | 8% |
| 5.7: Production of recycled metals | 6 | 0 | 6 | 0 | 6 | 0 | 18 | 0% |
| 5.8: Waste incineration and burning | 7,164 | 0 | 0 | 0 | 0 | 0 | 7,164 | 24% |
| 5.9: Waste deposition/ landfiling and waste water treatment*3*4 | 0 | 564 | 0 | 0 | 38 | 25 | 627 | 0% |
| 5.10: Crematoria and cemeteries | 0 | 0 | 450 | 0 | 0 | 0 | 450 | 0% |
| **SUM OF QUANTIFIED RELEASES*3*4** | **14,311** | **2,239** | **10,630** | **694** | **1,587** | **829** | **30,290** | **100%** |

Notes:

*1 *Includes production of cement, pulp and paper, lime and light weight aggregates.*

*2 *Includes dental amalgam fillings, manometers and gauges, lab chemicals and equipment, Hg use in religious rituals and folklore medicine, and miscellaneous product uses.*

*3 *The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.*

*4: *The estimated input and release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting, releases to water from waste water system/treatment have been subtracted automatically in the TOTALS.*

### *d) Major sources of mercury emissions (into air)*

The contribution of different source categories of mercury emissions (into air) is presented in **Figure 0-2**. The categories that made the largest contributions were waste incineration and burning followed by primary (virgin) metal production; and extraction and use of fuels /energy sources. It is worth noting that the individual source sub-categories with the largest contributions to mercury emissions were *informal waste burning* (22.9% of the total national mercury releases) followed by *gold (and silver) extraction with mercury amalgamation processes* (12.9%); and *biomass fired power and heat production* (2.8%). The contribution of the these sources to mercury emissions is basically related to evaporation of mercury associated with incineration and burning of mercury-containing waste, mercury amalgam during gold processing and fuels in vehicles and industrial production processes.

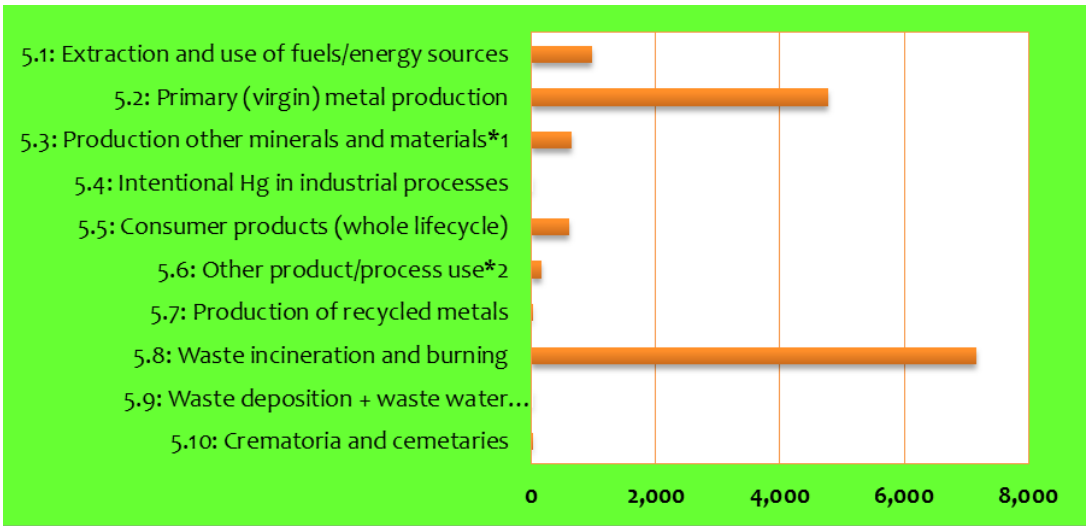


Figure 0-2: Mercury releases to air (kg Hg/yr)

*e) Major sources of mercury releases to water*

The contribution of different mercury release source categories to water is presented in **Figure 0-3**. The categories that made the largest contributions were: primary (virgin) metal production followed by other product/process; waste deposition and waste treatment; and consumer products. The individual source sub-categories with the largest contributions of mercury releases to water were: *gold (and silver) extraction with mercury amalgamation processes* (2.2% of the total national mercury releases) followed by *waste water system/treatment* (1.9%); and *thermometers with mercury* (1.7%). The notable contribution of these source sub-categories can be related to most of the sites for artisanal gold mining using mercury amalgamation process being located adjacent to water bodies due to substantive water demand for gold ore concentration; wastewater containing trace amounts of mercury from different sources part of which is retained in the treated effluent; and spillage from broken or disposed thermometers.

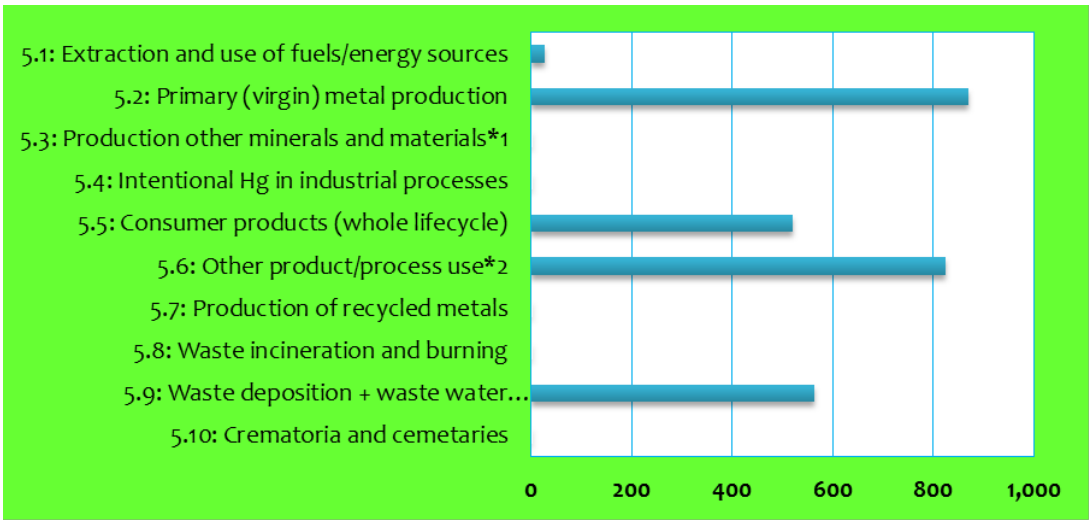


**Figure 0-3: Mercury releases to water (kg Hg/yr)**

*f) Major sources of mercury releases to land*

The contribution of different source categories to mercury releases on land is presented in **Figure 0-4**. The categories that made the largest contributions were: primary (virgin) metal production followed by consumer products; and crematoria and cemeteries. Further, the individual source sub-categories with the largest contributions to mercury releases to land were: *Gold extraction and initial processing by methods other than mercury amalgamation*; *gold (and silver) extraction with mercury amalgamation processes*; and *cemeteries*. The contribution of gold extraction with and without mercury amalgamation can be associated with mercury-containing tailings in both lined and unlined ponds/dams. In addition, cemeteries contribute to mercury releases from buried bodies (associated mainly with dental amalgam fillings) to the soil at the cemetery.

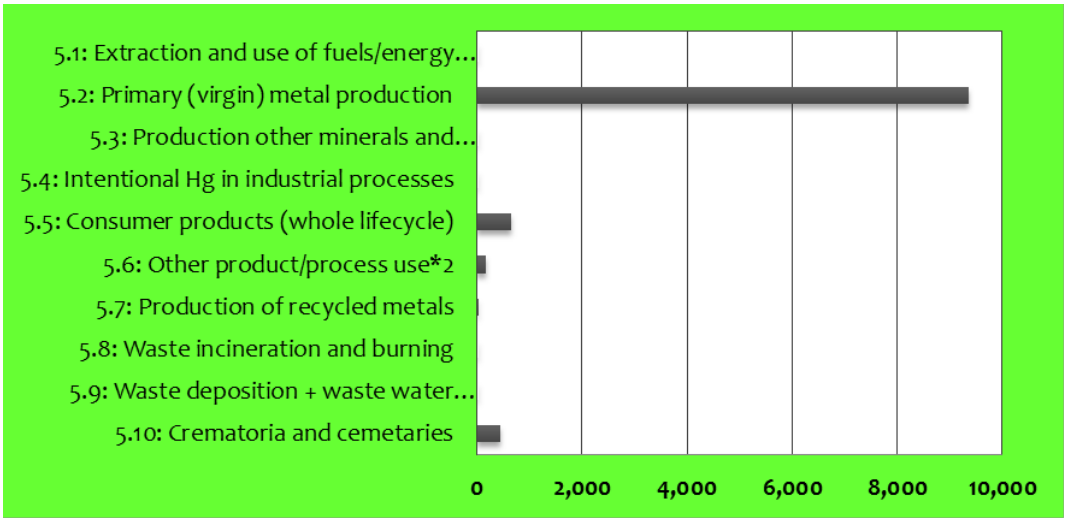


**Figure 0-4: Mercury releases to land (kg Hg/yr)**

*g) Major sources of mercury releases to by-products and impurities*

The contribution of different source categories to **mercury releases in by-products** and impurities is presented in **Figure 0-5**. The major contributing source categories were *primary (virgin) metal production* (mainly gold production) followed by *production of other minerals and materials* (mainly cement production). In relation to the leading source, this may be related to mercury contamination in tailings which often contain substantive amount of mercury particularly in artisanal gold mining due to mercury amalgamation practices. With regard to *production of other minerals and materials,* this may be associated with having mercury impurities in the raw materials which end up in flue gas and dust trapped by the air pollution control devices.

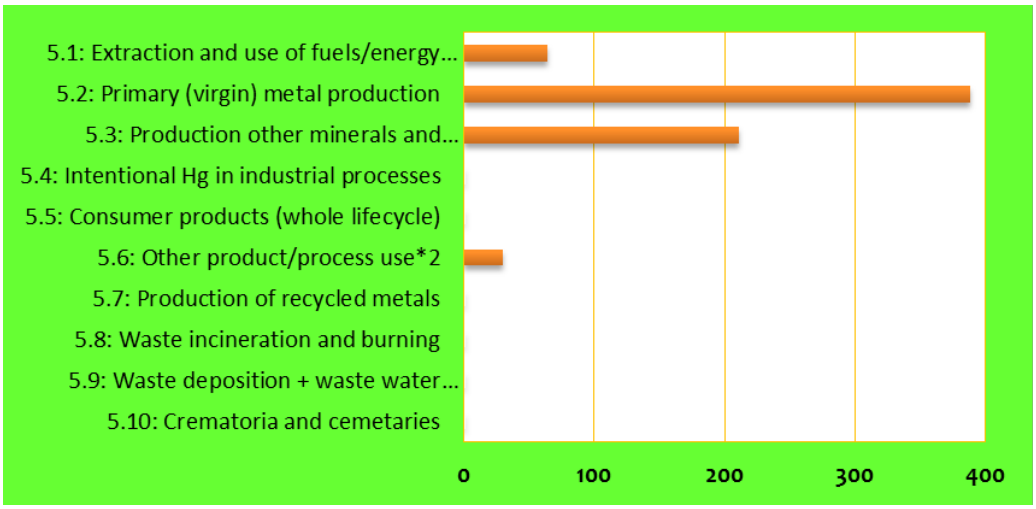


**Figure 0-5: Mercury releases to by-products and impurities (kg Hg/yr)**

*h) Major sources of mercury releases to general/municipal waste*

The contribution of different source categories to **mercury releases in general waste** is presented in **Figure 0-6**. The major source categories contributing mercury to general waste included: consumer products with intentional use of mercury followed by other product/process use. The contribution of these source categories can be related to breakage or loss of mercury containing products during use and upon disposal.

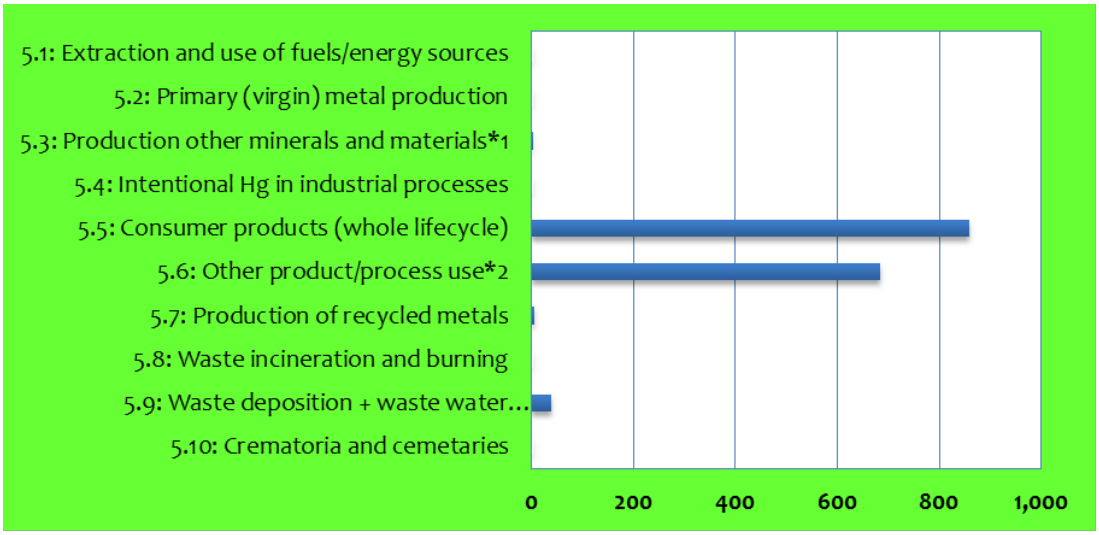


**Figure 0-6: Mercury releases to general waste (kg Hg/y)**

*i) Major sources of mercury releases to sector specific waste treatment/disposal*

The contribution of different source categories to **mercury releases to sector specific waste treatment/disposal** is presented in **Figure 0-7**. The major contributing source categories were *other intentional products and process uses* followed by *production of other minerals*

*and materials with mercury impurities*. For the leading source, this may be related to solid residues from medical waste incineration which is widely practiced whereas for the second contributing category, it may be attributed to high volume raw material with trace amounts of mercury used for production of materials such as cement.

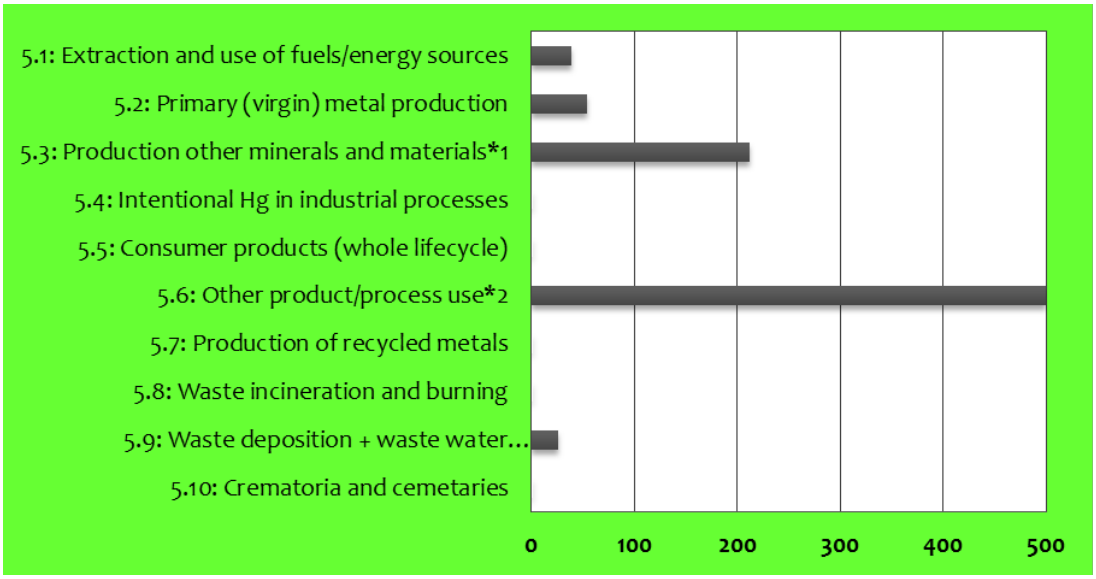


**Figure 0-7: Mercury releases to sector specific waste treatment/disposal (kg Hg/yr)**

## Major Findings of the Policy, Regulatory and Institutional Assessments

There exists several pieces of framework legislation comprising enabling provisions that would facilitate domestication of the Minamata Convention on Mercury (and other related Multilateral Environmental Agreements) in the country. These include the Environmental Management Act No. 20 of 2004; Industrial and Consumer Chemicals (Management and Control) Act No. 3 of 2003; Mining Act No. 14 of 2010; and Public Health Act No. 1 of 2009. In fact, these principle legislation would not require any amendments. However, effective domestication of the specific requirements of the provisions of the Minamata Convention would necessitate elaboration through subsidiary legislation/regulations. Indeed, funds have been sought to develop the Regulations under the Special Programme on Chemicals and Waste, supported by the United Nations Environment Programme (UNEP), through the project on "Strengthening Institutional Capacity for Sound Management of Chemicals and Waste in the United Republic of Tanzania " to be implemented for two years starting August, 2017.

It should also be noted that import, export, trading and use of mercury is still allowed though under stringent conditions (Sixth Schedule of the Industrial and Consumer Chemicals Act, 2003). However, this may still be applicable in terms of allowable uses under the Convention such as research activities.

There are several Government Ministries and Agencies as well as Local Government Authorities whose mandates have a bearing on environmental management including chemicals and waste management. The coordination of implementation of Multilateral Environmental Agreements (MEAs) in the country is vested under the Vice President's Office - Division of Environment. There are environmental units/committees at all levels from

national to street or *hamlet* level. There are also several inspectorates (Environment; Chemicals; Plant Protection; Health; and Food and Drugs) which enhance the institutional landscape supporting chemicals and waste management. In addition, the country has modest institutional expertise and experience in implementing chemicals and waste Conventions which is of direct relevance, supportive and synergistic to the implementation of the Minamata Convention.

Further, the main gaps that were identified in relation to institutional framework for implementation of the Minamata Convention include the following:

i) Inadequate research and monitoring capacity on mercury in the environmental media and bio-monitoring (urine, blood, hair and nails) of population groups at high risk;
ii) Inadequate resources in terms of financial and human resources; and
iii) Low level of awareness and understanding of mercury issues among senior government officials and technocrats.

## Populations at risk and gender dimensions

The major sources of mercury exposure in human population in the country include artisanal and small-scale gold mining; dental amalgam; mercury-added products and Medical Waste Incineration. ASGM sector presents mercury exposure risks to about 700,000 - 1.5 million people in the country of which 20 – 30% are women. Children are also involved in this sector, however, the estimated number is 75,000. Dental amalgam presents risk to dental personnel (about 400 dentists), who are potentially exposed to elemental mercury vapor from dental amalgams and patients who have amalgam fillings whose number is estimated at more than 350,000. In view of the widespread use of mercury-added products in the country it is estimated that about 20-40% of the population are at some risk to mercury exposure. The target population groups at risk from mercury exposure related to medical waste incineration include waste handlers and adjacent population.

Mercury exposure from dental amalgamation, ASGM, mercury added products and medical waste incineration affect women and men in various gender dimensions including inequality/differences, roles, equity, equality and ages. According to the mercury inventory conducted in ASGM there is a big difference in accessing jobs and other opportunities between women and men. About 20-30% of the miners are women. In small-scale gold mining of Tanzania women often conduct the processing activities, sometimes in the home exposing them and their families to harmful mercury used to extract gold from ore, with minimal ventilation and protection, in confined spaces. Whilst men are mostly involved in digging and drilling the ore in deep pits. Inventory results indicate that about 20% and 80% of people in ASGM are children and adults respectively. This implies that children are more at risk of exposure to mercury used in artisanal and small-scale gold mining compared with adults.

## Status on awareness and training

Currently there is generally low level of awareness on mercury issues including risk groups, government agencies and institutions, parliamentarians and the public at large. Initiatives and efforts undertaken has been largely adhoc, uncoordinated and thus not achieving the intended outcomes. Such initiatives include sensitization on health and environmental risks of mercury; demonstration and adoption of mercury retorts to artisanal gold miners; installation of dental amalgam separators in a few hospitals; and promotion of alternatives to mercury in

artisanal gold mining and dental amalgam. Further, a number of Civil Society Organizations (CSOs) are becoming effective in promoting public awareness.

Although limited initiatives have been undertaken by several stakeholders to address potential health and environmental risks associated with mercury, there is an urgent need for sustained and comprehensive awareness campaign particularly for risk groups such as artisanal gold miners (women, youth and children), but also for decision makers. Further, capacity building in terms of training on the management of mercury, mercury-added products and waste, and contaminated sites is required to improve the situation.

**Provisional implementation plan and Priorities for action**

Provisional national implementation plan has been developed whose goal is to protect human health and environment from anthropogenic emissions and releases of mercury and mercury compounds. The specific objectives include**:**

i) To facilitate ratification of the Minamata Convention on mercury;
ii) To strengthen legal and institutional framework governing management of mercury;
iii) To enhance information exchange, awareness raising and knowledge management;
iv) To phase down and where feasible phase out the use, emissions and releases of mercury from mercury-added products, manufacturing processes, ASGM, point and release sources;
v) To improve interim storage of mercury, management of mercury waste and contaminated sites;
vi) To facilitate resource mobilization, capacity building and technology transfer;
vii) To establish and strengthen capacity for preventive and heath care services; and
viii) To improve research, monitoring and reporting capacity on mercury.

The Plan will be implemented for a period of five years (2017 - 2022) with an estimated cost of **USD 7,130,500.** Resources for implementation of the Plan will be sought from government budget and international mechanisms. The Vice President's Office will coordinate implementation of the Plan.

## FOREWORD

Mercury is one of the top ten chemicals of global public health concern owing to its long-range atmospheric transport, its persistence in the environment, its ability to bio-accumulate in ecosystems and its adverse effects on human health and the environment. Due to increasing mercury emissions and releases primarily from anthropogenic sources, it continues to be an issue of concern at national and global levels.

Consequently, the Minamata Convention on Mercury, a global legally binding treaty, was negotiated and signed in October 2013 to address the unique challenges and risks posed by mercury. The objective of the Convention is to protect human health and the environment from the risks posed by anthropogenic emissions and releases of mercury and mercury compounds.

Tanzania being a signatory to the Minamata Convention on Mercury was eligible for financial support from the Global Environment Facility (GEF) to implement Minamata Initial Assessment (MIA) Enabling Activities (EAs) (referred to as "MIA project") that aim to strengthen national decision-making towards ratification of the Minamata Convention and build national capacity towards implementation of future obligations.

This is the final project report presenting results of a national mercury inventory; review of policy, legal and institutional framework; identification of population at risk and gender dimensions; public awareness, training and education efforts; and provisional implementation Plan and priorities for action. The prominent sources of mercury releases being large scale gold mining; artisanal and small-scale gold mining; cement production and medical waste incineration; and mercury-added products. Main capacity gaps that were identified for effective implementation of the Minamata Convention include inadequate policy and regulatory framework; insufficient financial and human resources; lack of facilities for environmentally sound management of mercury; inadequate adoption of best practices and techniques; and low public awareness. The project results serve both as a baseline and framework to facilitate planning and formulating measures designed to minimize mercury releases and associated impacts to human health and the environment

Cognizant on the need and importance for preventive approach and promoting multi-stakeholder response to address challenges posed by mercury releases, the Government is determined to and shall make every effort to mobilize resources and ensure effective engagement of all stakeholders. In this context, the Government welcomes support of local and international stakeholders in our ambition to achieve a mercury-free environment.

January Y. Makamba (MP)
**Minister of State**
**Vice President's Office - Union and Environment**

**ACKNOWLEDGEMENT**

The successful preparation of the Minamata Initial Assessment (MIA) Report has enlisted the assistance, participation and cooperation of various key stakeholders and experts and we would like to acknowledge their efforts.

We wish to express our gratitude to the National Team for their contribution in information collection and drafting of the report. The members of the team were drawn from the Vice President's Office; Ministry of Energy and Minerals; National Environment Management Council; and Government Chemist Laboratory Agency. We also appreciate stakeholders and experts who were involved in reviewing the report for their inputs.

We extend our appreciation to Eng. Ngosi Mwihava, Deputy Permanent Secretary-Vice President's Office and Mr. Richard S. Muyungi, Director of Environment, Vice President's Office for overseeing and guiding the whole exercise of preparing this report. We also acknowledge Ms. Magdalena J. Mtenga, Assistant Director-Division of Environment, Vice President's Office, who serves as the National Focal Point for the Minamata Convention on Mercury, for coordinating the report preparation exercise.

We are obligated to the International Consultants particularly Jacob Maag and Rico Euripidou for their technical guidance and inputs on the MIA report.

Finally, we wish to thank the Global Environment Facility (GEF) for the financial support and the United Nations Environmental Programme (UNEP) and the UNIDO for the technical support and guidance in preparing this report.

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**Permanent Secretary**
**Vice President's Office**

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**ABBREVIATIONS**

| | |
|---|---|
| ASGM | Artisanal and Small Scale Gold Mining |
| AU | African Union |
| BATs | Best Available Techniques |
| BEPs | Best Environmental Practices |
| CBOs | Community Based Organizations |
| CDR | Crude Death Rate |
| CMAC | Chemicals Management Advisory Committee |
| COSTECH | Commission for Science and Technology |
| CPCT | Cleaner Production Centre of Tanzania |
| CSOs | Civil Society Organizations |
| DoE | Division of Environment |
| EA | Enabling Activity |
| EAC | East African Community |
| EEZ | Exclusive Economic Zone |
| EMA | Environment Management Act |
| FEMATA | Federation of Miners Association of Tanzania |
| GCLA | Government Chemist Laboratory Agency |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GMP | Global Mercury Partnership |
| M & E | Monitoring and Evaluation |
| MEAs | Multilateral Environmental Agreements |
| MEM | Ministry of Energy and Minerals |
| MFP | Ministry of Finance and Planning |
| MIA | Minamata Initial Assessment |
| MITI | Ministry of Industry, Trade and Investment |
| MoHCDGEC | Ministry of Health, Community Development, Gender, Elderly and Children. |
| MSPI | Multi-Stakeholder Partnership Initiative |
| MT | Metric Tonnes |
| MUHAS | Muhimbili University of Health and Allied Sciences |
| NAP | National Action Plan |
| NEAC | National Environmental Advisory Committee |

| | |
|---|---|
| NEMC | National Environment Management Council |
| NGOs | Non-Government Organizations |
| OSHA | Occupational Safety and Health Authority |
| PMA | Phenyl Mercuric Acetate |
| SADC | Southern African Development Community |
| SAICM | Strategic Approach to International Chemicals Management |
| SMMRP | Sustainable Management of Mineral Resources Project |
| TAWOMA | Tanzania Women Miners Association |
| TBS | Tanzania Bureau of Standards |
| TCCIA | Tanzania Chamber of Commerce, Industry and Agriculture |
| TCF | Trillion Cubic feet |
| TFDA | Tanzania Foods and Drugs Authority |
| TRA | Tanzania Revenue Authority |
| UDSM | University of Dar es Salaam |
| UNEP | United Nations Environment Programme |
| UNITAR | United Nation Institute for Training and Research |
| VPO | Vice President's Office |
| WHO | World Health Organization |

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# CHAPTER I

## 1.0 INTRODUCTION

### 1.1 Background of the Project

Mercury is one of the top ten chemicals of global public health concern owing to its long-range atmospheric transport, its persistence in the environment, its ability to bio-accumulate in ecosystems and its adverse effects on human health and the environment. Due to increasing mercury emissions and releases primarily from anthropogenic sources, it continues to be an issue of concern at national and global levels. The identified major sources of mercury emission and releases in the country include large scale and artisanal gold mining, mercury-added products, medical waste incineration and industrial production.

Consequently, the Minamata Convention was negotiated and adopted in 2013 with the objective of protecting human health and the environment to address challenges and risks posed by mercury emissions and releases from anthropogenic sources. Tanzania signed the Convention in October, 2013 and it is in the ratification process.

Tanzania being a signatory to the Minamata Convention was eligible for funding to implement Minamata Initial Assessment (MIA) Project with the aim, among others, to help enhance national capacity to meet future obligations of the Convention. The project was implemented for a period of two years (2015 - 2017). The MIA project has six components as follows:

i) Establishment of a coordination mechanism and organisation of process;
ii) Assessment of the national infrastructure and capacity for management of mercury including national legislation;
iii) Development of a mercury inventory using the UNEP mercury toolkit and strategies to identify and assess mercury contaminated sites;
iv) Identification of challenges, needs and opportunities to implement the Minamata Convention;
v) Preparation and validation of national MIA reports and implementation of awareness raising activities and dissemination of results; and
vi) Information exchange, capacity building and knowledge generation.

The implementation of the MIA project is coordinated by the Vice President's Office - Division of Environment which also serves as the National Focal Point for the Minamata Convention.

### 1.2 Objectives of this Report

This is the final project report presenting a synthesis of situational analysis on sources, regulatory framework, population and gender dimensions, awareness and training related to anthropogenic emissions and releases of mercury and mercury compounds. The specific objectives of the report are to:

v) identify and quantify sources of anthropogenic emissions and releases of mercury and mercury compounds;
vi) assess adequacy of policy, regulatory and institutional framework in domesticating the Minamata Convention;

vii) identify population groups at risk associated with mercury exposure and gender dimensions; and
viii) highlight baseline on level of public awareness and training activities

### 1.3 Substantive Provisions of the Minamata Convention on Mercury

The Minamata Convention on Mercury was adopted in 2013 with the objective to protect human health and the environment from adverse effects of anthropogenic emissions and releases of mercury and mercury compounds. A summary for some of its provisions is provided in **Table 1**.

**Table 1-1**: Summary notes of substantive provisions of the Minamata Convention on Mercury

| Provisions of the Minamata Convention | Summary of Article Provisions |
|---|---|
| **Article 3: Mercury supply sources and trade** | • Not allow new primary mercury mining<br>• Phase out existing primary mercury mining within 15 years<br>• Prohibit the import and use of mercury from primary mercury mining for artisanal and small-scale gold mining (ASGM)<br>• Obtain information on stocks of mercury or mercury compounds exceeding 50 metric tons (MT), and mercury supply generating stocks exceeding 10 MT/yr<br>• The trading of mercury requires the written consent of the importing country, and the mercury is for an allowed use or environmentally sound storage |
| **Article 4: Mercury-added products** | • Not allow manufacture, import or export of mercury-added products in Part 1 of Annex A after the phase out date<br>• Discourage new mercury-added products |
| **Article 7: artisanal and small-scale gold mining** | • Reduce, and where feasible eliminate, the use of mercury and mercury compounds<br>• Develop and implement a National Action Plan and review every 3 years. |
| **Article 8: emissions** | • Control and, where feasible, reduce emissions of mercury and mercury compounds to the atmosphere from the point sources listed in Annex D. It differentiates between measures required for new sources and those required for existing sources |
| **Article 9: Releases** | • Control and, where feasible, reduce releases of mercury and mercury compounds from significant anthropogenic point sources.<br>• Identify the relevant point source categories of releases of mercury into land and water (every 3 years). |
| **Article 10: Interim storage of mercury** | • Take measures to ensure that mercury and mercury compounds intended for a use allowed under the Convention are stored in an environmentally sound manner. |
| **Article 11: Mercury wastes** | • Ensure management of mercury waste in an environmentally sound manner and transportation across international boundaries |
| **Article 12: Contaminated sites** | • Develop appropriate strategies for identifying and assessing sites contaminated by mercury or mercury compounds.<br>• Take action to reduce the risks posed by sites contaminated by mercury or mercury compounds in an environmentally sound manner. |
| **Article 16: Health aspects** | • Develop and implement strategies and programmes to identify and protect populations at risk. |

| | |
|---|---|
| | • Adopt and implement educational and preventive programmes on occupational exposure to mercury and mercury compounds.<br>• Promote health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds.<br>• Establish and strengthen institutional and health professional capacities.<br>information |
| **Article 17: Information exchange** | • Facilitate exchange of scientific, economic and legal information concerning mercury and mercury compounds; on viable alternatives to mercury use in products and processes; and on epidemiological information on health impacts from mercury. |
| **Article 18: Public information, awareness and education** | • Promote and facilitate provision of available information on the health and environmental effects of mercury; alternatives to mercury; results of any research, development and monitoring activities.<br>• Promote education, training and public awareness related to the effects of exposure to mercury on human health and the environment. |
| **Article 19: Research, development and monitoring** | • Develop and improve inventories, modelling and monitoring, technical and economic availability of mercury-free products and processes and on Best Available Techniques and Best Environmental Practices. |
| **Article 20: Implementation Plans** | • May develop and execute a national implementation plan (NIP) for meeting the obligations under the convention |
| **Article 21: Reporting** | • Report on the measures undertaken to implement the provisions of the Convention, on the effectiveness of such measures and the possible challenges in meeting the objectives of the Convention. |

### 1.4 Main Activities Implemented

In the course of implementing the project, the following specific activities were completed:

i) Establishment of a Project Management Unit;
ii) Organized Inception Workshop for the MIA project;
iii) Review of policy, legal and institutional framework for management of mercury including national legislation;
iv) Undertook national mercury inventory, using the UNEP Mercury Toolkit including field visit verification;
v) Formulated National Strategy for the Identification and Assessment of Mercury Contaminated Sites;
vi) Developed National Report on Identification of Challenges, Needs and Opportunities to Implement the Minamata Convention;
vii) Prepared National Implementation Plan and Priorities;
viii) Prepared Final National MIA Project Report; and
ix) Organized National Stakeholder Workshop to validate MIA project outputs;

### 1.5 Approach and Consultation Process

In undertaking the activities of the project, National Task Teams were constituted, from Government Ministries and Agencies, Academia and Civil Society Organizations, to provide technical inputs and consolidate national situation and experience. This approach facilitated awareness raising, enhanced working partnership and created ownership and support from the

participating institutions that would be useful in implementation of the Minamata Convention. The outputs from the Task Teams were then subjected to stakeholder consultative meetings that comprised a broad spectrum of stakeholders for further review and inputs which also helped in awareness raising and enriching national experience.

The consultation process during undertaking the activities of the MIA Project ensured engagement of all key stakeholders, offered platform for discussion and feedback through meetings and official communications, and encouraged institutionalization of mercury issues to support national mainstreaming efforts.

## 1.6 Country Profile

### *1.6.1 Geography and population*

The United Republic of Tanzania is located East of Africa's Great Lakes. It lies between Longitudes 29 and 41 East, and Latitudes 1 and 12 South. It is bordered by Kenya and Uganda to the North; Rwanda, Burundi and Democratic Republic of Congo to the West; Zambia and Malawi to the South West; Mozambique to the South; and Indian Ocean to the East. It has shorelines at three of the Great Lakes: Lake Victoria, Lake Tanganyika and Lake Nyasa.

The country consists of Tanzania Mainland and Zanzibar with a total area of 945,087 $km^2$. Out of this area, 883,749 $km^2$ (881,289 $km^2$ is for Tanzania mainland and 2,460$km^2$ is for Zanzibar) comprise the terrestrial land area and 59,050 $km^2$ comprise the inland water bodies and part of the Exclusive Economic Zone (EEZ) of the Indian Ocean that is approximately 0.204 Million $Km^2$. The estimated population of the country is about 50.1 million people in 2016.




**Figure 1-1**: The map of Tanzania showing regional and international boundaries.

### *1.6.2 Political, legal and economic profile*

The Government of the United Republic of Tanzania is a unitary republic based on multiparty parliamentary democracy. All state authority in the United Republic are exercised and controlled by the Government of the United Republic of Tanzania and the Revolutionary Government of Zanzibar. Each Central Government has three organs: The Executive; Judiciary; and The Legislature that have powers over the conduct of public affairs. In addition, Local Government Authorities assist each central government.

**a. The Executive:**

The Executive of the United Republic comprises the President, the Vice President, President of Zanzibar, the Prime Minister and the Cabinet Ministers. The President is the Leader of the Executive of the United Republic of Tanzania.

**b. Judiciary**

The Judiciary in Tanzania consists of three organs: the Court of Appeal of the United Republic of Tanzania, the High Courts for Mainland Tanzania and Tanzania Zanzibar, the Judicial Service Commission for Tanzania Mainland.

**c. Legislature (The Parliament):**

The National Assembly is the principal organ of the United Republic with the authority to discuss bills and passing laws. It also advises the Government of the United Republic and all its organs in the discharge of their respective responsibilities.

### *1.6.3 Macroeconomic profile*

The major contributing economic sectors to the national GDP in 2016 were agriculture (crop, livestock, forest and fisheries) (29.1%), construction (14%), trade and repairs (10.7%), manufacturing (5.1%) and mining (4.8%).

### *1.6.4 Regional and sub-regional Cooperation*

Tanzania participates in various regional and sub-regional economic blocks in which environmental management is one of the areas of cooperation. Some of these include:

**i) East African Community (EAC)**

The East African Community is a regional inter-governmental organization consisting of 6 partner States – the Republics of Burundi, Kenya, Rwanda, South Sudan, the United Republic of Tanzania and the republic of Uganda. The EAC was established in 1999 aiming at enhancing political, economic and social cooperation. Key environmental agreements in the EAC includes: Protocol on environment and natural resource management; Convention on the sustainable management of Lake Tanganyika; and Nairobi convention for the protection, management and development of the marine and coastal environment of the eastern African region.

**ii) African Union (AU)**

The African Union was established to promote political and socio-economic integration of the Africa continent. Key environmental agreements include: African convention on the conservation of nature and natural resources - signed on March 28, 2014; and Bamako convention on the ban of the import into Africa and the control of transboundary movement and management of hazardous wastes within Africa - signed on March 07, 2017.

**iii) Southern African Development Community (SADC)**

The Southern African Development Community was established in 1992 with the objective of enhancing economic development, peace and security. Key environmental agreements

include: Protocol on forestry (2002); Protocol on wildlife conservation and law enforcement (1999); Protocol on mining (1997); Protocol on fisheries (2006); revised protocol on shared watercourses (2000); and

**iv) The Africa Institute for the environmentally sound management of hazardous and other wastes.**

The Africa Institute is both a Basel Convention regional center (BCRC) and a Stockholm Convention regional center (SCRC) for English speaking African countries. The institute was established in October 2009 comprising of 23 member countries. Its objective is to build the capacity within the English speaking African region to implement effectively the Multilateral Environmental Agreements (MEAs) that address the sound management of hazardous wastes and chemicals.

### *1.6.5 Profiles of economic sectors*

The key economic sectors in the country where mercury use, trade, disposal, emissions or releases is relevant are;

**a. Manufacturing**

There are about 52,549 industries in Tanzania, where by 85.13% are very small scale industries (Micro), 14.02% are small scale industries, 0.35% are Medium scale industries and 0.5% are large scale industries. Contribution of the manufacturing sector to the national GDP was 5.1% in 2016 compared to 5.2 in 2015. Industrial sector has provided about 146, 892 employment in the country of which 23.4% are employed under Micro and small scale industries.

The manufacturing sector is considered to contribute in mercury releases and emissions particularly cement production; iron and copper smelting; waste incineration; coal fired industrial applications; and pulp and paper production.

**b. Artisanal and small-scale gold mining (ASGM)**

The mining sector contributed about 4% to the national GDP in 2016. The artisanal and small-scale gold mining (ASGM) sub-sector contributes about 10% of the total national gold production. Specifically, artisanal and small-scale gold mining (ASGM) is one of the leading sources of mercury emissions and releases in the country associated with the use of mercury during gold extraction. It is estimated that there are over 50 ASGM sites in the country. The number of ASGM miners in Tanzania ranges from 500,000 to 1.5 million where women constitute 20 - 30% of the miners.

### c. Mercury-added products

Mercury-added products are still in use in the country including thermometers, barometers, manometers, sphygmomanometers, dental amalgam, batteries, electrical and electronic devices, fluorescents lamps and laboratory chemicals and equipment.

### d. Waste treatment/recycling

Waste management services and practices are generally inadequate. The situation is characterized by lack of waste sorting at source resulting in mixing of different waste streams; poor infrastructure and facilities for collection, handling, treatment and disposal; and low level of public awareness. Only about 40% of the solid waste generated is collected and disposed of in crude dumpsites that do not have any environmental safeguards to prevent environmental pollution. Similarly, waste water management is inadequate.

There are several waste treatment practices involving onsite treatment such as pit latrine, septic tank and soak away pit, open burning, burying and medical waste incineration which are inappropriately designed or practiced and thus contributing to environmental pollution. Offsite treatment systems include waste stabilization ponds and constructed wetlands most of which are poorly operated.

There is limited recycling activities mostly involving solid waste particularly plastics, paper, glass, metals and aluminum. Due to lack of sorting at source, most of the recyclable materials end up in dumpsites or haphazardly disposed in the environment.

### e. Energy sector

In 2016, the contribution of different sources of electricity generation was 2365.82GWh from hydropower, 4097.03 GWh from natural gas and 629.2GWh from diesel thermal plants.

The share of electricity distribution to national GDP was 0.9% in 2016 compared to 1% 2015. In 2016 the electricity generated in the national grid and other sources decreased by 10.6% from 1643.5 MW in 2015 to 1469.39MW.

As of December, 2016 a total of 57.25 Trillion cubic feet of natural gas had been discovered. During the year 2016 a total of 48.32 Billion cubic feet of natural gas were produced. Out of this, a total of 36.7 Billion cubic feet were used to generate electricity while the remaining amount was used in commercial and industrial activities.

In 2016, oil imported for domestic consumption was 2539.9 Million litres while 2874.4 Million litres of oil imported was on transit.

### f. Cement production

Cement production is becoming an important manufacturing activity in view of increasing production level triggered by housing and infrastructural development in the country. The estimated annual growth of cement industry is about 10 – 12 %. The total annual cement production in 2016 was about 9.6 million Tones. Cement production is considered to be a

significance source of mercury emission and releases due to potential mercury impurities in raw materials.

**g. Health sector**

The contribution of health sector to national GDP was 1.4% in 2016. The number of health facilities in the country increased from 7249 in 2015 to 7346 in 2016. The health facilities include special and referral hospitals. In 2016, a total of 32.5 million patients attended health care facilities as compared to 31.3 million 2015, equivalent to an increase of 4%.

### *1.6.6 Environmental overview*

The current state of the Tanzania environment is a matter of concern. A national analysis has identified six major problems for urgent attention.

*i.* *Land degradation*
The general trends of land degradation in the country reveals that about 61% of the total land area is affected by land degradation. The most affected regions include Dodoma, Shinyanga, Simiyu, Singida, Mwanza, and parts of Arusha, Manyara, Tabora, Mara and Kilimanjaro regions. The total annual economic cost due to land degradation is estimated at USD10.2 billion.

*ii.* *Environmental pollution*
Environmental pollution is widespread and is a growing problem in the country. It is more pronounced in urban areas than in peri-urban and rural areas. Environmental pollution has contributed to significant deleterious effects on the quality of water, air and land, and on the quality of life in general. Some of the sources contributing to environmental pollution include untreated industrial and municipal effluent, unsustainable agricultural and mining activities, haphazard disposal of solid and liquid waste. Consequently, it is estimated that more than 40% of the disease burden in the country is attributable to environmental pollution, with children bearing most of it.

iii. *lack* of *accessible, good quality water for both urban and rural inhabitants*;
The major water uses in the country are for irrigation and domestic purposes. Irrigation is by far the largest consumptive use comprising about 89% of the total, with domestic water supply comprising 9% and industrial water use 2%. Water supply coverage in Tanzania is 86% and 57% for urban and rural areas, respectively. The water supply coverage varies considerably by region.

*iv.* *Loss of wildlife habitats and biodiversity*
Tanzania is endowed with diverse terrestrial and aquatic biodiversity located in various ecological zones and ecosystems. The country hosts 6 out of the 25 globally known biodiversity hotspots. It is among 15 countries globally with the highest number of endemic as well as threatened species. Biodiversity is critical to the

national economy contributing more than three quarters of the national GDP and sustaining livelihoods of majority of the population. Some of the drivers for biodiversity loss include population growth, increasing demand and trade for plant and animal species, climate change, invasive alien species and biofuel development.

*v. Deterioration of aquatic ecosystems*

Tanzania has vast aquatic systems of both fresh and marine waters. These ecosystems directly and indirectly support the livelihoods by providing goods and services whose deterioration decrease their capacity to support socio-economic welfare. Most rivers, lakes, and dams are facing changes in flow regimes and pollution problems from industrial and domestic waste as well as from agricultural practices. Similarly, most wet lakes are characterized by reduced fresh water inputs and changing flow regimes with consequent decline in area of the wet lands especially during the dry season. Mangrove cover has decreased from 115,000Ha in 1990 to about 108,000Ha. Some of the drivers threatening aquatic ecosystems include population growth, economic growth, poverty, deforestation, unsustainable agricultural practices, pollution and climate change.

*vi. Deforestation*

Tanzania has a total forest area of 48 million hectares (55% of the total land area), of which 93% is covered by woodlands and only 3% is covered by forests (mangroves, coastal forests, humid montane forests and plantations). About 40% of the total land area is under legal protection (protected forests and wildlife reserves). It is estimated that annual forest cover loss amounts to about 372,000 hectares. Some of the drivers for deforestation and forest degradation include poverty, population growth, economic growth, energy and unsustainable farming practices.

There are some initiatives undertaken to address environmental challenges in the country which include development and implementation of national policies, legislation, strategies, programmes and projects; promotion of best environmental practices; public awareness and stakeholder engagement; designation and conservation of protected areas; and promoting cleaner production techniques.

# CHAPTER II

## 2.0 MERCURY INVENTORY AND IDENTIFICATION OF EMISSIONS AND RELEASES

The national inventory of mercury sources and releases was undertaken basing on UNEP Toolkit for Identification and Quantification of Mercury Releases - Level 2 Version 1.3 (2015). The Toolkit was considered as a screening tool in the course of identifying and initial prioritization of major source categories of mercury in the country.

## 2.1 SUMMARY OF MERCURY RELEASES, STOCKPILES, AND SUPPLY AND TRADE

### *2.1.1 Summary of Mercury release source types present*

**Table 1-2**: Identified mercury release sources in the country [sources present (Y), absent (N), and possible but not positively identified (?)

| Toolkit Chapter | Source Category | Source Presence (Y/N/?) |
|---|---|---|
| **5.1** | **Main category - Extraction and use of fuels/energy sources** | |
| 5.1.1 | Coal combustion in large power plants | N |
| 5.1.2 | Other coal use | Y |
| 5.1.3 | Extraction, refining and use of mineral oil | Y |
| 5.1.4 | Extraction, refining and use of natural gas | Y |
| 5.1.5 | Extraction and use of other fossil fuels | N |
| 5.1.6 | Biomass fired power and heat production | Y |
| 5.1.7 | Geothermal power production | N |
| **5.2** | **Main category - Primary (virgin) metal production** | |
| 5.2.1 | Primary extraction and processing of mercury | N |
| 5.2.2 | Gold and silver extraction with the mercury-amalgamation process | Y |
| 5.2.3 | Zinc extraction and initial processing | N |
| 5.2.4 | Copper extraction and initial processing | Y |
| 5.2.5 | Lead extraction and initial processing | N |
| 5.2.6 | Gold extraction and initial processing by other processes than mercury amalgamation | Y |
| 5.2.7 | Aluminium extraction and initial processing | N |
| 5.2.8 | Extraction and processing of other non-ferrous metals | N |
| 5.2.9 | Primary ferrous metal production | N |
| **5.3** | **Main category - Production of other minerals and materials with mercury impurities** | |
| 5.3.1 | Cement production | Y |
| 5.3.2 | Pulp and paper production | Y |
| 5.3.3 | Lime production and light weight aggregate kilns | Y |
| 5.3.4 | Others minerals and materials | ? |
| **5.4** | **Main category – Intentional use of mercury as an auxiliary material in industrial processes** | |
| 5.4.1 | Chlor-alkali production with mercury-technology | N |

| | | |
|---|---|---|
| 5.4.2 | VCM (vinyl-chloride-monomer) production with mercury-dichloride ($HgCl_2$) as catalyst | N |
| 5.4.3 | Acetaldehyde production with mercury-sulphate ($HgSO_4$) as catalyst | N |
| 5.4.4 | Other production of chemicals and polymers with mercury compounds as catalysts | N |
| **5.5** | **Main category - Consumer products with intentional use of mercury** | |
| 5.5.1 | Thermometers with mercury | Y |
| 5.5.2 | Electrical and electronic switches, contacts and relays with mercury | Y |
| 5.5.3 | Light sources with mercury | Y |
| 5.5.4 | Batteries containing mercury | Y |
| 5.5.6 | Biocides and pesticides | N |
| 5.5.7 | Paints | N |
| 5.5.8 | Pharmaceuticals for human and veterinary uses | N |
| 5.5.8 | Cosmetics and related products | N |
| **5.6** | **Main category - Other intentional products/process uses** | |
| 5.6.1 | Dental mercury-amalgam fillings | Y |
| 5.6.2 | Manometers and gauges | Y |
| 5.6.3 | Laboratory chemicals and equipment | Y |
| 5.6.4 | Mercury metal use in religious rituals and folklore medicine | ? |
| 5.6.5 | Miscellaneous product uses, mercury metal uses and other sources | N |
| **5.7** | **Main category - Production of recycled metals** | |
| 5.7.1 | Production of recycled mercury ("secondary production) | N |
| 5.7.2 | Production of recycled ferrous metals (iron and steel) | Y |
| 5.7.3 | Production of other recycled metals | N |
| **5.8** | **Main category – Waste incineration** | |
| 5.8.1 | Incineration of municipal/ general waste | N |
| 5.8.2 | Incineration of hazardous waste | Y |
| 5.8.3 | Incineration of medical waste | Y |
| 5.8.4 | Sewage sludge incineration | N |
| 5.8.5 | Informal waste burning | Y |
| **5.9** | **Main category - Waste deposition/landfilling and waste water treatment** | |
| 5.9.1 | Controlled landfills/deposits | N |
| 5.9.2 | Diffuse deposition under some control | N |
| 5.9.3 | Informal local deposition of industrial production waste | N |
| 5.9.4 | Informal dumping of general waste | N |
| 5.9.5 | Waste water system/treatment | Y |
| **5.10** | **Main category - Cremation and cemeteries** | |
| 5.10.1 | Crematoria | Y |
| 5.10.2 | Cemeteries | Y |
| | **Main category - Potential hot spots** | |
| | Closed/abandoned chlor-alkali production sites | N |
| | Other sites of former chemical production where mercury compounds are/were produced (pesticides, biocides, pigments etc.), or mercury or compounds were used as catalysts (VCM/PVC etc.) | N |
| | Closed production sites for manufacturing of thermometers, switches, batteries and other products | N |
| | Closed pulp and paper manufacturing sites (with internal chlor-alkali production or former use of mercury-based slimicides) | N |
| | Tailings/residue deposits from mercury mining | N |
| | Tailings/residue deposits from artisanal and large scale gold mining | Y |

| | | |
|---|---|---|
| | Tailings/residue deposits from other non-ferrous metal extraction | N |
| | Sites of relevant accidents | N |
| | Dredging of sediments | ? |
| | Sites of discarded district heating controls (and other fluid controls) using mercury pressure valves | N |
| | Sites of previous recycling of mercury ("secondary" mercury production) | N |

### *2.1.2 Summary of Mercury Inputs to Society*

The total mercury inputs to society in the country for the year 2016 was about 30.29 MT
**Table 2.1-2** the largest contribution of mercury releases include; Gold extraction and initial processing by methods other than mercury amalgamation (32%) followed by informal waste burning (22.9%). In addition, the Gold (and silver) extraction with mercury amalgamation processes contributes (17%) of the total mercury input to society. However, other category such as cement production, thermometers with mercury, Light sources, Batteries with mercury, Dental mercury-amalgam fillings, Incineration of medical waste and Cemeteries contributes less than 5% of the total mercury input to society.

**Table 1-3**: Summary of mercury inputs to society

| Toolkit Chapter | Source category | Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant) | | |
|---|---|---|---|---|
| | | Production phase3 | Use phase | Disposal phase |
| 5.1 | Main category - Extraction and use of fuels/energy sources | | | |
| 5.1.1 | Coal combustion in large power plants | 0 | 0 | 0 |
| 5.1.2 | Other coal use | 0 | 104 | 0 |
| 5.1.3 | Extraction, refining and use of mineral oil | 0 | 7 | 0 |
| 5.1.4 | Extraction, refining and use of natural gas | 129 | 0 | 0 |
| 5.1.5 | Extraction and use of other fossil fuels | 0 | 0 | 0 |
| 5.1.6 | Biomass fired power and heat production | 0 | 860 | 0 |
| 5.1.7 | Geothermal power production | 0 | 0 | 0 |
| 5.2 | Main category - Primary (virgin) metal production | | | |
| 5.2.1 | Primary extraction and processing of mercury | 0 | 0 | 0 |
| 5.2.2 | Gold and silver extraction with the mercury-amalgamation process | 5,200 | 0 | 0 |
| 5.2.3 | Zinc extraction and initial processing | 0 | 0 | 0 |
| 5.2.4 | Copper extraction and initial processing | 540 | 0 | 0 |
| 5.2.5 | Lead extraction and initial processing | 0 | 0 | 0 |
| 5.2.6 | Gold extraction and initial processing by other processes than mercury amalgamation | 9,710 | 0 | 0 |
| 5.2.7 | Aluminium extraction and initial processing | 0 | 0 | 0 |
| 5.2.8 | Extraction and processing of other non-ferrous metals | 0 | 0 | 0 |
| 5.2.9 | Primary ferrous metal production | 0 | 0 | 0 |
| 5.3 | Main category - Production of other minerals and materials with mercury impurities | | | |
| 5.3.1 | Cement production | 1,057 | 0 | 0 |
| 5.3.2 | Pulp and paper production | 10 | 0 | 0 |
| 5.3.3 | Lime production and light weight aggregate kilns | 1 | 0 | 0 |
| 5.3.4 | Others minerals and materials | 0 | 0 | 0 |
| 5.4 | Main category – Intentional use of mercury as an auxiliary material in industrial processes | | | |
| 5.4.1 | Chlor-alkali production with mercury-technology | 0 | 0 | 0 |
| 5.4.2 | VCM (vinyl-chloride-monomer) production with mercury-dichloride (HgCl2) as catalyst | 0 | 0 | 0 |
| 5.4.3 | Acetaldehyde production with mercury-sulphate (HgSO4) as catalyst | 0 | 0 | 0 |
| 5.4.4 | Other production of chemicals and polymers with mercury compounds as catalysts | 0 | 0 | 0 |
| 5.5 | Main category - Consumer products with intentional use of mercury | | | |
| 5.5.1 | Thermometers with mercury | 0 | 0 | 1,734 |
| 5.5.2 | Electrical and electronic switches, contacts and relays with mercury | 0 | 0 | 401 |
| 5.5.3 | Light sources with mercury | 0 | 0 | 256 |
| 5.5.4 | Batteries containing mercury | 0 | 0 | 0 |
| 5.5.6 | Biocides and pesticides | 0 | 0 | 0 |
| 5.5.7 | Paints | 0 | 0 | 0 |

| Toolkit Chapter | Source category | Estimated Hg input, Kg Hg/y, by life cycle phase (as relevant) | | |
|---|---|---|---|---|
| | | Production phase3 | Use phase | Disposal phase |
| 5.5.8 | Pharmaceuticals for human and veterinary uses | 0 | 0 | 0 |
| 5.5.8 | Cosmetics and related products | 0 | 0 | 0 |
| 5.6 | Main category - Other intentional products/process uses | | | |
| 5.6.1 | Dental mercury-amalgam fillings | 0 | 0 | 704 |
| 5.6.2 | Manometers and gauges | 0 | 0 | 650 |
| 5.6.3 | Laboratory chemicals and equipment | 0 | 0 | 1,002 |
| 5.6.4 | Mercury metal use in religious rituals and folklore medicine | 0 | 0 | 0 |
| 5.6.5 | Miscellaneous product uses, mercury metal uses and other sources | 0 | 0 | 0 |
| 5.7 | Main category - Production of recycled metals | | | |
| 5.7.1 | Production of recycled mercury ("secondary production) | 0 | 0 | 0 |
| 5.7.2 | Production of recycled ferrous metals (iron and steel) | 18 | 0 | 0 |
| 5.7.3 | Production of other recycled metals | 0 | 0 | 0 |
| 5.8 | Main category – Waste incineration | | | |
| 5.8.1 | Incineration of municipal/general waste | 0 | 0 | 0 |
| 5.8.2 | Incineration of hazardous waste | 0 | 0 | 1 |
| 5.8.3 | Incineration of medical waste | 0 | 0 | 234 |
| 5.8.4 | Sewage sludge incineration | 0 | 0 | 0 |
| 5.8.5 | Informal waste burning | 0 | 0 | 6,929 |
| 5.9 | Main category - Waste deposition/landfilling and waste water treatment | | | |
| 5.9.1 | Controlled landfills/deposits | 0 | 0 | 0 |
| 5.9.2 | Diffuse deposition under some control | 0 | 0 | 0 |
| 5.9.3 | Informal local deposition of industrial production waste | 0 | 0 | 0 |
| 5.9.4 | Informal dumping of general waste | 0 | 0 | 0 |
| 5.9.5 | Waste water system/treatment | 0 | 0 | 627 |
| 5.10 | Main category - Cremation and cemeteries | | | |
| 5.10.1 | Crematoria | 0 | 0 | 0 |
| 5.10.2 | Cemeteries | 0 | 0 | 450 |

### *2.1.3 Summary of Mercury Releases*

A summary of mercury releases from all source categories present in the country is presented in **Table 2.1-3.** The contributions of the total mercury emission and releases to various output pathways include; (47%) to air, (35%) to Land and (7%) to Water. An additional output pathway include; general waste (5%), sector specific treatment (3%) and by-products and impurities (2%),

The source category that made largest contribution to mercury emissions and releases include; primary virgin metal production (51%) followed by Waste incineration and burning (24%). However, The mercury emission to air is high as compared to other releases pathways (Land and water), the source sub-categories that made contribution to air include; Informal waste burning (22.9%) of the total national mercury releases and emissions); Gold (and silver)

extraction with mercury amalgamation processes (12.9%); Biomass fired power and heat production (2.8%); and Cement production (2.1%).

**Table 1-4**: Summary of Mercury releases in Tanzania

| Toolkit Chapter | | Source category | Exists? (Y/N/?) | Calculated Hg input to society | Calculated Hg output, Kg/y | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Air | Water | Land | By-products and impurities | General waste | Sector specific treatment/ disposal |
| **5.1** | | **Source category: Extraction and use of fuels/energy sources** | | | | | | | | |
| | 5.1.1 | Coal combustion in power plants | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.2 | Other coal use | Y | 104 | 78 | 0 | 0 | 0 | 0 | 26 |
| | 5.1.3 | Mineral oils - extraction, refining and use | Y | 7 | 7 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.4 | Natural gas - extraction, refining and use | Y | 129 | 26 | 26 | 0 | 64 | 0 | 13 |
| | 5.1.5 | Other fossil fuels - extraction and use | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.6 | Biomass fired power and heat production | Y | 860 | 860 | 0 | 0 | 0 | 0 | 0 |
| | 5.1.7 | Geothermal power production | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.2** | | **Source category: Primary (virgin) metal production** | | | | | | | | |
| | 5.2.1 | Mercury (primary) extraction and initial processing (a | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.2.2 | Gold (and silver) extraction with mercury amalgamation processes | Y | 5,200 | 3,900 | 676 | 624 | 0 | 0 | 0 |
| | 5.3.3 | Zinc extraction and initial processing | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.3.4 | Copper extraction and initial processing | Y | 540 | 486 | 0 | 0 | 0 | 0 | 54 |
| | 5.3.5 | Lead extraction and initial processing | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.3.6 | Gold extraction and initial processing by methods other than mercury amalgamation | Y | 9,710 | 388 | 194 | 8,739 | 388 | 0 | 0 |
| | 5.3.7 | Aluminium extraction and initial processing | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.3.8 | Other non-ferrous metals - extraction and processing | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.3.9 | Primary ferrous metal production | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.3** | | **Source category: Production of other minerals and materials with mercury impurities** | | | | | | | | |
| | 5.3.1 | Cement production | Y | 1,057 | 634 | 0 | 0 | 211 | 0 | 211 |
| | 5.3.2 | Pulp and paper production | Y | 10 | 10 | 0 | 0 | 0 | 0 | 0 |
| | 5.3.3 | Production of lime and light weight aggregates | Y | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| **5.4** | | **Source category: Intentional use of mercury in industrial** | | 0 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **processes** | | | | | | | | |
| | 5.4.1 | Chlor-alkali production with mercury-technology | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.2 | VCM production with mercury catalyst | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.3 | Acetaldehyde production with mercury catalyst | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.4 | Other production of chemicals and polymers with mercury | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.5** | | **Source category: Consumer products with intentional use of mercury** | | | | | | | | |
| | 5.5.1 | Thermometers with mercury | Y | 1,734 | 347 | 520 | 347 | 0 | 520 | 0 |
| | 5.5.2 | Electrical switches and relays with mercury | Y | 401 | 120 | 0 | 160 | 0 | 120 | 0 |
| | 5.5.3 | Light sources with mercury | Y | 256 | 77 | 0 | 77 | 0 | 102 | 0 |
| | 5.5.4 | Batteries with mercury | Y | 231 | 58 | 0 | 58 | 0 | 116 | 0 |
| | 5.5.6 | Biocides and pesticides with mercury | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.5.7 | Paints with mercury | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.5.8 | Cosmetics and related products with mercury | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.6** | | **Source category: Other intentional product/process use** | | 0 | | | | | | |
| | 5.6.1 | Dental mercury-amalgam fillings (b | Y | 704 | 20 | 298 | 40 | 30 | 159 | 159 |
| | 5.6.2 | Manometers and gauges with mercury | Y | 650 | 130 | 195 | 130 | 0 | 195 | 0 |
| | 5.6.3 | Laboratory chemicals and equipment with mercury | Y | 1,002 | 0 | 331 | 0 | 0 | 331 | 341 |
| | 5.6.4 | Mercury metal use in religious rituals and folklore medicine | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.6.5 | Miscellaneous product uses, mercury metal uses, and other sources | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.7** | | **Source category: Production of recycled metals ("secondary" metal production)** | | | | | | | | |
| | 5.7.1 | Production of recycled mercury ("secondary production") | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.4.2 | Production of recycled ferrous metals (iron and steel) | Y | 18 | 6 | 0 | 6 | 0 | 6 | 0 |
| | 5.4.2 | Production of other recycled metals | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5.8** | | **Source category: Waste incineration*3** | | 0 | | | | | | |
| | 5.8.1 | Incineration of municipal/general waste | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.2 | Incineration of hazardous waste | Y | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.3 | Incineration of medical waste | Y | 234 | 234 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.4 | Sewage sludge incineration | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.8.5 | Informal waste burning | Y | 6,929 | 6,929 | 0 | 0 | 0 | 0 | 0 |
| **5.9** | | **Source category: Waste deposition/landfilling and waste water treatment** | | | | | | | | |
| | 5.9.1 | Controlled landfills/deposits*3 | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5.9.2 | Diffuse disposal under some control | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.9.3 | Informal local disposal of industrial production waste | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.9.4 | Informal dumping of general waste*1*3 | N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.9.5 | Waste water system/treatment*2 | Y | 627 | 0 | 564 | 0 | 0 | 38 | 25 |
| **5.10** | | **Source category: Crematoria and cemeteries** | | 0 | | | | | | |
| | 5.10.1 | Crematoria/cremation | Y | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5.10.2 | Cemeteries | Y | 450 | 0 | 0 | 450 | 0 | 0 | 0 |
| **SUM OF QUANTIFIED INPUTS AND RELEASES** | | | | **30290** | **14,311** | **2,239** | **10,630** | **694** | **1,587** | **829** |

### *2.1.4 Summary of mercury stockpiles supply and trade*

Currently, there is no identified mercury stockpiles in the country. However, future efforts to identify any possible existing mercury stockpiles may be necessary.

## 2.2 DATA AND INVENTORY ON EXTRACTION AND USE OF FUELS/ENERGY SOURCES

### *2.2.1 Coal combustion in power plants*

This sub-category covers coal combustion in power plants with a capacity greater than 300 MW. During the inventory, there were no coal-fired power plants of this size installed in the country and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.2.2 Other coal use*

This sub-category covers coal combustion in smaller combustion plants (< 300MW) including potential mercury releases from coal washing.

Tanzania has a sizeable coal reserve of about 1.9 billion tonnes of which 25% is proven. The coal consumption in the country is mainly related to industrial thermal applications, the annual consumption of coal in the country is 864,480 tonnes and this mainly used in cement industries, still mills and textile industries. However, no information is available on the collection efficiencies of these units with regard to mercury emissions.

### *2.2.3 Mineral oils - extraction, refining and use*

This sub-category includes extraction, refining, and uses of mineral oil (i.e. petroleum products) including combustion of oil to provide power, heat, and transportation, and other uses such as for example road asphalt (bitumen), synthesis of chemicals, polymer production, lubricants and carbon black production (black pigments). Like other natural materials, mineral oil contains small amounts of natural mercury impurities, which are mobilised to the biosphere by extraction and use.

Oil exploration in the country is being undertaken by several Multinational Companies but no oil discoveries have been made so far. However, no oil refineries in the country. In this regard, the contribution of these sub-categories to national mercury releases was not assessed.

### *2.2.4 Natural gas - extraction, refining and use*

This sub-category covers extraction, refining and use of natural gas for various purposes, especially combustion to produce electricity and heat. Natural gas contains small amounts of natural mercury impurities, which are mobilized to the biosphere during extraction, refining and combustion.

As of May 2016, natural gas reserves are estimated to be about 57.25 trillion cubic feet (TCF), out of which 47.13 TCF is offshore and 10.12 TCF is onshore. Natural gas is used to produce 711 MW of electricity, equivalent to approximately 49% of Tanzania's electricity generation.

### *2.2.5 Other fossil fuels - extraction and use*

This sub-category includes extraction and use of other fossil fuels such as peat (which is a very young form of coal) and oil shale. Similarly, these may contain traces of mercury, which can be mobilized by extraction and combustion.

However, these fuels are not available or in use in the country and therefore contribution of this sub-category to national mercury releases was not assessed.

### *2.2.6 Biomass fired power and heat production*

This sub-category include wood-fired boilers, other types of biomass-fired boilers, wood stoves, fireplaces and other biomass burning. The mercury in wood and other biomass originates from that taken up naturally from the soil, and mercury deposition from the atmosphere as a result of natural and anthropogenic emissions to air. Most of the mercury is discharged back into the air when the biomass is burned.

This source sub-category contributes about 2.8% of the total national mercury emissions and releases which ought to be maintained or even increase owing to the prevailing socio-economic trends.

### *2.2.7 Geothermal power production and use*

This sub-category covers production and use of geothermal power exploiting elevated underground temperatures. Geothermal hotspots are mostly situated in areas with special geothermal activity, sometimes in areas with volcanic activity.

The country has an estimated 650 MW of geothermal potential which is yet to be exploited. Most of the geothermal hotspots are located within the East African Rift Valley System and are mainly hot springs. However, the contribution of this sub-category to national mercury releases was not assessed.

### *2.2.8 Summary of inputs and results*

Toolkit results reveals that a total of 1.1 tonnes of mercury per year is estimated to be released into the environment **(Table 2.2 -1).** With the dominant source sub-category was biomass fired power and heat production contributing about 78% of the total emission and releases followed by natural gas extraction, refining and use (11.7%); and other coal use (9.5%). Contribution from other sub-categories was negligible.
From this source category, mercury is mainly released into the air (88.3%); as impurity in products (5.8%); sector specific treatment/disposal (3.5%); and water (2.4%).

**Table 1-5**: Inputs and output estimates for extraction and use of fuels/energy

| Source Category | Mercury input (kg/yr) | Mercury output (kg/yr) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Products | General waste | Sector specific treatment/ disposal |
| 1. Coal combustion in power plants | - | - | - | - | - | - | - |
| 2. Other coal use | 104 | 78.00 | 0.00 | 0.00 | 0.00 | 0.00 | 26.00 |
| 3. Mineral oils - extraction, refining and use | 7 | 7.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Natural gas - extraction, refining and use | 129 | 26.00 | 26.00 | 0.00 | 64.00 | 0.00 | 13.00 |
| 5. Other fossil fuels - extraction and use | - | - | - | - | - | - | - |
| 6. Biomass fired power and heat production | 860 | 860.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7. Geothermal power production | - | - | - | - | - | - | - |
| **TOTAL** | **1,100** | **971.0** | **26.00** | **0.00** | **64.00** | **0.00** | **39.00** |

## 2.3 DATA AND INVENTORY ON PRIMARY (VIRGIN) METAL PRODUCTION

### *2.3.1 Mercury (primary) extraction and initial processing*

This sub-category covers primary mercury mining which is known to have caused extensive mercury releases to terrestrial, atmospheric and aquatic environments, with both local and regional pollution as a consequence.

During the inventory, no primary mercury production activities were found in the country and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.3.2 Gold (and silver) extraction with mercury amalgamation processes*

This sub-category includes recovering of gold from ore concentrate using mercury (amalgamation).

Mercury amalgamation is still widely practised in artisanal and small-scale gold mining (ASGM) scattered in more than 50 sites in the country with the estimated amount of mercury consumed by this source sub-category varies widely among different literatures ranging from about 1 to 55 tonnes of mercury annually.

The toolkit results reveals that mercury releases for this source sub-category amounting to 5.2 tonnes per year. However, this estimates seems to be significantly higher than estimates made in national mercury inventory in 2012 of about 1.056 tonnes per year. The increment in mercury releases can be attributed to sizeable rise in number of artisanal and small scale gold miners influenced by poverty, unemployment particularly in rural areas, high price of gold, and discovery of additional gold ore deposits across the country.

### *2.3.3 Zinc Extraction and Initial Processing*

This sub-category includes extraction of zinc from the ore which can release mercury from the rock material as the ore might contain trace amount of mercury. Primary production of zinc generally includes the following processes: Concentration of zinc ore, oxidation (roasting or sintering) of zinc concentrate, production of zinc (by means of electrochemical or thermal processes), and refining of zinc.

Currently, there is no primary production of zinc in the country and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.3.4 Copper extraction and initial processing*

This sub-category involves extraction of copper mainly from sulphide ore which can contain trace amounts of mercury. In the extraction of the copper from the ore, processes are used which release this mercury from the rock material.

Copper ore reserves in the country is about 13.7 million tonnes. Currently, there is one small scale copper oxide ore smelting plant in the country which has the production capacity of 18,000 tonnes of copper blister ingots per year. The plant is among the point sources listed in Annex D to the Minamata Convention.

However, the contribution of this source sub-category to national mercury releases is only about 0.34% of the total national mercury releases.

### *2.3.5 Lead extraction and initial processing*

This sub-category involves lead extraction from a sulphide ore, primarily galena (lead sulphide) which also contains some mercury. In the extraction of the lead from the ore/concentrate, processes are used which release this mercury from the rock material.
Currently, there is no primary production of lead in the country and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.3.6 Gold extraction and initial processing by methods other than mercury amalgamation*

This sub-category covers industrial gold extraction and processing in which gold ore, often in the form of sulphide ore, contains trace amount of mercury which may be released in the environment during extraction and processing operations.

Gold reserves in the country is estimated to be about 2,222 tonnes. The annual national gold production was 45.8 tonnes in 2015.

### *2.3.7 Aluminium extraction and initial processing*

This sub-category covers extraction of bauxite involving two stages in the aluminium production cycle; initial refining of alumina from bauxite, and the production of aluminium metal from alumina, by smelting.

The bauxite ore reserves in Tanzania is estimated to about 37 million tonnes mostly found in the northern part of the country in Usambara Mountains in Lushoto District, Tanga Region. Currently, there is no primary aluminium production in the country.

The Toolkit results reveals that no mercury releases are expected from the mining of the bauxite and as the bauxite amounting to about 1,050 tonnes per year is exported for further processing abroad it is estimated that the mercury releases are negligible

### *2.3.8 Other non-ferrous metals - extraction and processing*

This sub-category includes extraction and processing of other non-ferrous metals which can be a source of mercury releases, such as silver, nickel, cobalt, tin, antimony, molybdenum and tungsten and others.
Currently, there is no processing of the available non-ferrous metals in the country. In this regard, the contribution of this sub-category to national mercury releases was not assessed.

### *2.3.9 Primary ferrous metal production*

This sub-category comprises smelting of iron ore to produce pig iron in molten or solid form; converting pig iron into steel by the removal, through combustion in furnaces, of the carbon in the iron.
The country has a reserve of 126 million tonnes of iron ore deposits that have been confirmed at Liganga area in Ludewa District, Njombe Region. The extraction and processing is anticipated to commence in 2018/19 with an annual production of 1.1 million tonnes of iron and steel products, vanadium pentoxide and titanium dioxide. In this context, the contribution of this sub-category to national mercury releases was not assessed.

### *2.3.10 Summary of inputs and results*

The toolkit result reveals that a total of 15.45 tonnes of mercury per year was released into the environment. The dominant source sub-category was industrial gold extraction and processing contributing about 62.8% of the total emission and releases, followed by Gold (and silver) extraction with mercury amalgamation processes (33.7%); and Copper extraction and initial processing (3.5%). Contribution from other sub-categories was negligible. However, mercury is mainly released into the land (60.6%); air (30.9%); water (5.6%) and products (2.5%).

**Table 1-6**: Summary inputs and outputs for primary (virgin) metal production

| Source category | Mercury input, kg/yr | Mercury Outputs (kg/yr) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Products | General waste | Sector specific treatment/ disposal |
| 1. Mercury (primary) extraction and initial processing | - | - | - | - | - | - | - |
| 2. Gold (and silver) extraction with mercury amalgamation processes | 5,200 | 3,900 | 676 | 624 | 0.00 | 0.00 | 0.00 |
| 3. Zinc extraction and initial processing | - | - | - | - | - | - | - |
| 4. Copper extraction and initial processing | 540 | 486 | 0.00 | 0.00 | 0.00 | 0.00 | 54 |
| 5. Lead extraction and initial processing | - | - | - | - | - | - | - |
| 6. Gold extraction and initial processing by methods other than mercury amalgamation | 9,710 | 388 | 194 | 8,739 | 388 | 0.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7. Aluminium extraction and initial processing | - | - | - | - | - | - | - |
| 8. Other non-ferrous metals - extraction and processing | - | - | - | - | - | - | - |
| 9. Primary ferrous metal production | - | - | - | - | - | - | - |
| **TOTAL** | **15,450** | **4,774** | **870** | **9,363** | **388** | **0.00** | **0.00** |

## 2.4 DATA AND INVENTORY ON PRODUCTION OF OTHER MINERALS AND MATERIALS WITH MERCURY IMPURITIES

### *2.4.1 Cement Production*

This sub-category covers production of cement in which the raw materials used may contain trace amounts of mercury. The use of waste products as feed materials may increase the total input of mercury to the cement production. This source sub-category is potential mercury release source of the type involving materials with low mercury concentrations, but in very large amounts.

Comparatively, current annual mercury releases associated with cement production stands at 1.057 tonnes as compared to 0.811 tonnes reported during the mercury inventory in 2012. The increment can be attributed to the increased cement production level due to investment in new cement production plants in the country triggered by demand for housing and infrastructure development.

### *2.4.2 Pulp and Paper Production*

This sub-category covers pulp and paper industry in which wood pulp is produced from raw wood via chemical means. The source of input mercury is trace levels of mercury in the wood raw material, in fuels used for energy production, and most likely in the chemicals applied in the processes (NaOH, chloride, and possibly other).

The toolkit results reveals that the contribution of this source sub-category to total national mercury releases is relatively negligible (<<<1%), however, it is expected to increase in view of the planned upgrading and expansion of the plant.

### *2.4.3 Production of lime and light weight aggregates*

This sub-category includes the production of lime in lime kilns in which mercury present in very small quantities in the limestone and in some of the fuels will be released during combustion.

The annual lime production in the country is estimated to be about 91,600 tonnes with negligible contribution (<<<1%) to total national mercury releases but may increase following new investments and rise in production level in the future.

### *2.4.4 Other minerals and materials*

No attempt was made to describe any other potential mercury sources under this sub-category and therefore its contribution to national mercury releases was not assessed.

### *2.4.5 Summary of inputs and results*

The toolkit results reveals that a total of 1.07 tonnes of mercury per year was released into the environment **Table 2.4-1** The dominant source sub-category was cement production contributing about 98.7% of the total emission and releases for this category, followed by pulp and paper production (0.9%); and lime production and lightweight aggregate kilns (0.1%). However, mercury is mainly released into the air (60.5%); products (19.8%); sector specific treatment/ disposal (19.8%); and comparatively negligible amount to general waste.

**Table 1-7**: Summary inputs and outputs for production of other minerals and materials with mercury impurities

| Source category | Mercury input, kg/yr | Mercury Outputs (kg/yr) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Products | General waste | Sector specific treatment/ disposal |
| 1. Cement production | 1,057 | 635 | 0.00 | 0.00 | 211 | 0.00 | 211 |
| 2. Pulp and paper production | 9.5 | 9.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Lime production and lightweight aggregate kilns | 1 | 0.9 | 0.00 | 0.00 | 0.00 | 0.1 | 0.00 |
| 4. Other minerals and materials | - | - | - | - | - | - | - |
| **TOTAL** | **1,067.5** | **645.4** | **0.00** | **0.00** | **211** | **0.1** | **211** |

## 2.5 DATA AND INVENTORY ON INTENTIONAL USE OF MERCURY IN INDUSTRIAL PROCESSES

This category covers mercury releases from several industrial chemical processes including Chlor-alkali production with mercury technology; VCM (vinyl-chloride-monomer) production with mercury-dichloride (HgCl2) as catalyst; Acetaldehyde production with mercury-sulphate (HgSO4) as catalyst; and other production of chemicals and polymers with mercury co pounds as catalysts.

During the inventory, there were no information obtained regarding possible existence of other industrial production processes using mercury and mercury compounds, therefore the estimates of mercury releases under this source category was not established.

## 2.6 DATA AND INVENTORY ON CONSUMER PRODUCTS WITH INTENTIONAL USE OF MERCURY

### *2.6.1 Thermometers with mercury*

This sub-category covers mercury thermometers used for most medium temperature range measurements. Mercury releases may occur during their production, breakage when in use and inappropriate disposal after their use.
There is no industrial production of medical thermometers in the country implying that their use solely relies on imports

The estimated annual mercury releases for this sub-category stands at 1.7 tonnes which is significantly higher than that of 0.06 tonnes reported during the national mercury inventory in 2012 this may probably due to decreased tonnage of net imported liquid filled thermometers from 29 tonnes in 2011 to 5.1 tonnes in 2015.

### *2.6.2 Electrical switches and relays with mercury*

This sub-category covers electrical switches and relays with mercury. Mercury releases may occur during the production, breakage when in use and inappropriate disposal after their use. There is no production of electrical switches and relays in the country, their use solely relies on importation. The contribution of this source sub-category to national mercury releases was not assessed.

### *2.6.3 Light sources with mercury*

This sub-category covers different types of discharge lamps containing mercury particularly fluorescent tubes, compact fluorescent lamps (CFLs) and in high-pressure discharge types, such as metal halide; mercury vapour; sodium; and neon lamps.

There is no industrial production of discharge lamps in the country implying that their use solely relies on imports. The contribution of this source sub-category to national mercury releases is relatively low (<<1%) partly due to low electrification level in the country.

### *2.6.4 Batteries with mercury*

This sub-category covers various types of batteries containing mercury including mercury-zinc cells, zinc-air button cells and other button cells. Mercury releases associated with this source sub-category may occur during production, when in use and disposal. There is no industrial production of primary cells in the country implying that their use solely relies on imports. The contribution of this source sub-category to national mercury releases is relatively low (<<1%)

### *2.6.5 Polyurethane with mercury catalysts*

This sub-category covers production of Polyurethane elastomers, coatings, sealants and adhesives using mercury compound as catalyst. There is no industrial production of Polyurethane products containing mercury that was found during the inventory implying that their use is solely import dependant.

### *2.6.6 Biocides and pesticides with mercury*

This sub-category covers mercury containing biocides and pesticides used in paper industry, paints, seed dressing and other agricultural applications
There is no production or importation of biocides and pesticides containing mercury that was found during inventory. The contribution of this source sub-category to national mercury releases was not assessed.

### *2.6.7 Paints with mercury*

This sub-category covers water based paints containing phenyl mercuric acetate (PMA) and related mercury compounds as biocides to extend shelf life by controlling bacterial fermentation in the can and to retard fungus attacks upon painted surfaces under damp conditions
There is no production or importation of paints containing mercury that was found during inventory.

### *2.6.8 Cosmetics and related products with mercury*

This sub-category covers mercury containing cosmetics and related products particularly skin lightening creams and soaps. Mercury releases associated with this source sub-category may occur during production, use and disposal.
There is no production or importation of cosmetics containing mercury that was found during inventory as it is prohibited by the Tanzania Foods and Drugs Act, 2003

### *2.6.9 Summary of inputs and results*

The estimated inputs and outputs for consumer products with intentional use of mercury are summarised in **Table 2.6-1**. Under this category, a total of 2.823 tonnes of mercury per year was released into the environment. The dominant source sub-category was Thermometers with mercury contributing about 61.4% of the total emission and releases for this category, followed by on electrical switches and relays with mercury (14.2%); light sources with mercury (9.1%); batteries with mercury (8.2%) and Polyurethane with mercury catalysts (7.1%). The remaining source sub-categories have negligible contribution to mercury releases.

From this source category, mercury is mainly released into the general waste (32.5%); land (25.6%); air (22.7%); and water (19.1%).

**Table 1-8**: Summary of inputs and outputs for consumer products with intentional use of mercury

| Source category | Mercury input, kg/yr | Mercury Outputs (kg/yr) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Products | General waste | Sector specific treatment/ disposal |
| 1. Thermometers with mercury | 1,734 | 347 | 520 | 347 | 0.00 | 520 | 0.00 |
| 2. Electrical switches and relays with mercury | 401 | 120 | 0.00 | 160 | 0.00 | 120 | 0.00 |
| 3. Light sources with mercury | 256 | 77 | 0.00 | 77 | 0.00 | 102 | 0.00 |
| 4. Batteries with mercury | 231 | 58 | 0.00 | 58 | 0.00 | 115 | 0.00 |
| 5. Polyurethane with mercury catalysts | 201 | 40 | 20 | 80 | 0.00 | 61 | 0.00 |
| 6. Biocides and pesticides with mercury | - | - | - | - | - | - | - |
| 7. Paints with mercury | - | - | - | - | - | - | - |
| 8. Cosmetics and related products with mercury | - | - | - | - | - | - | - |
| **TOTAL** | **2,823** | **642** | **540** | **722** | **0.00** | **918** | **0.00** |

## 2.7 DATA AND INVENTORY ON OTHER INTENTIONAL PRODUCT/PROCESS USES

### *2.7.1 Dental mercury amalgam fillings*

This sub-category covers dental amalgams containing elemental mercury (liquid) in the range of 45 – 50% and a powdered alloy of various metals including silver (22 - 32%), tin (14%) and copper (8%). The dental amalgams are used for treatment of tooth decay as a filling for cavities. Mercury releases associated with this source sub-category may occur during production; preparation, placement and removal of dental restorations; use and disposal of the amalgam fillings. Also, releases can occur at the end of life of a person with amalgam fillings, or more so, when his remains are cremated.

The estimated annual mercury releases for this source sub-category is about 0.5 tonnes which is much lower than the reported amount of 6.5 tonnes by the national mercury inventory in 2012. The discrepancy can be attributed to the differences in the assumptions made and input data used between the two inventories.

### *2.7.2 Manometers and gauges with mercury*

This sub-category covers mercury containing blood pressure gauges, industrial and meteorological manometers and pressure valves. Mercury releases associated with this source sub-category may occur during production, use and disposal.

The inventory results reveals no production of mercury containing manometers and gauges in the country implying that the demand is solely met by importation. However, the contribution of this sub-category to national mercury releases is about 2% which is anticipated to decrease in the future due to continuing international efforts to phase-out mercury containing devices and equipment

### *2.7.3 Laboratory Chemicals and equipment*

This sub-category covers mercury used in laboratory instruments, reagents, preservatives and catalysts. Some of these equipment include electron microscope, blood lead analyser, centrifuge and atomic absorption spectrophotometer. Mercury releases associated with this source sub-category may occur during use and disposal.

Estimates on mercury releases for this source sub-category was based on electrification rate and number of inhabitants. This estimates reveals that this sub-category contributes about 3% of the national mercury releases.

### *2.7.4 Mercury use in religious rituals and folklore medicine*

This sub-category covers mercury use in religious rituals and folklore medicine involving carrying it in a sealed pouch or in a pocket as an amulet; sprinkling mercury on floors of homes or automobiles; burning it in candles; and mixing it with perfumes. Such uses are considered to bring luck in love, money or health and to ward off evil. Mercury releases associated with this source sub-category may occur during packaging and distribution at shops, use and disposal.

During the inventory, none of these practices were identified in the country and therefore, the contribution of this source sub-category to national mercury releases was not assessed

### *2.7.5 Miscellaneous product uses and other sources*

This sub-category covers miscellaneous uses and other sources of mercury particularly infrared based equipment; explosives; bougie tubes and cantor tubes; fireworks and toys. Mercury releases associated with this source sub-category may occur during production, use and disposal.

During the inventory, no information was found on any of these devices and equipment and therefore the contribution of this source sub-category to national mercury releases was not assessed.

### *2.7.6 Summary of inputs and results*

The Toolkit results reveals that a total of 2.36 tonnes of mercury per year was released into the environment. The dominant source sub-category contributing to mercury releases was laboratory

chemicals and equipment (42.5%), followed by Dental mercury amalgam fillings (29.9%) and Manometers and gauges (27.6%) The remaining source categories have negligible contribution.

From this source category, mercury is mainly released into the water (35%) followed by general waste (29.1%); land (7.2%); air (6.4%); and product (1.3%).

**Table 1-9**: Summary of inputs and outputs for other intentional product/process uses

| Source Category | Mercury inputs, kg/year | Mercury outputs, kg/year | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Product | General waste | Sector specific treatment/ disposal |
| 1. Dental mercury amalgam fillings | 704 | 20 | 298 | 40 | 30 | 159 | 159 |
| 2. Manometers and gauges | 650 | 130 | 195 | 130 | 0.00 | 195 | 0.00 |
| 3. Laboratory chemicals and equipment | 1002 | 0.00 | 331 | 0.00 | 0.00 | 331 | 341 |
| 4. Mercury use in religious rituals and folklore | - | - | - | - | - | - | - |
| 5. Miscellaneous product uses<br>6. mercury metal and other sources | - | - | - | - | - | - | - |
| **TOTAL** | **2,356** | **150** | **824** | **170** | **30** | **685** | **500** |

## 2.8 DATA AND INVENTORY ON PRODUCTION OF RECYCLED METALS

### *2.8.1 Production of recycled mercury ("secondary production)*

This sub-category covers recovery of liquid mercury from dismantled equipment and scrap products using thermal or chemical extractive processes. Mercury releases associated with this source sub-category may occur during recovery, extraction and by-product mercury recovery.

During the inventory, no mercury recycling or recovery operations were found in the country and therefore the contribution of this source sub-category to national mercury releases was not assessed.

### *2.8.2 Production of recycled ferrous metals (iron and steel)*

The major source of scrap metals considered under this source sub-category is scraped vehicles as they ought to contain comparatively higher mercury content than other types of scrap metals. The use of mercury in vehicles is mainly in switches, relays, thermostats and sensors for breaking

systems. Mercury releases associated with this source sub-category may occur during shredding, storage and smelting.

During the inventory, a total of 14 iron and steel industries were found to operate in the country. It was assumed that, out of the total number of vehicles in use in the country which amounts to 1.6 million, about 1% equivalent to 16,000 vehicles are scraped annually which contributes to negligible amount (<<1%) of total national mercury releases.

### *2.8.3 Production of other recycled metals*

This sub-category covers recycling of aluminium, copper, zinc and other metals. Mercury releases for this source sub-category may occur during shredding, storage and smelting.

During the inventory, no recycling operations were found for these metals in the country and therefore the contribution of this source sub-category to national mercury releases was not assessed.

### *2.8.4 Summary of inputs and results*

The Toolkit results reveal that, a total of 0.017 tonnes of mercury per year was released into the environment (**Table 2.8 1)**. The only source sub-category was production of recycled ferrous metals (iron and steel) contributing 100% of the total emission and releases for this category. From this source category, mercury is mainly released into the land (34%); general waste (33%); and air (33%).

**Table 1-10**: Summary of inputs and outputs for Production of recycled metals (Secondary metal production).

| Category | Mercury Inputs kg/y | Mercury Outputs, kg/ yr | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Product | General Waste | Sector specific treatment/ disposal |
| 1. Production of recycled mercury ("secondary production") | - | - | - | - | - | - | - |
| 2. Production of recycled ferrous metals (iron and steel) | 17.6 | 5.8 | 0.00 | 6 | 0.00 | 5.8 | 0.00 |
| 3. Production of other recycled metals | - | - | - | - | - | - | - |
| **TOTAL** | **17.6** | **5.8** | **0.00** | **6** | **0.00** | **5.8** | **0.00** |

## 2.9 DATA AND INVENTORY ON WASTE INCINERATION AND BURNING

### *2.9.1 Incineration of Municipal Waste*

Mercury releases associated with this source sub-category may occur during collection, storage, transportation, shredding and incineration.

During the inventory, no dedicated municipal waste incinerators were found operating in the country, and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.9.2 Incineration of Hazardous Waste*

This sub-category covers hazardous waste constituting the residues and waste containing mercury and other hazardous materials in significant amount. Mercury releases associated with this source sub-category may occur during collection, storage, transportation, incineration and eventual disposal of residues.

During the inventory, only two small scale hazardous waste incinerators were found to be operating in the country with a total capacity of 40 tonnes per year which contributes to negligible amount (<<<1%) to national mercury releases. However, none of these incinerators have appropriate pollution control equipment.

### *2.9.3 Incineration of Medical Waste*

This sub-category covers infectious and non-infectious wastes generated by a variety of healthcare facilities such as hospitals, veterinary clinics and hospitals, medical laboratories, and medical and veterinary schools and research units. Mercury releases associated with this source sub-category may occur during collection, storage, transportation, incineration and eventual disposal of residues.

During the inventory, all referral, regional and district hospitals were found to have some form of medical waste combustion facilities which may generally be considered to be incinerators which contributes to about 0.23 tonnes per year of mercury releases. However, none of the incinerators have air pollution control devices.

### *2.9.4 Sewage Sludge Incineration*

This sub-category covers incineration of mercury containing sewage sludge from various wastewater treatment processes regardless of its origin (e.g., wastewater from municipal, agricultural or industrial activities).

During the inventory, there were no dedicated sewage sludge incinerators operating in the country and therefore the contribution of this source sub-category to national mercury releases was not assessed.

### *2.9.5 Informal Waste Burning*

This sub-category covers uncontrolled and haphazard burning of waste in containers or on bare land with diffuse spreading of residues on land. The mercury concentrations are directly dependent on the inputs of mercury to the waste.

During the inventory, the amount of waste generated was found to be as high as 1,385,800 tonnes per annum in which at least half (>50%) of this waste is burned, buried and/or disposed of haphazardly into the environment as this contributes to about 25.6% of the total national mercury releases.

### *2.9.6 Summary of inputs and results*

The toolkit results reveals that, a total of 7.2 tonnes of mercury per year was released into the environment. The dominant source sub-category was informal waste burning (96.7%) followed by medical waste incineration (3.2%) and hazardous waste incineration with negligible contribution. From this source category, mercury is solely released into the air (100%). (**Table 2.9-1)** Summary of inputs and outputs for production of recycled metals (Secondary metal production)

**Table 1-11**: Summary of inputs and outputs for Incineration of Medical Waste

| Source Category | Mercury Inputs, kg/year | Mercury Outputs, kg/yr | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Product | General Waste | Sector specific treatment/ disposal |
| 1. Municipal waste incineration | - | - | - | - | - | - | - |
| 2. Hazardous waste incineration | 0.96 | 0.96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. Medical waste incineration | 234 | 234 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. Sewage sludge incineration | - | - | - | - | - | - | - |
| 5. Informal waste burning | 6,929 | 6,929 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL** | **7163.96** | **7,163.96** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 2.10 DATA AND INVENTORY ON WASTE DISPOSAL, DEPOSITION/LANDFILLING

### *2.10.1 Controlled landfills/deposits,*

This sub-category covers disposal of mercury containing general municipal waste in controlled landfills originating from mercury containing spent products and process wastes; mercury impurities in bulk materials (e.g. paper, plastics, and metals); mercury as an anthropogenic trace pollutant in bulk materials; and trace levels of mercury contamination of food wastes. Mercury releases associated with this source sub-category may occur through leaching and surface runoff, mercury evaporating from the waste and long term accumulation of the waste.

In this context, no proper controlled landfills were found in the country and therefore the contribution of this sub-category to national mercury releases was not assessed.

### *2.10.2 Diffuse deposition under some control*

This sub-category includes deposition of incineration residues and other solid residues under roads and relevant constructions under controlled procedures (based on risk assessment) and with some retention of pollutants from washout. Mercury releases associated with this source sub-category may occur in the long term due to releases to soil, groundwater, surface water and atmosphere.

The sub-category is covered under the sub-categories where the waste is generated and designated as outputs to "sector specific treatment/disposal" and therefore no attempt was made to assess its contribution to national mercury releases

### *2.10.3 Informal local deposition of industrial production waste*

This sub-category covers informal local disposal of industrial and other waste. Mercury releases associated with this sub-category may occur in the immediate, short and long term to air, soil and water.

This source sub-category is covered under section on potential hotspots and therefore no attempt was made to assess its contribution to national mercury releases.

### *2.10.4 Informal dumping of general waste*

This sub-category covers uncontrolled and informal dumping of waste with no safeguards to minimize releases of mercury and other pollutants to the surroundings. This waste disposal method may pose immediate and long term risks to the local community. This source sub-category is covered under individual products and materials as described in the Toolkit, therefore no attempt was made to assess its contribution to national mercury releases.

### *2.10.5 Wastewater system/treatment*

This sub-category covers treatment of mercury containing wastewater originating from mercury containing products and processes and atmospheric mercury washed out by precipitation that goes to the wastewater systems.

During the inventory, it was found that most of the generated wastewater (>80%) is partially or completely untreated and is discharged to water bodies posing significant environmental and health risks. The estimated amount of generated wastewater is about 119 million $m^3$ whose estimated annual mercury releases is about 0.63 tonnes and the mercury content has not been established to a large extent.

### *2.10.6 Summary of Inputs and Results*

The Inventory results reveal that a total of 0.63 tonnes of mercury per year was released into the environment (**Table 2.10-1)** the only source sub-category contributing to mercury releases was wastewater system/treatment (100%). The remaining source categories have negligible contribution. From this source category, mercury is mainly released into the water (90%) followed by general waste (6%); and sector specific waste treatment (4%).

**Table 1-12**: Summary of inputs and output estimates for waste disposal, deposition and Landfilling

| Source Category | Mercury Inputs kg/ yr | Mercury Outputs, kg/ yr | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Product | General Waste | Sector specific waste treatment |
| 1. Controlled landfills/deposits | - | - | - | - | - | - | - |
| 2. Diffuse deposition under some control | - | - | - | - | - | - | - |
| 3. Informal local deposition of industrial production waste | - | - | - | - | - | - | - |
| 4. Informal dumping of waste | - | - | - | - | - | - | - |
| 5. Wastewater system/treatment | 627 | 0.00 | 564 | 0.00 | 0.00 | 38 | 25 |
| **TOTAL** | **627** | **0.0** | **564** | **0.0** | **0.0** | **38** | **25** |

## 2.11 DATA AND INVENTORY ON CREMATORIA AND CEMETERIES

### *2.11.1 Crematoria/cremation*

This sub-category covers incineration of human corpses at a temperature between 1,400-1,800oC for about 2 to 2.5 hours. Major source of mercury releases is due to the presence of dental amalgam fillings and trace amounts of mercury present in body tissues. Mercury releases for this source sub-category occurs mainly during cremation.

In Tanzania, cremation is mostly practiced by Hindus. It is estimated that about 200 corpses are cremated annually countrywide

Low end input factor of 1gHg/corpse was used to estimate mercury releases for this sub-category based on the fact that the level of dental care services in the country is generally lower than the average according to World Health Organization (WHO) data provided on the Toolkit.

### *2.11.2 Cemeteries*

This sub-category covers burial of human corpses and cemeteries. Major source of mercury releases for this source sub-category is primarily dental amalgam fillings. Mercury releases associated with this source sub-category may occur in the immediate, medium and long term through release to the soil at the cemetery.

The national Crude Death Rate (CDR) in 2015 was estimated to be about 9 deaths per 1000 persons. Based on the national CDR the estimated number of people that may die in a year amounts to about 449,800 after deducting the number of cremated corpses.

The estimated mercury releases for this source sub-category was about 0.45 tonnes as compared to 8.21 tonnes reported in the national mercury inventory in 2012. The discrepancy can be attributed to the widely ranging inputs for the number of corpses buried per year between the two inventories.

### *2.11.3 Summary of inputs and results*

The inventory results reveals that, a total of 0.45 tonnes of mercury per year was released into the environment under this category. The dominant source sub-category contributing to mercury releases was cemeteries (99.9%), followed by crematoria (0.1%).

From this source category, mercury is mainly released into land (99.9%) followed by air (0.1%).

**Table 1-13**: Summary of inputs and results for crematoria and cemeteries

| Source Category | Mercury input (kg/yr) | Mercury output (kg/yr) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | Product | General waste | Sector specific waste treatment |
| 1. Crematoria | 0.20 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. Cemeteries | 450.00 | 0.00 | 0.00 | 450.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL** | **450.2** | **0.2** | **0.0** | **450** | **0.0** | **0.0** | **0.0** |

## 2.12 Supply and trade of mercury and mercury containing compounds, including sources, recycling activities and quantities

Official trade statistics (import data) indicates highly fluctuating amounts in import of mercury from numerous countries. Between 2014 - 2016, an average of about 2.9 tons of mercury was imported to Tanzania. The major exporters being China, The Netherlands and Switzerland.

There is significant discrepancy between official import data on mercury as compared to estimated domestic consumption particularly in relation to artisanal and small-scale gold mining (ASGM) activities. The average official annual imports of mercury is about 2.9 tons as compared to estimated annual consumption of between 30 – 55 tons reported in various literatures. This suggests that most of the mercury supply occurs through informal channels originating mostly from neighbouring countries.

Mercury supply is mainly met through imports. Further, no industrial processes using mercury and related recycling activities were identified in the country.

## 2.13 Mercury Contaminated Sites

The national mercury inventory did not undertake identification and assessment of mercury contaminated sites. However, national strategy for the identification and assessment of mercury contaminated sites was developed. The strategy based on the identified gaps and deficiencies existing in the country which included the following:

i). Inadequate policy, legal and institutional framework for the identification, assessment, monitoring, management and control of mercury contaminated sites;
ii). Inadequate capacity in terms of specialized skills, remediation technology and financial resources;
iii). Inadequate enforcement capacity of relevant legislation;
iv). Lack of database/register for mercury contaminated sites;
v). Information and status of potential mercury contaminated sites is almost non-existent;
vi). Improper handling and management of mercury containing waste; and
vii). Low level of awareness among key stakeholders.

By comparing the baseline situation with the requirements of the Minamata Convention, the following strategic measures and activities were proposed under the Strategy (2018 - 2022):

i) Strengthen policy, legal and administrative framework for identification, assessment and management of mercury contaminated sites;
   - Develop Regulations on management and control of mercury and mercury contaminated sites
   - Develop National Guidelines on Identification, Assessment and Management of Mercury Contaminated Sites

ii) Enhance information generation, management and dissemination related to mercury contaminated sites;
   - Conduct sensitization campaign on mercury contaminated sites to key stakeholder target groups (parliamentarians, senior government officials, artisanal gold miners, gold dealers, students and teachers)
   - Carry out baseline survey of mercury contaminated sites (including limited sampling)
   - Update regularly national inventory on mercury sources and releases
   - Establish and maintain database for mercury contaminated sites
   - Establish and implement comprehensive awareness programme on management and remediation of mercury contaminated sites.

iii) Promote cleaner production and pollution prevention and control interventions to address mercury contaminated sites;
   - Promote adoption of Best Available Techniques (BATs) and Best Environmental Practices (BEPs) in mercury related industrial and waste management activities

- Prioritize identified mercury contaminated sites and develop and implement a national management, remediation and monitoring plan for mercury contaminated sites
- Develop and implement Public Health Mini-Strategy on Preventing and Minimizing Mercury Exposure Associated with Mercury Contaminated Sites
- Improve waste management practices for mercury containing wastes.

iv) Strengthen institutional capacity to support enforcement of related laws, monitoring and management of mercury contaminated sites; and
- Update National Profile to assess chemicals management infrastructure
- Establish and implement capacity building programme on management and control of mercury waste and mercury contaminated sites targeting Regulatory Authorities, Local Government Authorities and Academia
- Develop and implement national phase-out plan for mercury-added products in priority sectors.

v) Enhance mobilization of resources to support management of mercury and other chemical contaminated sites.
- Liaise and organize courtesy consultations with Executives of key government ministries and agencies to solicit budget allocations to address management of mercury contaminated sites (Environment, Health, Mining and Finance)
- Develop programme proposal on management of mercury contaminated sites and solicit funding from development partners
- Prepare and share a "Discussion Paper" on Management of Contaminated Sites to influence establishment of a funding window within the National Environmental Trust Fund.

## 2.14 Impacts of mercury in human health and the environment

Mercury exposure occurs principally through occupational and non-occupational setting. Occupational exposure occurs through inhalation, ingestion and dermal exposure. Non-occupational exposure occurs mainly through ingestion, particularly associated with consumption of food products, such as fish, which have been contaminated by methylmercury.

There are few studies conducted in different localities in the country attempting to determine mercury pollution levels in environmental media and exposure to population at high risk. There has been particular emphasis to explore such evidence in ASGM sites in view of their comparatively voluminous and haphazard use of mercury over long periods. Table 2-13 highlights the biomonitoring results for the selected ASGM sites based on sampling of various environmental media from the goldfields of Geita and Chunya districts. These results show evidence of mercury pollution levels and associated health risks to ASGM miners and residing population.

**Table 1-14**: Summary of biomonitoring for some selected mining sites

| Sites | Media | Average Hg Concentration | Tanzania Standards | WHO Standards | Reference |
|---|---|---|---|---|---|
| 1. Rwamgasa | Soil | 0.05 – 9.2 mg/kg | n.m | | Taylor, H. *et al.* (2005). |
| | Rice | 0.011 - 0.013 mg/kg | n.m | | |
| | Vegetable and grain | <<<0.004 mg/kg | n.m | | |
| 2. Londoni | Soil | 1.7 - 53.8 mg/kg | n.m | | Herman, A. and C. Kihampa (2015) |
| | Surface and ground water | <<<0.01mg/L | 0.001mg/L | 0.001 mg/L | |
| 3. Mgusu | Sediments | 1 mg/kg | n.m | | Ikingura J. R. *et al*. (2006) |
| | Surface water | | 0.001mg/L | 0.001 mg/L | |
| | Fish | 2–35 mg/kg | n.m | 0.2mg/kg | |
| 4. Makongolosi | Soil | | n.m | | Harada M. *et al.* (1999) |
| | Surface water | | 0.001mg/L | 0.001 mg/L | |
| | Hair sample | 48.3 ppm | n.m | 50ppm | |

# CHAPTER III

## 2.15 POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK ASSESSMENT

There exists several pieces of framework legislation comprising enabling provisions that would facilitate domestication of the Minamata Convention on Mercury (and other related Multilateral Environmental Agreements) in the country. These include the Environmental Management Act No. 20 of 2004; Industrial and Consumer Chemicals (Management and Control) Act No. 3 of 2003; Mining Act No. 14 of 2010; Public Health Act No. 1 of 2009; Occupational Health and Safety Act (OSHA Act) No. 5 of 2003; and Tanzania Food, Drugs and Cosmetics Act No. 1 of 2003. In fact, these principle legislation would not require any amendments. However, effective domestication of the specific requirements of the provisions of the Minamata Convention would necessitate elaboration through subsidiary legislation/regulations. Indeed, funds have been sought to develop the Regulations under the Special Programme on Chemicals and Waste, supported by the United Nations Environment Programme (UNEP), through the project on "Strengthening Institutional Capacity for Sound Management of Chemicals and Waste in the United Republic of Tanzania " to be implemented for two years starting August, 2017.

It should also be noted that import, export, trading and use of mercury is still allowed though under stringent conditions (Sixth Schedule of the Industrial and Consumer Chemicals Act, 2003). However, this may still be applicable in terms of allowable uses under the Convention such as research activities.

There are several Government Ministries and Agencies as well as Local Government Authorities whose mandates have a bearing on environmental management including chemicals and waste management. The coordination of implementation of Multilateral Environmental Agreements (MEAs) in the country is vested under the Vice President's Office - Division of Environment. There are environmental units/committees at all levels from national to street or *hamlet* level. There are also several inspectorates (Environment; Chemicals; Plant Protection; Health; Food and Drugs; and Occupational Safety and Health) which enhance the institutional landscape supporting chemicals and waste management. In addition, the country has modest institutional expertise and experience in implementing chemicals and waste Conventions which is of direct relevance, supportive and synergistic to the implementation of the Minamata Convention. Further, the main gaps that were identified in relation to institutional framework for implementation of the Minamata Convention include the following:

i) Inadequate research and monitoring capacity on mercury in the environmental media and bio-monitoring (urine, blood, hair and nails) of population groups at high risk;
ii) Inadequate resources in terms of financial and human resources; and
iii) Low level of awareness and understanding of mercury issues among senior government officials and technocrats.

**Table 0-1**: Assessment of relevant legislation for implementing the Minamata Convention

| LEGAL INSTRUMENT | RELEVANT ASPECTS COVERED | GAPS |
|---|---|---|
| **The Industrial and Consumer Chemicals (Management and Control) Act No. 3 of 2003** | • The Act provides for registration, management and control of the importation, production, transportation, dealing, storage, and disposal of chemicals (Sect. 9 & 10)<br><br>• One of the functions of the Chief Government Chemist as stipulated by the Act is to implement ratified international Conventions related to chemicals (Section 10(2) (e)).<br><br>• The Act lists Mercury and mercury compounds as highly hazardous chemicals subject to stringent control measures (sixth schedule of the Act) | • The Act lacks specific provisions for implementing the Minamata Convention. However, being a framework legislation, it contains enabling provisions which may otherwise be elaborated through subsidiary legislation/regulations under this or any other relevant legislation.<br><br>• Mercury import, export, trading and use is still allowed but under stringent conditions (Article 3). However, this may still be relevant in terms of the allowed uses under the Convention such as research activities. |
| **The Environmental Management Act No. 20 of 2004** | • The Act provides for, among others, legal and institutional framework, for sustainable management of environment, prevention and control of pollution, waste management, environmental quality standards, public participation, compliance and enforcement, and basis for implementation of international instruments on environment.<br><br>• The Act requires initiation and | • The Act lacks specific provisions for implementing the Minamata Convention. However, being a framework legislation, it contains enabling provisions which would be elaborated through subsidiary legislation/regulations. |

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| | preparation of legislative proposals; identification of appropriate measures for implementation of international and regional environmental agreements; and creation of collaboration mechanism with international and regional communities (Section 179).<br><br>• The Act provides for measures on prior informed consent procedures for certain hazardous chemicals and pesticides (Section 78).<br><br>• The Act promotes cleaner production and sustainable consumption of goods and services (Section 79). | |
| **Mining Act No. 14 of 2010** | • The Act provides for legal and institutional framework in relation to prospecting of minerals, mining, processing and dealing with minerals.<br>• The Act obliges holders of mining licenses to take all appropriate measures for the protection of the environment in accordance with the existing laws and regulations (Section 52). | • Inadequate provisions for addressing informal nature of ASGM and associated worst practices including haphazard use of mercury and other hazardous substances.<br>•<br>• Inadequate provisions promoting public awareness on sustainable mining practices. |
| **Public Health Act No. 1 of 2009** | • The Act provides for the promotion, preservation and maintenance of public health with a view to ensuring provision of | • Inadequate provisions for monitoring, prevention and control of exposure to hazardous chemicals and waste |

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| | comprehensive, functional and sustainable public health services.<br>• The Act provides for handling and disposal of healthcare waste and other wastes (section 92) | particularly for population at high risk |
| **Occupational Health and Safety Act (OSHA Act) No. 5 of 2003** | • The Act provides for safety, health and welfare of persons at work factories and other places of work; protection of persons other than those at work against hazards to health and safety arising out of or in connection with activities of persons at work.<br>• The Act requires toxic materials or substances only to be used where the use of a non-toxic material or substance is not reasonably practicable and appropriate exposure preventive measures should be instituted including periodical medical examination (Section 67).<br>• The Act provides for general precautions in handling chemicals including preventing or reducing contamination of the work and environment to the lowest possible level (Section 73). | • Inadequate provisions to address safety and health concerns in the context of the informal nature of the ASGM activities. |
| **Tanzania Food, Drugs and Cosmetics Act No. 1 of 2003** | • The Act provides for the efficient and comprehensive regulation and control of food, drugs, medical devices, cosmetics, herbal drugs and poisons. | • Inadequate provisions instituting specific measures for phasing out medical devices containing hazardous chemicals or substances in response to |

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| | • The Act prohibits manufacture, sell and distribution of medical devices which do not comply with prescribed requirements (Section 89).<br><br>• The Act prohibits the manufacture, sell, importation, storage or exhibition of cosmetics unless they conform to legal requirements including prohibited ingredients (Section 86 & 87). | relevant international and regional agreements. |

**Table 0-2**: Assessment of institutional capacity for implementing the Minamata Convention

| NAME OF INSTITUTION | ROLES IN IMPLEMENTATION OF MINAMATA CONVECTION | EXISTING CAPACITY | GAPS |
|---|---|---|---|
| 1. President Office - Regional Administration and Local government | – Enforcement of EMA, 2004, and other related legislation<br>– Collaborates with other stakeholders in environmental management.<br>– Public awareness | – Existence of policy, legal and regulatory framework supporting management of mercury<br>– Existence of sector environmental coordination unit with few staffs.<br>– Limited budget allocation on environmental management issues | – Inadequate enforcement capacity in terms of financial and human resources.<br>– Low level of awareness on mercury issues |
| 2. Vice President's Office | – The national focal point for the Minamata Convention on mercury<br>– Oversees the enforcement of Environmental Management Act, 2004.<br>– Prepare environmental regulations, guidelines, strategies and plans.<br>– Promote public awareness and education. | – Existence of policy, legal and regulatory framework supporting domestication of the Minamata Convention<br>– Institutional experience on implementation of chemicals and waste related Conventions<br>– Existence of multi-stakeholder coordination and advisory mechanisms such as National Environmental Advisory Committee (NEAC), Environment Working Group (EWG) and technical committees.<br>– Efforts to establish | – Inadequate institutional capacity in terms of financial and human resources. |

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| | | Environmental Management Trust Fund. | |
| 3. Ministry of Energy and Minerals | – Oversee and enforce Mining Act, 2010 and other related legislation.<br>– Prepare regulations and guidelines governing mining activities and related environmental issues.<br>– Promote Mercury free alternative in ASGM and Energy sector.<br>– Promote public awareness and education. | – Existence of policy, legal and regulatory framework supporting management of mercury.<br>– Existence of Environment Management Unit<br>– Existence of inspectorate for enforcing the Mining Act, 2010.<br>– Institutional experience in promoting use of mercury retorts in artisanal gold mining, mercury-free technologies and formalization of ASGM.<br>– Institutional participation and support in addressing mercury and related issues. | – Inadequate institutional capacity in terms of financial and human resources. |
| 5. Ministry of Health, Community Development, Gender, Elderly and Children | – Enforcement of the Public Health Act, 2009 and other related legislation<br>– Prepare and implement public health strategies to prevent and minimize exposure to mercury.<br>– Prepare regulations and | – Existence of Environment Management Unit<br>– Existence of policy, legal and regulatory framework supporting enhancement of public health from potential adverse effects of mercury. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Low capacity in monitoring health impacts associated with exposure to mercury. |

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| | guidelines for reducing health risks from mercury exposure<br>– Promote public awareness and education. | – Existence of medical research and training institutions | |
| 6. Ministry of Justice and Constitutional Affairs | – Overseeing development of legislations and regulations<br>– Promote public awareness and education | – Existence of policy, legal and regulatory framework.<br>– Existence of legal experts and directorate supporting international negotiations<br>– Institutional experience in environmental legal issues. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Low level of awareness on mercury issues |
| 7. Ministry of Foreign Affairs and East African Cooperation | – Articulate political, economic and social diplomacy, foreign policy and international cooperation. | – Existence of foreign policy, international recognition and partnerships.<br>– Institutional experience and expertise in international negotiations.<br>– Existence of Centre for Foreign Relations (CFR) that provide training on international diplomacy and relations. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Inadequate awareness on mercury issues. |
| 8. Ministry of Finance | – Manage overall government revenue, expenditure and financing as well as economic affairs.<br>– Support financing mechanisms and incentives for addressing environmental issues | – Existence of national development frameworks that integrate environmental issues<br>– Institutional experience in resource mobilization. | – Financial and human resources constraints.<br>– Inadequate awareness on mercury issues. |

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| 9. Ministry of Education, Science and Technology | – Articulate national policies on education, science and technology.<br>– Promote mainstreaming of the environmental education in curricula.<br>– Promote public awareness and education. | – Existence of policy, legal and regulatory framework supporting environmental education.<br>– Existence of training, education and research institutions.<br>– Existence of a National Commission for Science and Technology (COSTECH) supporting knowledge management. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Low level of awareness on mercury issues |
| 10. Ministry of Industry, Trade and Investment | – Articulate national policies on industrialization, trade and investment.<br>– Promote sustainable industrial development and trade.<br>– Promote public awareness and education. | – Existence of policy, legal and regulatory framework supporting sustainable industrial development and trade.<br>– Existence of Environment Management Unit, Cleaner Production Center of Tanzania (CPCT) and Industrial Intelligence Team providing technical support. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Low level of awareness on mercury issues |
| 11. Ministry of Labor and Employment | – Articulate national policies on labor and employment<br>– Promote occupational health | – Existence of policy, legal and regulatory framework supporting occupational health and safety. | – Inadequate institutional capacity in terms of financial and human resources. |

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| | and safety.<br><br>– Promote public awareness and education. | – Institutional experience and expertise in occupational health and safety. | – Low level of awareness on mercury issues. |
| 12. Ministry of Water and Irrigation | – Articulate national policies on water and irrigation.<br><br>– Promote water resource management and quality.<br><br>– Enforcement of laws and regulation | – Existence of policy, legal and regulatory framework supporting water resource management.<br><br>– Availability of laboratory infrastructure. | – Inadequate institutional capacity in terms of financial and human resources. |
| 13. Local Government Authorities (LGAs) | – Enforcement of Environmental Management Act and other related laws and regulations.<br><br>– Facilitate public and awareness and participation. | – Existence of policy, legal and regulatory framework supporting environmental management.<br><br>– Existence of environmental coordination mechanisms including environmental units and committees at all levels. | – Inadequate institutional capacity in terms of financial and human resources.<br>– Low level of awareness on mercury issues |
| 14. GCLA | – Enforce Industrial and Consumer Chemicals Act and other related legislation on chemicals and waste management.<br><br>– Promote public awareness and education on management of | – Existence of policy, legal and regulatory framework supporting management of chemicals and waste.<br><br>– Existence of chemicals inspectorate and zonal offices providing enforcement | – Inadequate institutional capacity in terms of financial and human resources. |

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| | chemicals and waste. | support. | |
| 15. NEMC | – Enforcement of EMA, 2004, and other related legislation on environmental management.<br><br>– Promote public awareness, education and participation. | – Existence of policy, legal and regulatory framework supporting environmental management.<br><br>– Existence of inspectorate and zonal offices providing enforcement support.<br>– Availability of mini-laboratory for environmental sample analysis.<br>– Existence of a National Environmental Advisory Committee (NEAC) and Chemicals Management Advisory Committee (CMAC) providing policy and technical support. | – Inadequate institutional capacity in terms of financial and human resources. |
| 16. OSHA | – Enforcement of occupational safety and health Act and other related legislation and regulations.<br><br>– Promote prevention, control and monitoring of hazards and risks in relation to occupational health and safety. | – Existence of policy, legal and regulatory framework supporting occupational safety and health.<br>– Existence of inspectorate and zonal offices providing enforcement support. | – Inadequate institutional capacity in terms of financial and human resources. |

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| | – Provide training, public awareness and education. | | |
| 17. Tanzania Bureau of Standards (TBS) | – Enforcement of Standards Act (2009) and other related legislation and regulations.<br><br>– Establish and enforce environmental quality standards.<br><br>– Promote public awareness, education and participation. | – Existence of policy, legal and regulatory framework supporting environmental quality standards.<br><br>– Existence of inspectorate providing enforcement support. | – Inadequate institutional capacity in terms of financial and human resources. |
| 18. Tanzania Food and Drugs Authority (TFDA) | – Enforcement of Tanzania food, Drugs and Cosmetics Act No. 1 of 2003 and other related legislation and regulations.<br><br>– Promote safe and environmental friendly Cosmetics and medical devices.<br>– Public awareness and education | – Existence of relevant policy, legal and regulatory framework<br><br>– Existence of inspectorate providing enforcement support | – Inadequate institutional capacity in terms of financial and human resources. |
| 19. Tanzania Revenue Authority (TRA) | – Enforcement of customs and tax related laws and regulation<br>– Control import and export of | – Existence of policy, legal and regulatory framework supporting control and management of chemicals | – Inadequate institutional capacity in terms of financial and human resources. |

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| | goods including chemicals<br>– Promote public awareness and education. | – Existence of enforcement personnel at entry points | – Low level of public awareness |
| 20.Cleaner Production Centre of Tanzania (CPCT) | – Provide technical support on resource efficient and cleaner production.<br>– Provide training and demonstration in cleaner production techniques<br>– Promote public awareness and education. | – Existence of policy, legal and regulatory framework supporting sustainable consumption and production | – Inadequate institutional capacity in terms of financial and human resources |

# CHAPTER IV

## 4.0 IDENTIFICATION OF POPULATIONS AT RISKS AND GENDER DIMENSIONS

### 4.1 Potential population at risk

The major sources of mercury exposure in human population in the country include artisanal and small-scale gold mining; dental amalgam; mercury-added products and Medical Waste Incineration.

*a) Artisanal and Small-scale Gold Mining (ASGM)*

ASGM is the leading source of mercury consumption and environmental releases in the country. Major concerns lies with haphazard handling and discharge of mercury-containing tailings exposing miners to mercury and contributing to significant environmental pollution. Target population groups at risk from mercury exposure related to ASGM activities include women, children, amalgam burners and residing community population.

The sector employs about 700,000 to 1.5 million people in the country of which 20 – 30% are women. Children are also involved in this sector, however, the estimated number is 75,000.

*b) Dental amalgam*

Dental amalgam constitutes a potentially significant source of exposure to elemental mercury, with estimates of daily intake from amalgam restorations ranging from 1 to 27 μg/day, the majority of dental amalgam holders being exposed to less than 5 μg mercury/day (WHO, 2003). The population at risk in the country includes dental personnel (about 400 dentists), who are potentially exposed to elemental mercury vapour from dental amalgams and patients who have amalgam fillings whose number is estimated at more than 350,000.

*c) Mercury-added products*

Mercury-added products are solely imported as they are not produced in the country. Such products include medical thermometers; electrical switches and relays; discharge lamps; primary cells; or polyurethane products containing mercury; and paints containing mercury. Exposure to mercury may occur during use if broken or disposed of haphazardly in the environment. In view of the widespread use of mercury-added products in the country it is estimated that about 20-40% of the population are at some risk to mercury exposure.

*d) Medical Waste Incineration*

All referral, regional and districts hospitals as well as health centers have some form of medical waste combustion facilities which may generally be considered to be incinerators. Most of the incinerators do not have air pollution control devices. The target population groups at risk from mercury exposure related to medical waste incineration include waste handlers and adjacent population.

## 4.2 Health risks

There exist several sources of mercury releases and emissions with potential health and environmental risks including ASGM, Dental amalgam, mercury-added products and medical waste incineration. However, out of these, ASGM is considered to be associated with significant public health and occupation safety risks that many individuals engage out of poverty. Based on indicative population of ASGM miners of 800,000 it is estimated that between 25-33% of the miners suffer from moderate chronic metallic mercury vapor intoxication (CMMVI). The resulting national burden of disease is estimated to range from 0.07(uncertainty interval 0.05 – 0.09) to 0.13(uncertainty interval 0.09-0.16) million disability-adjusted life years (DALYs) (Steckling et al, 2017).

Several studies have been undertaken in an attempt to explore health and environmental impacts of mercury particularly in ASGM sites. Some of the results indicate total mercury uptake by breast feeding children exceeding by far recommended limit; mean mercury hair and urine level of miners being higher than allowable reference dose; total mercury levels in liver samples from free ranging cattle and domestic fowl exceeding the acceptable maximum limit for human consumption; and average dietary intake of mercury (from rice, maize, tubers and fish) exceeding daily intake recommended by WHO.

## 4.3 Gender Dimensions

Mercury exposures from dental amalgamation, ASGM, mercury added products and medical waste incineration affect women and men in various gender dimensions including inequality/differences, roles, equity, equality and ages. This assessment provides succinct explanations on mercury exposures in ASGM.

*a) Gender differences/inequalities*

Although chemicals pose a risk to all human beings, especially if not properly managed, they affect women and men differently. In ASGM about 75,000 are women. Due to biological differences and their higher proportion of body fat, women store more environmental pollutants than men in their tissues and are hence more vulnerable to the adverse impacts of fat-soluble chemicals. According to the mercury inventory conducted in ASGM there is a big difference in accessing jobs and other opportunities between women and men. About 20-30% is solely women employed in ASGM. In this case men are more compared with women in ASGM.

*b) Gender roles*

In small-scale gold mining of Tanzania women often conduct the processing activities, sometimes in the home exposing them and their families to harmful mercury used to extract gold from ore, with minimal ventilation and protection, in confined spaces. Whilst men are mostly involved in digging and drilling the ore in deep pits. In terms of health risks associated with mercury exposures from gold amalgamation/processing women are more exposed to mercury risks than men because of their differences/inequalities in gender roles.

*c) Gender equality*

In ASGM gender equality is not considered because as per the mercury inventory conducted women are less than men accounting for 20-30%. This indicates that men and women have no equal rights in accessing jobs and other opportunities in ASGM. Health effects on exposures to mercury in ASGM do not affect women and men equally and in case of health risks associated with mercury releases and emissions more men are more vulnerable to such risks compared with women.

*d) Gender equity*

There is fairness of women and men in accessing employments and other opportunities in ASGM. Based on the inventory of mercury in ASGM both women and men have access to jobs and other opportunities. This implies that there is gender equity consideration in ASGM. However, health risks associated with mercury exposures both women and men are also treated fairly in ASGM.

*e) Ages*

Inventory results indicate that about 20% and 80% of people in ASGM are children and adults respectively. The most engaging age is of eight years old which may risk serious injury and even death from work in every phase of the mining process. These imply that children are more at risk of exposure to mercury used in artisanal and small-scale gold mining compared with adults.

*f) Management of mercury exposures in ASGM*

Generally mercury exposure in ASGM is managed by providing appropriate protective gears to both women and men for protecting human health and environment during gold processing and digging and drilling of the ore in deep pits respectively. Also, alternative technologies/best available techniques such as use of retort which reduces mercury emissions to air and recycles mercury are used in ASGM.

# CHAPTER V

## 5.0 PUBLIC AWARENESS, TRAINING AND EDUCATION EFFORTS

There are several policy and legal instruments that promote public awareness and involvement in environmental management issues. However, there is low level of awareness on mercury related issues among risk groups, key stakeholders and the public at large. Some of the contributing factors include inadequate human and financial resources; inadequate information generation, management and dissemination infrastructures; limited capacity and experience in managing and monitoring mercury releases and emissions; and lack of specific awareness programmes on mercury.

There are several initiatives implemented by different stakeholders involving training, awareness and demonstration of mercury free technologies (**Table 5-1**). Most of the efforts have been targeting artisanal and small-scale gold mining (ASGM) and phasing down of dental amalgam in health sector. However, these efforts have not achieved considerable impact due to limited resources and scope, inadequate consideration of cultural and socio-economic factors, isolated planning and inadequate involvement of the target community. Although some limited awareness raising activities have been provided in the past, additional awareness on the issues surrounding mercury, in particular for risk groups, but also for decision makers, is highly needed. Capacity building, in the form of training on the adoption of alternatives to the use of Mercury, or the proper management, storage, transport and disposal/treatment of Mercury and Mercury containing products and wastes is also needed.

**Table 0-3**: A list of some of the awareness raising and training activities undertaken by different stakeholders

| INSTITUTION/ STAKEHOLDER | INITIATIVE UNDERTAKEN |
|---|---|
| Ministry of Energy and Minerals | 1. Global Mercury Partnership (GMP) (2006): A total of 120 artisanal and small-scale gold miners were trained on health and environmental risks on mercury and 70 mercury retorts were disseminated to help minimize exposure to mercury. |
| | 2. Sustainable Management of Mineral Resources Project (SMMRP): The project aims to support formalization of ASGM, identifying suitable geological area for artisanal miners, provision of grants, training and establishment of demonstration and training centers for ASGM on mercury-free technologies. A total of 2,045 $km^2$ of land with 8,800 licenses has been demarcated for small-scale miners and about 50 small-scale miners have been provided grants. The implementation of this initiative is ongoing. |
| | 3. Multi-Stakeholder Partnership Initiative (MSPI) (2014 - 2015): The project aims to support the formalization (training; and access to finance, equipment and market) and promote the co-existence between ASGM and large-scale mining. The implementation of this initiative is ongoing. |
| | 4. Awareness campaign to ASGM: Several training and awareness sessions were organized targeting ASGM country wide between 2013 – 2017. A total of 500 ASGM miners were involved in which the focus was on health and environmental risks of mercury, occupational safety and promotion of retorts. |
| Vice President's Office and Muhimbili University of Health and Allied Sciences (School Of Dentistry) | East Africa Dental Amalgam phase down project – Tanzania (2012 - 2015): The objective of the project was to determine supply and trade of dental amalgam and alternative materials; assess current waste management practices; create awareness on preventive dental care and alternatives to dental amalgam; and demonstrate sound management of dental restoration materials waste. Key achievements of the project include installation of three amalgam separators in three hospitals; 42 dentists were trained. |

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| Vice President's Office | Development of National Action Plan for ASGM (2016 - 2018): The objective of the project is to facilitate the development of a National Action Plan (NAP) to reduce and where feasible to eliminate use of mercury from ASGM sector. The implementation of the project is ongoing. |
| AGENDA for Environment and Responsible Development (NGO) | Zero mercury working group project (2011): A total of 110 ASGM miners were trained on fume hood technology and best available techniques other than mercury and best environmental practices. |
| Government Chemist Laboratory Agency (GCLA) | 1. In April, 2009 training and Promotion of Best Available Techniques (BATs) and Best Environmental Practices (BEPs) applications and Training of Technical Personnel in Chemicals Management was done to trainers from Lake Zone, eastern zone, northern zone and southern highlands in mainland Tanzania. |
| | 2. In the years 2006 to 2009 Tanzania implemented in collaboration with United Nation Institute for Training and Research (UNITAR) a pilot project to strengthen national capacity for chemicals management and for implementation of the Strategic Approach to International Chemicals Management (SAICM) |

Although some limited awareness raising activities have been provided in the past, additional awareness on the issues surrounding mercury, in particular for risk groups, but also for decision makers, is highly needed. Capacity building, in the form of training on the adoption of alternatives to the use of Mercury, or the proper management, storage, transport and disposal/treatment of Mercury and Mercury containing products and wastes is also needed.

# CHAPTER VI

## 6.0 PROVISIONAL IMPLEMENTATION PLAN AND PRIORITIES FOR ACTION

### 6.1 Goal and Objectives of the Plan

*6.1.1 Goal*

To protect human health and environment from anthropogenic emissions and releases of mercury and mercury compounds

*6.1.2 Specific objectives*

6.1.2.1 To facilitate ratification of the Minamata Convention on mercury;
6.1.2.2 To strengthen legal and institutional framework governing management of mercury;
6.1.2.3 To enhance information exchange, awareness raising and knowledge management;
6.1.2.4 To phase down and where feasible phase out the use, emissions and releases of mercury from mercury-added products, manufacturing processes, ASGM, point and release sources;
6.1.2.5 To improve interim storage of mercury, management of mercury waste and contaminated sites;
6.1.2.6 To facilitate resource mobilization, capacity building and technology transfer;
6.1.2.7 To establish and strengthen capacity for preventive and heath care services; and
6.1.2.8 To improve research, monitoring and reporting capacity on mercury.

### 6.2 Action Plan Matrix

The National Action Plan establishes the milestones that will enable the country to reduce mercury releases, provides the timeframe and indicative cost estimates for implementation and assign responsibilities to government agencies to take place in implementation of activities in line with their policy and legal mandates (Refer **Table 6-1**). The national action plan is the first step for meeting future obligations of Minamata Convention on mercury.

**Table 0-4**: Proposed priority actions for implementation of Minamata Convention in Tanzania 2017 - 2022

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| **Objective 1: To facilitate ratification of the Minamata Convention on mercury** | | | | | |
| Sensitize policy and decision makers on obligations and requirements of the Minamata Convention. | Minutes | • Number of policy and decision makers consulted<br>• Number of meetings | 2017 | 20,000 | VPO, MEM, MoHCDGEC, Standing Parliamentary Committee responsible for environment, Cabinet Committee on environment, |
| Publish public notice on the intention to ratify the Minamata Convention in print and electronic media. | Notice | Number and type of media used | 2017 | 10,000 | VPO, MEM, MoHCDGEC |
| Organize stakeholders consultation for validation of national MIA report and dissemination of results | Proceedings | Number and categories of stakeholders consulted | 2017 | 26,000 | VPO, MEM, MoHCDGEC |
| **Objective 2: To strengthen legal and institutional framework governing management of mercury** | | | | | |
| Prepare and adopt regulations on management and control of mercury | Regulations | • Number of meetings<br>• Regulations | 2017 - 2018 | 24,500 (UNEP) | VPO, MEM, MoHCDGEC |
| Adopt international guidelines and standards for management of contaminated sites, interim storage of mercury and Best | Guidelines and standards | Number and type of guidelines and | 2018 - 2019 | 20,000 | VPO, MEM, MoHCDGEC, UDSM, TBS, COSTECH |

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| Available Techniques and Best Environmental Practices | | standards | | | |
| **Objective 3: To enhance information exchange, awareness raising and knowledge management** | | | | | |
| Develop national mercury communication strategy | Strategy | Number of meetings and strategy | 2018 | 30,000 | VPO, MEM, MoHCDGEC, UDSM, TBS, COSTECH, CSOs, Media |
| Develop awareness materials and conduct awareness campaign on mercury to different target groups particularly those at high risk. | • Awareness materials<br>• Reports | • Number and type of awareness materials<br>• Number and categories of stakeholders involved | 2017 - 2022 | 200,000 | VPO, NEMC, MEM, MoHCDGEC, UDSM, TBS, COSTECH, CSOs, Media |
| Conduct tailor-made training on mercury management for risk groups (waste handlers, dentists, schools, power generation sector, jewelry sector, cement production, laboratory personnel involved in mercury analysis) | Training reports | Number of trainees<br>Reports | 2017 - 2022 | 100,000 | UDSM, NEMC, VPO, MEM, MoHCDGEC, , TBS, COSTECH, CSOs, Media |
| Create a repository for management and sharing of results and outcomes of the assessment and studies pertaining to mercury | Repository | Number of studies and reports shared | 2017 - 2022 | 50,000 | UDSM, NEMC, VPO, MEM, MoHCDGEC, , TBS, COSTECH, CSOs, Media |
| **Objective 4: To phase down and where feasible phase out the use, emissions and releases of mercury from mercury-added products,** | | | | | |

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| **manufacturing processes, ASGM, point and release sources** | | | | | |
| Develop and implement a national phase out plan for priority mercury-added products. | – Plan | – Number of meetings and stakeholders consulted<br>– Plan | 2018 | 50,000 | UDSM, NEMC, VPO, TFDA, MEM, MITI, MoHCDGEC, , TBS, COSTECH, CSOs, Media |
| Conduct awareness campaign on mercury free cost effective alternatives. | – Awareness materials | – Number of meetings and stakeholders involved<br>– Number and type of awareness materials | 2017 - 2020 | 80,000 | TBS, UDSM, NEMC, VPO, MEM, MITI, MoHCDGEC, COSTECH, CSOs, Media |
| Develop and implement a national action plan to reduce and where feasible eliminate use of mercury in ASGM sector. | – ASGM Baseline report<br>– Action Plan | – Number and categories of stakeholders consulted<br>– Baseline report<br>– Action Plan | 2017 - 2018 | 420,000 (UNEP/GEF) | VPO, MEM, MoHCDGEC, MITI, TBS, UDSM, NEMC, COSTECH, CSOs, Media |
| Develop and implement a national plan for identification, controlling and where feasible reducing releases of mercury and mercury compound from point sources. | – Plan | – Number and categories of stakeholder consulted<br>– Plan | 2018 - 2022 | 150,000 | VPO, MEM, MoHCDGEC, MITI, TBS, UDSM, NEMC, COSTECH, CSOs, Media |
| **Objective 5: To improve interim storage of mercury, management of mercury waste and contaminated sites** | | | | | |

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| Adopt international guidelines for interim storage of mercury, management of mercury waste and contaminated sites; | – Guidelines | – Number and categories of stakeholders consulted<br>– Number and type of Guidelines | 2018 - 2022 | 100,000 | VPO, MEM, MoHCDGEC, MITI, TBS, UDSM, NEMC, COSTECH, CSOs, Media |
| Review and implement the national strategy for identification and assessment of mercury contaminated sites. | – Strategy | – Number and categories of stakeholders consulted<br>– Strategy | 2018 - 2022 | 500,000 | UDSM, NEMC, VPO, MEM, MoHCDGEC, MITI, TBS, COSTECH, CSOs, Media |
| Develop and implement national strategy for management of mercury waste and contaminated sites | – Strategy | – Number and categories of stakeholders consulted<br>– Strategy | 2018 - 2022 | 1,000,000 | NEMC, UDSM, VPO, MEM, MoHCDGEC, MITI, TBS, COSTECH, CSOs, Media |
| **Objective 6: To facilitate resource mobilization, capacity building and technology transfer** | | | | | |
| Develop and implement national plan for resource mobilization to support implementation of the Minamata Convention. | – Plan | – Number and categories of stakeholders consulted<br>– Plan | 2018 - 2022 | 100,000 | VPO, MFP, NEMC, UDSM, MEM, MoHCDGEC, MITI, TBS, COSTECH, CSOs, Media |
| Review the national capacity needs assessment report and develop and implement national capacity building plan for implementation of the Minamata | – Assessment report<br>– Plan | – Number and categories of stakeholders consulted<br>– Assessment | 2018 - 2022 | 1,000,000 | VPO, MFP, NEMC, UDSM, MEM, MoHCDGEC, MITI, TBS, COSTECH, CSOs, Media |

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| Convention | | report<br>– Capacity building plan | | | |
| Identify and promote adoption of BATs and BEPs related to mercury. | – Reports | – Number and categories of stakeholders consulted<br>– Reports | 2018 - 2022 | 100,000 | VPO, MFP, NEMC, UDSM, MEM, MoHCDGEC, MITI, TBS, COSTECH, CSOs, Media |
| **Objective 7: To establish and strengthen capacity for preventive and heath care services** | | | | | |
| Develop and implement the public health strategy for minimization and prevention of exposure to mercury. | – Strategy | – Number and categories of stakeholders consulted<br>– Strategy | 2019 - 2022 | 100,000 | MoHCDGEC, GCLA, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| Promote development and implementation of science based educational and preventive programmes on occupational exposure to mercury and mercury compounds | – Programmes | – Number and type of programmes<br>– Number of graduates | 2019 - 2022 | 150,000 | MUHAS, MoHCDGEC, GCLA, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| Promote appropriate health care services for prevention, treatment and care for populations affected by exposure to mercury or mercury compound. | – Healthcare equipment and services | – Number and type of healthcare equipment and services | 2019 - 2022 | 700,000 | MoHCDGEC, MUHAS, GCLA, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |

| PROPOSED ACTION | EXPECTED OUT PUT | INDICATORS | TIME FRAME | BUDGET (USD) | LEAD INSTITUTIONS |
|---|---|---|---|---|---|
| Strengthen institutional and health professional capacity for the prevention, diagnosis, treatment and monitoring of health risks related to the exposure to mercury and mercury compounds | – Healthcare equipment<br>– Trained health professionals | – Number and type of equipment and trained professionals | 2019 - 2022 | 500,000 | MoHCDGEC, MUHAS, GCLA, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| **Objective 8: To improve research, monitoring and reporting capacity on mercury** | | | | | |
| Promote research on environmental and health impacts of mercury exposure and cost effective alternatives to mercury. | – Research reports | – Number and type of research reports | 2019 - 2022 | 100,000 | MUHAS, MoHCDGEC, GCLA, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| Strengthen national monitoring capacity on mercury including laboratories and human resources | – Laboratory equipment<br>– Trained personnel | – Number and type of laboratory equipment and trained personnel | 2019 - 2022 | 1,000,000 | MoHCDGEC, GCLA, TFDA, MUHAS, VPO, MFP, NEMC, UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| Conduct regular environmental monitoring of point sources of mercury. | – Monitoring reports | – Number and type of monitoring reports | 2019 - 2022 | 600,000 | GCLA,NEMC, MoHCDGEC, MUHAS, VPO, MFP, , UDSM, MEM, MITI, TBS, COSTECH, CSOs, Media |
| **GRAND TOTAL** | | | | **7,130,500.00** | |

## 6.3 Monitoring and Evaluation

To ensure effective and efficient implementation of this Plan, monitoring and evaluation is important. A monitoring and evaluation system will be developed and operationalized as part of implementation Strategy. Monitoring and evaluation framework will guide thinking through, objectives and programmatic strategies and whether they are indeed the most appropriate ones to implement. M & E will be done at all levels through different approaches outlining milestones and key performance indicators under each priority objective. The system of monitoring and evaluation will serve the following main functions:

i) To Assist/serve the Ministry and Government institutions to monitor the implementation of the plan in their respective jurisdiction;

ii) Develop and provide all indicators that must be reported to the stakeholders on regular basis;

iii) Provide early warning signals about the required development and subsequent change and/or review; and

iv) Serve as a communication tool so that all stakeholders clearly understand the objectives.

The overall responsibility for the monitoring and evaluation of the plan implementation lies within the Ministry responsible for Environment. The Ministry will play key roles in coordination, implementation, monitoring and evaluation of the revised policy. For effective monitoring and evaluation, each stakeholder will have to establish a reliable internal monitoring system and ensure capacity is available to assess efficiency and effectiveness of their respective organizations.

## 6.4 Endorsement of the implementation plan

The endorsement process will involve extensive stakeholder consultations to ensure that concerns and needs of different stakeholders are considered and addressed by the proposed implementation plan. The first phase will involve zonal consultations in order to broaden the spectrum of stakeholders' involvement. A national stakeholder consultative meeting will be organized for final review and endorsement of the Implementation Plan.

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# ANNEXES

*Annex I:*

## STAKEHOLDER ENGAGEMENT PROCESS

### A. Stakeholder's Participation in Inception workshop 2015

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**B. Stakeholder Participation in Training on Development of Inventory using UNEP Toolkit September 21-23, 2016**

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***Annex II:***

**UNEP Toolkit Calculation Spreadsheet**

The UNEP Toolkit calculation spreadsheet is presented as a separate document.